



L-Università
ta' Malta

MATSEC
Examinations Board



SEC 24 Syllabus

Physics

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Introduction

This syllabus is based on the curriculum principles outlined in *The National Curriculum Framework for All* (NCF) which was translated into law in 2012 and designed using the *Learning Outcomes Framework* that identify what students should know and be able to achieve by the end of their compulsory education.

As a learning outcomes-based syllabus, it addresses the holistic development of all learners and advocates a quality education for all as part of a coherent strategy for lifelong learning. It ensures that all children can obtain the necessary skills and attitudes to be future active citizens and to succeed at work and in society irrespective of socio-economic, cultural, racial, ethnic, religious, gender and sexual status. This syllabus provides equitable opportunities for all learners to achieve educational outcomes at the end of their schooling which will enable them to participate in lifelong and adult learning, reduce the high incidence of early school leaving and ensure that all learners attain key twenty-first century competences.

This programme also embeds learning outcomes related to cross-curricular themes, namely digital literacy; diversity; entrepreneurship creativity and innovation; sustainable development; learning to learn and cooperative learning and literacy. In this way students will be fully equipped with the skills, knowledge, attitudes and values needed to further learning, work, life and citizenship.

What is Physics?

One way of defining Physics is in terms of the study of the most fundamental measurable quantities in the universe (e.g. velocity, electric field, kinetic energy), the study of relationships between those fundamental measured quantities (e.g. Newton's Laws, conservation of energy, special relativity) and the study of patterns and correlations as expressed when using words, equations, graphs, charts, diagrams, models, and any other means that can be used to demonstrate a relationship in an understandable way. Physics is the study of matter and the movement of that matter through the space and time of the universe. It's one of the fundamental sciences and covers a huge range of subjects.

Physicists ask big questions like:

- How did the universe begin? How will the universe change in the future?
- How does the Sun keep on shining?
- What are the basic building blocks of matter?

Many physicists work in 'pure' research, trying to find answers to these types of question. The answers they come up with often lead to unexpected technological applications. For example, all of the technology we take for granted today, including games consoles and mobile phones, is based on a theoretical understanding of electrons that was developed around the turn of the 20th Century.

Physics is applied in every sphere of human activity, including:

- Development of sustainable forms of energy production;
- Treating cancer, through radiotherapy, and diagnosing illness through various types of imaging;
- Developing computer games;
- Design and manufacture of sports equipment;
- Understanding and predicting earthquakes;

... in fact, pretty much every sector you can think of needs people with Physics knowledge.

What does a study of Physics entail?

The study of Physics is a natural science based on experiments, measurements and mathematical analysis with the purpose of finding quantitative physical laws for everything from the nanoworld of the micro cosmos to the planets, solar systems and galaxies that occupy the macro cosmos.

The laws of nature can be used to predict the behaviour of the world and all kinds of machinery. Many of the everyday technological inventions that we now take for granted resulted from discoveries in Physics.

The early Greeks established the first quantitative physical laws, such as Archimedes' descriptions of the principle of levers and the buoyancy of bodies in water. By the 17th Century, however, Galileo Galilei and later Isaac Newton helped pioneer the use of mathematics as a fundamental tool in physics, which led to advances in describing the motion of heavenly bodies, the laws of gravity and the three laws of motion.

The laws of electricity, magnetism and electromechanical waves were developed in the 1800s by Faraday and Maxwell while many others contributed to our understanding of optics and thermodynamics.

Modern physics can be said to have started around the turn of the 20th century, with the discovery of X-rays, radioactivity, the quantum hypothesis, relativity and atomic theory.

Quantum mechanics (Heisenberg and Schrödinger), beginning in 1926, also gave scientists a better understanding of chemistry and solid-state physics, which in turn has led to new materials and better electronic and optical components. Nuclear and elementary particle physics have become important fields, and particle physics is now the basis for astrophysics and cosmology

How is Physics related to candidates' lives, to Malta, and/or to the world?

Physics extends well into your everyday life, describing the motion, forces and energy of ordinary experience. In actions such as walking, cooking, seeing, driving a car or using a phone, physics is at work. The use of sustainable energy, the caring for the environment and the love for nature are also aspects of how Physics relates to our daily lives, in Malta and globally. The applications of Physics are deeply rooted in our lives, using principles of Physics to provide insight, reference and relevance.

The Physics topics at MQF Level 3, 2 and 1 deal with mechanics, energy and fields. Applications to everyday life is a continuous exercise in the whole Physics syllabus. All topics are closely related to the candidates' lives, now and in the future.

The aspirational programme learning outcomes for this subject are:

At the end of the programme, I can:

- recall facts and ideas;
- show an understanding of facts, terminology, principles and concepts;
- use units correctly;
- demonstrate an understanding of the application of Physics in everyday life;
- understand that scientific concepts are developed within a contemporary and historical context;
- recognise the importance of the work of key scientists;
- understand the outcomes of the applications of science;
- use Physics principles and concepts to describe and explain everyday or unfamiliar situations;
- interpret data presented in tables, diagrams or graphs;
- carry out relevant calculations;
- plan and carry out investigations;
- use safe and accurate practical techniques;
- record data accurately;
- interpret data and draw conclusions;
- communicate the data in a clear and accurate manner;
- evaluate the implications of science and how it affects the quality of one's life, that of others and the quality of the environment.

List of Subject Foci

- Waves
- Motion, Forces and Energy
- Thermal Physics
- Electricity and Electromagnetism
- Radioactivity
- The Earth and the Universe
- The Science of the Physical World

List of Learning Outcomes

At the end of the programme, I can:

- LO 1. Show an understanding of the nature and application of different types of waves.
- LO 2. Relate forces and energy to motion.
- LO 3. Show an understanding of the properties of states of matter and of thermal processes.
- LO 4. Show an understanding of static and moving charges.
- LO 5. Show an understanding of magnetism and electromagnetism.
- LO 6. Show an understanding of nuclear phenomena.
- LO 7. Show an awareness of some features of the Earth and the Universe.
- LO 8. Demonstrate an understanding of how Physics works and is communicated.

Programme Level Descriptors

This syllabus sets out the content and assessment arrangements for the award of Secondary Education Certificate in **PHYSICS** at MQF Level 1, 2 or 3. Level 3 is the highest level which can be obtained for this qualification.

Table 1 overleaf refers to the qualification levels on the Malta Qualifications Framework (MQF) with minor modifications to reflect specific **PHYSICS** descriptors. These are generic statements that describe the depth and complexity of each MQF level of study and outline the knowledge, skills and competences required to achieve an award at Level 1, 2 or 3 in **PHYSICS**.

Knowledge involves the acquisition of basic, factual and theoretical information. Skills involve the application of the acquired knowledge and understanding to different contexts. Competences indicate sufficiency of knowledge and skills that enable someone to act in a wide variety of situations, such as whether one is competent to exercise skills with or without supervision, autonomy or responsibility.

MQF Level 1	MQF Level 2	MQF Level 3
Basic general Physics related knowledge 1. Acquires basic general knowledge related to the immediate physical environment and expressed through a variety of simple tools and context as an entry point to lifelong learning; 2. Knows and understands the steps needed to complete simple tasks and activities in a scientific environment; 3. Is aware and understands basic tasks and instructions; 4. Understands basic Physics textbooks and instruction guides.	Basic factual knowledge of the Physics-related fields of work or study. 1. Possesses good knowledge of the Physics-related field of work or study; 2. Is aware and interprets Physics-related information and ideas; 3. Understands facts and procedures in the application of basic tasks and instructions; 4. Selects and uses relevant Physics knowledge to accomplish specific actions for self and others.	Knowledge of facts, principles, processes and general concepts in the Physics-related field of work or study. 1. Understands the relevancy of theoretical knowledge and information related to the Physics-related field of work or study; 2. Assesses, evaluates and interprets facts, establishing basic principles and concepts in the Physics-related field of work or study; 3. Understands facts and procedures in the application of more complex tasks and instructions; 4. Selects and uses relevant Physics knowledge acquired on one's own initiative to accomplish specific actions for self and others.
Basic skills required to carry out simple Physics-related tasks. 1. Has the ability to apply basic Physics knowledge and carry out a limited range of simple tasks; 2. Has basic repetitive communication skills to complete well defined routine tasks and identifies whether actions have been accomplished; 3. Follows instructions and be aware of consequences of basic actions for self and others.	Basic cognitive and practical skills required to use relevant information in order to carry out tasks and to solve Physics-related routine problems using simple rules and tools. 1. Has the ability to demonstrate a range of skills by carrying out a range of complex tasks within the Physics-related field of work or study; 2. Communicates basic Physics-related information; 3. Ensures Physics-related tasks are carried out effectively.	A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information. 1. Demonstrates a range of developed Physics-related skills to carry out more than one complex task effectively and in unfamiliar and unpredictable scientific/physical contexts; 2. Communicates more complex Physics-related information; 3. Solves basic problems by applying basic methods, tools, materials and information given in a restricted learning environment.

MQF Level 1	MQF Level 2	MQF Level 3
Work out or study under Direct Supervision in a structured context. 1. Applies basic knowledge and skills to do simple, repetitive and familiar tasks; 2. Participates in and takes basic responsibility for the action of simple tasks; 3. Activities are carried out under guidance and within simple defined timeframes; 4. Acquires and applies basic Physics-related key competences at this level.	Work or study under supervision with some autonomy. 1. Applies factual Physics-related knowledge and practical skills to do some structured tasks; 2. Ensures one acts pro-actively; 3. Carries out activities under limited supervision and with limited responsibility in a quality controlled context; 4. Acquires and applies basic Physics-related key competences at this level.	Take responsibility for completion of tasks in work or study and adapt own behaviour to circumstances in solving Physics-related problems. 1. Applies Physics-related knowledge and skills to do some tasks systematically; 2. Adapts own behaviour to circumstances in solving problems by participating pro-actively in structured learning environments; 3. Uses own initiative with established responsibility and autonomy, but is supervised in quality controlled learning environments; 4. Acquires Physics-related key competences at this level as a basis for lifelong learning.

Learning Outcomes and Assessment Criteria

Subject Focus:	Waves
Learning Outcome 1: (Controlled and Coursework)	At the end of the programme, I can show an understanding of the nature and application of different types of waves. • Features of different types of waves. • Waves and ray diagrams to show the path taken by waves in media. • Calculations to work out measurable features of waves.

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
1.1a Demonstrate that waves are caused by vibrations and that they carry energy as they travel without carrying matter.	1.2a State that waves are caused by vibrations and that they carry energy as they travel, without carrying matter.	
1.1b Identify amplitude, wavelength, longitudinal and transverse waves in diagrams as applied to mechanical waves.	1.2b Define amplitude, periodic time, frequency, wavelength, longitudinal and transverse waves as applied to mechanical waves.	1.3b Explain what is meant by a mechanical wave.
1.1c Identify crest, trough, compression and rarefaction as applied to mechanical waves.	1.2c Describe crest, trough, compression and rarefaction as applied to mechanical waves.	1.3c Describe the length of a wavelength as applied to mechanical waves.
1.1d Identify hertz, Hz, as the SI unit of frequency, f , and seconds, s , as the SI unit of periodic time, T .	1.2d Use the equation $T=1/f$ to solve simple problems by substitution, where T is the periodic time and f is the frequency.	1.3d Use the equation $T=1/f$ to solve problems requiring the use of subject of the formula.
1.1e Identify m/s as the SI unit of wave speed, v , and m as the SI unit of wavelength, λ .	1.2e Use the equation $v=f\lambda$ to solve simple problems by substitution, where v is the speed of propagation and λ is the wavelength.	1.3e Use the equation $v=f\lambda$ to solve problems requiring the use of subject of the formula.
1.1f Read wavelength and amplitude from a displacement-distance graph.	1.2f Sketch the displacement-distance graph for a travelling wave.	1.3f Compare the displacement-distance and the displacement-time graphs for a travelling wave. <i>Show that correspondence between the two graphs which are similar in shape but the quantity on the x-axis varies (distance or time).</i>

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
1.1g Demonstrate how to create transverse and longitudinal waves on a slinky spring.	1.2g Draw a diagram to show how to generate transverse and longitudinal waves on a slinky spring.	1.3g Describe how to generate transverse and longitudinal waves on a slinky spring.
1.1h Give examples of transverse waves, including water surface waves and waves on slinky springs.		
1.1i Demonstrate plane and circular water waves in a ripple tank.	1.2i Identify the wavelength as the distance between two successive and similar points in plane and circular waves.	
1.1j Demonstrate reflection of plane water waves in a ripple tank.	1.2j Draw reflection of plane water waves in a ripple tank.	1.3j Describe a simple experiment to investigate the reflection of plane water waves in a ripple tank.
1.1k State that wavelength changes when a plane water wave passes from one medium to another.	1.2k Draw refraction of plane water waves in a ripple tank.	1.3k Describe a simple experiment to investigate the refraction of plane water waves in a ripple tank.
1.1l Demonstrate diffraction of plane water waves in a ripple tank.	1.2l Draw diffraction of plane water waves in a ripple tank.	1.3l Describe how the diffraction pattern of plane water waves change as the width of a gap and the wavelength are varied.
1.1m Give examples of longitudinal waves, including sound waves and waves along slinky springs.	1.2m Describe an experiment that demonstrates how a medium is required for sound to travel from a source to a detector (bell jar experiment).	1.3m Explain how sound is produced from vibrating objects that compress and rarefy the particles of the carrying medium.
1.1n Take readings from an experimental setup to determine the speed of sound in air.	1.2n Carry out an experiment to determine the speed of sound in air.	1.3n Describe an experiment to determine the speed of sound in air. <i>This includes providing a diagram, the procedure, adequate precautions and measurements made.</i>

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
1.1o State that an echo is the reflection of sound.	1.2o Identify examples of the uses of reflection of sound (echo) in nature and in industrial applications.	1.3o Describe examples of reflection of sound (echo) in nature and in industrial applications.
1.1p State the meaning of v , s and t in the equation $v = s/t$ is velocity, displacement and time respectively.	1.2p Use the equation $v=s/t$ in situations where sound is reflected from a surface. <i>Equation is used only by simple substitution.</i>	1.3p Apply the equation $v=s/t$ in situations where sound is reflected from a surface including the use of subject of the formula.
1.1q Recognise m/s as the SI unit of speed; metre, m as the SI unit of distance and second, s, as the SI unit of time.		
1.1r Produce sounds of different frequencies using for example tuning forks, digital tuner or other instruments.	1.2r Relate frequency to the pitch of the sound and amplitude to the loudness.	
1.1s Give examples on the uses of ultrasound.	1.2s Explain that ultrasound consists of sound waves that have a frequency above the audible range of human beings, which is 20000 Hz.	1.3s Describe examples related to the use of ultrasound. <i>Examples include: sonar, medical ultrasound, dog's whistle.</i>
1.1t List the properties which are common to all electromagnetic waves.		1.3t Explain the relationship between frequency and wavelength as applied to the electromagnetic spectrum. <i>High frequency electromagnetic waves have a short wavelength; low frequency electromagnetic waves have a long wavelength.</i>
1.1u List the various regions of the electromagnetic spectrum. <i>In order of increasing wavelength.</i>	1.2u Give uses of each region of the electromagnetic spectrum.	1.3u Describe the source and mode of detection of each region of the electromagnetic spectrum.
1.1v List the colours in the visible spectrum in increasing or decreasing wavelength.		

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
1.1w Draw a ray of light representing direction of travel of a wave. <i>Limited to plane wavefronts.</i>		
1.1x Identify the incident ray and the reflected ray for a light ray hitting a reflective surface.	1.2x Draw the incident ray and the reflected ray for a light ray hitting a reflecting surface.	
1.1y Identify the normal to the boundary in a given diagram.	1.2y Draw the normal to a boundary in a given diagram.	
1.1z Identify the angle of incidence and the angle of reflection.	1.2z State the laws of reflection based upon the identification of the angle of incidence and the angle of reflection.	1.3z Draw ray diagrams to show the use of more than one reflecting surface placed in the path of the ray such as in periscopes.
1.1aa List the properties of images in plane mirrors.	1.2aa Represent, using a ray diagram, the properties of images in plane mirrors.	
1.1ab Carry out an experiment that proves the laws of reflection of light hitting a plane mirror.	1.2ab Measure the angle of incidence and the angle of reflection for the experiment that proves the laws of reflection of light.	1.3ab Describe in detail an experiment that proves the laws of reflection for light hitting a plane mirror. <i>This includes providing a diagram, the procedure, adequate precautions and observations made.</i>
1.1ac Identify the ray and angle of incidence and the ray and angle of refraction as light passes from one medium to another.	1.2ac Describe refraction in terms of speed in different media.	
	1.2ad Define the refractive index, n , of a medium for light travelling from air into the medium.	1.3ad Use the equation $n = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$.

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
1.1ae Identify everyday situations where refraction occurs. <i>Examples should include everyday real life applications – e.g. depth of water, bent pencil.</i>		1.3ae Use $n = \frac{\text{real depth}}{\text{apparent depth}}$.
1.1af Carry out an experiment that shows refraction of light as it passes through a transparent medium.	1.2af Draw diagrams to show what happens to light rays travelling in an optically denser medium when they meet a boundary at different angles of incidence.	1.3af Describe an experiment that shows refraction of light as it passes through a transparent medium. <i>This includes providing a diagram, the procedure, adequate precautions and observations made.</i>
1.1ag Demonstrate critical angle and total internal reflection.	1.2ag Define the term critical angle and total internal reflection.	1.3ag Explain the conditions for total internal reflection.
1.1ah Identify situations where total internal reflection occurs. <i>Examples should include everyday life applications - fibre optic, reflectors, etc.</i>	1.2ah Draw rays of light passing through an isosceles right angle prisms to bend light by 90° and 180° .	1.3ah Discuss how isosceles right angle prisms can be used to deflect light by 90° and 180° .
1.1ai Carry out an experiment that demonstrates total internal reflection of light using a semi-circular glass block.	1.2ai Discuss advantages of using fibre optics over traditional methods.	1.3ai Describe in detail an experiment that demonstrates total internal reflection of light (using either semi-circular glass block, reflecting prisms, light guides). <i>This includes providing a diagram, the procedure, adequate precautions and observations made.</i>
1.1aj Draw diagrams showing how white light is dispersed as it passes through a dispersive medium such as a prism.	1.2aj Describe the dispersion of white light into its constituent colours. <i>Distinction between pure and impure spectra is not required.</i>	1.3aj Explain what causes the dispersion of white light made when it is incident at an angle on an optically denser medium.
		1.3ak Describe an experiment that demonstrates dispersion of white light.

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
	1.2al Identify principal axis, principal focus, optical centre and focal length for converging and diverging lenses in a given diagram.	1.3al Draw ray diagrams at 1:1 scale to show how an image is formed by a given single converging lens for different object distances. <i>Limited to object beyond 2F, at 2F, between 2F and F, between F and lens.</i>
1.2am State the properties of images formed by single, thin, converging lenses.	1.3am Distinguish between real and virtual images.	
1.1an State that the meaning of m is the magnification, h_i is the image height, h_o is the object height, v is the image distance and u is the object distance in diagrams involving thin converging lenses.		1.3an Use the equations for linear magnification $m = \frac{h_i}{h_o} = \frac{v}{u}$ to solve problems involving thin converging lenses.
1.1ao State applications of converging lenses for different object distances. <i>Limited to object beyond 2F, at 2F, between 2F and F, between F and lens.</i>		1.3ao Describe applications of converging lenses for different object distances. <i>Limited to object beyond 2F, at 2F, between 2F and F, between F and lens.</i>
1.1ap Set up a simple experiment to carry out a rough method experiment to determine the focal length of a thin converging lens.		1.3ap Carry out an experiment to determine the focal length of a thin converging lens using the rough and the accurate method experiment. <i>This includes providing a diagram, the procedure, adequate precautions, measurements made and how to determine the focal length.</i>

Subject Focus:	Motion, Forces and Energy
Learning Outcome 2: (Controlled and Coursework)	At the end of the programme, I can relate forces and energy to motion. <i>Motion related to different parts of a journey.</i> <i>Relate forces in a system to different physical concepts and laws, including Hooke's law, Moments and Pressure.</i> <i>Newton's laws and momentum to typical applications.</i> <i>Quantify different forms of energy in a system in relation to Power and Efficiency.</i>

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
2.1a Distinguish between distance and displacement.	2.2a Distinguish between speed and velocity.	2.3a Distinguish between vectors and scalars.
	2.2b Use (total distance travelled)/(total time taken) to calculate the average speed.	2.3b Apply the equation in MQF Level 2 to solve problems including use of subject of the formula.
	2.2c Use (total displacement)/(total time) to calculate the average velocity.	2.3c Apply the equation in MQF Level 2 to solve problems including use of subject of the formula.
2.1d Explain the meaning of acceleration as (change in velocity)/(time taken).	2.2d Use the equation of acceleration to solve simple problems.	2.3d Apply the equation of acceleration to solve problems including use of subject of the formula.
2.1e Recognise the symbols s, u, v, a and t as referring to the displacement, initial velocity, final velocity, acceleration and time respectively.	2.2e Distinguish between the SI unit for velocity, m/s and the SI unit for acceleration m/s ² .	
2.1f Identify which section(s) in a distance-time graph indicate(s): i. a state of rest; ii. constant speed.		2.3f Sketch a distance-time graph to represent different sections of a journey: at rest and constant speed.

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
	2.2g Determine the speed from a distance-time graph.	2.3g Determine the average speed from a distance-time graph.
2.1h Identify which section(s) in a velocity-time graph indicate(s) an object: - at rest; - moving with constant velocity; - moving with a constant acceleration.		2.3h Sketch a velocity-time graph to represent different sections of a journey: constant velocity and constant acceleration/ deceleration.
2.1i Identify acceleration and deceleration from a velocity-time graph.		2.3i Relate a negative gradient from a velocity-time graphs to deceleration.
	2.2j Calculate acceleration from a velocity-time graph. <i>No calculation of deceleration is required.</i>	2.3j Determine the displacement and the acceleration/deceleration from a velocity-time graph using a graphical method.
	2.2k Use the equations of rectilinear motion $v=u+at$, $s=ut+\frac{1}{2}at^2$, $v^2=u^2+2as$, $s=(u+v)t/2$ to solve simple problems.	2.3k Apply the equations of rectilinear motion $v=u+at$, $s=ut+\frac{1}{2}at^2$, $v^2=u^2+2as$, $s=(u+v)t/2$ to solve problems including use of subject of the formula.
2.1l Describe the thinking distance as the distance travelled by an object moving at constant speed during the driver's reaction time.		
2.1m Identify the factors that affect the thinking distance.		2.3m Describe the factors that affect the thinking distance.
2.1n Describe the braking distance as the distance travelled by an object during deceleration.		

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
2.1o Identify the factors that affect the braking distance.		2.3o Describe the factors that affect the braking distance.
2.1p Identify between the thinking, braking and stopping distances represented in real-life situations.	2.2p Calculate total stopping distance as the addition of the thinking and braking distance.	2.3p Calculate the thinking, the braking and the stopping distances represented in real-life situations.
2.1q Compare human reaction time using a simple experiment in terms of distance fallen by a meter ruler.		
2.1r Describe the motion of a falling object on Earth.	2.2r Compare the motion of a falling object on Earth and on the Moon.	2.3r Describe in detail an experiment to measure the acceleration of free fall. <i>This includes providing a diagram, the procedure, adequate precautions, measurements made and how to determine the acceleration of free fall.</i>
		2.3s Explain how objects of different mass fall equal distances in equal time neglecting air resistance. <i>In a situation of no air resistance, two objects fall with the same acceleration and touch the ground at the same time, irrespective of their mass.</i>
2.1t Demonstrate a situation showing Newton's first law of motion.	2.2t Identify Newton's first law of motion in various situations.	2.3t Link inertia with Newton's first law of motion.
2.1u Label forces acting on an object.	2.2u Draw diagrams of an object which has forces acting on it.	2.3u Describe force as a vector quantity measured in newtons, N.
2.1v Demonstrate what is meant by centre of mass.	2.2v Find the centre of mass of a regularly and an irregularly shaped lamina.	

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
2.1w Demonstrate the effect of an unbalanced force acting on an object initially at rest.	2.2w Identify examples where Newton's first law of motion applies.	2.3w State Newton's first law of motion.
	2.2x Determine the resultant (indicating both the magnitude and direction) of forces acting in the same straight line.	
2.1y Represent, using a simple diagram, the acceleration of an object due to an unbalanced force acting on a fixed mass.	2.2y Carry out an experiment that shows the relationship between resultant force and acceleration for a system with constant mass.	2.3y Describe in detail an experiment that shows the relationship between resultant force and acceleration for a system with constant mass. <i>This includes providing a diagram, the procedure, adequate precautions, measurements made and how to determine the magnitude of the resultant force from the graph.</i>
2.1z Represent, using a simple diagram, the acceleration of an object due to a constant force acting on different masses.		2.3z Describe qualitatively the relationship between the acceleration and the mass of a system when acted upon by a constant resultant force.
	2.2aa Use Newton's second law of motion, as $F=ma$, to solve simple problems.	2.3aa State Newton's second law of motion as acceleration is directly proportional to resultant force and inversely proportional to mass ($a \propto F/m$) where m is the mass, F is the resultant force and a is the acceleration
		2.3ab Apply the equation for Newton's second law of motion to solve problems including use of subject of the formula.
2.1ac Define linear momentum as the product of the mass of the object and its velocity, that is $p=mv$ with the SI unit being kg m/s.	2.2ac Use $p=mv$ to solve simple problems.	2.3ac State the principle of conservation of momentum. <i>No calculations are required.</i>
	2.2ad State Newton's second law of motion in terms of momentum.	2.3ad Apply the equation for Newton's second law of motion as $F = (\text{change in momentum}) / (\text{change in time})$ to solve simple problems including use of subject of the formula.

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
2.1ae State the meaning of time of impact.	2.2ae Explain how the time of impact is affected when various safety features are applied. <i>Examples to include: Seat belts, crumple zones, air bag, protective foam padding round poles.</i>	2.3ae Discuss how the time of impact and the force affect the change in momentum experienced by an object.
2.1af State Newton's third law of motion in terms of a pair of identical forces which must act on different bodies.	2.2af Give examples of Newton's third law pairs of forces, including contact forces and non-contact forces.	
2.1ag Identify a force as any interaction that can change any of: the state of motion of a body, size, shape.	2.2ag Identify the following contact and non-contact forces in a diagram: friction, tension, drag/ air resistance, reaction, gravitational (weight), electric and magnetic.	2.3ag Identify the different types of forces occurring in a given situation.
2.1ah Use different measuring instruments to measure mass (balance) and weight (Newton meter).	2.2ah Calculate the weight of an object given its mass and the gravitational field strength (expressed in N/kg) and state its direction.	2.3ah Describe the difference between mass and weight.
2.1ai Investigate which factors affect friction between two surfaces in contact.		
2.1aj Describe the behaviour of a helical spring when subjected to an increasing force.	2.2aj State Hooke's law as follows: The stretching force is directly proportional to the extension provided that the elastic limit is not exceeded.	2.3aj Apply Hooke's law in simple situations. <i>(Use of equation $F=k.\Delta x$ not required.)</i>
	2.2ak Define the term elastic limit as the point up to which a spring can be loaded and when unloaded goes back to its original length.	
	2.2al Identify the elastic limit in force-extension graphs.	2.3al Explain how stiffness is related to the steepness of a force-extension graph.
	2.2am Carry out an experiment that demonstrates Hooke's Law.	2.3am Describe in detail an experiment that demonstrates Hooke's Law. <i>This includes providing a diagram, the procedure, adequate precautions, measurements made as well as the calculations and the representation of data in a graph.</i>

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
2.1an Demonstrate that moment (turning effect) depends on the force and the perpendicular distance from the pivot.	2.2an Identify clockwise and anticlockwise moments using simple diagrams.	
2.1ao Identify newton metre, Nm, as the SI unit of moment of a force.	2.2ao Use the equation for the moment of a force to solve simple problems.	2.3ao Apply the equation for the moment of a force to solve problems including use of subject of the formula.
2.1ap Demonstrate when a system is in equilibrium.	2.2ap State the law of moments.	2.3ap Apply the law of moments to solve problems involving systems in equilibrium having only one pivot including use of subject of the formula.
2.1aq Carry out an experiment to show moments about a pivot. <i>No calculation is required.</i>	2.2aq Carry out an experiment to prove the law of moments using only one clockwise force and one anticlockwise force.	2.3aq Describe in detail an experiment to prove the law of moments. <i>This includes providing a diagram, the procedure, adequate precautions, the measurements made as well as the calculations.</i>
	2.2ar State the two conditions for the equilibrium of a body. <i>Upward forces = Downward forces; Clockwise moments = Anticlockwise moments</i>	
2.1as Identify that an increase in force or a decrease in area, increases pressure on an object.	2.2as Use the equation for Pressure, $P=F/A$ where A is the area of contact and F is the applied normal force, to solve simple problems.	2.3as Apply the equation $P=F/A$ to solve problems including use of subject of the formula.
2.1at Identify pascal, Pa, as the SI unit of pressure, P.		
	2.2au Carry out an experiment to find the pressure exerted by a body on a surface.	2.3au Describe in detail an experiment to find the pressure exerted by a body on a surface. <i>This includes providing a diagram, the procedure, adequate precautions, the measurements made as well as the calculations.</i>
	2.2av Use the equation for pressure in a liquid, $P=pgh$ to solve simple problems.	2.3av Apply the equation for pressure in a liquid, $P=pgh$ to solve problems including use of subject of the formula.

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
2.1aw Identify situations where pressure changes with height or depth.	2.2aw Demonstrate the relationship between liquid pressure and depth.	2.3aw Investigate the relationship between liquid pressure and depth. <i>This includes providing a diagram, the procedure, adequate precautions, measurements made and how to determine the density of the liquid from the graph.</i>
	2.2ax Identify simple hydraulic systems.	2.3ax Describe how a simple hydraulic machine uses pressure transmitted in a liquid to magnify forces and use the equation for $P=F/A$ to solve simple problems related to hydraulic machines.
	2.2ay Describe atmospheric pressure as the force per unit area exerted against a surface by the weight of the air above that surface.	2.3ay Explain why atmospheric pressure decreases with increasing height above Earth's surface.
	2.2az Describe how the pressure of a gas is affected by a change in volume or a change in temperature of a fixed mass of gas.	2.3az Describe in terms of the kinetic theory the relationship between the pressure, volume and temperature of a fixed mass of gas.
2.1ba Identify situations where Work is being done.	2.2ba Use the equation for the work done, $W=Fs$ where F is the force and s is the displacement in the direction of the force, to solve simple problems.	2.3ba Apply the equation $W=Fs$ to calculate the mechanical work done by a force in a number of situations including use of subject of the formula. <i>Limited only to the work done by constant forces that are in the direction of motion.</i>
2.1bb Recognise the joule, J, as the SI unit of work, W, and energy, E.	2.2bb Define energy as the ability to do work.	
2.1bc Identify between different forms of energy.	2.2bc Recognise energy transformations in everyday life situations.	
2.2bd State the law of conservation of energy	2.2bd Identify examples of conservation of energy.	2.3bd Apply the law of conservation of energy qualitatively in everyday life situations.
		2.3be Apply the law of conservation of energy to solve problems.

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
2.2bf Recall that an object placed at an altitude above the Earth's surface has gravitational potential energy.	2.2bf Use the equation for gravitational potential energy changes (mgh) near the Earth's surface where m is the mass, g is the gravitational field strength and h is the change in height.	2.3bf Apply the equation for the gravitational potential energy changes, mgh near the Earth's surface including use of subject of the formula.
2.1bg Recall that a moving object has kinetic energy.	2.2bg Use the equation for kinetic energy, $\frac{1}{2}mv^2$, to solve simple problems by substitution.	2.3bg Apply the equation for the kinetic energy, $\frac{1}{2}mv^2$, to solve problems including use of subject of the formula.
2.1bh Write down the equation for Power as $P=E/t$.	2.2bh Define power as the rate of doing work.	
2.1bi Recognise the watt, W , as the SI unit of Power, P . <i>Note that 1 J/s is equivalent to 1 watt.</i>	2.2bi Use the equation for Power, $P=E/t$ to solve simple problems.	2.3bi Apply the equation for Power to solve problems including use of subject of the formula.
	2.2bj Carry out an experiment to find the personal power.	2.3bj Describe in detail an experiment to find the personal power. <i>This includes providing a diagram, the procedure, adequate precautions, the measurements made as well as the calculations.</i>
2.1bk Describe efficiency in terms of useful energy output in relation to total energy input.	2.2bk Compare the efficiency of two simple mechanical systems.	2.3bk Apply the equation of efficiency to solve problems including use of subject of the formula.

Subject Focus:	Thermal Physics
Learning Outcome 3: (Controlled and Coursework)	At the end of the programme, I can show an understanding of the properties of states of matter and of thermal processes. • <i>Relate the three states of matter to density and temperature.</i> • <i>Different thermal processes and their link to their everyday applications.</i> • <i>Specific heat capacity in everyday applications.</i>

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
3.1a Identify kilogram, kg, as the SI unit of mass, m and cubic metre, m ³ , as the SI unit of volume, V.	3.2a Define density as the mass per unit volume.	
3.1b Identify kg/m ³ as the SI unit of density, ρ .	3.2b Use the equation for density $\rho = m/V$ in simple problems.	3.3b Use the equation for density to solve problems requiring the use of the subject of the formula.
3.1c List different materials according to their given densities in terms of whether they sink or float on water.	3.2c Explain why objects float or sink when immersed in a fluid by considering the density of the object and the fluid.	
3.1d Compare the density of a mix of liquids and solids.	3.2d Carry out an experiment to find the density of regular objects.	3.3d Describe in detail an experiment to find the density of a liquid and an irregular object. <i>This includes providing a diagram, the procedure, adequate precautions, the measurements taken as well as the calculations.</i>
3.1e Identify substances in their different states from a given representation of their particle arrangement.	3.2e Describe, using the Kinetic Theory of Matter, the different properties of solids, liquids and gases, including particle arrangement and their motion.	
	3.2f Link the changes of state of matter to the addition or removal of energy to/from the atoms or molecules of the material. <i>Reference to latent heat is NOT required.</i>	3.3f Interpret evaporation as the change of state in which the more energetic particles leave the surface of the liquid and cause cooling.

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
	3.3g Describe the motion of particles in solids, liquids and gases in relation to temperature and their internal energy.	3.2g Relate temperature change to the change in the average speed of particles in matter.
3.1h Identify the degrees Celsius, °C, as a unit of temperature.	3.2h Identify the Kelvin (K) as the SI unit of temperature. <i>No conversion from degrees Celsius to Kelvin is required.</i>	
	3.2i Identify the freezing point and boiling point of pure water at normal atmospheric pressure as 0 °C and 100 °C respectively.	
3.1j Demonstrate how objects expand on heating.	3.2j Identify practical situations where expansion and contraction occur due to changes in thermal energy.	3.3j Describe how changes in thermal energy result in expansion and contraction. <i>The unusual expansion of water is not required.</i>
3.1k Draw the particles of a gas in a closed container.	3.2k Describe how particles of a gas exert pressure in a closed container due to the continuous bombardment of the particles of the gas on the container. <i>Brownian motion is not required.</i>	3.3k Explain how the increase in the kinetic energy of the particles of a gas increases the pressure of the gas.
3.1l Demonstrate how the direction of heat flow depends on temperature difference.	3.2l Describe heating as an energy transfer due to a temperature difference (from a high temperature to a lower temperature).	
3.1m Identify situations where the three types of heat transfer occur	3.2m Define conduction as heat flow through solids, convection as heat flow through fluids and radiation as heat flow through gases or a vacuum.	3.3m Describe qualitatively conduction, convection and radiation as the fundamental modes of heat transfer.
3.1n Carry out a simple experiment that differentiates between conductors and insulators of heat.	3.2n Classify materials as conductors or insulators of heat.	3.3n Describe the difference between good, poor and bad thermal conductors and give examples of each.

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
	3.2o Describe a simple experiment that compares rates of thermal conduction in different types of solids.	3.3o Describe conduction in terms of particle vibration and free electrons in the case of metals.
	3.2p Describe a thermal insulator as a bad thermal conductor.	3.3p Describe an experiment to show how a thermal insulator reduces heat transfer.
3.1q Draw arrows on a diagram to show how convection of heat takes place in a fluid.	3.2q Describe convection as a method of heat transfer through fluids with hot less dense fluid rising on top of cold denser fluid.	3.3q Identify convection currents in everyday life situations such as the formation of land/sea breeze.
	3.2r Describe a simple experiment that shows convection currents in fluids.	
3.1s Identify radiant heat as an electromagnetic wave.		3.3s State that objects radiate/emit or absorb heat energy (infra-red radiation) in the form of waves.
3.1t Demonstrate that matt/dark objects are best absorbers/radiators of heat.	3.2t Compare the different rates of heat emission/absorption for dark and light coloured body surfaces.	3.3t Describe the different rates of heat emission/absorption for dark and light coloured body surfaces in everyday life situations.
3.1u Demonstrate that shiny/ white objects are best reflectors of heat.	3.2u Compare the different rates of heat emission/absorption for matt/dark and shiny/white surfaces.	3.3u Describe the different rates of heat emission/absorption for matt and shiny surfaces in everyday life situations.
	3.2v Carry out an experiment to show how the colour of the surface affects the absorption or emission of heat.	3.3v Describe an experiment to show how the colour of the surface affects the absorption and emission of heat. <i>This includes providing a diagram, the procedure, precautions necessary, observations made and representation of data in graphical form.</i>

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
3.1w List a number of ways of limiting energy costs at home or other buildings.		3.3w Explain a number of ways of limiting energy costs at home and other buildings including a typical Maltese house.
3.1x Identify J/kgK and J/kg°C as the units of Specific Heat Capacity, c.	3.2x Demonstrate that the final temperature of different materials is different when heated by the same amount of heat.	3.3x Define the specific heat capacity c as the heat energy required to increase the temperature of 1 kg of substance by 1 K or 1 °C.
		3.3y Apply the equation $Q = mc\Delta\theta$ to get the unknown quantity c or m or $\Delta\theta$, where Q represents the quantity of heat transferred, m is the mass and $\Delta\theta$ is the change in temperature.
		3.3z Work out problems related to the specific heat capacity of a heated metal/liquid using an electric heater.
		3.3aa Describe in detail an experiment to measure the specific heat capacity of a solid metal or a liquid using a heater of known power and/or a joulemeter. <i>This includes providing a diagram, the procedure, precautions, the measurements taken as well as any calculations.</i>
	3.2ab Identify everyday life situations where the final temperature of various materials is different when heated or cooled by the same amount of heat transfer such as the difference in temperature of sea and sand after receiving the same amount of heat.	3.3ab Interpret how the specific heat capacity of different materials relates to practical situations where they are used.

Subject Focus:	Electricity
Learning Outcome 4:	At the end of the programme, I can show an understanding of static and moving charges.
(Controlled and Coursework)	• <i>Link static charge with forces of attraction and repulsion in different situations.</i> • <i>Describe the energy changes in circuits both qualitatively and quantitatively.</i> • <i>Relate current, voltage and resistance in series, parallel and combination circuits.</i>

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
	4.2a Label the structure of an atom in terms of protons, neutrons and electrons.	4.3a Describe the structure of an atom in terms of protons, neutrons and electrons.
	4.2b State the charges on protons, neutrons and electrons and that electrons and protons have equal charge.	
4.1c Demonstrate that friction charges an insulator by using lab and everyday examples.	4.2c Describe how to charge an insulator by friction.	
	4.2d Explain how charging an insulator involves the movement of charges between two materials to leave one positively charged and one negatively charged.	4.3d Explain how charging an insulator involves the movement of negative charges between two materials. <i>The material that loses electrons becomes positively charged and the material that gains electrons becomes negatively charged.</i>
4.1e Carry out a simple experiment that demonstrates repulsion and attraction between charged objects.	4.2e State the conditions for electrical attraction and repulsion between charges. <i>Like charges repel; unlike charges attract.</i>	
		4.3f Explain how a charged object attracts a neutral object. <i>No reference to induction is required.</i>

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
4.1g Show that a charged object can attract an uncharged object.	4.2g Explain that when a charged object A attracts another object B, then object B either has an opposite charge to A or is neutral.	4.3g Explain why electrostatic repulsion is the only way to identify an unknown type of charge.
		4.3h Describe earthing as a process by which a charged object becomes neutral due to a flow of electrons to or from earth. <i>No reference to induction is required.</i>
4.1i List uses of static electricity. - <i>spray painting of charged objects;</i> - <i>lightning conductor for earthing;</i> - <i>electrostatic precipitator.</i> <i>No reference to induction required.</i>	4.2i Describe the uses of static electricity listed in MQF 1. <i>No reference to ionisation required.</i>	4.3i Apply the principles of electrostatics to other everyday life situations.
4.1j Distinguish between electric conductors and insulators in terms of conductivity of electricity.		4.3j Distinguish between electric conductors and insulators in terms of conductivity and relative numbers in free electrons.
4.1k Name suitable examples of conductors and insulators.		
4.1l Carry out an experiment that distinguishes between conductors and insulators.	4.2l Describe an experiment that distinguishes between conductors and insulators.	
4.1m Identify the ampere, A, as the SI unit of electric current, I and the coulomb, C, as the SI unit of quantity of electric charge, Q.		
4.1n Describe current as the rate of flow of charge.	4.2n Use $I=Q/t$ to define current I, as the rate of flow of charge past a point in a circuit, where Q is the quantity of charge and t is the time.	4.3n Use the equation $I=Q/t$ to solve problems requiring the use of subject of the formula.
4.1o Draw the direction of flow of conventional current.		4.3o Distinguish between the direction of conventional current and the direction of motion of the negative charge (electrons).

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
4.1p Demonstrate that a voltage can create a current.	4.2p State that a voltage / potential difference creates a current.	4.3p Define voltage as the energy that 1 Coulomb of charge uses up between two points in a circuit.
4.1q Identify volt, V, as the SI unit of voltage / potential difference, V.		4.3q Apply the equation $E=QV$, where E is the electrical energy, V is the potential difference and Q is quantity of charge, to solve problems requiring the use of subject of the formula.
4.1r Demonstrate that electrical energy is being converted to different types of energies according to the specific type of circuit.		4.3r Apply the equation $E=IVt$, where E is the electrical energy, V is the potential difference and I is the current flow during time t, to solve problems requiring subject of the formula.
4.1s Identify ohm, Ω , as the SI unit of resistance, R.	4.2s Describe electrical resistance as an opposition to the flow of charge or current.	4.3s Demonstrate that current and resistance are inversely proportional.
4.1t Show how the resistance of a nichrome wire depends on its length.	4.2t Take readings in an experiment that demonstrates how the resistance of a wire depends on its length.	4.3t Describe in detail an experiment that demonstrates how the resistance of a wire depends on its length. <i>This includes providing a diagram, the procedure, adequate precautions, observations made and a graphical representation of the data.</i>
	4.2u Relate qualitatively the resistance of a wire to its length, diameter, the type of material and temperature.	
4.1v State that current can be doubled if voltage is doubled.	4.2v State Ohm's law - current is directly proportional to the voltage across a resistance if the temperature remains constant.	
	4.2w Use $V=IR$ to find V, where V is the voltage, R is the resistance and I is current.	4.3w Apply the equation $V=IR$ to solve problems requiring subject of the formula.

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
4.1x Show that the voltage is directly proportional to current for an ohmic conductor.	4.2x Carry out an experiment to prove Ohm's Law for a metallic conductor (ohmic conductor).	4.3x Describe in detail an experiment that proves Ohm's law for a metallic conductor. <i>This includes providing a circuit diagram, the procedure, adequate precautions, measurements made and how to determine the resistance of the metallic conductor from the graph.</i>
4.1y Recognise the V-I graph of a metallic conductor at constant temperature.	4.2y Sketch the V-I graph of a metallic conductor at constant temperature and a filament lamp.	4.3y Discuss the V-I graph of a metallic conductor at constant temperature and a filament lamp.
	4.2z Carry out an experiment to investigate how current varies with voltage for a filament lamp. <i>This includes any measurements made and a graphical representation of the data.</i>	4.3z Describe in detail an experiment to investigate how current varies with voltage for a filament lamp. <i>This includes providing a circuit diagram, the procedure, adequate precautions, measurements made and a graphical representation of the data.</i>
4.1aa Draw the standard electronic symbols of: a wire, a cell, a battery, an alternating current supply, a direct current power supply, an earthed point, a switch, a fixed resistor, a variable resistor, a fuse, a voltmeter, an ammeter, and a filament lamp.	4.2aa Recognise the standard electronic symbol of a centre-zero galvanometer.	
4.1ab Use the correct circuit symbols to draw circuit diagrams of simple circuits.		
4.1ac Assemble a simple circuit that can include: a wire, a cell or battery, a direct current power supply, a switch, a fixed resistor, a variable resistor and a light bulb.	4.2ac Assemble a simple circuit that can include: a wire, a cell or battery, a direct current power supply, a switch, a fixed resistor, a variable resistor, a voltmeter, an ammeter and a light bulb.	4.3ac Design a simple circuit that can include: a wire, a cell or battery, an alternating current supply, a direct current power supply, an earthed point, a switch, a fixed resistor, a variable resistor, a voltmeter, an ammeter and a light bulb.

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
4.1ad Distinguish between open and closed circuits.	4.2ad Describe a short circuit as an alternative route for current to flow through.	
4.1ae Identify the correct wiring of ammeters and voltmeters in a circuit.		
		4.3af Explain why an ideal ammeter has negligible resistance.
		4.3ag Explain why an ideal voltmeter has an infinitely high resistance.
4.1ah Recognise resistors connected in series and resistors connected in parallel in a circuit.	4.2ah Use the equation for total resistance for resistors connected in series: $R_{\text{total}} = R_1 + R_2 + R_3$.	4.3ah Use the equation for total resistance for two resistors connected in parallel: $1/R_{\text{total}} = 1/R_1 + 1/R_2$.
4.1ai Assemble a circuit that uses resistors connected in series or in parallel to demonstrate how the total current in the circuit varies. <i>This can be represented visually by the change of brightness of a bulb connected to the same circuit.</i>		
4.1aj Measure the voltage across electrical components in a series circuit by connecting the voltmeter in a suitable position.	4.2aj State that for electrical components in series, current is the same, voltage is shared: ($V_{\text{total}} = V_1 + V_2 + \dots$).	4.3aj Solve problems involving electrical components in series, where current is the same and voltage is shared: ($V_{\text{total}} = V_1 + V_2 + \dots$).
4.1ak Measure the current through electrical components in a series and parallel circuits by connecting the ammeter in a suitable position.	4.2ak State that for electrical components in parallel, voltage is the same, current is shared: ($I_{\text{total}} = I_1 + I_2 + \dots$).	4.3ak Solve problems involving electrical components in parallel, where voltage is the same and current is shared: ($I_{\text{total}} = I_1 + I_2 + \dots$).

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
		4.3al Solve problems involving a combination of series and parallel electrical components in a circuit.
	4.2am Define electrical power as the rate at which electrical energy is transferred in an electric circuit.	
	4.2an Use the equation $P = IV$ to find Power in simple problems.	4.3an Use the equation $P = IV$ to solve problems requiring the use of the subject of the formula.
4.1ao Mention the sources of alternating current and direct current.	4.2ao Recognise each type of current from the display of a cathode ray oscilloscope.	4.3ao Distinguish between the properties of direct and alternating currents.
4.1ap Identify the live, neutral and earth wires from the colour of their insulation.	4.2ap Explain the function of the live, neutral and earth wires in domestic mains electricity.	
4.1aq Identify the live, neutral and earth wires from their position in a standard three pin plug.	4.2aq Draw connections from the live, neutral and earth wires in a ring circuit to the corresponding points in a wall socket.	
4.1ar Wire correctly and safely a three pin plug.	4.2ar Distinguish between correctly and incorrectly wired three pin plugs.	
4.1as Demonstrate how a fuse works.	4.2as Explain why fuses have various ratings.	4.3as Solve problems to identify the appropriate fuse rating from given values.
4.1at Identify the earth wire and the circuit breaker in a house.	4.2at Explain the function of the earth wire in a household circuit.	4.3at Describe the electrical safety features in a house. <i>Including earthing and circuit breakers</i>

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
4.1au Identify household appliances that are double insulated.	4.2au Explain why double insulated appliances do not need an earth wire while appliances with a metal case need to be earthed.	
4.1av Identify dangerous practices in the use of mains electricity.		4.3av Recognise and explain dangerous practices in the use of mains electricity.
4.1aw Relate kilowatt-hour to one unit of electrical energy.	4.2aw Define the kilowatt-hour as a unit of energy.	4.3aw Calculate the cost of domestic electricity using the number of units consumed and the cost per unit.
		4.3ax Convert energy from joules to kilowatt-hour and vice versa.

Subject Focus:	Magnetism and Electromagnetism
Learning Outcome 5: (Controlled and Coursework)	At the end of the programme, I can show an understanding of magnetism and electromagnetism. • <i>Explain the processes leading to magnetism.</i> • <i>Relate electricity to electromagnetism as applied in a variety of uses.</i>

5.1a Show that magnetic materials are attracted to a permanent magnet.	5.2a Distinguish between magnetic and non-magnetic materials.	
5.1b Demonstrate attraction and repulsion between magnets.	5.2b Describe that permanent magnets have two poles.	5.3b Explain how the alignment of dipoles leads to the poles of a magnet.
5.1c Use a plotting compass to demonstrate the presence of a magnetic field.	5.2c Explain how a plotting compass works in terms of the Earth's magnetic field.	5.3c State that the Earth has its own magnetic field and that the magnetic north pole and geographical North Pole are not on the same place on Earth.
5.1d Carry out an experiment that uses iron filings to show the magnetic field around a permanent bar magnet.	5.2d Describe an experiment that uses iron filings to show the magnetic field lines around a permanent magnet.	5.3d Link the closeness of the magnetic field lines to the strength of the magnetic field.
5.1e Describe a magnetic field as a 3D space around a permanent magnet where another magnet or magnetic material experiences a force.		
5.1f Create a magnet using both the stroking method and the direct current electrical method.	5.2f Describe how to create a permanent magnet using both the stroking method and the direct current electrical method.	5.3f Explain why permanent magnets are created by the stroking method and direct current electrical method.
5.1g Identify simple everyday practices that cause a demagnetising effect. <i>E.g. leaving credit card in car/sun in summer, banging fridge door, etc...</i>	5.2g Describe how demagnetisation can be achieved using hammering, heating or the electrical method using alternating current.	5.3g Explain why demagnetisation can be achieved using hammering, heating or the electrical method using alternating current.

		5.3h Explain magnetic induction using a permanent magnet.
5.1i Show experimentally that like poles repel and unlike poles attract.	5.2i Deduce the type of magnetic pole on another magnet depending on the magnetic forces that can exist between it and another known magnetic pole.	5.3i Deduce the type of magnetic pole on a material depending on the magnetic forces that can exist between it and another known magnetic pole.
	5.2j Explain why magnetic repulsion is the only way to identify an unknown type of magnetic pole.	
5.1k Draw the magnetic field lines around two bar magnets to show the magnetic field between different pole combinations.	5.2k Indicate the direction of the magnetic field lines between different pole combinations.	
5.1l Demonstrate the direction of the field around a single long straight current-carrying conductor.	5.2l Draw the magnetic field lines around a single long straight current-carrying conductor. <i>No reference to direction of magnetic field lines required.</i>	5.3l Draw the magnetic field lines around a single long straight current-carrying conductor and a solenoid using the right hand grip rule.
5.1m Demonstrate the presence of a magnetic field around an electromagnet.	5.2m Describe how a field is setup around an electromagnet when current flows through the wire.	5.3m Identify the magnetic polarities of an electromagnet using the right hand grip rule.
5.1n Carry out experiments to observe how the strength of an electromagnet depends on the number of turns in the coil or the strength of the current.	5.2n Carry out experiments to observe how the strength of an electromagnet depends on the number of turns in the coil or strength of the current. This includes taking and comparing measurements.	5.3n Describe in detail and carry out an experiment to show how the strength of an electromagnet depends on the number of turns in the coil or strength of the current. This includes providing a diagram, the procedure, adequate precautions, measurements made and a graphical representation of the data.
5.1o List the factors (the number of turns, the size of current flow and the use of an iron core) that affect the strength of the magnetic field around an electromagnet.	5.2o Compare the properties of permanent magnets and electromagnets.	5.3o Explain how the factors (the number of turns, the size of current flow and the use of an iron core) affect the strength of the magnetic field around an electromagnet.

5.1p List applications where electromagnets are used.		5.3p Describe applications where electromagnets are used.
5.1q Demonstrate how a force acts on a current carrying conductor placed in a magnetic field.	5.2q State that a current carrying conductor placed at right angles to a magnetic field will experience a force.	5.3q Explain how the magnetic fields interact when a current carrying conductor is placed at right angles to a magnetic field, causing a perpendicular catapult force to act on the conductor.
	5.2r List the factors (the current and the magnetic field strength) that affect the magnitude of the force acting on the conductor.	5.3r Describe how the factors (the current and the magnetic field strength) affect the magnitude of the force acting on the conductor.
5.1s Demonstrate how the force acting on a current carrying conductor is affected by: - the amount of current flowing in the conductor; - the strength of the magnetic field.	5.2s Demonstrate how the force acting on a current carrying conductor is affected by: - changing the direction of the current; - changing the direction of the magnetic field. <i>No reference to Fleming's Left Hand Rule required.</i>	5.3s Use Fleming's Left Hand Rule for a current carrying conductor in a magnetic field to give the relative directions of the catapult force, magnetic field and current.
		5.3t Recognise that no catapult force can act on the current carrying conductor if it is placed parallel to the direction of the magnetic field.
5.1u Outline practical situations where a simple motor is used. <i>E.g. Food mixer, washing machine, driller, electric toy car, etc.</i>	5.2u Demonstrate that a current carrying rectangular coil placed in a magnetic field experiences a turning effect.	5.3u Explain that a current carrying rectangular coil placed in a magnetic field experiences a turning effect including the action of an electric dc motor. <i>No reference to split ring commutators required.</i>
	5.2v List the factors (current through coil, magnetic field strength and number of turns) that increase the turning effect of the rectangular coil in the magnetic field.	5.2v Explain why increasing current through coil, magnetic field strength and number of turns in a simple dc motor increase the turning effect of the rectangular coil in the magnetic field.

5.1w Identify that a current is induced when a magnet is moved back and forth close to a stationary conductor.	5.2w State that when a magnet is moved back and forth close to a stationary conductor, an emf is induced across the conductor as observed on a centre zero galvanometer.	5.3w Explain, in terms of the cutting of magnetic field lines, that when a magnet is moved back and forth close to a stationary conductor, an emf is induced across the conductor as observed on a centre zero galvanometer.
	5.2x State Faraday's law.	5.3x Explain how the current induced in a conductor depends on the rate of cutting of the magnetic flux, the number of turns of the coil and the magnetic field strength using Faraday's law of electromagnetic induction.
	4.2y List the factors that affect the size of the induced current: the number of turns of coil, the rate of cutting of magnetic flux and the magnetic field strength.	5.3y Relate the size of the induced current with the number of turns in a coil, the rate of cutting of magnetic flux and the magnetic field strength.
		5.3z State Lenz's law.
		5.3aa Determine the direction of the induced current in the coil when a magnet is moved back and forth by applying the right hand grip rule.
		5.3ab Apply the concepts of electromagnetic induction in given situations.
		5.3ac Relate generation of electricity to electromagnetic induction.
5.1ad Distinguish between a step up and a step down transformer.	5.2ad Draw the construction of a basic iron core transformer, i.e. step-up and step-down.	5.3ad Relate the operation of a basic iron core transformer to Faraday's law.

	5.2ae Identify that a transformer has an input from an a.c. source.	5.3ae Explain why transformers can only be used with alternating current.
		5.3af Solve problems using $N_1/N_2 = V_1/V_2$, where N_1 is the number of turns in the primary coil, N_2 is the number of turns in the secondary coil, V_1 is the voltage across the primary coil and V_2 is the voltage across the secondary coil for an ideal transformer.
		5.3ag Distinguish between ideal and practical transformers in terms of heat energy losses.
		5.3ah Use the equation $I_1V_1 = I_2V_2$ for an ideal transformer to solve problems requiring the use of the subject of the formula.
		5.3ai Describe why transformers are required to adjust voltages to reduce energy losses, when electrical energy is distributed from power stations to consumers.

Subject Focus:	Radioactivity
Learning Outcome 6:	At the end of the programme, I can show an understanding of nuclear phenomena.
(Controlled)	• <i>Relate nuclear phenomena to instability, randomness and spontaneity.</i> • <i>Compare the properties of different types of nuclear radiation.</i> • <i>Describe some characteristics and applications of radioactive substances.</i>

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
	6.2a Define the terms: proton (or atomic) number Z, neutron number N and nucleon (or mass) number A.	
6.1b Draw a model of an atom having a nucleus with protons and neutrons surrounded by electrons.	6.2b State the charge of subatomic particles: neutrons and protons and electrons.	6.3b Describe an atom as having a nucleus with most of the mass of the atom, surrounded by orbiting electrons of negligible mass.
	6.2c Represent an element with a given chemical symbol using letter(s) together with the nucleon and proton number. These should be set in the general form A_ZX where X is the symbol for the element.	6.3c Identify isotopes as atoms of the same element that have the same proton number but a different nucleon number.
6.1d State that nuclear radiation is emitted from the nucleus of an unstable atom.	6.2d Explain that nuclear radiation is a random and spontaneous process.	6.3d Describe the terms radioactive decay and ionisation.
	6.2e Describe the nature of alpha particles, beta negative particles (electrons from nuclei) and gamma radiation (electromagnetic waves).	6.3e Write down nuclear equations to represent alpha (helium nucleus) and beta [negative] decay.
6.1f Compare the range in air and penetrating power of alpha, beta and gamma radiation.	6.2f Compare the nature, charge and mass of alpha, beta and gamma radiation.	6.3f Compare properties of alpha, beta and gamma radiation including their ionizing effect. <i>Use of cloud chamber not expected.</i>

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
6.1g Describe how to detect radioactive radiation using the Geiger Muller tube and a rate meter.	6.2g Describe an experiment using the Geiger Muller tube and a ratemeter to identify the type of radioactive radiation present.	6.3g Explain how a Geiger Muller tube and a ratemeter can be used to determine properties of radioactive radiation.
6.1h List the sources of background radiation.	6.2h Describe a simple experiment to measure the background radiation.	6.3h Describe a simple experiment to determine the corrected count rate of a radioactive source.
6.1i Explain the meaning of the term 'half-life' using a model.	6.2i Determine the half-life of a radioactive substance from a graph.	6.3i Calculate the fraction/percentage of the original isotope left after a period of time.
6.1j Describe how radioactivity can be used to detect a leakage in underground pipes.	6.2j Describe how radioactivity can be used in the thickness control of a material and as tracers to help radiographers see inside a patient's body.	6.3j Relate the properties of the three types of radiation to given practical applications.
6.1k Describe ways of storing and handling radioactive materials.		

Subject Focus:	The Earth and the Universe
Learning Outcome 7:	At the end of the programme, I can show an awareness of some features of the Earth and the Universe.
(Controlled)	• <i>Earth's motion.</i> • <i>The solar system.</i> • <i>The universe and its component parts.</i>

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
7.1a Draw a labelled diagram of the solar system - the sun and its eight orbiting planets.	7.2a Describe the solar system as consisting of the sun and its eight orbiting planets.	7.3a Describe the solar system as consisting of the sun, the eight planets, the asteroid belt and the moons.
7.1b Identify the eight planets of the solar system according to their distance from the sun.		7.3b Distinguish inner planets as rocky and outer planets as gaseous.
7.1c Describe three features (atmosphere, water and life) of the earth that distinguishes it from other planets.	7.2c Define a planet as being a celestial body that: is in orbit around the Sun; has a nearly spherical shape; has cleared the neighbourhood around its orbit.	7.3c Recognise a dwarf planet as a celestial object which has not cleared the neighbourhood around its orbit.
7.1d State that the Earth spins about its own axis to create day and night. <i>Example using a bulb and a ball.</i>		7.3d Explain how as the Earth revolves around the sun about its own axis, the spinning of the Earth causes day and night.
7.1e Make a simple model of the orbit of the Earth around the sun.	7.2e State that the Earth takes approximately 365.25 days to orbit once around the sun.	7.3e Explain how the tilt of the Earth in relation to the sun gives rise to the seasons.
	7.2f Demonstrate the gravitational pull acting between the Earth and other objects.	7.3f Explain how the force of gravity between objects increases with mass and decreases with distance.
7.1g Identify that satellites orbit planets.	7.2g Distinguish between artificial satellites and natural satellites.	7.3g Distinguish between geostationary and polar orbit satellites by considering their different orbitals, distance from Earth, duration of an orbit and their uses. <i>No specific values are required.</i>

7.1h Distinguish between stars, planets and galaxies.	7.2h Describe how our solar system is part of the Milky Way galaxy which is a small part of the Universe.	
	7.2i Recognise the telescope as the instrument used to observe celestial bodies.	7.3i Discuss the advantages and disadvantages of using orbiting telescopes as opposed to terrestrial telescopes.
7.1j Use the term 'light year' to compare relative distances in space.	7.2j Define one light year as the distance travelled by light in one year.	7.3j Calculate the distance travelled by light in one year.
7.1k State that the sun is a star.	7.2k Explain how the sun is one of billions of stars in the Milky Way.	7.3k Describe how the Milky Way is one of billions of galaxies in the Universe.
	7.2l Relate the origin of the universe to the Big Bang theory.	7.3l Describe the Big Bang theory in relation with the expansion of the Universe.
7.1m List a few of the social and economic benefits of space explorations.	7.2m Explain that when looking at the stars at night, one would be observing light emitted from the stars light years ago.	7.3m Research about the role of the International Space Station for space exploration and its benefits to human kind.

Subject Focus:	The Science of the Physical World
Learning Outcome 8:	At the end of the programme, I can demonstrate an understanding of how Physics works and is communicated. <i>The assessment criteria of this learning outcome are to be implemented in combination with learning outcomes and refer to experiments and investigations.</i>

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
8.1a State that scientific knowledge changes with new evidence / observations / experiments	8.2a Distinguish between a fact, a hypothesis and a theory.	8.3a Discuss briefly the meaning of science in terms of its healthy scepticism, aimed objectivity and the value of physical (observable / measurable) evidence.
8.1b Discuss the importance of fair (objective) testing in science.		8.3b Evaluate an experiment in terms of its objectivity.
	8.2c Plan an experiment/investigation to solve a given problem with supervision.	8.3c Plan an experiment/investigation to solve a given problem without supervision.
	8.2d Carry out an investigation/experiment to solve a given problem with supervision.	8.3d Carry out an investigation/experiment to solve a given problem without supervision.
8.1e Carry out, with supervision, a written procedure for an experiment.	8.2e Carry out, with limited supervision, a written procedure for an experiment.	8.3e Carry out, with no supervision, a written procedure for an experiment.
8.1f Record observations / measurements in a given table.	8.2f Record observations / measurements appropriately.	8.3f Determine which observations / measurements are to be measured for an experiment.

Assessment Criteria (MQF 1)	Assessment Criteria (MQF 2)	Assessment Criteria (MQF 3)
	8.2g Structure a laboratory report in sections.	8.3g Write a scientific report for an experiment carried out.
8.1h Label diagrams of given apparatus.		8.3h Draw labelled diagrams of apparatus used during experiments/investigations.
8.1i Read simple graphical representations.	8.2i Plot simple, linear graphical representations.	8.3i Plot graphical representations from data.
		8.3j Interpret graphical representations.
	8.2k Draw conclusions from an experiment.	8.3k Write sources of error for experiments/investigations.

Scheme of Assessment

School candidates

The assessment consists of 2 parts:

Coursework: 30% of the total marks; comprising 5 tasks of equal weighting i.e. 6% each; set during the three-year course programme.

Coursework can be pegged at either of two categories:

- A coursework at MQF level categories 1-2 must identify assessment criteria from these two MQF levels. The ACs are to be weighted within the assignment's scheme of work and marking scheme at a ratio of 40% at Level 1 and 60% at Level 2.
- A coursework at MQF level categories 1-2-3 must identify assessment criteria from each of Levels 1, 2, and 3. These ACs are to be weighted within the assignment's scheme of work and marking scheme at a ratio of 30% at each of Levels 1 and 2 and 40% at Level 3.

The mark for assignments at level categories 1-2 presented for a qualification at level categories 2-3 is to be recalculated to 60% of the original mark. The mark stands in all other cases.

Controlled assessment: 70% of the total marks; comprising of a two-hour written exam; set at the end of the programme and differentiated between two tiers:

- MQF levels 1 and 2;
- MQF levels 2 and 3.

Candidates can obtain a level higher than Level 1 if they satisfy the examiners in both the coursework and the controlled assessments, irrespective of the total marks obtained.

Part 1: Coursework

- The **coursework** will be based on LO 1, LO 2, LO 3, LO 4 and LO 5.
- An overview of the coursework assignments is shown in the table below:

Part 1: Coursework – Category Levels 1-2-3 (30 %)				
Assignment 1 (6 %)	Assignment 2 (6 %)	Assignment 3 (6 %)	Assignment 4 (6 %)	Assignment 5 (6 %)
1 Investigation (4%) + 1 Experiment (2%)	3 Experiments (2% each)	1 Design Task (2%) + 2 Experiments (2% each)	1 Site Visit (4%) + 1 Experiment (2%)	1 Project (6%)

Figure 1: Coursework Assignments for School Candidates

- Candidates will be assessed through 5 assignments carried out during this three-year programme - 2 assignments in Year 9, 2 assignments in Year 10 and 1 assignment in Year 11.
- Coursework Assignments 1 and 2 are mandatory and one can choose or repeat any of the 5 Assignments in completing the coursework part.
- All assignment tasks shall be marked out of 100 according to guidelines and rubrics available with this syllabus.

- Levels 1-2-3 will be determined from the mark obtained in the task set, by a continuous method, during the course of instruction according to the following table.

MQF Level	1	2	3
Global % obtained	0 - 30	31 - 60	61 - 100

Figure 2: MQF Level cut off points

- School candidates' assignments, forming part of coursework, are to be available at the candidates' school for moderation purposes as indicated by the MATSEC Board.

Part 2: Controlled Assessment II

Part 2: Controlled Assessment II (2 hours) (70 %)

Paper consisting of 3 sections including items of graded difficulty at Level 1-2

OR

Paper consisting of 3 sections including items of graded difficulty at Level 2-3.

Figure 3: Part 2 Controlled assessment for School Candidates

Controlled Assessment II will:

- cover most learning outcomes including all learning outcomes which are not indicated to be covered through coursework;
- have three sections as follows:
 - Section A consisting of 8 – 10 short questions (40 marks)
 - Section B consisting of 1 structured question including graph plotting (15 marks)
 - Section C consisting of 3 long structured questions (45 marks)
- be marked out of 100 and all questions are compulsory.

Private Candidates

Private candidates shall be assessed by means of two controlled assessments.

The first controlled assessment (I) will focus on the learning outcomes identified for school candidates' coursework. Learning outcomes with assessment criteria in the psychomotor domain can be assessed by asking questions in pen-and-paper format seeking understanding of the activity.

Controlled Assessment I will:

- assess all learning outcomes which were indicated as part of school candidates' coursework and some other outcomes;
- have two sections as follows:
 - Section A consisting of 5 long structured questions of 15 marks each (75 marks)
 - Section B consisting of 1 – 2 structured questions which may be based on a local context (25 marks)
- include items which will focus on the practical aspect of the assessed learning outcomes;
- have questions which include graph plotting;
- be marked out of 100 and all questions are compulsory.

Part 1: Controlled Assessment I (2 hours) (30 %)

Paper consisting of 2 sections including items of graded difficulty at Level 1-2

OR

Paper consisting of 2 sections including items of graded difficulty at Level 2-3.

Figure 4: Part 1 Controlled assessment for Private Candidates

The second controlled assessment (II) is common with school candidates.

Part 2: Controlled Assessment II (2 hours) (70 %)

Paper consisting of 3 sections including items of graded difficulty at Level 1-2

OR

Paper consisting of 3 sections including items of graded difficulty at Level 2-3.

Figure 5: Part 2 Controlled assessment for Private Candidates

Appendices

Appendix 1: Mathematical Notations

Students should be able to:

- recognise and use expressions in decimal and standard form (scientific) notations;
- recognise and use prefixes indicating multiplication by 10^{-6} , 10^{-3} , 10^3 , 10^6 ;
- make evaluations of numerical expressions and use such approximations to check calculations;
- change the subject of an equation;
- solve simple algebraic equations.

Appendix 2: Table of Circuit Symbols

Name	Circuit symbol	Name	Circuit Symbol
a. c. supply		filament lamp	
voltmeter		ammeter	
cell		battery	
d. c. supply		junction	
switch		earth	
fuse		galvanometer	
fixed resistor		variable resistor	

Appendix 3: SI Units and Symbols

Physical Quantity	Symbol	Name of S.I. Unit	Symbol of S.I. unit
length	l	metre	m
area	A	square metre	m ²
volume	V	cubic metre	m ³
mass	m	kilogram	kg
density	ρ	kilogram per metre cubed	kg/m ³
time	t	second	s
periodic time	T	second	s
frequency	f	hertz [per second]	Hz
wavelength	λ	metre	m

work	W	joule [newton metre]	J
energy	E	joule	J
power	P	watt [joule per second]	W
potential energy	PE	joule	J
kinetic energy	KE	joule	J
heat energy	Q	joule	J
temperature*	θ	kelvin	K
specific heat capacity*	c	joule per kilogram kelvin	J/kg K

force	F	newton [kg m/s ²]	N
weight	W	newton	N
moment of a force	M	newton metre	Nm
pressure	P	pascal [N/m ²]	Pa
distance	s	metres	m
speed	s	metre per second	m/s
initial velocity	u	metre per second	m/s
final velocity	v	metre per second	m/s
acceleration	a	metre per second squared	m/s ²
acc. due to gravity	g	metre per second squared	m/s ²
momentum	p	kilogram metre per second	kg m/s

Quantity of electric charge	Q	coulomb	C
electric current	I	ampere	A
electromotive force	EMF	volt [joule per coulomb]	V
potential difference pd	V	volt [joule per coulomb]	V
voltage	V	volt [joule per coulomb]	V
resistance	R	ohms	Ω
electrical energy	E	joule	J

* Questions in Controlled Papers using these units may be set in degrees celsius(°C).

Appendix 4: Useful information given in Controlled Papers

When necessary, take g , acceleration due to gravity, as 10m/s^2 .

Density	$\rho = \frac{m}{V}$
Pressure	$P = \frac{F}{A}$ $P = h \rho g$
Moments	Moment = $F \times$ perpendicular distance
Energy and Work	$PE = m g h$ $KE = \frac{1}{2} m v^2$ $W = F s$ $P = \frac{E}{t}$
Force and Motion	resultant force = $m a$ $W = m g$ $p = m v$ $F = \frac{(mv - mu)}{t}$
	average speed = $\frac{\text{total distance}}{\text{total time}}$ $v = u + a t$ $s = (u + v) \frac{t}{2}$
	$v^2 = u^2 + 2 a s$ $s = u t + \frac{1}{2} a t^2$
Waves	$n = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$ $n = \frac{\text{real depth}}{\text{apparent depth}}$
	Magnification = $\frac{\text{image height}}{\text{object height}}$ Magnification = $\frac{\text{image distance}}{\text{object distance}}$
	$v = f \lambda$ $T = \frac{1}{f}$
Electricity	$I = \frac{Q}{t}$ $V = I R$ $P = I V$
	$E = Q V$ $E = I V t$
	$R_{\text{total}} = R_1 + R_2 + R_3$ $\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2}$
Electromagnetism	$\frac{V_p}{V_s} = \frac{N_p}{N_s}$ $V_p I_p = V_s I_s$
Heat	$Q = m c \Delta \theta$
Radioactivity	$A = Z + N$
Other equations	Area of a triangle = $\frac{1}{2} b h$ Area of a trapezium = $\frac{1}{2} (a + b) h$

Appendix 5: A non-exhaustive suggested list of activities

Subject Focus: Waves	
Learning Outcome 1:	At the end of the programme I can show an understanding of the nature and application of different types of waves.
	Reflection of light in a plane mirror
	Refraction of light (with more than one angle)
	Critical angle and total internal reflection for light rays
	Focal length of a convex lens
	Site Visit: Mater Dei Hospital [B’Kara] - EM radiation

Subject Focus: Motion, Forces and Energy	
Learning Outcome 2:	At the end of this programme, I can relate forces and energy to motion.
	Acceleration of free fall
	Finding the centre of mass of an irregularly shaped lamina
	Relationship between resultant force and acceleration for a system with constant mass.
	Hooke’s law
	Law of Moments
	Pressure exerted by a body on a surface
	Relationship between liquid pressure and depth
	Determining personal power
	Site Visit: Institute of Sustainable Energy - Energy sources
	Site Visit: Archery Foundation - Forces and energies

Subject Focus: Thermal Physics	
Learning Outcome 3:	At the end of the programme I can show an understanding of the properties of matter and of thermal processes.
	Determining the density of a regular/irregular object and a liquid
	Absorption of radiation
	Emission of radiation
	Determining the specific heat capacity of a solid metal or a liquid

Subject Focus: Electricity and Electromagnetism	
Learning Outcome 4:	At the end of the programme, I can show an understanding of static and moving charges.
	Determining variation of resistance of a wire with length
	Proving Ohm's law for a metallic conductor
	Variation of current with voltage for a filament lamp
	Site Visit: Carlo Gavazzi Ltd [Bulebel Industrial Estate] - Electrical components
	Site Visit: SG Microelectronics - Static Electricity
	Site Visit: Enemalta Sites

Subject Focus: Electricity and Electromagnetism	
Learning Outcome 5:	At the end of the programme, I can show an understanding of magnetism and electromagnetism.
	Strength of an electromagnet
	Plotting lines of flux (Around a single bar magnet and two magnets in attraction and repulsion)
	Site Visit: Enemalta Sites

Subject Focus: Various	
Learning Outcome:	Various
	Site Visit: National Science Centre, Bighi (Esplora)
	Site Visit: Maritime Museum, Cospicua

Appendix 6: Components of the Modes of Assessment

	Formulating a hypothesis	Planning (procedure, questions, etc)	Working in the lab	Collection of data and/or information	Processing of data (inc. graphs)	Writing a report	Creating an artefact	Presentation of findings
Experiment			X	X	X	X		
Investigation	X	X	X	X	X	X		
Design Question	X	X				X		
Site Visit		X		X		X		
Project		X		X		X	X	X

Coursework Modes

Coursework Mode 1: Experiment

Experiment																			
100 marks internally-assessed externally-moderated	Practical work is a common element among the science subjects. Through experiments students develop experimental skills and techniques such as handling apparatus, performing tests or procedures, identifying variables to alter or control, conducting observations and measurements, and tabulating data. Furthermore, during data processing students can plot graphs, work out calculations, look for patterns and trends, analyse and interpret data observed, draw conclusions and link to scientific knowledge, principles and theory. Conducting experiments helps students to get a feel of the phenomena such as when they make connections between observing concrete evidence and the more abstract ideas or theories. Each experiment should not take more than around a double lesson to complete. Experiments may be carried out in groups of ideally not more than four students. Students in each group should gather and interpret their own data but each student must present his/her own individual report. The following information shows the sections and respective notes that should be included in an experiment report. Third person past tense should be used when writing experimental reports. A rubric for marking experiments is presented at the end of this document. <table border="1"> <thead> <tr> <th>Section</th><th>Details</th></tr> </thead> <tbody> <tr> <td>Date</td><td>Write the date when the experiment was carried out in the lab.</td></tr> <tr> <td>Title</td><td>The title indicates the links to particular assessment criteria as outlined in the curriculum.</td></tr> <tr> <td>Aim</td><td>The purpose of the experiment is clearly stated.</td></tr> <tr> <td>Apparatus</td><td>A list of apparatus used during the experiment.</td></tr> <tr> <td>Diagram</td><td>Clear diagram/s of the experimental setup are to be drawn and labelled in pencil. Diagrams should not be too small nor too large.</td></tr> <tr> <td>Procedure</td><td>This section will be provided to the students by the teacher.</td></tr> <tr> <td>Precautions</td><td>A list of precautions taken to improve the accuracy of the experiment is presented. This might include taking readings at eye-level to avoid parallax error, starting and stopping the stopwatch on time, ways of reducing human reaction error, etc. Each precaution needs to be supported with reason/s explaining why such precautions are taken.</td></tr> <tr> <td>Results and Observations</td><td> Depending on the nature and type of the experiment: - Numerical results should be tabulated. - Write the name of the measurement and its units in the column headers of the table of results. - Repeated readings should be taken when possible and recorded in the table. </td></tr> </tbody> </table>	Section	Details	Date	Write the date when the experiment was carried out in the lab.	Title	The title indicates the links to particular assessment criteria as outlined in the curriculum.	Aim	The purpose of the experiment is clearly stated.	Apparatus	A list of apparatus used during the experiment.	Diagram	Clear diagram/s of the experimental setup are to be drawn and labelled in pencil. Diagrams should not be too small nor too large.	Procedure	This section will be provided to the students by the teacher.	Precautions	A list of precautions taken to improve the accuracy of the experiment is presented. This might include taking readings at eye-level to avoid parallax error, starting and stopping the stopwatch on time, ways of reducing human reaction error, etc. Each precaution needs to be supported with reason/s explaining why such precautions are taken.	Results and Observations	Depending on the nature and type of the experiment: - Numerical results should be tabulated. - Write the name of the measurement and its units in the column headers of the table of results. - Repeated readings should be taken when possible and recorded in the table.
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Precautions	A list of precautions taken to improve the accuracy of the experiment is presented. This might include taking readings at eye-level to avoid parallax error, starting and stopping the stopwatch on time, ways of reducing human reaction error, etc. Each precaution needs to be supported with reason/s explaining why such precautions are taken.																		
Results and Observations	Depending on the nature and type of the experiment: - Numerical results should be tabulated. - Write the name of the measurement and its units in the column headers of the table of results. - Repeated readings should be taken when possible and recorded in the table.																		

	○ Numerical values should be given to the same number of significant figures appropriate to the measuring device. • Observation statements can be written in a sequential order as noted during the different stages of the experiment. Observations can also be drawn in diagrams (magnetic field patterns / different balancing forces on a pivoted system etc.).
	Processing data • Graphs are a pictorial way of looking at a table of results. Patterns can be observed and anomalous results can be identified. • Graphs should include at least 5 data points. • Suitable scales should be chosen which makes it easy to plot data. At least 2/3 of the graph paper should be used. • Each axis should be labelled with the name and unit of the quantity being plotted. • Each graph should have a title. • The data points should be clearly marked with a "X" and the points are joined to have a line of best fit or a smooth curve. • The line must go through the origin for quantities which are directly proportional. • Gradient of line graphs are calculated and answers are given with the appropriate units. • Show all steps in the calculations. • In working calculations, the answer should have the same number of significant figures as the measurements used in the calculation.
	Conclusion and Discussion Include the following points as applicable to the nature of the experiment. • A summary of the findings of the experiments and relate them clearly to the aim of the experiment. • A discussion of any patterns or trends in the data. • State any relationships discovered or confirmed between variables being tested in the experiment. • Compare numerical results with known values from data books and suggest any reasons for any differences. • A complete analysis or interpretation of observations noted in the experiment. • Discuss any difficulties encountered in carrying out the experiment. • Suggest way/s of improving the experimental set-up and/or results. • Draw a conclusion based on experimental evidence and relate it to scientific knowledge, laws, and theory.

Marking Criteria: Experiment

MARKING CRITERIA – Experiment		
Maximum 100 marks		
Date & Title & Aim & Apparatus (0 – 10 marks)		
0 – 3 marks	4 – 6 marks	7 – 10 marks
Date when experiment was carried out is missing.	The date when experiment was conducted in the lab.	The date when experiment was conducted in the lab.
Title of the experiment is missing.	The title of the experiment.	A clear title of the experiment.
Only part of the aim of the experiment is written	Only part of the aim of the experiment is written	A clear and concise aim of the experiment.
Lists few or none of the equipment used during the experiment.	Lists some of the equipment used during the experiment.	Lists all apparatus used during the experiment.
Diagram and Procedure (0 – 10 marks)		
0 – 3 marks	4 – 6 marks	7 – 10 marks
No or poor diagrams are drawn.	Diagrams are incomplete.	Diagram/s are neat and clear.
Diagram/s are incompletely and/or incorrectly labelled.	Diagram/s are labelled correctly but lacks some labels.	Diagrams include all the correct labelling.
No marks shall be given for procedure.		
Precautions (0 – 10 marks)		
0 – 3 marks	4 – 6 marks	7 – 10 marks
Lists few of the precautions taken during the experiment with no/wrong explanation.	Lists most of the precautions with no/unclear explanation why such precautions are taken.	Lists all precautions and explain why such precautions are taken during the experiment.
Results and Observations & Processing data (0 – 20 marks)		
0 – 6 marks	7 – 12 marks	13 – 20 marks
No/few measurements are taken and/or recorded incorrectly in an incomplete table. OR (depending on experiment) No/few observations noted.	Most measurements are taken and recorded correctly in an appropriate table with incomplete/incorrect headers and units. OR (depending on experiment) Most observations noted and adequately organized.	All measurements are taken and recorded correctly in an appropriate table with correct headers and units. OR (depending on experiment) All observations correctly noted and well organized.
Plots a poor graph. OR (depending on experiment) Draws clear and labelled diagrams including the necessary details of observations. OR (depending on experiment) Use of inappropriate formulae and/or makes incorrect calculations.	Plots a fairly accurate line graph of the data obtained using an inappropriate scale. OR (depending on experiment) Draws fairly clear diagrams of observations but lack the necessary details. OR (depending on experiment) Use of appropriate formulae and makes incorrect calculations ignoring correct units.	Plots an accurate line graph of the data obtained using the appropriate scale with headings and units labelled on each axis. OR (depending on experiment) Draws clear and labelled diagrams including the necessary details of observations. OR (depending on experiment) Use of appropriate formulae and makes correct calculations including use of correct units.

Conclusion & Discussion (0 – 20 marks)		
0 – 6 marks	7 – 12 marks	13 – 20 marks
Conclusion provides no indication that the aim of the experiment was achieved.	Conclusion provides an unclear indication that the aim of the experiment was achieved.	Conclusion provides a clear indication that the aim of the experiment was achieved.
Conclusion includes no/wrong explanation of how the results obtained can be related to scientific knowledge, laws and theory (including further research on the specific concept).	Conclusion includes an inadequate explanation of how the results obtained can be related to scientific knowledge, laws and theory (including further research on the specific concept).	Conclusion includes a good explanation about how the results obtained can be related to scientific knowledge, laws and theory (including further research on the specific concept)
Discussion includes no/wrong suggestions of ways in which the experiment can be improved.	Discussion includes poor suggestions of ways in which the experiment can be improved.	Discussion includes good suggestions of ways in which the experiment can be improved.
No connection of the scientific concepts involved to real-life situations.	Gives an unclear connection of the scientific concepts involved to real-life situations.	Gives a clear and correct explanation of how the scientific concepts involved are related to real-life situations.
Conducting the experiment (0 – 30 marks)		
0 – 9 marks	10 – 18 marks	19 – 30 marks
Handles the apparatus carelessly.	Handles the apparatus in a fairly correct and safe way.	Handles apparatus carefully, correctly, safely and skilfully.
Follows written procedure and verbal instructions with continuous guidance.	Follows written procedure and verbal instructions with minimal guidance.	Follows written procedure and verbal instructions without guidance.
No/limited participation during the experiment.	Passively participates during the experiment.	Actively participates during the experiment.

Coursework Mode 2: Investigation

Investigation					
100 marks internally-assessed externally-moderated	Gott & Duggan (1995) define investigations as "... a specific type of problem solving which allow pupils a varying degree of autonomy and which are problems to which the solution is not obvious." Investigations should allow freedom, allowing students to be creative and choose their own methods to investigate the given problem. Students must be allowed time (at least one lesson) to solve the problem and design an experiment to check their solution. The students' plan must be checked by the teacher for health and safety concerns only. Otherwise, the plan must remain unchanged, and students must be allowed to carry out the investigation that they designed which should take approximately a double lesson. The notes below contain information, definitions, and requirements that are important when carrying out an investigation. The following guidelines are designed to ensure that teachers can carry out valid and consistent assessment. It is suggested that informal feedback is given to students after the investigation has been planned to ensure safety of the experiment. Investigations may be carried out in groups of ideally not more than four. Each group should gather and interpret their own data but each student must present his/her own individual report. The following information shows the sections and respective notes that should be included in an investigation report. <table border="1"> <thead> <tr> <th>Section</th><th>Details</th></tr> </thead> <tbody> <tr> <td>Investigation Outline</td><td> This section should contain an outline of the procedure that will be devised in the investigation together with scientific theory required to understand the investigation. The plan should be concise and written in the future tense. This section should include: • The title. • A short statement of the problem to be investigated. • The aim of the investigation. • A brief description of the scientific procedure. • A list of materials and apparatus. • Any pre-experiment work. • A variables grid may be presented to highlight all the variables in the investigation (where applicable). Variables should be identified as independent and dependent variables. Other significant/relevant variables should be noted including the way they are controlled for results to be more reliable. • Any background theory/research where applicable is given. • The hypothesis section (where applicable) should give an outline of what may happen and why. <i>(Note: Students are to be made aware that no marks will be lost if the hypothesis is disproved.)</i> </td></tr> </tbody> </table>	Section	Details	Investigation Outline	This section should contain an outline of the procedure that will be devised in the investigation together with scientific theory required to understand the investigation. The plan should be concise and written in the future tense. This section should include: • The title. • A short statement of the problem to be investigated. • The aim of the investigation. • A brief description of the scientific procedure. • A list of materials and apparatus. • Any pre-experiment work. • A variables grid may be presented to highlight all the variables in the investigation (where applicable). Variables should be identified as independent and dependent variables. Other significant/relevant variables should be noted including the way they are controlled for results to be more reliable. • Any background theory/research where applicable is given. • The hypothesis section (where applicable) should give an outline of what may happen and why. <i>(Note: Students are to be made aware that no marks will be lost if the hypothesis is disproved.)</i>
Section	Details				
Investigation Outline	This section should contain an outline of the procedure that will be devised in the investigation together with scientific theory required to understand the investigation. The plan should be concise and written in the future tense. This section should include: • The title. • A short statement of the problem to be investigated. • The aim of the investigation. • A brief description of the scientific procedure. • A list of materials and apparatus. • Any pre-experiment work. • A variables grid may be presented to highlight all the variables in the investigation (where applicable). Variables should be identified as independent and dependent variables. Other significant/relevant variables should be noted including the way they are controlled for results to be more reliable. • Any background theory/research where applicable is given. • The hypothesis section (where applicable) should give an outline of what may happen and why. <i>(Note: Students are to be made aware that no marks will be lost if the hypothesis is disproved.)</i>				

	Precautions and safety considerations	This section should include: - Any precautions taken to achieve a more accurate result and improve the outcome of the investigation. - Safety considerations associated with the preparation and implementation of the investigation to prevent any accidents.
	Procedure Followed	This section should include: A detailed account of the procedure followed. All the steps involved to perform the experiment including any modifications made to the plan and any additional materials and apparatus used should be stated. The method should include measurements used, diagrams, and photos, where applicable. Note: - Results should not be included in this section. - Third person past tense should be used. - Any concentrations, measurements, amounts, times, and temperatures should be quantified. - The procedure should be written in such a way that an independent person could repeat the experiment without referring to the person writing the report.
	Results and observations	This section should include: - All observations and/or measurements should be presented in an organised form. - Any calculated data should be presented showing all steps. - Graphical representations should be used to display data when possible. Note: - Tables may be the best way of presenting data. - Tables should have headings and units. - An adequate number of readings should be taken especially if a graph has to be plotted. - Results should not be interpreted in this section. - Third person past tense should be used to describe any observations.
	Discussion and Conclusion	This section should include : - A brief summary of the aim of the investigation. - A summary of the most important findings including trends and patterns emerging from analysis of the results. - An explanation why calculations were used if any, and their link to the investigation.

		• A very brief description stating whether the investigation has supported/falsified the hypothesis. • A description and an explanation of how the results relate to the expectations based on laws, theories, relationships, patterns and models studied. • This section should be concluded by a closure of all findings.
	Evaluation and references	This section should include: • A list of procedural/sources of errors that may have affected the result. • A list of improvements and any other experiments which can be done to support the conclusions. • All sources cited in the text should be listed in full. A basic format should be used when listing the sources.

Marking Criteria: Investigation

MARKING CRITERIA – Investigation		
Maximum 100 marks		
Investigation outline (0 – 20 marks)		
0 – 6 marks	7 – 12 marks	13 – 20 marks
A poor outline of the investigation is given, providing the following requirements (where applicable)	A less detailed outline of the investigation is given, providing the following requirements (where applicable)	A detailed outline of the investigation is given, providing the following requirements (where applicable)
The title and statement of the problem is not stated.	The title or statement of the problem is stated.	The title and statement of the problem is stated in detail.
The aim is stated poorly.	The aim is stated adequately.	The aim is stated in detail.
Some of the stages of the scientific procedure are included.	Most stages of the scientific procedure are included.	A detailed description of the scientific procedure is included as well as any pre experiment work if applicable.
Lists some of the materials and equipment required.	Lists most of the materials and equipment required.	Lists all the materials and equipment required.
Mentions variables but the dependent and independent variables are not specified. Few or none of the variables that are controlled are mentioned.	Includes a variable grid which specifies the dependent and independent variables, including some of the variables that are controlled.	Includes a variable grid which specifies the dependent and independent variables, including variables that are controlled.
Mentions aspects of the scientific background knowledge related to the investigation.	Gives a brief summary of the scientific background knowledge related to the investigation.	Gives a comprehensive summary of the scientific background knowledge related to the investigation.
States the hypothesis but the relationship is not clear and no explanation is given.	States the hypothesis showing the relationship between variables but no explanation is given.	States the hypothesis clearly and its justification.
Precautions and Safety considerations (0 – 10 marks)		
0 – 3 marks	4 – 6 marks	7 – 10 marks
A list of few of the precautions and no explanations are given.	A list of some of the precautions, including an explanation.	A comprehensive list of precautions, including an explanation.
A list of few safety considerations without giving reasons.	A list of some of the safety considerations giving reasons.	A list of all safety considerations giving reasons.
Procedure Followed (0 – 10 marks)		
0 – 3 marks	4 – 6 marks	7 – 10 marks
List some of the steps of the procedure but not in sequential order. Some steps may be missing or incomplete. Names a few of any additional equipment needed.	Lists most of the steps of the procedure which are easy to follow. Discusses some of refinements and names some of the additional equipment (if needed) to the outline of the investigation.	Lists all steps of the procedure in a detailed, sequential order that are easy to follow. Discusses refinements and names all the additional equipment (if needed) to the outline of the investigation.
Draws poorly labelled diagrams. Not all diagrams are included.	Draws suitably labelled diagrams but not all diagrams are included.	Draws neat and labelled diagrams showing of all steps in the method.

Results and observations (0 – 10 marks)		
0 – 3 marks	4 – 6 marks	7 – 10 marks
Records only some of the observations noted.	Records most of the observations noted but observations are not clearly organised.	Records all observations in detail and organises them in a clear manner e.g. in a paragraph or in a table format.
An inadequate number of numerical data is poorly presented in a table with appropriate heading. Units may be missing and numerical values are not all given to the same number of significant figures appropriate to the measuring device. No evidence of repeated readings.	A sufficient number of numerical data is presented in a table with appropriate headings. Some units may be missing and numerical values are not all given to the same number of significant figures appropriate to the measuring device. Repeated readings taken when appropriate.	An appropriate number of numerical data is presented in a table with appropriate headings and units. Numerical values are given to the same number of significant figures appropriate to the measuring device. Repeated readings taken when appropriate.
Works out some of the calculations with missing steps. Answers may be incorrect and without the proper units.	Works out most of the calculations with a few missing steps. Answers are correct but not all units are included.	Works out the necessary calculations showing all the steps and giving correct answers and units.
Constructs a poor graph with an inadequate scale. Incorrect plotting with missing headings and units on the axis.	Constructs an accurate graph but it is not of the appropriate scale. Headings and units may not be labelled on each axis.	Constructs an accurate graph of the data obtained using the appropriate scale. Headings and units are labelled on each axis.
Discussion & Conclusion (0 – 10 marks)		
0 – 3 marks	4 – 6 marks	7 – 10 marks
Presents an incomplete analysis/ interpretation of observations or measurements with many errors.	Identifies trends or patterns in observations or measurements/ graphs and supports them with a satisfactory analysis/ interpretation of data. Some errors are present.	Identifies trends or patterns in observations or measurements/graphs and supports them with a complete and correct analysis/interpretation of the data.
Makes a poor conclusion that is partially based on the observations/ data obtained. Gives a poor explanation it in terms of scientific knowledge.	Makes a satisfactory conclusion which is consistent with the observations/ data and explains it in terms of scientific knowledge.	Makes a detailed conclusion which is consistent with the observations/ data and explains it in terms of scientific knowledge.
Poorly relates the outcome of the investigation to the hypotheses stated without explaining whether it is supported or falsified.	Satisfactorily relates the outcome of the investigation to the hypotheses stated without explaining whether it is supported or falsified.	Relates the outcome of the investigation to the hypotheses stated explaining whether it is supported or falsified.
Evaluation and References (0 – 10 marks)		
0 – 3 marks	4 – 6 marks	7 – 10 marks
Identifies few of the experimental errors but does not give an explanation why such errors are observed.	Identifies some of the experimental errors or anomalous observations and gives a partial explanation why such errors are observed.	Identifies any experimental errors or anomalous observations and gives an adequate explanation why such errors are observed. Indicates whether the range and quality of data collected was sufficient to draw a conclusion.

Identifies few limitations of the experiment but does not discuss ways of improving experiment.	Discusses limitations of the experiment and suggest some ways of improving the experiment set up and/ or results	Discusses the limitations and weaknesses of the investigation and suggests ways of improving the experimental set up and/or results. Suggests follow up experiments to investigate further ideas related to the investigation.
Few or no references are listed.	Most references are listed correctly.	All references are listed correctly.
Conducting the Investigation (0 – 30 marks)		
0 - 9 marks	10 – 18 marks	19 – 30 marks
Can handle some of the apparatus and correctly and safely, when instructed by the teacher.	Handles most of the apparatus correctly and safely.	Handles apparatus safely, correctly and skilfully.
Not always using equipment appropriate for the task, making few observations and measurements and recorded data is not organised appropriately.	Using equipment appropriate for the task, making most of the observations, taking measurements and records limited data.	Using equipment appropriate for the task, making systematic observations, taking accurate measurements and records data in an orderly manner. Works in an organised and diligent manner.
Working with others but not always being cooperative.	Works with others in a cooperative manner most of the time.	Works in a team and is respectful of others.
No/limited participation during the investigation.	Passively participates during the investigation.	Actively participates during the investigation.
Failing to make use of the appropriate attire ensuring personal safety.	Makes use of the appropriate attire ensuring personal safety most of the time.	Makes use of the appropriate attire ensuring personal safety.
Does not clean the apparatus and leaves the working station in a disorganised manner.	Cleans the apparatus and workstation after being reminded.	Cleans the apparatus and workstation.

Coursework Mode 3: Design Task

Design Task									
100 marks internally-assessed externally-moderated	The design question is meant to extend the application of the Physics concepts beyond the classroom/textbooks/teachers' notes. It is a problem-solving exercise which aims to enhance the learning experience of students. It also focuses on the Physics principles present in everyday life. Chamoso, Sanchez et al (2002) define problem-solving as an endeavour where the student does not have a procedure or an algorithm to rely upon in order to solve the problem automatically but must rely upon experiential strategies. <i>"The capacity and ability to solve problems is not only acquired by solving many problems but is also favoured by acquiring ease and familiarity with different solving techniques and by discovering the mental processes used in solving one of them. These processes can be learned and assimilated when they are known and practised."</i> The exercise would help students, who generally struggle in higher order thinking, to see the validity of the concepts taught in class by extending their learning to practical situations. The design question task (i) does not necessarily involve the actual setting up or demonstration of the experiment; but (ii) can complement a practical session done in the lab. The following format is suggested to <i>encourage (i) significant reflection, rather than just memory recall or execution of practiced skills.... (ii) discussion: within small groups before answers are collected, and by the whole class afterwards... (iii) the instructor continually probes for and adjusts to the students' learning needs.</i> (Beatty, I., D., et al., 2008) The Design Question Task should involve group work in the classroom to enhance twenty-first century skills. It should be conducted in about 3 lessons, so that students: i) are introduced to the concept presented; ii) can research, evaluate and synthesize their initial prompts and maybe try out an idea on their own; iii) participate in group work (groups not including more than 4 students) in which ideas are discussed; iv) compile their own write up which includes the following sections: Research, Diagram/s, Procedure, Precautions and Fair testing It is suggested that a closing session is done in class to present all ideas in the different groups. In this way, students acknowledge that there can be more than one solution to a task. This process involves higher order thinking skills in Bloom's taxonomy and enables peer assessment to be implemented effectively in Physics teaching. The following information shows the sections in the Design Question Task write up. Third person past tense should be used when writing the procedure section. A rubric of this task is presented at the end of this document. <table border="1"> <thead> <tr> <th>Section</th><th>Details</th></tr> </thead> <tbody> <tr> <td>Date</td><td>Write date of Design Question Task</td></tr> <tr> <td>Title</td><td>The title relates directly to one or more assessment criteria as outlined in the syllabus.</td></tr> <tr> <td>Introduction</td><td>The setting of the Design Question and the physical problem to be investigated are presented. (The question should relate to a situation observed and that could be researched but not solved from online means).</td></tr> </tbody> </table>	Section	Details	Date	Write date of Design Question Task	Title	The title relates directly to one or more assessment criteria as outlined in the syllabus.	Introduction	The setting of the Design Question and the physical problem to be investigated are presented. (The question should relate to a situation observed and that could be researched but not solved from online means).
Section	Details								
Date	Write date of Design Question Task								
Title	The title relates directly to one or more assessment criteria as outlined in the syllabus.								
Introduction	The setting of the Design Question and the physical problem to be investigated are presented. (The question should relate to a situation observed and that could be researched but not solved from online means).								

	Keywords (optional) A list of keywords may be outlined especially if the task relates to specific detail to which students may not be familiar but which when implied will render better understanding of the physical situation, for instance (for the topic of heat - body temperature, room temperature, etc...). They may relate to other subjects and hence might not have been part of the Physics assessment criteria done in class. Research This section should include: • presentation of the relevant background research conducted which can take various forms such as: a short paragraph, highlighting of important points, diagrams or pictures, etc. • list of possible variables involved; • list of references in a basic consistent format. Diagram This section should include: • a labelled diagram/s of the experimental setup suggested which should be drawn in pencil; • the diagram should take about half an A4 page; • a list of any other apparatus where necessary. Procedure This section should include: • identification of the dependent and independent variables • an outline of the suggested steps to follow to be able to record variables involved when using the presented setup; • a reference to any useful equation; • an appropriate proposal for the representation of the relationship between the variables which can be: table of results, graph sketching, diagrams, etc. Precautions and Fair Testing This section should include: • a set of precautions suggested including the reason/s why they are necessary; • an indication of the variables which must be kept constant to ensure fair testing.
	References • Beatty, I.D. & Gerace, W.J. J Sci Educ Technol (2009) 18: 146. Accessed on 25th May, 2018 at https://doi.org/10.1007/s10956-008-9140-4 • Sanchez, Jose Chamoso, Encinas, Luis Hernandez, Lopez, Ricardo Fernandez, and Sanchez, Mercedes Rodriguez., (2002). Designing hypermedia tools for solving problems in mathematics. Computers & Education 38 303-317

Marking Criteria: Design Task

MARKING CRITERIA – Design Task		
Maximum 100 marks		
Research (0 – 20 marks)		
0 – 6 marks	7 – 12 marks	13 – 20 marks
No evidence of background research is done or the research done is not relevant to the task.	Some evidence of background research is done on different ideas presented in the task.	Relevant and detailed evidence of background research is done in relation to the task.
No variables identified.	Some variables identified.	Lists all relevant variables.
No references are cited.	One reference is cited.	Some references are cited.
Group work session (0 – 20 marks)		
0 – 6 marks	7 – 12 marks	13 – 20 marks
Poor or no participation in the group work discussion and does not respect other opinions / lacks interest.	Needs prompting to participate in the group work discussion.	Participates actively in the group work discussion and respects other opinions.
Diagram (0 – 10 marks)		
0 – 3 marks	4 – 6 marks	7 – 10 marks
Diagram for the setup is missing or poorly drawn.	Most of the setup is drawn in the diagram but there are missing details.	All the setup is drawn well.
The setup does not indicate any quantity to be measured and no reference to any additional apparatus is included.	The setup does not indicate adequately different quantities to be measured and an incomplete list of any additional apparatus is included.	The setup indicates different quantities to be measured and a list of any additional apparatus is included.
No labelling is done.	Some labelling is done to the setup.	Full clear labelling is done to the setup.
Diagram is not neat and/or not in pencil.	Diagram presented neat and in pencil.	Diagram presented neat and in pencil.
Procedure (0 – 30 marks)		
0 – 9 marks	10 – 18 marks	19 – 30 marks
Identifies variables not relevant to the task and no reference to any useful equation is included	Identifies variables without stating whether they are the dependent and independent variables and an indication of any useful equation is given but in an incorrect format.	Identifies the dependent and independent variables and an indication of any useful equation is given in the correct format.
The procedure is missing. Or few steps listed in the procedure or the steps are not in the correct order.	Most of the steps are listed in the correct order but procedure is incomplete.	All the necessary steps are listed and in the correct order.
No reference to communication of results.	Proposes an incomplete / inappropriate way of communicating the results/observations.	Proposes an appropriate way of communicating the results/observations (table of results, graph sketching, diagrams, etc.)

Precautions and Fair Testing (0 – 20 marks)		
0 – 6 marks	7 – 12 marks	13 – 20 marks
Precautions are missing or irrelevant.	A set of precautions is listed but there are inaccuracies or no explanation is provided.	An adequate set of precautions are listed to ensure accuracy in results and explained.
No reference to variables that are kept constant during experiment to ensure fair testing.	Identifies some of the variables that are kept constant during experiment to ensure fair testing.	Identifies main variables that are kept constant during the experiment to ensure fair testing.

Coursework Mode 4: Site Visit

Site Visit													
100 marks internally-assessed externally-moderated	Site visits offer opportunities to observe the actual world and relate the theory learned in class to a contextualised setting giving an authentic picture of science, its relevance to everyday life and its social purposes. During a site visit, students are exposed to multiple stimuli, thus attracting students of different learning styles, learning abilities and backgrounds. Such contextualised settings drive students to explore and discover new environments and become involved in the activity. In fact, it is a symbiosis of intrinsic motivation to learn and an entertaining environment that help significant learning gains for the students. Research shows that sites of scientific interest help the students consolidate the work carried out in class, allow them to apply theory to the actual world, introduce the students to the world of work, help them take actions in their real life as they increase awareness about issues discussed and contribute to less compartmentalisation among subjects. For a site-visit experience to be valuable, prior work is required. This involves preparation such as planning it in time to compliment work carried out in class, carrying out risk assessment on site and showing pictures to students to make them more familiar with the premises thus reducing the novelty effect that can hinder the commencement of cognitive tasks. Prior to the students' visit, communication with the guide on the premises is essential to determine the learning objectives. However, one should be aware that the learning that occurs during a site visit is not exclusive to knowledge and facts. Learning outcomes such as awareness, enjoyment, interest, opinion and understanding are also achieved. The following table shows the relevant sections in the site visit report. There is no established word limit, however the guidelines accompanying each sections give a clear indication of the amount of work expected. Each student should present an individual report. This may include various forms such as text, photographs with captions, labelled diagrams/drawings and tables with information. A rubric for marking a site visit report is presented at the end of this document. <table border="1"> <thead> <tr> <th>Section</th><th>Details</th></tr> </thead> <tbody> <tr> <td>Date</td><td>Date of site visit</td></tr> <tr> <td>Title</td><td>The title should include the name of the site where the visit is being carried out.</td></tr> <tr> <td>Aim</td><td>The aim should consist of a brief note stating the aim/s and objectives of the visit.</td></tr> <tr> <td>Keywords (optional)</td><td>This section should contain three to five keywords which link the site visit to the relevant learning outcomes and/or assessment criteria.</td></tr> <tr> <td>Preparatory activities</td><td> This section should include: - background information about the scientific aspects relevant to the site visit; - questions the students would be asking the relevant practitioner/s; - an outline of any activities to be carried out. </td></tr> </tbody> </table>	Section	Details	Date	Date of site visit	Title	The title should include the name of the site where the visit is being carried out.	Aim	The aim should consist of a brief note stating the aim/s and objectives of the visit.	Keywords (optional)	This section should contain three to five keywords which link the site visit to the relevant learning outcomes and/or assessment criteria.	Preparatory activities	This section should include: - background information about the scientific aspects relevant to the site visit; - questions the students would be asking the relevant practitioner/s; - an outline of any activities to be carried out.
Section	Details												
Date	Date of site visit												
Title	The title should include the name of the site where the visit is being carried out.												
Aim	The aim should consist of a brief note stating the aim/s and objectives of the visit.												
Keywords (optional)	This section should contain three to five keywords which link the site visit to the relevant learning outcomes and/or assessment criteria.												
Preparatory activities	This section should include: - background information about the scientific aspects relevant to the site visit; - questions the students would be asking the relevant practitioner/s; - an outline of any activities to be carried out.												

	Site details	This section should include: • a brief history of the site (where applicable). • a brief description of the location where the site visit took place.
	Precautions and Safety Considerations	This section should contain potential hazard/s and the precautionary measures taken to reduce them.
	Site Activities	This section should include a description of the activities carried out on site. Each activity should be reported in the third person past tense.
	Communication of outcomes	This section should include the answers to the questions prepared by the students prior to the visit and any other information collected during the visit.
	Discussion and Evaluation	This section should include a discussion and/or an evaluation and/or an interpretation of the outcomes achieved including the processing of any data collected. Any other information collected with respect to the aims of this task may form part of this section.
	Reflection	This section should include the students' self-reflection/s on their experience of the site visit, related to good practices, possible improvements and alternative activities that could have been carried out during the visit.
	References	All sources cited in the report should be listed in full. A consistent format should be used when listing the sources.

Marking Criteria: Site Visit

MARKING CRITERIA – Site Visit		
Maximum 100 marks		
Title & Aim (0 – 5 marks)		
0 – 1 mark	2 – 3 marks	4 – 5 marks
Title is missing.	Title is incomplete.	Title includes the full name of the site and the location where the visit took place.
Date is missing.	Date is missing.	Date of site visit.
A limited description of the aim/s and objective/s of the site visit is given.	A partial description of the aim/s and objective/s of the site visit.	Aim/s and objective/s of the visit clearly stated.
Preparatory Activities (0 – 15 marks)		
0 – 4 marks	5 – 9 marks	10 – 15 marks
No/minimal background information about the scientific aspects relevant to the site visit.	Inadequate background information about the scientific aspects relevant to the site visit.	Background information about the scientific aspects relevant to the site visit.
No/minimal number of questions to ask the relevant practitioner/s.	Few or not so relevant questions the students would be asking the practitioner/s on site.	Relevant questions the students would be asking the practitioner/s on site.
No/minimal outline of activities to be carried out.	An incomplete and/or incoherent outline of activities to be carried out.	A thorough outline of the activities to be carried out.
Site Details (0 – 10 marks)		
0 – 3 marks	4 – 6 marks	7 – 10 marks
No/minimal description of the location.	An incomplete and/or incoherent description of the location.	A complete description of the location.
No/incorrect history of the site.	An incomplete history of the site.	A brief history of the site.
The main purpose of the site is not stated.	The main purpose of the site is not clearly stated.	The main purpose of the site is clearly stated.
Precautions and Safety Considerations (0 – 5 marks)		
0 – 1 mark	2 – 3 marks	4 – 5 marks
No/minimal list of potential hazard/s and the precautionary measures taken to reduce them is presented.	Incomplete list of potential hazard/s and the precautionary measures taken to reduce them is presented.	Comprehensive list of potential hazard/s and the precautionary measures taken to reduce them is presented.
Site Activities (0 – 20 marks)		
0 – 6 marks	7 – 12 marks	13 – 20 marks
No/minimal description of the activities carried out on site.	Incomplete description of the activities carried out on site.	Detailed description of the activities carried out on site.
Communication of Outcomes (0 – 15 marks)		
0 – 4 marks	5 – 9 marks	10 – 15 marks
No/poor communication of outcomes to the questions prepared by the students.	Good communication of outcomes to the questions prepared by the students.	Comprehensive communication of outcomes to the questions prepared by the students.

Discussion and Evaluation & References (0 – 20 marks)		
0 - 6 marks	7 – 12 marks	13 – 20 marks
No/poor discussion and/or evaluation and/or interpretation of the outcomes achieved or information collected with respect to the aim/s and objective/s set including processing of data.	A good discussion and/or evaluation and/or interpretation of the outcomes achieved or information collected with respect to the aim/s and objective/s set including processing of data.	A comprehensive discussion and/or evaluation and/or interpretation of the outcomes achieved or information collected with respect to the aim/s and objective/s set including processing of data.
No sources cited listed.	Incomplete list of sources cited and/or presented inconsistently.	All sources cited in the report are listed in full in a basic format.
Reflection (0 – 10 marks)		
0 – 3 marks	4 – 6 marks	7 – 10 marks
No/minimal self-reflection/s on the experience of the site visit including good practices, possible improvements and alternative activities.	Superficial self-reflection/s on the experience of the site visit including good practices, possible improvements and alternative activities.	Thorough self-reflection/s on the experience of the site visit including good practices, possible improvements and alternative activities.

Coursework Mode 5: Project

Project	
100 marks internally-assessed externally-moderated	A project is an interdisciplinary approach that involves tasks based on challenging questions and / or problems, culminating in realistic tangible products. The project should help enhance the student creativity and interest in the subject whilst improving knowledge and attitudes towards science. It gives the students the opportunity to apply and enhance a range of skills (cognitive, technical, physical, creative, etc) Projects are of particular importance in science classes because they give students the opportunity to work like scientists. Furthermore, '<i>A growing body of evidence suggests that inquiry-based instruction resulting from project work results in significantly higher student achievement with respect to content knowledge, reasoning, and argumentation skills</i>' (Abdi 2014; Riga et al. 2017). The project in the Physics classroom assesses how a student applies the scientific method to work on a solution to a single task, situation and/or scenario which the students propose, based upon the theme/s indicated by the teacher. A project should consist of ONE of components A, B or C AND component D as outlined below. A. Written: students use written language to communicate ideas and information supported, where applicable, by data, tables, flow charts, diagrams, referenced research, etc.; (e.g. reports which include separate headings, an elaborate article for a newspaper/magazine, leaflet, chart, script for a role play, etc. (about 500 words)) OR B. Product: using a range of skills students create a product, including a model (e.g. water heater model), prototypes (e.g. solar oven), automated control systems (e.g. air conditioning system), digital presentation OR C. Demonstration: students will make an actual demonstration in class/lab of an innovative/creative way how to represent a scientific situation or concept AND D. Spoken: students use spoken language to give an explanation (2 – 3 minutes) of the written / product / demonstration component. In addition teachers should ask questions to confirm students' understanding of scientific concepts involved in project as well as to confirm the authenticity of the project. Students should work individually on the project. The whole project should take around 6 lessons, which might not be consecutive, and include all the steps indicated in the guidelines below. On the other hand, students should be given some continuous class time to develop their project, which can be continued at home. The following steps related to the implementation of the project in the classroom setting, should be followed: 1. The teacher indicates the theme/s for the project based on one or more Learning Outcomes / Assessment Criteria. The student is to be made aware of the types of projects (A or B or C) which can be submitted, keeping in mind the scientific merit of the project as explained in the attached rubric. The student should be encouraged to research the area under study to help determine the project that is to be carried out. 2. The student selects an appropriate project and presents a plan of action that would lead to the final product. It is important that the student is allowed to choose their own project format, based on their interests, and the most suitable way to present it. 3. It is suggested that the teacher gives feedback to the students about the plan. The student can revise the plan based on the feedback received. 4. The project is carried out over a period of time established by the teacher. Students should keep a step by step log of the progress in a learning journal. 5. The project (A or B or C) is submitted together with the journal and is presented to the class (Component D) as outlined above. Additional resources (e.g. visual aids) may be used to assist the students in the presentation. The student may also answers questions from the rest of the class.

The Project Guidelines

Section	Details
Title and Plan	This section should include: • An appropriate title. • The aim/s of the project. • A brief description (short paragraph) of what the project will consist of including the related scientific concepts
Written or Product or Demonstration Component	The student will present the chosen Project component to the teacher: A: Written OR B: Product OR C: Demonstration
The Learning Journal	The journal should include: • The plan of the project. • A step by step log of the procedure involved in creating the project including possible trials, modifications, etc. • The relevant research, diagrams, photographic evidence of the process, etc. required for the project development What was learnt/concluded by the end of the project.
Spoken Component	In this section the student needs to explain: • The aim of the project. • Brief outline of the steps involved in developing the project. • What was learnt/concluded from the project.
	The teacher asks the student questions to:- • Assess the learning of the scientific concepts covered by the project. • Assess the student's involvement in the actual build-up of the project itself.

Marking Criteria: Project

MARKING CRITERIA – Project Maximum 100 marks		
Title and Plan (0 – 10 marks)		
0 – 3 marks	4 – 6 marks	7 – 10 marks
Title is missing or not relevant to the project presented.	Title is vague and not indicative of what the project is about.	A relevant and indicative title.
Aim is missing/vague.	Aim is clear however does not make use of accurate scientific terminology.	The aim is clear, concise and fully stated with accurate terms.
Description of the project plan lacks basic details or not well explained, and no/wrong scientific concepts are identified.	Description of the project plan is not always clear and cannot be understood completely and some scientific concepts are identified and listed.	The project plan description includes a clear outline of what is being proposed and the scientific concepts covered in the project are all listed.
The Project (0 – 50 marks)		
0 – 15 marks	16 – 30 marks	31 – 50 marks
Project is very basic, lacks organisation and does not show effort.	Project shows basic levels of organisation and thought. It shows minimal effort.	Project is organized, and easy to understand. Project is complete with strong evidence of effort.
Scientific Merit of the Project		
The chosen project: • Demonstrates no original ideas or thoughts. • Relays information that required no research. • The student's knowledge of science has not been extended beyond what was covered in class	The chosen project: • Is an experiment or an idea that has already been done / discussed in class. • Relays information that required a slight amount of research. • The student's knowledge of science has been increased marginally.	The chosen project: • Is an innovative application of a science concept; • Is an innovative comparative study / observation / investigation. • Is an interesting and insightful piece of work that furthers the student's knowledge of science
The Learning Journal (0 – 30 marks)		
0 – 9 marks	10 – 18 marks	19 – 30 marks
Does not include the revised project plan.	Includes the project plan without any revisions suggested by the teacher.	Includes the project plan with revisions as suggested by the teacher's feedback.
Steps are missing, not well explained and not in a chronological order.	List of the steps required to construct the project but they are not in order and have missing steps.	Chronologically documents all the steps taken during the process to construct the project.
No evidence of research, preparatory work relevant to the development of the project.	Inadequate/incomplete evidence of the research/preparatory work required for the development of the project.	Detailed evidence of research/preparatory work involved in developing the project.
No conclusion is given	Poor conclusion, lacking detail.	The conclusion is clear, complete and directly related to the aim of the project and what was learnt.

Spoken Component (0 – 10 marks)		
0 – 3 marks	4 – 6 marks	7 – 10 marks
Demonstrated little or no knowledge of the subject. Unable to comment further on any part of the presentation. Student was not well understood and prepared for the presentation.	Demonstrated a basic knowledge of the subject matter. - did not provide any additional information. Student spoke clearly most of the time and was generally understood and somewhat prepared but had to use prompts to finish presentation.	Demonstrated a thorough knowledge of the subject matter. Student spoke clearly, was understood by all and was well prepared for the presentation.
Student was unable to accurately answer questions posed by teacher. The students' knowledge about the Physics content covered by the project was very basic. Student finds it hard to elaborate further even when prompted. Student was not knowledgeable about the process required to develop the project.	Student was able to accurately answer a few questions posed by the teacher. Students' knowledge about the Physics content covered by the project was adequate however could not elaborate further even when prompted. Student could briefly explain the most important aspects of developing the project.	Student was able to accurately answer almost all questions posed by the teacher about the project. The student showed mastery of the Physics content covered by the project and made use of scientific terms and concepts while explaining. Student gave a well-organised, comprehensive account of the most important aspects in developing the project.

Specimen Assessments

This section presents sample assessments with respective marking schemes. It should be reminded that a marking scheme is not a list of model answers. Teachers may use these guiding documents to develop an assignment based on one of the modes presented in this syllabus as specimen. Otherwise, teachers may develop their own assignment and select an appropriate mode for assessment as long as this assignment is sent to MATSEC for approval before being given to students.

Specimen Assessments: Controlled Paper MQF 1-2



L-Università
ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
SAMPLE PAPER

SUBJECT: **Physics**
PAPER NUMBER: **Level 1 – 2**
DATE:
TIME: 2 Hours

Answer **ALL** questions.

You are requested to show your working and to write the units where necessary.

When necessary, take g , acceleration due to gravity, as 10m/s^2 .

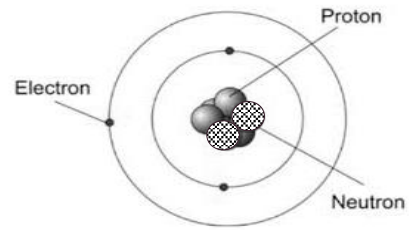
Density	$\rho = \frac{m}{V}$
Pressure	$p = \frac{F}{A}$ $p = h \rho g$
Moments	Moment = $F \times$ perpendicular distance
Energy and Work	$PE = m g h$ $KE = \frac{1}{2} m v^2$ $W = F s$ $P = \frac{E}{t}$
Force and Motion	resultant force = $m a$ $W = m g$ $p = m v$ $F = \frac{(mv - mu)}{t}$
	average speed = $\frac{\text{total distance}}{\text{total time}}$ $v = u + a t$ $s = (u + v) \frac{t}{2}$
	$v^2 = u^2 + 2 a s$ $s = u t + \frac{1}{2} a t^2$
Waves	$\eta = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$ $\eta = \frac{\text{real depth}}{\text{apparent depth}}$
	Magnification = $\frac{\text{image height}}{\text{object height}}$ Magnification = $\frac{\text{image distance}}{\text{object distance}}$
	$v = f \lambda$ $T = \frac{1}{f}$
Electricity	$I = \frac{Q}{t}$ $V = I R$ $P = I V$
	$E = Q V$ $E = I V t$
	$R_{\text{total}} = R_1 + R_2 + R_3$ $\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2}$
Electromagnetism	$\frac{V_p}{V_s} = \frac{N_p}{N_s}$ $V_p I_p = V_s I_s$
Heat	$Q = m c \Delta \theta$
Radioactivity	$A = Z + N$
Other equations	Area of a triangle = $\frac{1}{2} b h$ Area of a trapezium = $\frac{1}{2} (a + b) h$

Section A

Answer ALL questions

1. This question is about Static Electricity.

a. The diagram shows a simple model of the atom.



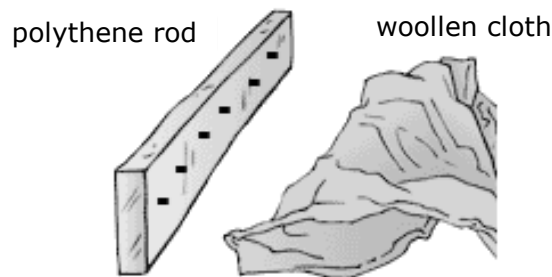
Match the following:

Electron	•		•	No charge
Proton	•		•	Negatively charged
Neutron	•		•	Positively charged

(3)

b. Mary charges a polythene rod as shown below. She rubs the rod with a woollen cloth. The polythene rod ends up with a negative charge. On the diagram below, draw the overall charge left on the woollen cloth.

(1)



(Total: 4 marks)

2. This question is about measurements

Steve has a shiny regularly shaped metal cube. He wishes to determine the material it is made from experimentally.

a. The instrument used to measure a side of the cube is called a _____.

(1)

b. One side of the cube is 3 cm long. Underline the correct volume of the cube from the following:

6cm³

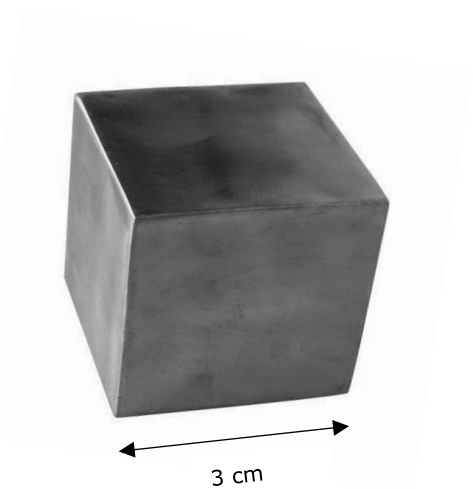
9cm³

27cm³

(1)

c. The mass of the metal cube is measured using a _____ balance.

(1)



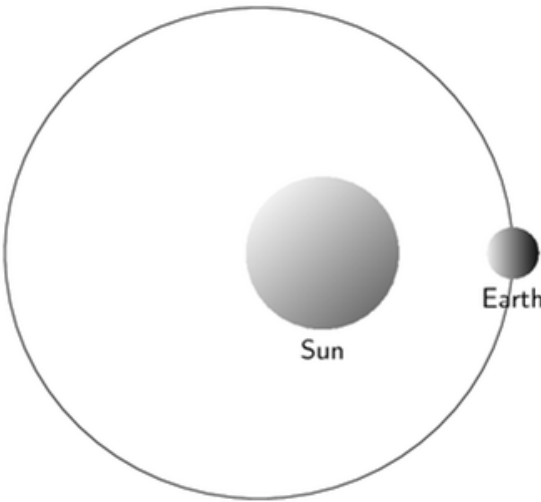
- d. The cube has a mass of 243 g. Use the volume chosen in part b. to calculate the density of the metal cube.

(2)

(Total: 5 marks)

3. This question is about the Earth and the Universe

The diagram shows the orbit of the Earth around the Sun.



On the figure:

- a. Label with an 'X' the side of the Earth that is in darkness.
- b. Draw the position of the Earth six months later.
- c. Draw an arrow to show the direction of the force of gravity that keeps the Earth orbiting the Sun.

(Total: 3 marks)

4. This question is about Radioactivity

- a. In the table below, tick off (✓) the penetrating power of **each** type of radioactive radiation.

Radiation	Penetrating power		
	Low	Medium	High
Gamma			
Alpha			
Beta			

(3)

- b. The paragraphs below provide some information about nuclear waste disposal. Complete the paragraphs by choosing missing words from the list.

concrete harm buried safe

Radioactive waste can give out three types of radiation; alpha, beta and gamma. Exposure to any of these three radiations can _____ any living organism. Various ways have been suggested for _____ disposal of the waste.



The waste could be sealed in steel drums or _____ blocks. It could then be kept at power stations or dumped at sea. It could also be _____ in the ground, either close to the surface or deep down in rocks. (4)

(Total: 7 marks)

5. This question is about Current Electricity

- a. Figure 1 shows a diagram of a circuit which includes a cell, a resistor, an ammeter and a switch.

i. On the diagram, label:

- the cell with a letter C;
- the resistor with a letter R.

(2)

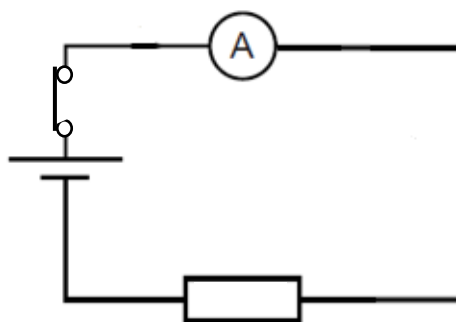


Figure 1

ii. On the diagram above:

- indicate the positive terminal of the battery with a "+";
- draw the direction of current flowing in the circuit.

(2)

- b. The current flowing through the resistor is 0.4 A. The resistor has a resistance of 5 Ω . Calculate the voltage across the resistor.

(2)

(Total: 6 marks)

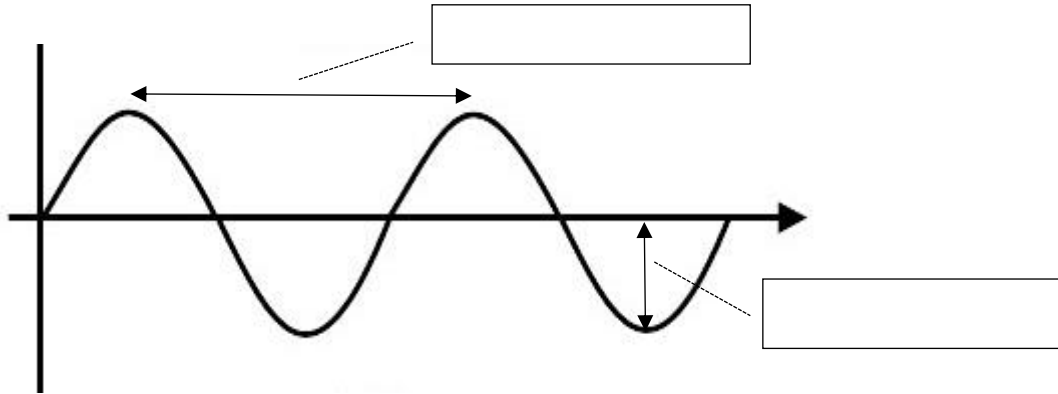
6. This question is about Waves

a. Complete the following:

i. _____ is an example of a longitudinal wave; (1)

ii. _____ is an example of a transverse wave. (1)

b. The diagram below represents a wave.



i. On the above diagram, fill in the boxes given to indicate which of the arrows represent:

- the amplitude of the wave; (1)
- wavelength of the wave. (1)

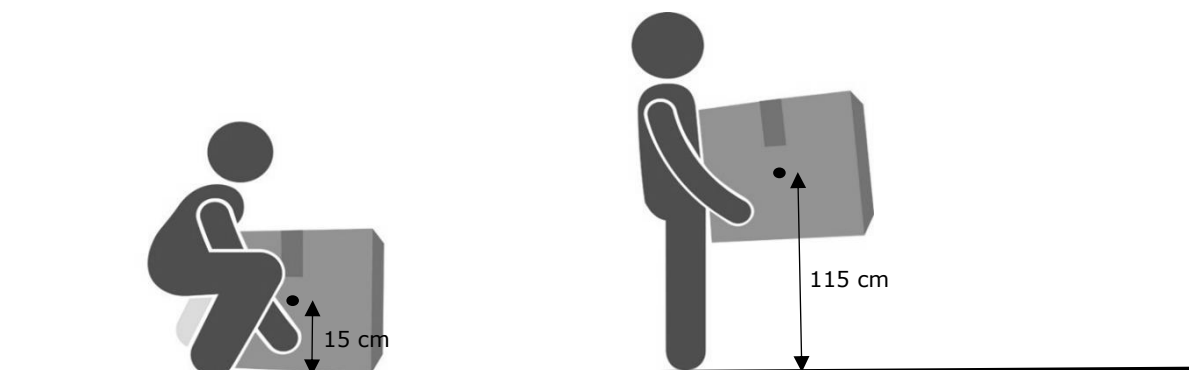
ii. The frequency of a wave is 0.1Hz. Calculate the periodic time of this wave.

_____ (1)

(Total: 5 marks)

7. This question is about Energy

a. A man lifts a box of mass 20 kg as shown in the diagram below.



i. The Law of Conservation of Energy states that:

_____ (1)

ii. Calculate the gravitational potential energy gained by the box.

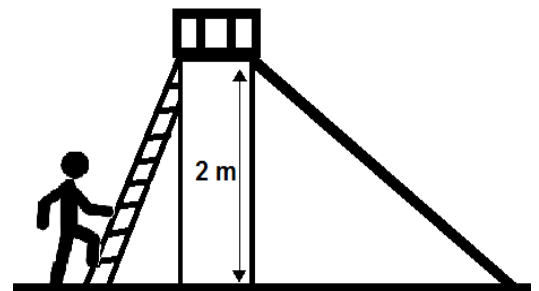
(3)

iii. The man accidentally drops the box. State the types of energy when the box reaches the following stages:

- Just before it hits the ground; _____ (1)
- Just after it hits the ground; _____ and _____ (2)

b. A child of mass 30 kg climbs up a ladder 2 m high, to slide down the slide as shown in the figure.

i. What is the weight of the child?



(1)

ii. Determine the work the child must do to reach the top of the slide.

(2)

(Total: 10 marks)

Section B

8. Ana boils water in an electric kettle containing a heating element at the bottom.

a. State whether the following statements are True (T) or False (F).

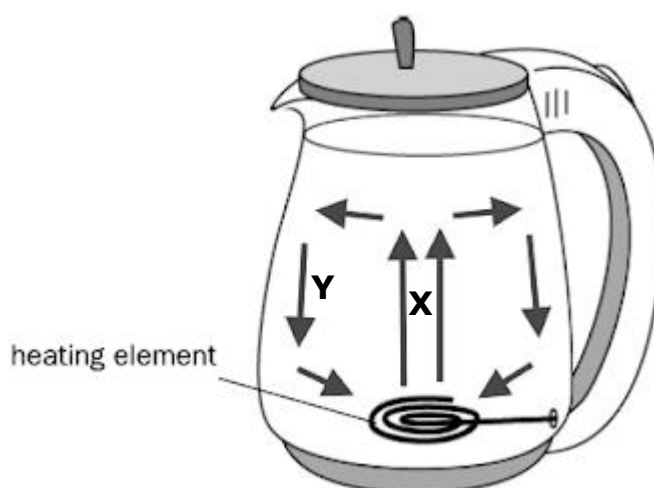
(4)

	Statement	True [T] or False [F]
i.	The heating element heats the water by radiation.	
ii.	The circulation of water creates a convection current in it.	
iii.	Ana feels heat coming off the shiny kettle surface. This is due to radiation emitted from it.	
iv.	Putting a towel round the kettle keeps the water warm for a longer period of time.	

b. The diagram below shows the process by which water is being heated. Underline the correct answer.

i. At point X (hot/cold) water rises. (1)

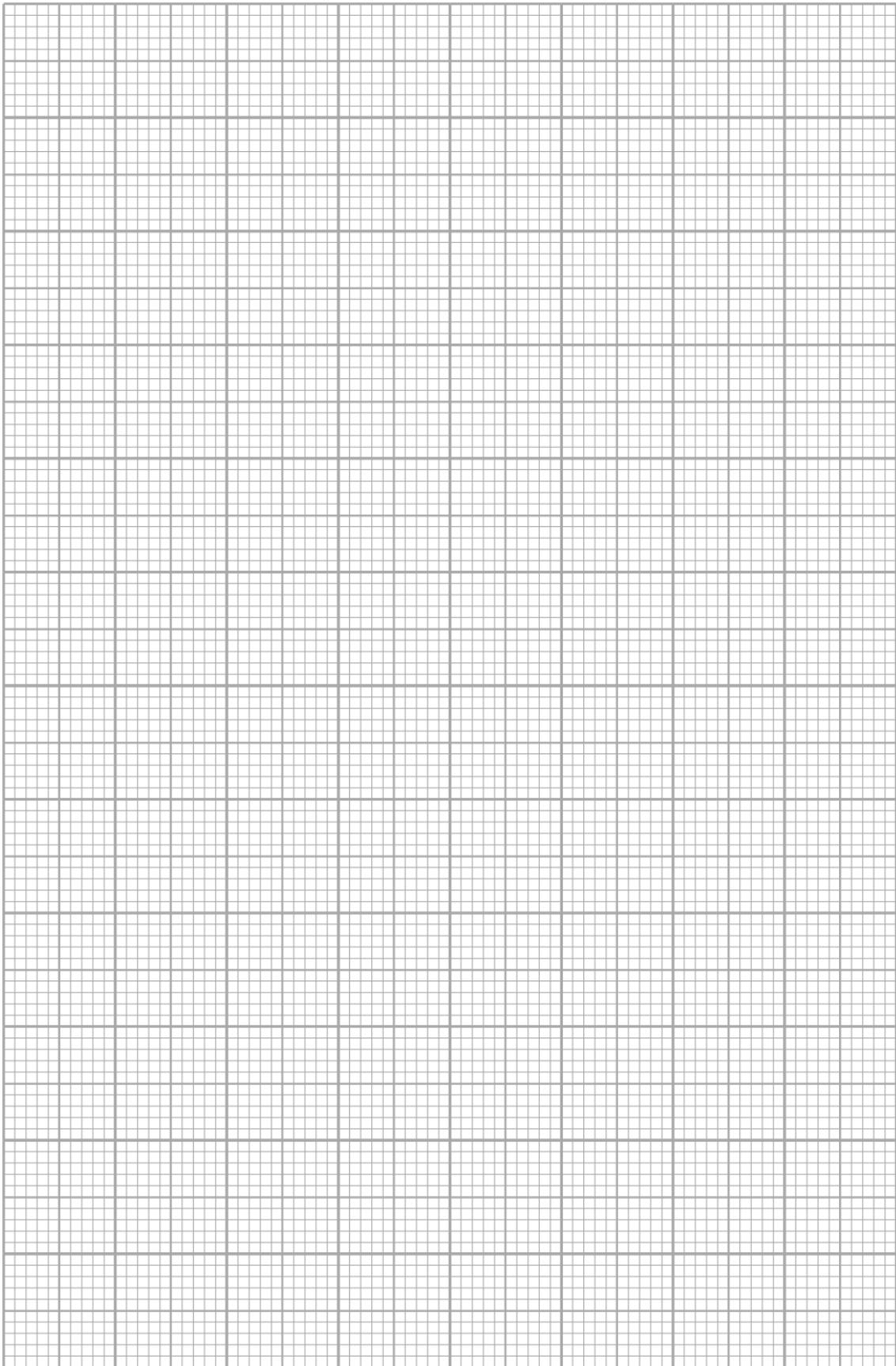
ii. At point Y (hot/cold) water sinks. (1)



c. Ana records the temperature of the water at equal time intervals during heating. The following readings are noted.

Temperature / °C	20	40	60	80	100
Time / s	0	50	100	150	200

i. Plot a graph of Temperature on the y-axis against Time on the x-axis. (4)



ii. From the graph:

- the room temperature is _____ °C; (1)
- the temperature of the water after 70 s is _____ °C. (1)

d. The boiling water is used for soup. Which items will feel warm to the touch if used to stir the soup?

Tick off the correct answer(s) with an (X). (3)

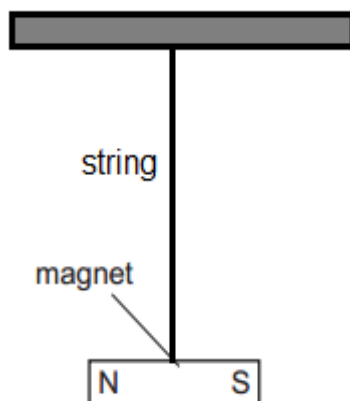
plastic spoon	
stainless steel ladle	
wooden spoon	
metal fork	
copper spoon	

(Total: 15 marks)

Section C

9. This question is about Electricity and Magnetism.

a. A magnet is suspended by a string as shown below.



i. Suggest a suitable metal to be used to make the permanent magnet shown in the figure above.

_____ (1)

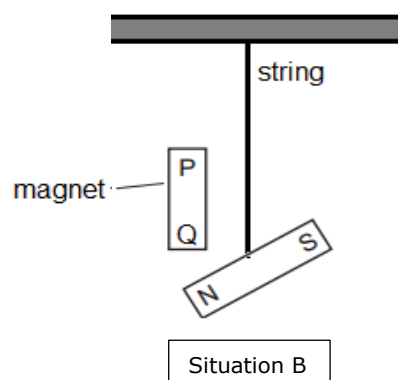
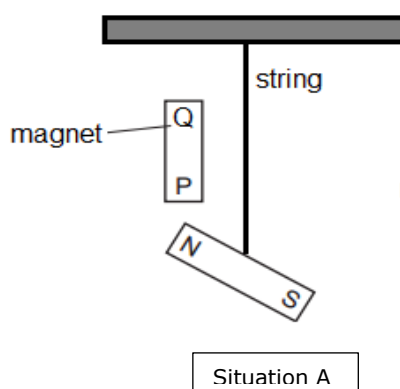
ii. What do the letters N and S stand for?

N _____ S _____ (2)

- iii. In the space below draw the magnetic field pattern around the single bar magnet. Show also the direction of the magnetic field lines. (2)



- b. Another bar magnet is brought close to the N pole of the suspended magnet. When end P is brought close, the suspended magnet is observed to tilt upwards (Situation A). When end Q of the bar magnet is brought close, the suspended magnet tilts away (Situation B).



- i. Identify poles P and Q of the magnet.

P: _____ Q: _____ (2)

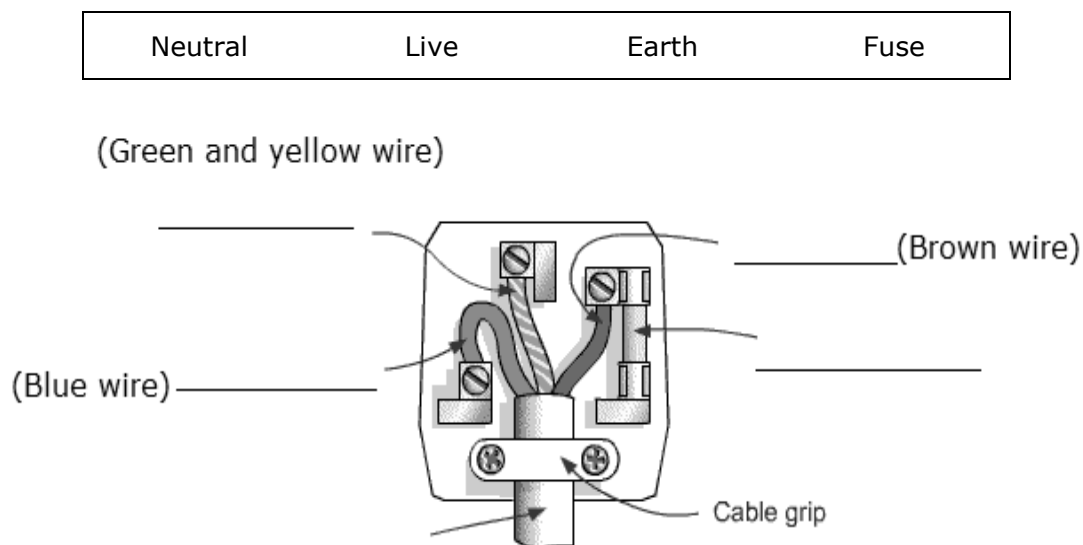
- ii. Complete the following statement:

The above experiment shows that unlike poles _____ each other, whereas like poles _____ each other. (2)

c. The diagram below shows an electrical plug connected with three wires of different colours.

i. Fill in using the words given below.

(4)



ii. Explain why **each** wire above has a different colour.

(1)

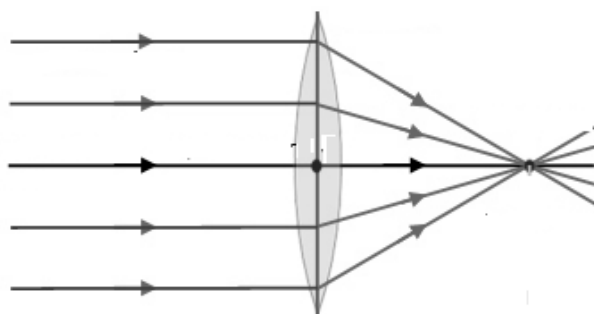
iii. State **ONE** safety feature found in the electrical plug.

(1)

(Total 15 marks)

10. This question is about Waves.

a. The diagram below shows parallel rays passing through a lens.



Underline the correct answer:

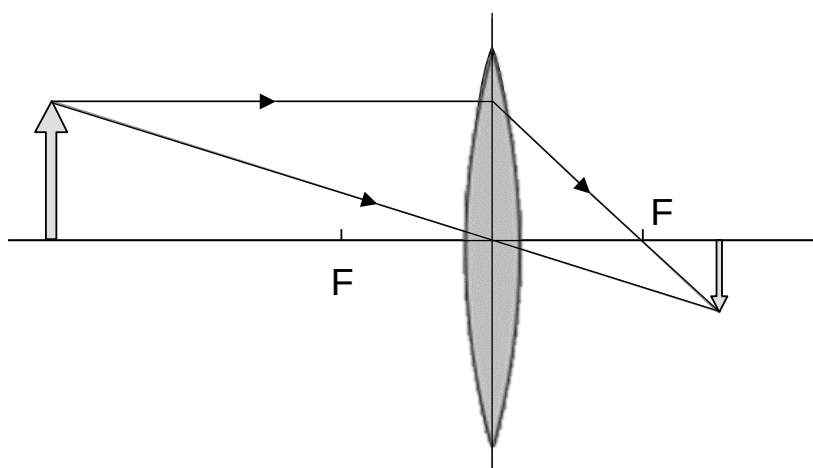
i. the lens shown in the diagram is a (convex / concave) lens;

(1)

ii. the rays (converge / diverge) after passing through the lens.

(1)

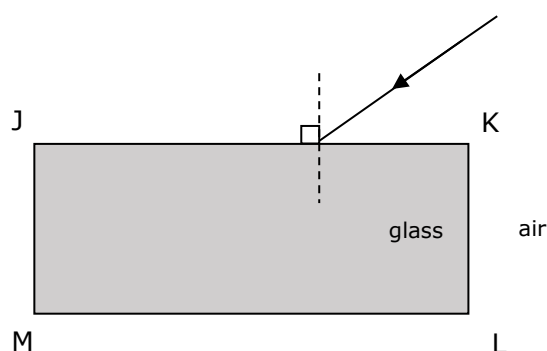
b. The diagram below is not drawn to scale.



- i. Mark on the diagram, the image height with the letters **h_i** and the object distance with the letter **u** . (2)
- ii. Given the object height to be 4 cm and the image height 2 cm, calculate the magnification of the lens.

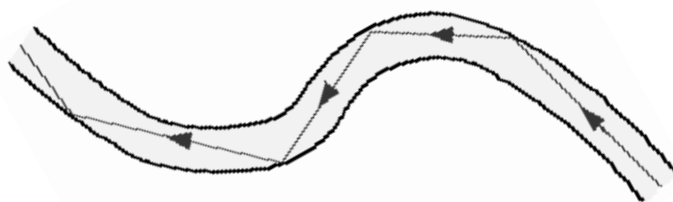
(2)

c. The diagram below shows a ray of light incident on side JK of a glass block JKLM.



- i. On the diagram:
 - Mark the angle of incidence with the letter **i** . (1)
 - Complete the ray of light as it passes through the glass block and out again. (2)
- ii. Fill in:
 As light enters the glass block, its speed _____. (1)

- d. The diagram below shows a light signal travelling through an optical fibre made of solid glass.



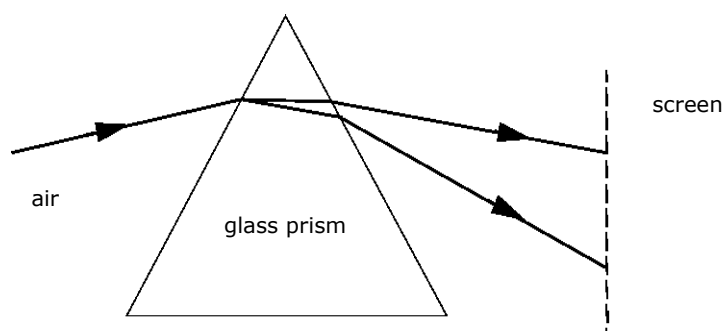
- i. Underline **ONE** of the following terms which describes the path being taken by light inside the glass optical fibre. (1)

Total internal reflection Refraction Dispersion

- ii. Give **ONE** use of the optical fibre.

_____ (1)

- e. The diagram below shows white light passing through a prism and forming a spectrum.



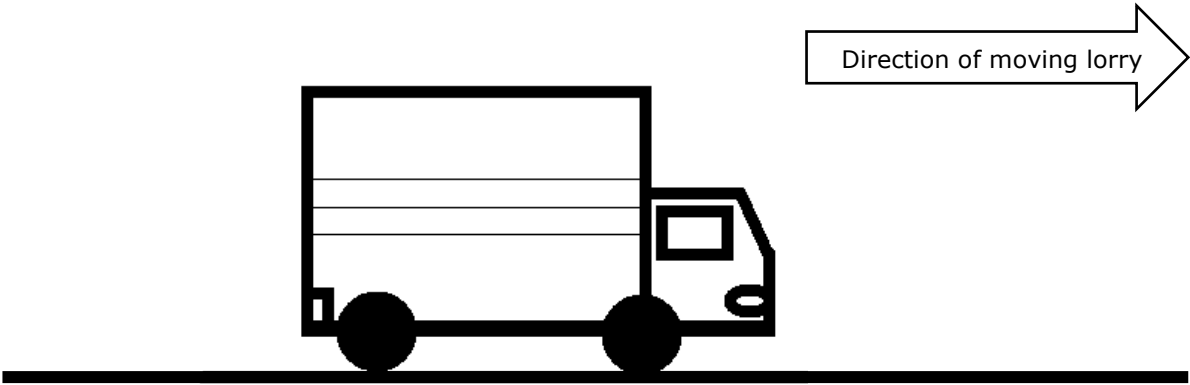
- i. On the diagram above, label the red ray with the letter **R** and the violet ray with the letter **V**. (2)
- ii. Underline **ONE** of the following terms which describes the path of light through a glass prism.

Total internal reflection Dispersion Reflection

(1)

(Total: 15 marks)

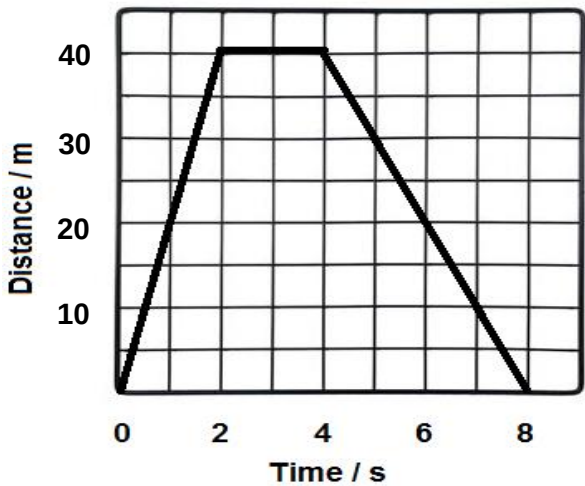
11. Air resistance, friction and the engine force are three forces acting on a moving lorry.



- a. On the diagram, draw the above-mentioned forces acting on the lorry. (3)
- b. The lorry is travelling at constant speed. Mark with a ☒ the option from A, B, C and D which shows the motion of the lorry. (2)

		Air Resistance:	Friction:	Engine force:
A	☐	2000 N	1000 N	3000 N
B	☐	2000 N	2000 N	5000 N
C	☐	3000 N	3000 N	3000 N
D	☐	3000 N	4000 N	6000 N

c. The Distance-Time graph below describes 8s of the lorry’s motion.



i. Describe the motion between:

- 0 – 2 s;

_____ (1)
- 2 – 4 s.

_____ (1)

- i. What is the speed of the lorry during the last 4 s?

_____ (2)

- ii. How far does the lorry travel in the first 4 s?

_____ (1)

- iii. Determine the total distance travelled during the journey.

_____ (2)

- d. While driving the lorry, the driver notices an obstacle, applies the brakes and the lorry stops. The total stopping distance depends on the thinking distance and the braking distance.

- i. Explain what is meant by thinking distance.

_____ (1)

- ii. Underline **ONE** factor, from the list below, which increases the braking distance.

wet road

high friction road

dry road

(1)

- iii. Complete the following table:

Thinking distance	Braking distance	Stopping distance
15 m	18 m	

(1)

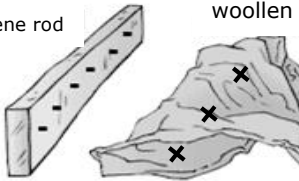
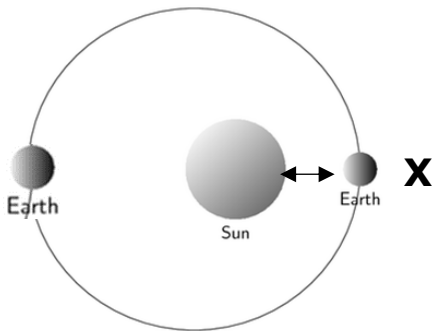
(Total: 15 marks)

END OF PAPER

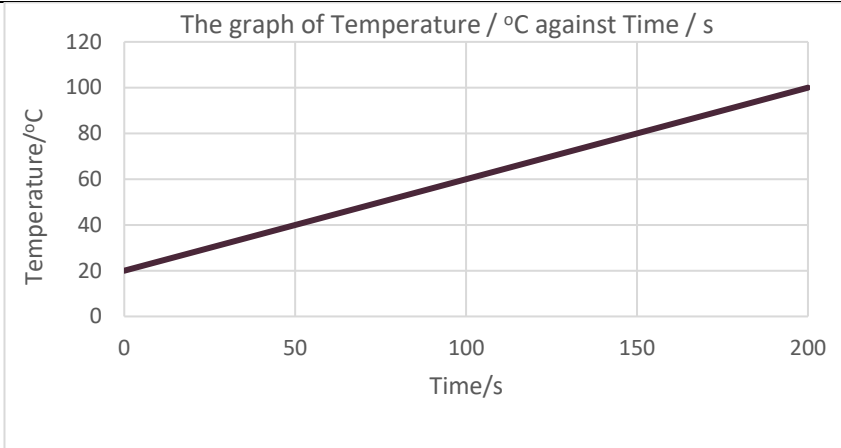
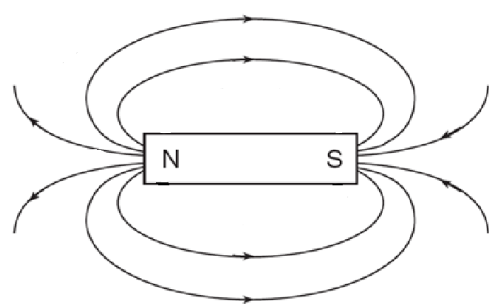
Specimen Assessments: Controlled Paper MQF 1-2 Marking Scheme

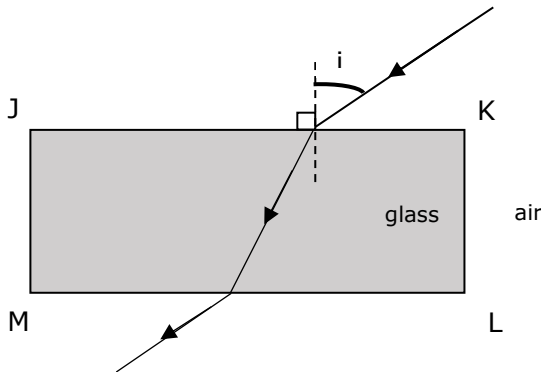
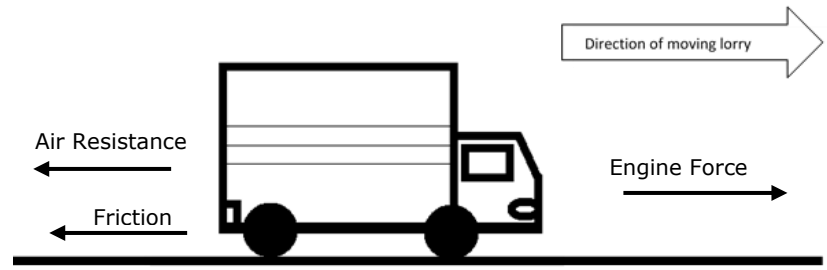
L-Università
ta' MaltaMATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARDSECONDARY EDUCATION CERTIFICATE LEVEL
SAMPLE PAPER MARKING SCHEME

SUBJECT: **Physics**
 PAPER NUMBER: **Level 1 –2**
 DATE:
 TIME: 2 Hours

Question			Suggested Answer/s			Marks	Remarks												
1.	a.		<table><tr><td>Electron</td><td>•</td><td>•</td><td>No charge</td></tr><tr><td>Proton</td><td>•</td><td>•</td><td>Negatively charged</td></tr><tr><td>Neutron</td><td>•</td><td>•</td><td>Positively charged</td></tr></table>			Electron	•	•	No charge	Proton	•	•	Negatively charged	Neutron	•	•	Positively charged	3	
	Electron	•	•	No charge															
Proton	•	•	Negatively charged																
Neutron	•	•	Positively charged																
	b.		polythene rod 			1													
			Total			4													
2.	a.		Ruler	1															
	b.		27cm ³	1															
	c.		lever	1															
	d.		Density = mass/volume = 243 / 27 = 9 g/cm ³	1 1															
			Total			5													
3.	a.			1 1 1															
	b.																		
	c.																		
			Total			3													

4.	a.		<table><tr><th rowspan="2">Radiation</th><th colspan="3">Penetrating power</th></tr><tr><th>Low</th><th>Medium</th><th>High</th></tr><tr><td>Gamma</td><td></td><td></td><td>✓</td></tr><tr><td>Alpha</td><td>✓</td><td></td><td></td></tr><tr><td>Beta</td><td></td><td>✓</td><td></td></tr></table>	Radiation	Penetrating power			Low	Medium	High	Gamma			✓	Alpha	✓			Beta		✓		1 1 1	
	Radiation	Penetrating power																						
		Low	Medium	High																				
	Gamma			✓																				
	Alpha	✓																						
Beta		✓																						
	b.		Harm, safe, concrete, buried	1,1,1,1																				
			Total	7																				
5.	a.	i.	Correct labelling of cell Correct labelling of resistor	2																				
		ii.	Correct marking of positive terminal Correct indication of conventional current flow	2																				
	b.		V=IR = 0.4 x 5 = 2 V	1 1																				
			Total	6																				
6.	a.	i.	Sound waves	1																				
			Micro waves	1	Any other acceptable answer																			
	b.	i.	Correct labelling of amplitude and wavelength	1,1																				
		ii.	T = 1/f = 1/0.1 = 10s	1 1																				
			Total	6																				
7.	a.	i.	Energy cannot be created nor destroyed, but can only be transformed from one form to another	1 1																				
		ii.	PE = mgh = 20 x 10 x (1.15 - 0.15) = 20 x 10 x 1 = 200J	1 1 1																				
		iii.	KE Sound, heat	1 1,1																				
	b.	i.	W=m x g = 30 x 10 = 300 N	1																				
		ii.	Work = F x d = 300 x 2 = 600 J	1 1																				
			Total	10																				

8.	a.	i.	False	1											
		ii.	True	1											
		iii.	True	1											
		iv.	True	1											
	b.	i.	Hot	1											
		ii.	Cold	1											
	c.	i.	The graph of Temperature / °C against Time / s 	1 correct scale 1 correct axes/graph labelling 1 correct plotting 1 straight line											
		ii.	20 °C 48 °C	1 1											
	d.		<table><tr><td>plastic spoon</td><td></td></tr><tr><td>stainless steel ladle</td><td>X</td></tr><tr><td>wooden spoon</td><td></td></tr><tr><td>metal fork</td><td>X</td></tr><tr><td>copper spoon</td><td>X</td></tr></table>	plastic spoon		stainless steel ladle	X	wooden spoon		metal fork	X	copper spoon	X	1,1,1	
	plastic spoon														
stainless steel ladle	X														
wooden spoon															
metal fork	X														
copper spoon	X														
		Total	15												
9.	a.	Any one from iron, steel, cobalt, nickel	1												
	b.	N – North; S - South	2												
	c.			1 mark for correct shape of field lines 1 mark for arrows											
	d.	i.	P – South; Q - North	1,1											
		ii.	Attract, repel	1,1											
	e.	i.	Correct labelling	4											
		ii.	To be able to identify the different wires	1	Any suitable answer.										
		iii.	Any one of: Fuse, earth wire, cord grip	1											
		Total	15												

10.	a.	i.	Convex	1	
		ii.	Converging	1	
	b.	i.	Correct marking of h_i and u	1,1	
		ii.	Mag = h_i / h_o = $0.6/1.2$ = 0.5 (to be confirmed when printed)	1 1	
	c.	i.		1 correct angle of incidence 2 correct rays and arrows	
		ii.	Decreases	1	
	d.	i.	Total internal reflection	1	
		ii.	Data transfer	1	Other acceptable answer
	e.	i.	Correct labelling of R and V	2	
		ii.	Dispersion	1	
			Total	15	
11.	a.			3	
	b.		A	2	
	c.	i.	The lorry is moving at constant speed	1	
			The lorry is at rest	1	
		ii.	Speed = distance / time = $40 / 4$ = 10 m/s	1 1	
		iii.	40 m	1	
		iv.	$40 + 40 = 80$ m	2	
	d.	i.	Time taken by the driver to apply the brakes after seeing the obstacle	1	
		ii.	Wet road	1	
		iii.	$15 \text{ m} + 18 \text{ m} = 33 \text{ m}$	1	
			Total	15	

Specimen Assessments: Controlled Paper MQF 2-3



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EXAMINATIONS BOARD

**SECONDARY EDUCATION CERTIFICATE LEVEL
SAMPLE PAPER**

SUBJECT: **Physics**
PAPER NUMBER: **Level 2 – 3**
DATE:
TIME: 2 Hours

Answer **ALL** questions.

You are requested to show your working and to write the units where necessary.

When necessary, take g , acceleration due to gravity, as 10m/s^2 .

Density	$\rho = \frac{m}{V}$
Pressure	$p = \frac{F}{A}$ $p = h \rho g$
Moments	Moment = $F \times$ perpendicular distance
Energy and Work	$PE = m g h$ $KE = \frac{1}{2} m v^2$ $W = F s$ $P = \frac{E}{t}$
Force and Motion	resultant force = $m a$ $W = m g$ $p = m v$ $F = \frac{(mv - mu)}{t}$
	average speed = $\frac{\text{total distance}}{\text{total time}}$ $v = u + a t$ $s = (u + v) \frac{t}{2}$
	$v^2 = u^2 + 2 a s$ $s = u t + \frac{1}{2} a t^2$
Waves	$\eta = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$ $\eta = \frac{\text{real depth}}{\text{apparent depth}}$
	Magnification = $\frac{\text{image height}}{\text{object height}}$ Magnification = $\frac{\text{image distance}}{\text{object distance}}$
	$v = f \lambda$ $T = \frac{1}{f}$
Electricity	$I = \frac{Q}{t}$ $V = I R$ $P = I V$
	$E = Q V$ $E = I V t$
	$R_{\text{total}} = R_1 + R_2 + R_3$ $\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2}$
Electromagnetism	$\frac{V_p}{V_s} = \frac{N_p}{N_s}$ $V_p I_p = V_s I_s$
Heat	$Q = m c \Delta \theta$
Radioactivity	$A = Z + N$
Other equations	Area of a triangle = $\frac{1}{2} b h$ Area of a trapezium = $\frac{1}{2} (a + b) h$

Answer ALL questions in ALL sections

Section A

1. The solar water heater has a length of copper pipe through which water passes and is heated by the Sun.

- a. What is the thermal process by which water is heated in the copper pipes?



_____ (1)

- b. The storage tank of a solar water heater contains 80 kg of water. The specific heat capacity of water is 4200 J/kg°C. Calculate the quantity of energy absorbed from the sun to raise the temperature of water in the tank from 25 °C to 60 °C.

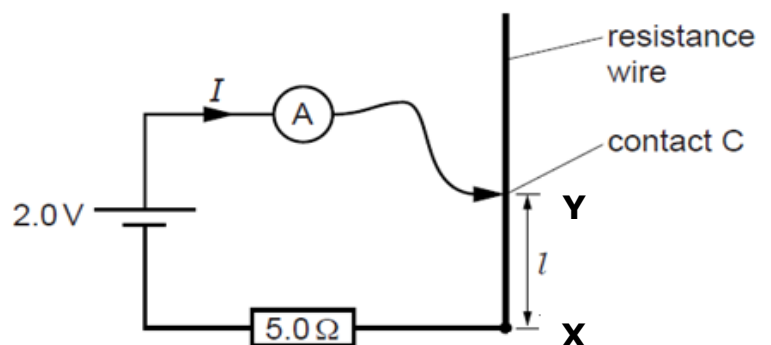
_____ (2)

- c. The solar water heater also has an electric heater to be used on cloudy days. The electric heater has a power of 2000 W. How long would it take for the electric heater to heat up all the water in the tank from 25 °C to 60 °C?

_____ (2)

(Total: 5 marks)

2. A length of bare uniform resistance wire is included in the circuit as shown below. Contact C can be moved to any position along the resistance wire.



- a. Explain how the resistance in the circuit changes as contact C moves from point X to point Y.

_____ (2)

- b. Calculate the reading on the ammeter when contact C is at point X.

_____ (2)

- c. Contact C is moved so that the resistance of the length l of the resistance wire is $15\ \Omega$. Calculate:
i. the total resistance of the circuit;

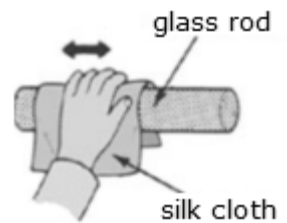
_____ (1)

- ii. the new ammeter reading.

_____ (1)

(Total: 6 marks)

3. A glass rod is rubbed with a silk cloth as shown in the diagram. The glass rod becomes positively charged.



- a. What is the charge left on the silk cloth after rubbing?

_____ (1)

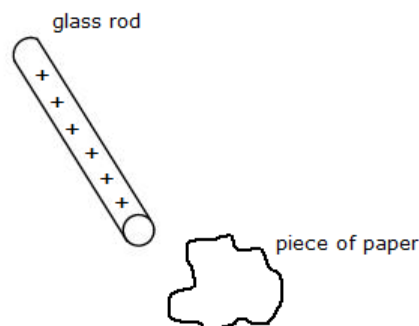
- b. The positive glass rod is now brought close to a neutral piece of paper.

- i. What can you say about the number of positive and negative charges in a neutral piece of paper?

_____ (1)

- ii. On the diagram below, draw what happens to the charges on the paper when the rod is brought close.

(1)

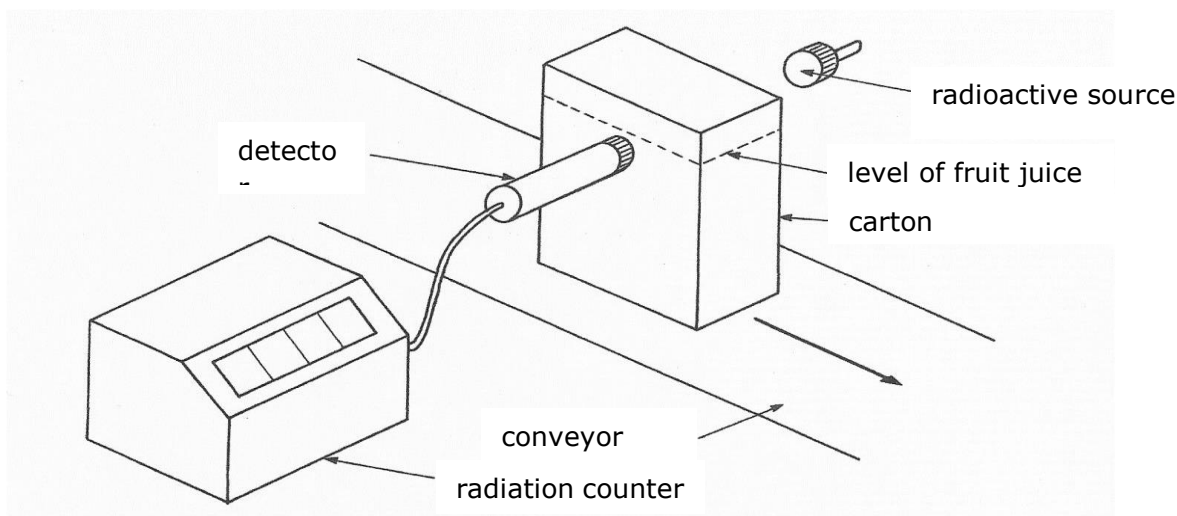


- iii. State what you would observe.

_____ (1)

(Total: 4 marks)

4. A radioactive source and a detector are used to check the level of fruit juice in a carton. Cartons of fruit juice on a conveyor belt pass between the radioactive source and the detector.



The count rates for five cartons labelled A, B, C, D and E as they pass the detector are noted and recorded in this table below.

Packet	A	B	C	D	E
Count rate	40	39	38	410	42

- a. The five statements shown below are related to the above diagram and table. Read these statements and indicate which of these are True [T] or False [F] in the right hand column. (5)

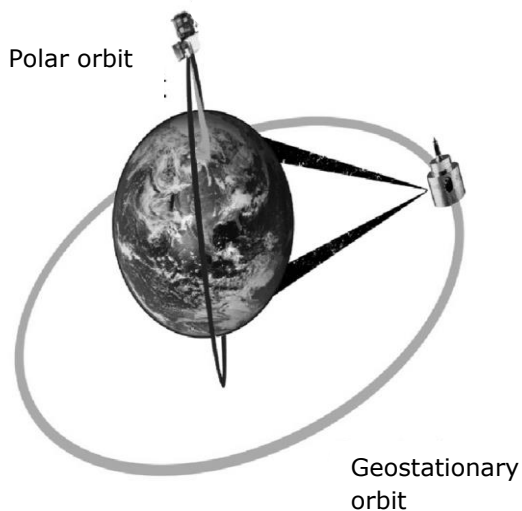
	Statement	True [T] or False [F]
i.	The radiation counter shows a high count-rate as carton D passes by it because radiation from the radioactive source is reaching the detector. This means that the carton is not filled to the required level.	
ii.	In this set up, the source of radiation being used is gamma radiation.	
iii.	The count rate readings for cartons A, B, C, and E all show that a small amount of radiation is reaching the detector. This radiation is called background radiation.	
iv.	One source of background radiation is cosmic rays from the sun.	
v.	When used in such set ups, radioactive sources need to have a long half-life so that they can be used for a long time.	

(Total: 5 marks)

5. Different types of man-made and natural satellites orbit the earth.
- a. Give **ONE** example of a natural satellite.

(1)

- b. The diagram shows two man-made satellites that orbit the Earth. Read the passage below and answer the questions related to these two types of satellites.



Source: <https://tinyurl.com/y9hgxm7>

Satellites in polar orbits are positioned around 200 km above the Earth. They rotate around the Earth over its poles several times per day. These satellites are often used for earth-mapping and observation. They can also be used to relay pictures of cloud movement and other factors that help to forecast weather over all places on Earth.

Geostationary satellites are around 35800 km above the equator and rotate around the Earth once a day. Therefore, they remain in the same position above the Earth. By acting as relay stations, they make continuous, worldwide communications, such as Global Positioning Systems (GPS), mobile phones and television programmes possible.

- i. State **ONE** difference between these two types of satellites.

(1)

- ii. Explain how this difference is related to the function of **each** type of satellite.

(2)

- iii. By considering the height of the satellites above the Earth, which of these satellites will be mostly affected by air resistance?

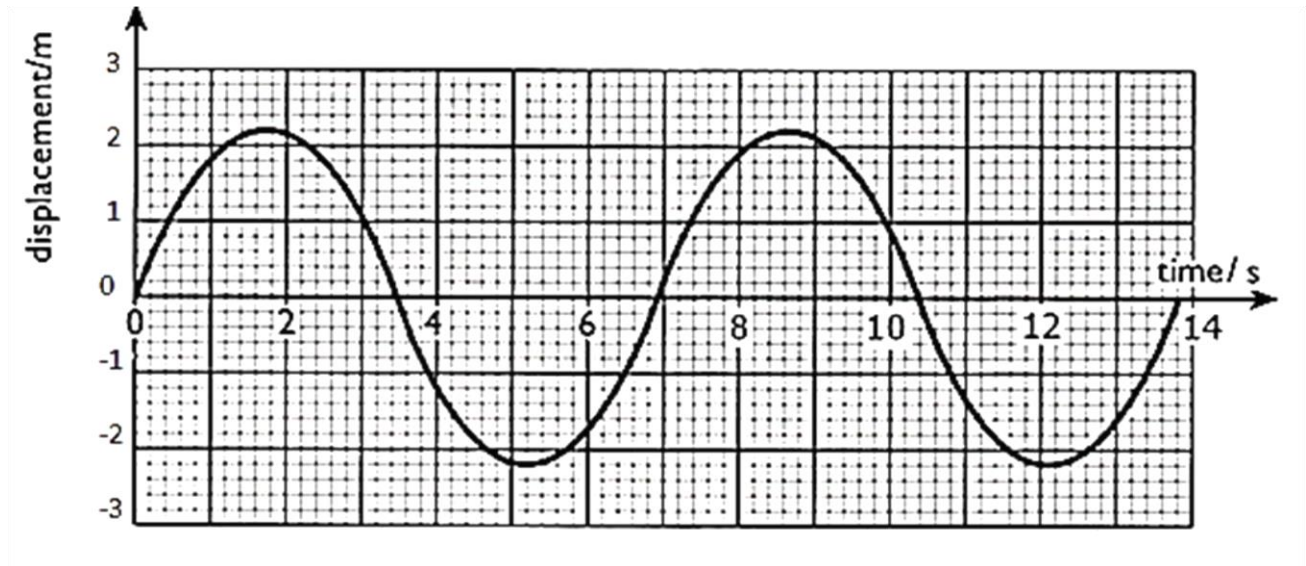
(1)

(Total: 5 marks)

6. a. Explain how sound travels through the particles of air.

(2)

b. The graph below shows the displacement (m) of an oscillating body with time (s).



i. Use the above graph to determine:

- the amplitude;

(1)

- the period.

(1)

ii. Calculate the frequency of the wave.

(1)

(Total: 5 marks)

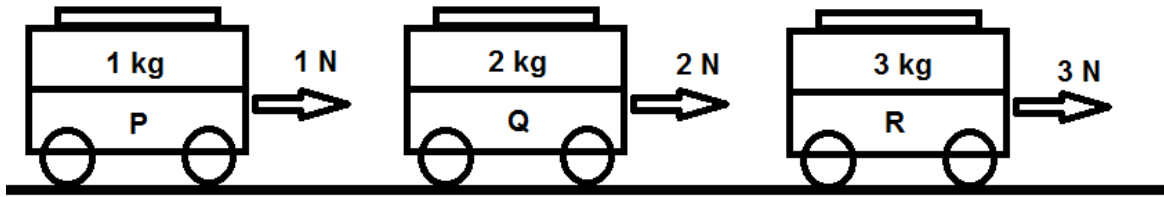
7. The diagram shows a parachutist who is falling at constant velocity.

a. Mark with a ☒ the option that shows the possible values for both the weight of the parachutist and the air resistance acting on the parachute. (1)



		Weight of parachutist	Air resistance
A	☐	70 N	60 N
B	☐	700 N	600 N
C	☐	700 N	700 N
D	☐	7000 N	6000 N

- b. Three trolleys are pulled by the forces shown in the diagram below on a frictionless surface.



Mark with a ☒ **ONE** option from A, B, C and D.

(1)

- A ☐ P has the biggest acceleration.
- B ☐ Q has the biggest acceleration.
- C ☐ R has the biggest acceleration.
- D ☐ P, Q and R all accelerate at the same rate.

- c. An astronaut is on the Moon. He drops a hammer from a height of 3.2 m and it takes 2.0 s to hit the lunar landscape.

- i. What is the acceleration due to gravity on the Moon?

_____ (2)

- ii. Explain why the result for part c. i. is different from the value of acceleration due to gravity on Earth.

_____ (1)

(Total: 5 marks)

8. Martina, of mass 50 kg, runs up a flight of stairs in 9 s. The stairs are 3 m high.

- a. Calculate her power output.

_____ (2)

- b. Her sister throws Martina's purse of mass 0.4 kg vertically upwards with a kinetic energy of 10 J. Will it reach Martina?

_____ (3)

(Total: 5 marks)

Section B

9. Sarah boils water in a beaker. She wishes to test which material round the beaker is the best insulator. All necessary apparatus is available in the school laboratory.

a. Underline the right answer:

The best insulator is one which keeps the water in the beaker warm for the (longest, shortest) period of time. (1)

b. Design a simple experiment to determine whether a plastic bag or a cotton wool are the best materials for insulation.

i. In the space below, draw a well-labelled diagram of the required setup. (3)

ii. Briefly explain the method that Sarah needs to follow.

(3)

iii. The following data is recorded during the experiment for the plastic bag insulation.

Temperature / °C	100	91	87	84	81	78	76
Time / minutes	0	5	10	15	20	25	30

Plot a graph of Temperature (°C) on the y-axis against Time (minutes) on the x-axis. (4)

- iv. Predict whether the graph for the cotton wool insulation would be above or below the plotted graph? Give **ONE** reason for your answer.

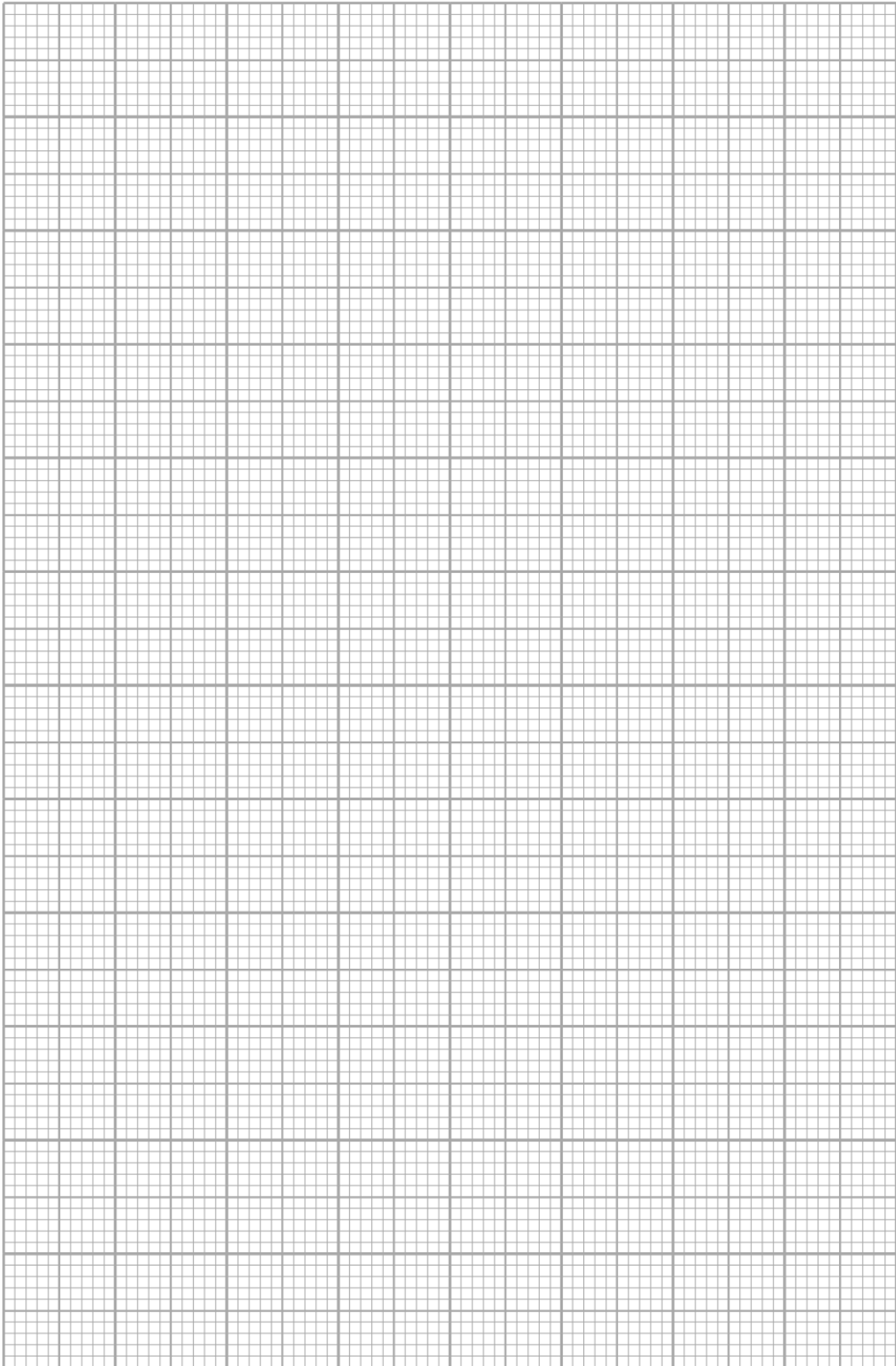
(2)

- v. What do insulating materials, like cotton, contain to ensure conduction of heat is reduced?

(1)

- vi. State **ONE** method of reducing heat losses in the home.

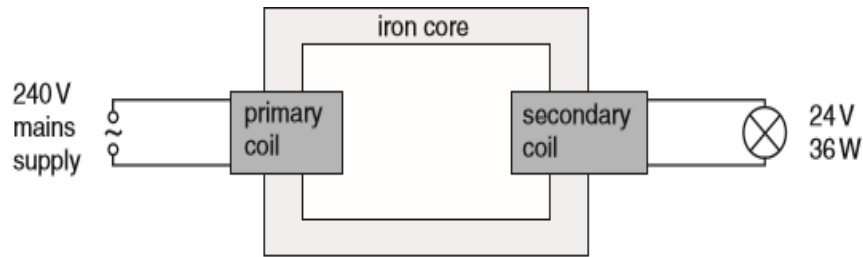
(1)



(Total: 15 marks)

Section C

10. a. The diagram below shows a simple transformer that is used to light a lamp as shown.



i. Name the type of transformer used and explain its function.

_____ (2)

ii. Explain why the primary coil needs to be connected to an alternating current source so that the transformer can serve its purpose.

_____ (2)

iii. The primary coil of the transformer contains 500 turns. Calculate the number of turns on the secondary coil of the transformer.

_____ (2)

iv. Calculate the current flowing in the secondary circuit of this transformer.

_____ (2)

v. Underline a suitable fuse that is to be included in the secondary coil and give a reason for your choice.

1A

2A

5A

13A

_____ (2)

vi. The secondary coil and the lamp are connected in series. Calculate the total resistance in the secondary arm.

_____ (2)

vii. Find the resistance of the lamp, if the coil has a total resistance of $10\ \Omega$.

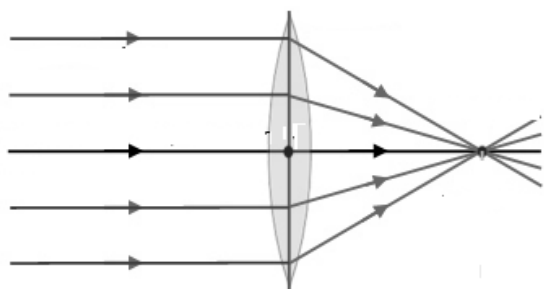
(1)

b. Lamps, heaters and other electrical appliances in a household are connected in parallel. Give **TWO** reasons for this arrangement.

(2)

(Total: 15 marks)

11. The following diagram shows a number of light rays passing through a convex lens.



a. On the given ray diagram, mark:

i. the Focal Point with a letter 'F';

(1)

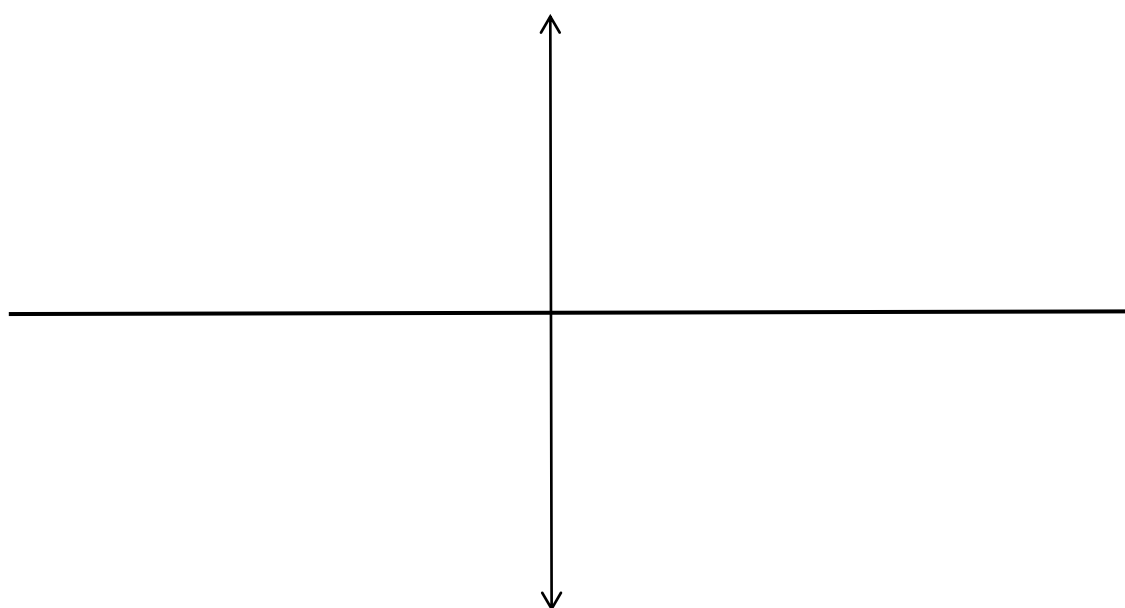
ii. the Principal Axis with a letter 'X'.

(1)

b. An illuminated object, 2.2 cm high, is placed 5 cm from a convex lens of focal length 3 cm.

i. Draw a ray diagram (to scale) to show the formation of a real image.

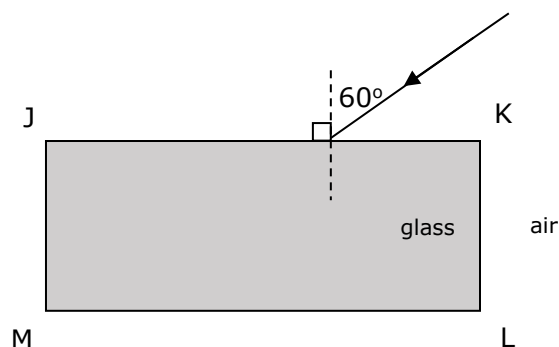
(3)



ii. Calculate the magnification of the lens.

(2)

- c. The diagram below shows a ray of light incident on side JK of a square glass block JKLM. The angle of incidence of the ray of light is 60° .

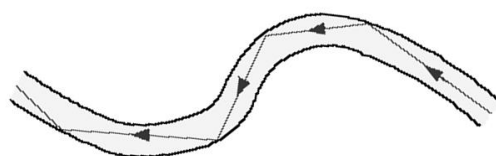


- Complete the ray of light as it passes through the glass block and out again. (2)
- Label the Normal on the side LM of the above diagram. (1)
- Name another change which occurs when the ray of light passes from air to glass. (1)

- Explain the term 'critical angle'.

(2)

- d. The diagram below shows a light signal travelling through an optical fibre made of solid glass.



Explain how the light follows the path shown after hitting the walls of the fibre.

(2)

(Total: 15 marks)

12. The figure below represents the displacement of a car with time.



Tom made the following statements with regards to the graph.

- A. The graph represents the motion of the car moving with uniform velocity.
- B. The area under the graph represents the displacement travelled by the car.
- C. The car is at rest.

a. Identify the correct statement. _____ (1)

b. Explain briefly why Tom was wrong in the other two statements.

Statement: _____

Reason:

 _____ (1)

Statement: _____

Reason:

 _____ (1)

c. Tom draws a second graph of velocity against time and considers the following statements again.



- A. The graph represents the motion of the car moving with uniform velocity.
- B. The area under the graph represents the displacement travelled by the car.
- C. The car is at rest.

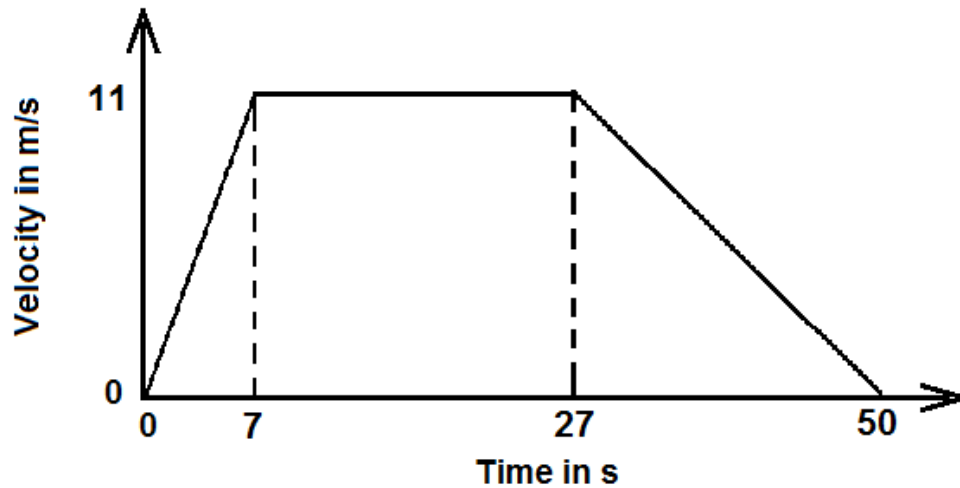
Identify **ONE** correct statement and give a brief explanation.

Statement: _____ (1)

Reason:

 _____ (1)

d. The following diagram represents the motion of a van.



i. Using the diagram above, explain the motion of the van between 0 – 7 s.

_____ (1)

ii. Calculate the displacement of the van while moving at uniform velocity.

_____ (2)

iii. Calculate the deceleration of the van.

_____ (3)

iv. Use the graph to find:

- the total distance travelled by the van;

_____ (2)

- the average speed of the van.

_____ (2)

(Total: 15 marks)

END OF PAPER

Specimen Assessments: Controlled Paper MQF 2-3 Marking Scheme

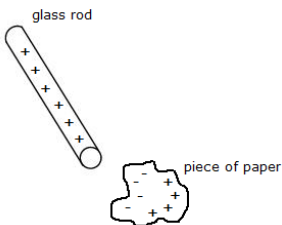


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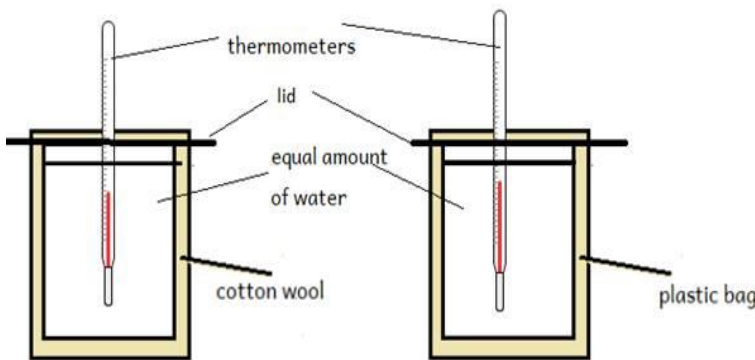
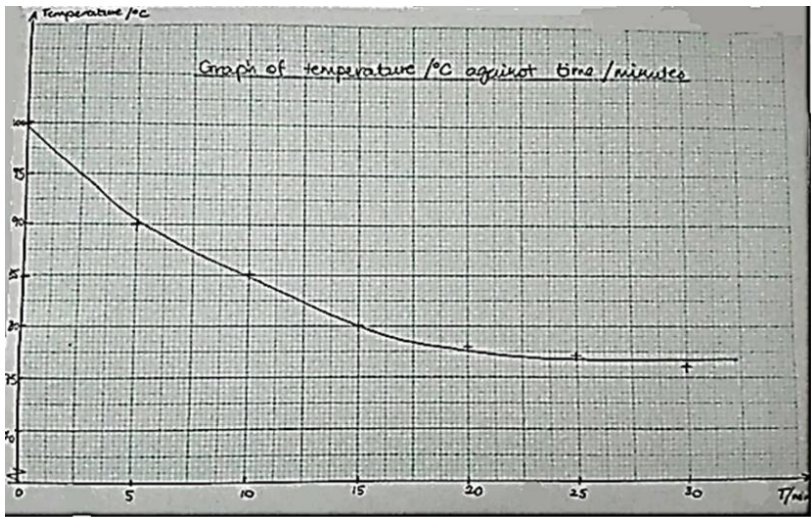
MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
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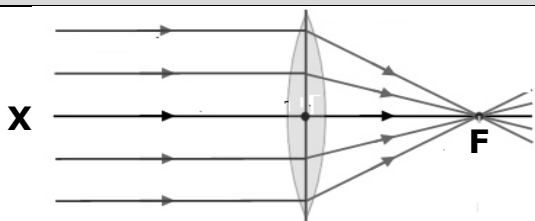
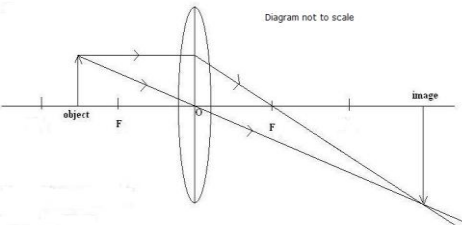
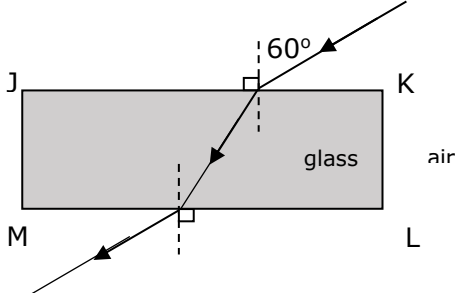
**SECONDARY EDUCATION CERTIFICATE LEVEL
SAMPLE PAPER MARKING SCHEME**

SUBJECT: **Physics**
PAPER NUMBER: **Level 2 –3**
DATE:
TIME: 2 Hours

Question			Suggested Answer/s	Marks	Remarks
1.	a.		conduction	1	
	b.		$\Delta Q = mc \Delta \theta$ $= (80) (4200) (60-25)$ $= 11\,760\,000 \text{ J}$	1 1	
	c.		$E = Pt$ $11\,760\,000 = (2000) t$ $t = 5880 \text{ s}$	1 1	
			Total	5	
2.	a.		Resistance increases Length of wire is proportional to resistance	1 1	
	b.		$I = V / R$ $= 2 / 5$ $= 0.4 \text{ A}$	1/2 1 1/2	
	c.	i.	$R_T = R_1 + R_2$ $R_T = 15 + 5$ $= 20 \, \Omega$	1/2 1/2	
		ii.	$I = V / R$ $= 2 / 20$ $= 0.1 \text{ A}$	1/2 1/2	
			Total	6	
3.	a.		Negative charge	1	
	b.		Number of positive and negative charges is equal	1	
	c.			1	
	d.		Attraction	1	
			Total	4	

4.	i.		True	1	
	ii.		False	1	
	iii.		True	1	
	iv.		True	1	
	v.		False	1	
			Total	5	
5.	a.		Moon	1	
	b.	i.	Polar satellites rotate about the poles while geostationary satellites rotate above the equator.	1	
		ii.	Polar satellites are suitable for weather forecast and geostationary satellites are suitable for worldwide communication.	1 1	
		iii.	Polar satellites	1	
			Total	5	
6.	a.		Sound causes air particles to vibrate creating compressions and rarefactions in the air	1 1	
	b.	i.	2.2 m 6.9 s	1 1	
		ii.	$F = 1/T = 1/6.9 = 0.15 \text{ Hz}$	1	
			Total	5	
7.	a.		C	1	
	b.		D	1	
	c.	i.	$S = u t + \frac{1}{2} g t^2$ $3.2 = 0 + \frac{1}{2}(g)2^2$ $3.2 / 2 = g = 1.6 \text{ N/kg}$	1 1	
		ii.	Difference in mass	1	
			Total	5	
8.	a.		Power = Energy / time $= (50 \times 10 \times 3) / 9$ $= 167 \text{ W}$	1 1	
	b.		KE lost = PE gained $10\text{J} = 0.4 (10) h$ $2.5\text{m} = h$ NO, the purse will not reach Martina.	1 1 1	
			Total	5	

9.	a.		longest	1	
	b.	i.		3	1 mark for thermometer inside can 1 mark for insulation all around 1 mark for lid
		ii.	The above apparatus was arranged with equal amount of (boiling) water in both cans. Take readings of temperature simultaneously every minute. Repeat this for about 15 minutes.	1 1 1	
		iii.		4	1 axes labels 1 title of graph 1 for plot 1 suitable curve
		iv.	Above	1	
			Cotton wool would have more entrapped air	1	
		v.	Entrapped air	1	
		vi.	Any one from: (Solar) water heater; tea cosy; oven gloves; double glazing; carpets	1	Any other acceptable answer
			Total	15	
10.	a.	i.	Step down transformer Decreases the voltage	1 1	
		ii.	Since a.c. creates a fluctuating magnetic field Required for induction of emf.	1 1	
		iii.	$N_1/N_2 = V_1/V_2$ $500/N_2 = 240/24$ $N_2 = 50$ turns	1 1	
		iv.	$P = IV \rightarrow I = P/V$ $I = 36/24$ $= 1.5 \text{ A}$	1 1	

		v.	2 A Slightly higher than the current in the circuit.	1 1	
		vi.	$V = IR$ $R = 24/0.5$ $= 48 \Omega$	1 1	
		vii.	$R_T = R_1 + R_2$ $48 = 10 + R_2$ $R_2 = 38 \Omega$	$\frac{1}{2}$ $\frac{1}{2}$	
	b.		Any two of: When one goes off the other is still on / they light brighter / more current in each appliance / can be switched on separately.	2	
			Total	15	
11.	a.	i.		2	
		ii.		1	
	b.	i.	 correct positioning of F correct arrows drawing correct measurements	3	
		ii.	Magnification = image height / object height Magnification = 3 (correct measurement from diagram +/- 0.2cm) / 2.2 Magnification = 1.36 (Accept values for magnification between 1.27 and 1.45)	1 1	Accept workings with $m = \frac{\text{image distance}}{\text{object distance}}$
	c.	i.		2	
		ii.		1	Correct labelling of Normal
		iii.	Any one of: Velocity decreases / Wavelength decreases	1	
		iv.	That angle, beyond which, light rays are totally reflected when going from a medium to a less dense medium	1	
	d.		The angle at which the emergent ray skims the surface between two media. The incident ray should be passing from the more dense to the less dense medium.	1 1	
			Total	15	

12.	a.	Statement C	1	
	b.	Statement A: The car is not moving with uniform velocity but is at rest.	1	
		Statement B: The area under a displacement time graph does not represent distance travelled	1	
	c.	Statement A, a horizontal line in a velocity-time indicates that the body is travelling with uniform velocity. OR Statement B, the area below a velocity-time graph gives the displacement of the body.	1 1	
	d	i. The car starts from rest and accelerates uniformly for 7 s and reaches a velocity of 11 m/s.	1	
		ii. Displacement = velocity x time = 11 m/s x 20 s = 220 m/s	1 1	
		iii. $a = (v - u)/t$ $a = (0 - 11)/23$ $a = -0.48 \text{ m/s}^2$ OR decel. = 0.48 m/s^2	1 1 1	Deduct 1 mark if answer does not include "-" sign or "decel. = "
		iv. Total distance travelled = area under graph = $\frac{1}{2} \times (20 + 50) \times 11$ = 385 m	1 1	Accept also addition of areas of composite shapes
		average speed of motion = Total Distance / Total Time = $385/50$ = 7.7 m/s	1 1	
		Total	15	

Specimen Assessments: Private Candidates Paper MQF 1-2



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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

**SECONDARY EDUCATION CERTIFICATE LEVEL
PRIVATE CANDIDATES SAMPLE PAPER**

SUBJECT: **Physics**
PAPER NUMBER: **Level 1 – 2**
DATE:
TIME: 2 Hours

Answer **ALL** questions.

You are requested to show your working and to write the units where necessary.

When necessary, take g , acceleration due to gravity, as 10m/s^2 .

Density	$\rho = \frac{m}{V}$
Pressure	$p = \frac{F}{A}$ $p = h \rho g$
Moments	Moment = $F \times$ perpendicular distance
Energy and Work	$PE = m g h$ $KE = \frac{1}{2} m v^2$ $W = F s$ $P = \frac{E}{t}$
Force and Motion	resultant force = $m a$ $W = m g$ $p = m v$ $F = \frac{(mv - mu)}{t}$
	average speed = $\frac{\text{total distance}}{\text{total time}}$ $v = u + a t$ $s = (u + v) \frac{t}{2}$
	$v^2 = u^2 + 2 a s$ $s = u t + \frac{1}{2} a t^2$
Waves	$\eta = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$ $\eta = \frac{\text{real depth}}{\text{apparent depth}}$
	Magnification = $\frac{\text{image height}}{\text{object height}}$ Magnification = $\frac{\text{image distance}}{\text{object distance}}$
	$v = f \lambda$ $T = \frac{1}{f}$
Electricity	$I = \frac{Q}{t}$ $V = I R$ $P = I V$
	$E = Q V$ $E = I V t$
	$R_{\text{total}} = R_1 + R_2 + R_3$ $\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2}$
Electromagnetism	$\frac{V_p}{V_s} = \frac{N_p}{N_s}$ $V_p I_p = V_s I_s$
Heat	$Q = m c \Delta \theta$
Radioactivity	$A = Z + N$
Other equations	Area of a triangle = $\frac{1}{2} b h$ Area of a trapezium = $\frac{1}{2} (a + b) h$

Section A**Answer ALL questions**

1) Alan has 200 ml of water in a beaker.

a)

i. From Figure 1, the initial temperature recorded for the water is:

_____ (1)

ii. The water is boiled. What is the temperature change of the water?

_____ (2)



Figure 1

b) Label the apparatus in Figure 2.

(3)

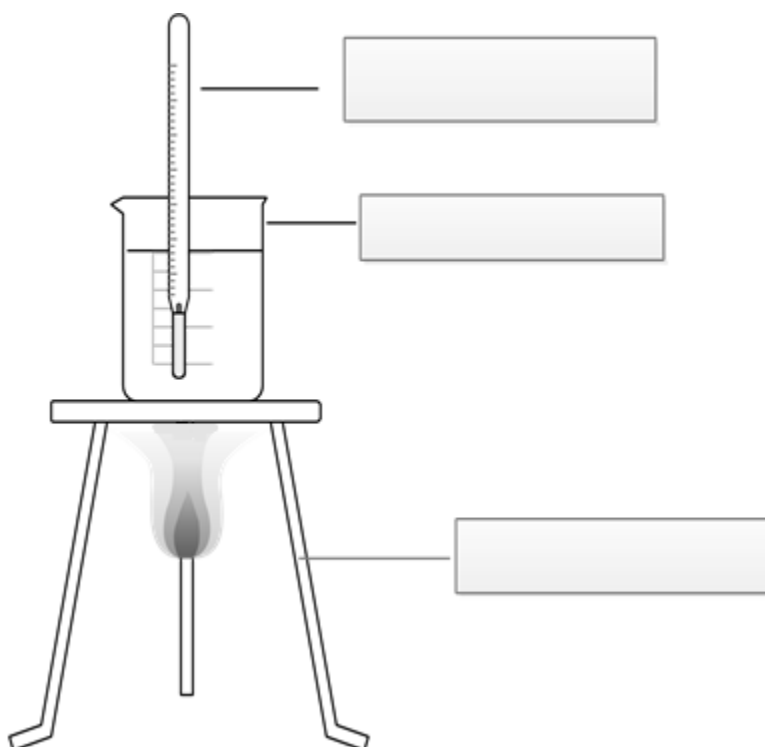


Figure 2

- c) The following is the procedure used in the experiment. Put the steps in the correct order using numbers 1 to 4.

The final temperature of the water was noted.	
The apparatus was set up as in Figure 2.	
The initial temperature of the water was noted.	
The Bunsen Burner was carefully lit up.	

(4)

- d) Underline the correct answer:

An important precaution taken in the experiment is to read the temperature (at an angle, at eye level).

(1)

- e) The boiling water is used to prepare tea in a mug as in Figure 3.

- i. Draw arrows to show how heat flows as the tea cools down.

(1)



Figure 3

- ii. Complete the following statement by filling the missing word and underlining the correct word:

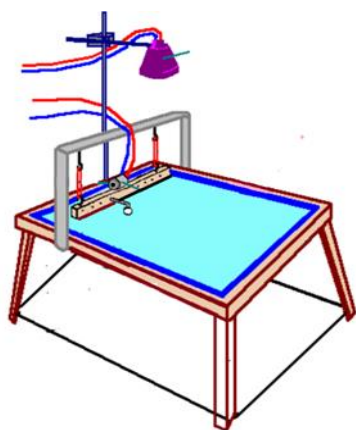
The tea could remain warmer for a longer period of time if the mug is made of _____ which is a good (insulator/conductor) of heat.

(2)

- f) For the following particle representations, circle the diagram that shows the arrangement of particles in water.

(1)

**(Total: 15 marks)**



2) Water waves are being created in a ripple tank in the school laboratory as shown in the diagram.

a)

i. How are straight wavefronts created in a ripple tank?

_____ (1)

ii. How are circular wavefronts created in a ripple tank?

_____ (1)

iii. The distance between one wavefront and the next is called a _____. (1)

b) The ripple tank is used to show the behaviour of water waves.

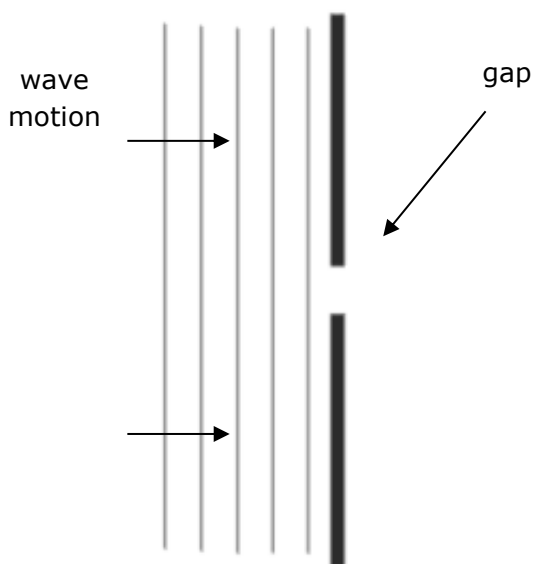


Diagram 1

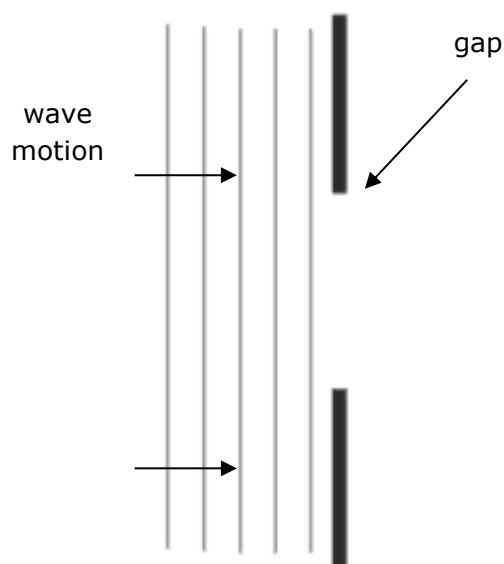


Diagram 2

i. Draw what happens to plane waves after they pass through the gap in:

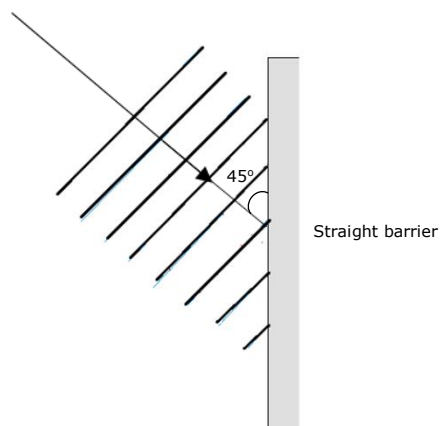
• Diagram 1; (2)

• Diagram 2. (2)

ii. What is this phenomenon called?

_____ (1)

- iii. Complete the following diagram to show what happens to plane waves in a ripple tank when they hit a straight barrier at 45° . (3)



- c) To avoid collision with huge rocks on a misty day, a ship's captain ordered one of the seamen to blow a whistle every few minutes. At one point, an echo was heard.

i. What is an echo?

_____ (1)

ii. The echo was heard 2.4 s after the seaman whistled. How long did the sound take to travel from the ship to the rocks?

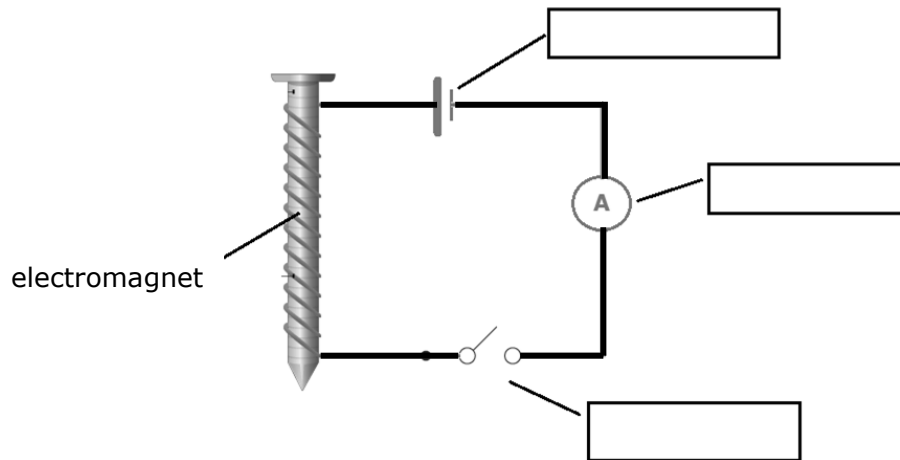
_____ (1)

iii. The seaman worked out that the ship was 396 m away from the rocks. Calculate the speed of sound in air.

 _____ (2)

(Total: 15 marks)

- 3) Paul and Sarah want to investigate how the strength of an electromagnet changes as the number of turns in the coil change. They have set up the following apparatus.



a) Label **ALL** the components in the circuit. (3)

b) Underline the correct answer.

The electromagnet is made from:

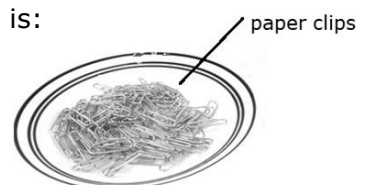
- An aluminium nail with copper wire around it.
- A steel nail with copper wire around it.
- An iron nail with copper wire around it.

(1)

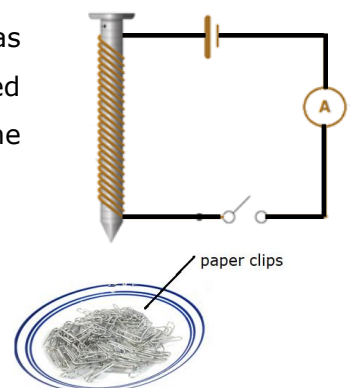
c) A plastic plate full of paper clips is placed under the electromagnet.

i. What will happen to the paper clips as soon as the electromagnet is:

- switched on? _____ (1)
- switched off? _____ (1)



ii. Paul and Sarah replace the electromagnet with another that has double the number of turns of wire. The paper clips are placed again under the electromagnet as shown in the diagram. The switch is turned on.



What difference will you notice when compared to the first experiment in part c.i. above?

(2)

- iii. Mention **ONE** factor that should remain constant throughout the experiment.

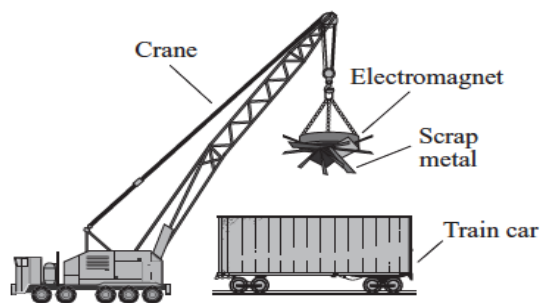
_____ (1)

- iv. Fill in the blanks using the words given below. Not all the words need to be used.

stronger bigger smaller strength colour

From this experiment Paul and Sarah conclude that the _____ of an electromagnet depends on the number of turns of coil. The _____ the number of turns, the _____ the electromagnet is. (3)

- d) Electromagnets are used in scrap yards to lift heavy loads. The crane operator notices that some scrap metal is not picked up by the electromagnet.



- i. Underline the metal from the following list that is picked up by the electromagnet. (1)

Copper Brass Steel Silver

- ii. Aluminium scrap is not picked up by the electromagnet. This is because aluminium is a _____ material. (1)

- iii. Underline the correct answer.

If the electromagnet is used to lift a heavier object, then the strength of the electromagnet is normally increased by:

- Increasing the current passing through the electromagnet.
- Increasing the length of the crane's arm.
- Lowering the voltage in the circuit of the electromagnet.

(1)

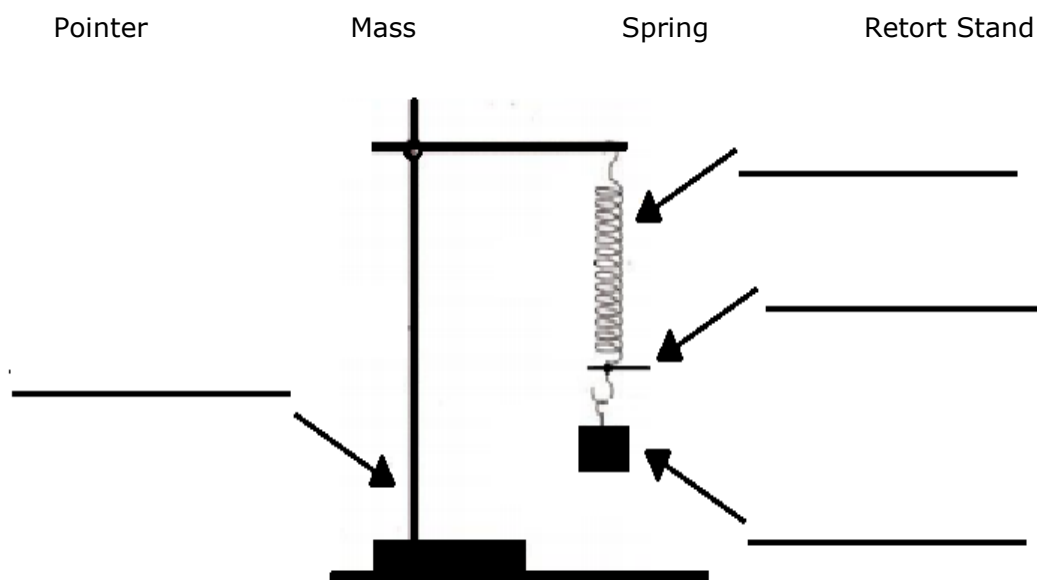
(Total: 15 marks)

4) Two students perform an experiment using a helical spring to verify Hooke's Law.

a) Complete the following:

Hooke's Law states that for an elastic material, the stretching force is _____ proportional to the extension provided the _____ limit is not exceeded. (2)

b) Choose from the following options in order to label the apparatus below: (4)



c) The **ONE** missing piece of apparatus in the setup above is the _____. (1)

d) The students record their measurements in a table as shown below.

Force (N)	0	2	4	6	8	10	12
Extension (mm)	0	4	8		16	20	

i. Complete the above table. (1)

ii. Plot the graph of Extension (mm) on the y-axis against Force (N) on the x-axis. (4)

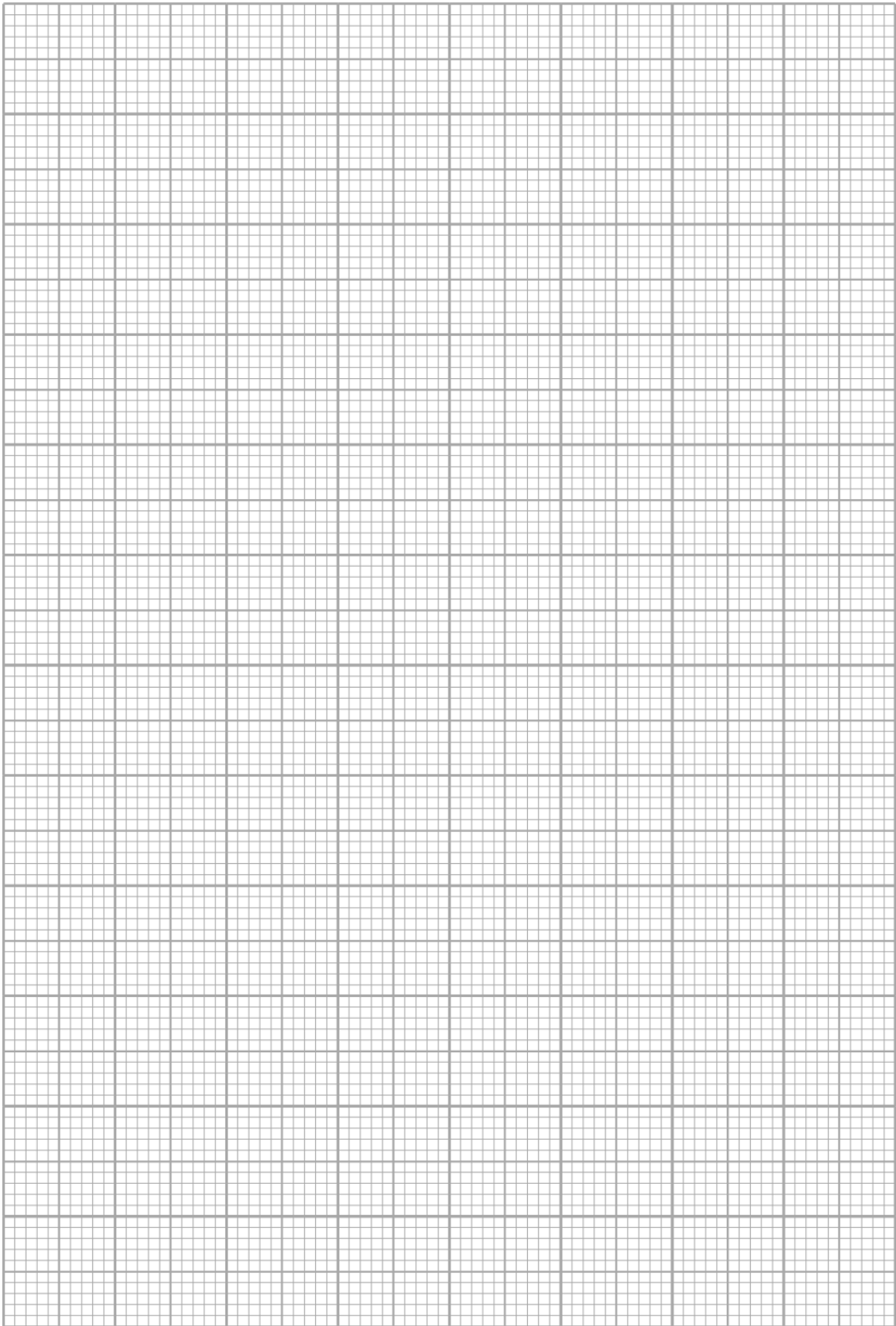
e) The original length of the spring is 8 cm. A 7 N weight is attached to the spring.

i. Use the graph to find the extension of the spring. (1)

ii. What is the new length of the spring? (1)

f) A weight of 14 N is attached to the spring and extension was measured to be 31 mm. Explain.

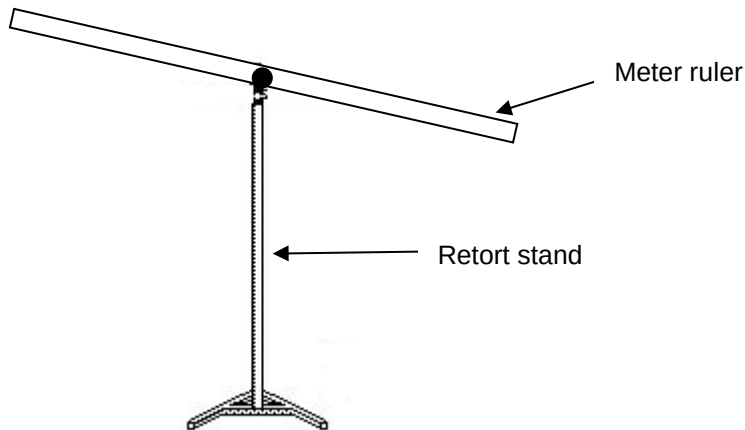
(1)



(Total: 15 marks)

5) Matthew and Amy were provided with a metre ruler with a hole on the 50 cm mark, a retort stand and some slotted masses of 100 g each. They were asked to investigate the Law of Moments.

- a) The metre ruler was hung on a retort stand from the hole on the 50 cm mark, and allowed to settle. The diagram below shows how the ruler stopped.



- i. Give **ONE** possible reason why the ruler is not perfectly balanced.

_____ (1)

- ii. Explain what can be done to balance the ruler before the start of the experiment.

_____ (1)

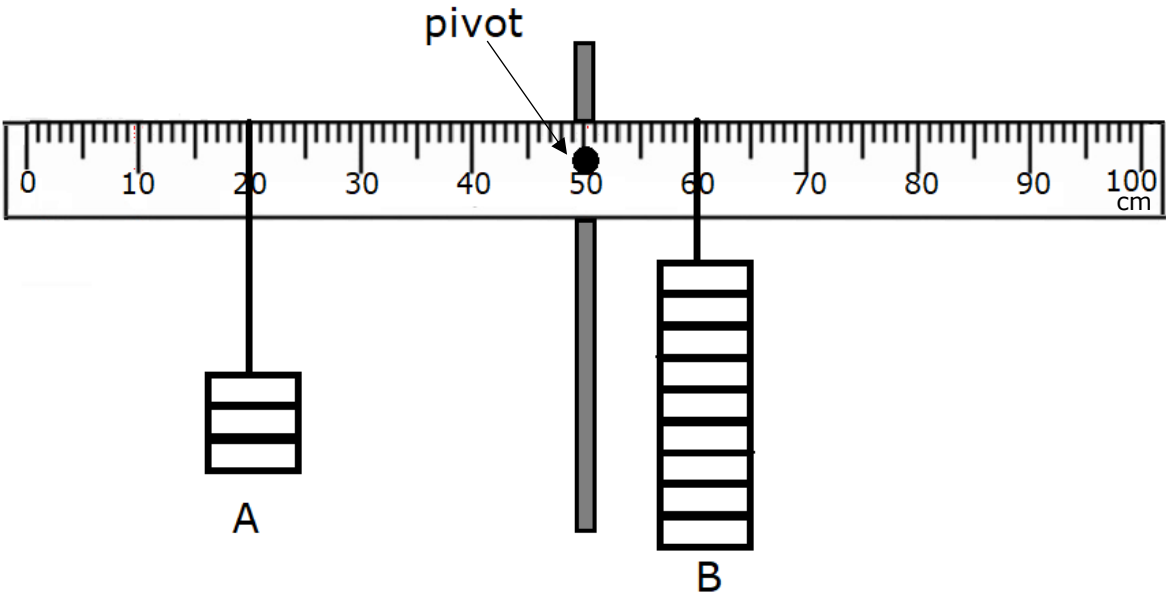


- b) The students are provided with slotted weights as shown in the diagram below. Fill the table below to find the weight of each slotted mass.

Mass / g	Mass / kg	Weight / N
100 g		

(2)

c) Matthew and Amy hang a number of the slotted masses mentioned in part (b) above on both sides of the metre ruler as shown below. The metre ruler is in equilibrium.



i. What is the distance of weight A away from the pivot?
_____ (1)

ii. Use the diagram above to find the weight of stack A and stack B.

Weight A in N	Weight B in N

(1)

iii. Calculate the anticlockwise moment created by weight A.

_____ (1)

iv. Calculate the clockwise moment created by weight B.

_____ (2)

v. What can you state about the clockwise and anticlockwise moments?

_____ (1)

d) Weight A is increased. The ruler does not remain in equilibrium.

Underline the correct answers:

- i. The ruler turns (clockwise / anti-clockwise). (1)
- ii. To restore equilibrium, weight B needs to be moved (closer to / further away from) the pivot or (increase / decrease) weight B. (2)

e) A tin of paint has a very tight lid. A screw driver is used to open the lid.



Fill in the blanks with the appropriate words.

It is easier to open the lid because when a _____ is exerted at a larger distance away from the pivot, a _____ moment is produced. (2)

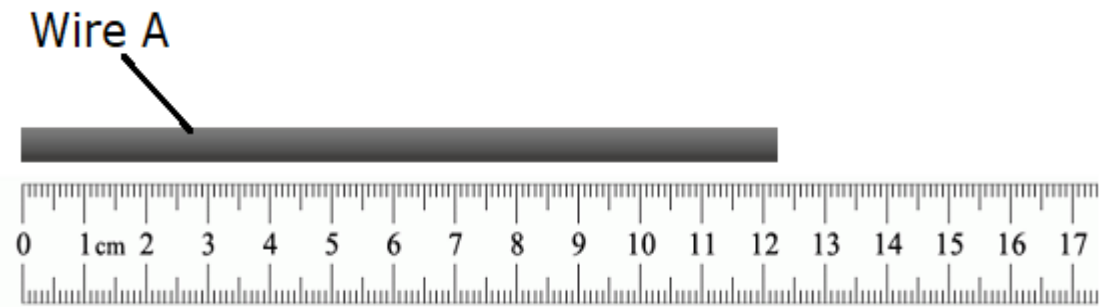
(Total: 15 marks)

Section B

Answer ALL questions.

6) Rachel was working with wires of different lengths in the lab. She picks up wire A.

a) Use the diagram below to complete the table.

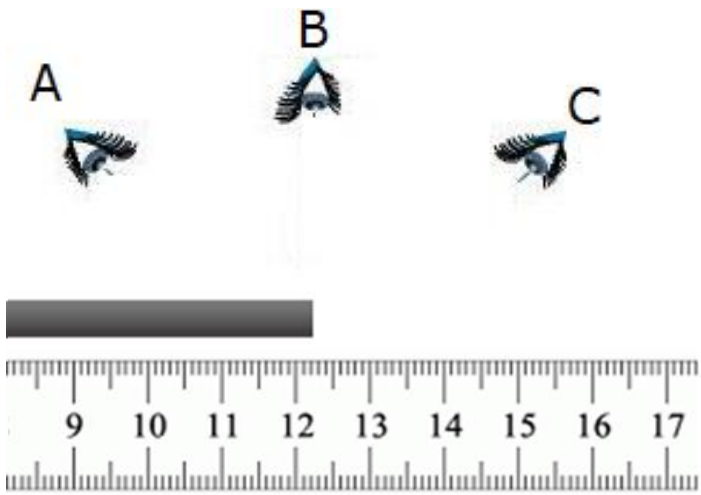


	cm	m
Length of Wire A		

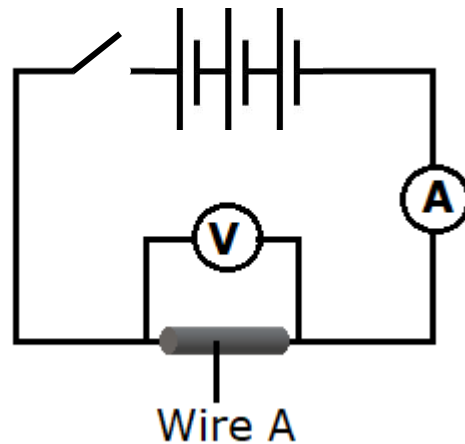
(2)

b) From which position should the length of the wire be read? Circle the correct answer.

(1)



c) Wire A is connected in the circuit as shown in the diagram below.



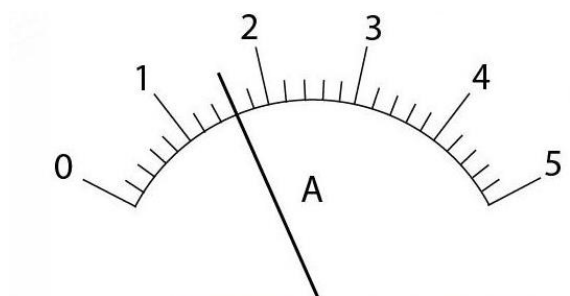
i. Underline the correct answer:

Wire A is connected to (a d.c supply / an a.c. supply). (1)

ii. Complete.

The ammeter is connected in _____ to wire A whereas the voltmeter is connected in _____ with wire A. (2)

iii. When wire A is placed in the circuit, the ammeter shows the following reading. Underline the correct answer.



The reading on the ammeter is:

- 1.3
- 1.6
- 3.0

(1)

d) Wire A is replaced with a wire B of same material and thickness. The ammeter now reads 1.2A.

i. Complete the following:

Wire B has a _____ resistance than wire A. (1)

ii. Is wire B longer or shorter than wire A?

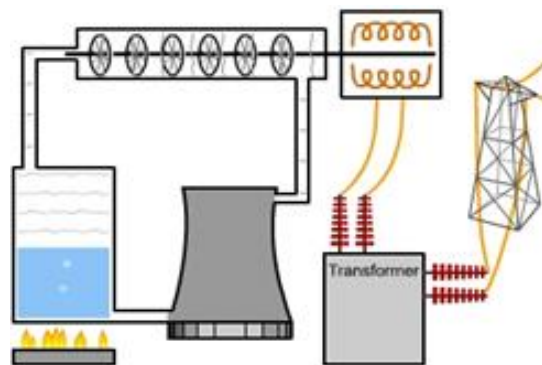
_____ (1)

e) Name **ONE** precaution that should be taken when working with this circuit.

_____ (1)

(Total: 10 marks)

- 7) Ms Galea took her class for a site visit at the Delimara Power Station. Fossil fuels are used to provide electrical energy from the power station to our homes.



- a) Four energy sources present in the power station are shown below.

Heat energy, Chemical energy, Electrical energy, Kinetic energy

In the right hand column, choose the type of energy that each energy source provides from the above list.

No	Energy source	Type of energy
i.	Energy of fossil fuel	
ii.	Energy of boiling water	
iii.	Energy of rotating turbines	
iv.	Energy in the homes	

(4)

- b) Three devices that form part of the power station are the: generator, steam turbine and boiler. State the device that does the task indicated in the right hand column.

Device		Task
	→	Water is heated and changes into steam
	→	The steam causes the blades to rotate
	→	Mechanical energy changes to electrical energy

(3)

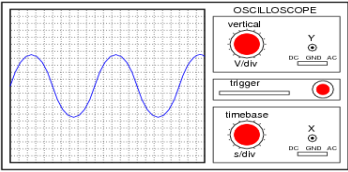
- c) In Maltese towns and villages, a transformer located at the sub-station changes the voltage from 33,000 V to 240 V.
- i. What type of transformer would be needed to do this?

(1)

- ii. Draw a labelled diagram of the main parts of this basic iron core transformer in the space below.

(4)

- iii. State whether the following statements are True [T] or False [F].

Statement	True or False [T/F]
Use of fossil fuels causes environmental and health hazards.	
 This is a.c. supply.	
In our homes, electrical energy changes to light or heat energy only.	

(3)

(Total: 15 marks)

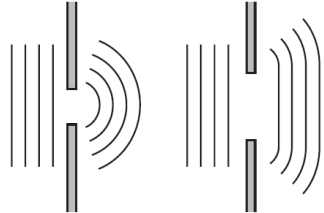
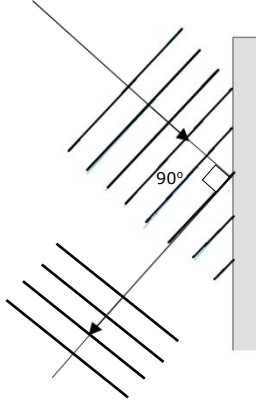
END OF PAPER

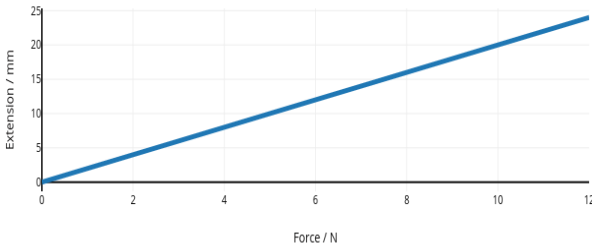
Specimen Assessments: Private Candidates Paper MQF 1-2 Marking Scheme

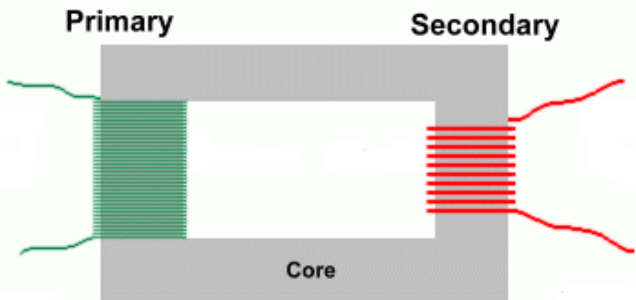
L-Università
ta' MaltaMATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS
BOARDSECONDARY EDUCATION CERTIFICATE LEVEL
PRIVATE CANDIDATES SAMPLE PAPER MARKING SCHEME

SUBJECT: **Physics**
 PAPER NUMBER: **Level 1 – 2**
 DATE:
 TIME: 2 Hours

Qn no.			Suggested answers	Marks	Additional remarks								
1	a	i	20°C	1									
		ii	100 – 20 = 80°C	1 1									
	b		Thermometer Beaker tripod	1 1 1									
	c		<table><tr><td>The final temperature of the water was noted.</td><td>4</td></tr><tr><td>The apparatus was set up as in Figure 2.</td><td>1</td></tr><tr><td>The initial temperature of the water was noted.</td><td>2</td></tr><tr><td>The Bunsen Burner was carefully lit up.</td><td>3</td></tr></table>	The final temperature of the water was noted.	4	The apparatus was set up as in Figure 2.	1	The initial temperature of the water was noted.	2	The Bunsen Burner was carefully lit up.	3	4	One mark for each correct step
	The final temperature of the water was noted.	4											
	The apparatus was set up as in Figure 2.	1											
	The initial temperature of the water was noted.	2											
	The Bunsen Burner was carefully lit up.	3											
d		Eye level	1										
e	i		1										
	ii	Polystyrene Insulator	1* 1	* Any suitable material									
f			1										

	b	i		2,2	
		ii	diffraction	1	
		iii		3	1 mark for 90° angle between incident and reflected rays 1 mark for arrow 1 mark for drawing of reflected rays with same wavelength
	c	i	The reflection of a sound wave from a sound wave back to the listener	1	
		ii	$2.4 / 2 = 1.2\text{s}$	1	
		iii	Speed = distance / time = $396 / 1.2$ = 330 m/s	1 1	
			Total	15	
3	a		Battery	1	
			Ammeter	1	
			switch	1	
	b		An iron nail with copper wire around it	1	
	c	i	- Attracted to the electromagnet - Fall back in the plate	1 1	
		ii	More paper clips are attracted Paper clips are attracted faster	2	Any acceptable answer
		iii	Battery voltage or use same paper clips	1	Any acceptable answer
		iv	Strength, bigger, stronger	3	
	d	i	Steel	1	
		ii	Non-magnetic	1	
		iii	Increasing the current passing through the electromagnet.	1	
			Total	15	
4	a		Directly elastic	1 1	
	b		Correct labelling	4	
	c		Ruler	1	
	d	i	12, 24	1	

		ii	The graph of Extension / mm vs Force / N 			4	1 for labelling 1 for scale 1 for plotting 1 for straight line						
	e	i	14mm			1							
		ii	8cm + 1.4cm = 9.4cm			1							
	f		The elastic limit of the spring was exceeded			1							
			Total			15							
5	a	i	Hole not exactly in the middle of the rod			1	Any acceptable answer						
		ii	Attach small pieces of plasticene on one end of the ruler until it is balanced			1							
	b		<table><tr><td>Mass / g</td><td>Mass / kg</td><td>Weight / N</td></tr><tr><td>100 g</td><td>100/1000 = 0.1</td><td>0.1 x 10 = 1N</td></tr></table>	Mass / g	Mass / kg	Weight / N	100 g	100/1000 = 0.1	0.1 x 10 = 1N			1,1	
	Mass / g	Mass / kg	Weight / N										
	100 g	100/1000 = 0.1	0.1 x 10 = 1N										
	c	i	30 cm			1							
		ii	3 N, 9 N			1							
		iii	Anti-clockwise mom = Force x dist. from pivot = 3 N x 0.3 m = 0.9 Nm			1	Accept 90 Ncm						
		iv	Clockwise mom = Force x dist. from pivot = 9 N x 0.1 m = 0.9 Nm			1 1	Accept 90 Ncm						
		v	They are equal (and opposite)			1							
	d	i	Anti-clockwise			1							
		ii	Further away from, increase			2							
e		Force, larger			2								
			Total			15							
6	a		12.2 cm, 0.122 m			1,1							
	b		B			1							
	c	i	d.c. supply			1							
		ii	Series, parallel			1,1							
		iii	1.6 A			1							
	d	i	Larger			1							
		ii	longer			1							
	e		The circuit is switched on for a short time			1	Any acceptable answer						
			Total			10							

7	a	<table><tr><th>No</th><th>Energy source</th><th>Type of energy</th></tr><tr><td>i.</td><td>Energy of fossil fuel</td><td>Chemical energy</td></tr><tr><td>ii.</td><td>Energy of boiling water</td><td>Heat energy</td></tr><tr><td>iii.</td><td>Energy of rotating turbines</td><td>Kinetic energy</td></tr><tr><td>iv.</td><td>Energy in the homes</td><td>Electrical energy</td></tr></table>	No	Energy source	Type of energy	i.	Energy of fossil fuel	Chemical energy	ii.	Energy of boiling water	Heat energy	iii.	Energy of rotating turbines	Kinetic energy	iv.	Energy in the homes	Electrical energy	4	
No	Energy source	Type of energy																	
i.	Energy of fossil fuel	Chemical energy																	
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b		<table><tr><th>Device</th><td rowspan="2">→</td><th>Task</th></tr><tr><td>Boiler</td><td>Water is heated and changes into steam</td></tr><tr><td>Steam turbine</td><td>→</td><td>The steam causes the blades to rotate</td></tr><tr><td>Generator</td><td>→</td><td>Mechanical energy changes to electrical energy</td></tr></table>	Device	→	Task	Boiler	Water is heated and changes into steam	Steam turbine	→	The steam causes the blades to rotate	Generator	→	Mechanical energy changes to electrical energy	3					
Device	→	Task																	
Boiler		Water is heated and changes into steam																	
Steam turbine	→	The steam causes the blades to rotate																	
Generator	→	Mechanical energy changes to electrical energy																	
c	i	Step down	1																
	ii		4	2 marks for drawing and labelling primary and secondary coils 1 mark for primary coil bigger than secondary coil 1 mark for drawing and labelling iron core															
d		True True False	1 1 1																
		Total	15																



MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

**SECONDARY EDUCATION CERTIFICATE LEVEL
PRIVATE CANDIDATES SAMPLE PAPER**

SUBJECT:	Physics
PAPER NUMBER:	Level 2 – 3
DATE:	
TIME:	2 Hours

You are requested to show your working and to write the units where necessary.

When necessary, take g , acceleration due to gravity, as 10m/s^2 .

Density	$\rho = \frac{m}{V}$
Pressure	$p = \frac{F}{A}$ $p = h \rho g$
Moments	Moment = F × perpendicular distance
Energy and Work	$PE = m g h$ $KE = \frac{1}{2} m v^2$ $W = F s$ $P = \frac{E}{t}$
Force and Motion	resultant force = m a $W = m g$ $p = m v$ $F = \frac{(mv - mu)}{t}$
	average speed = $\frac{\text{total distance}}{\text{total time}}$ $v = u + a t$ $s = (u + v) \frac{t}{2}$
	$v^2 = u^2 + 2 a s$ $s = u t + \frac{1}{2} a t^2$
Waves	$\eta = \frac{\text{speed of light in air}}{\text{speed of light in medium}}$ $\eta = \frac{\text{real depth}}{\text{apparent depth}}$
	Magnification = $\frac{\text{image height}}{\text{object height}}$ Magnification = $\frac{\text{image distance}}{\text{object distance}}$
	$v = f \lambda$ $T = \frac{1}{f}$
Electricity	$I = \frac{Q}{t}$ $V = I R$ $P = I V$
	$E = Q V$ $E = I V t$
	$R_{\text{total}} = R_1 + R_2 + R_3$ $\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2}$
Electromagnetism	$\frac{V_p}{V_s} = \frac{N_p}{N_s}$ $V_p I_p = V_s I_s$
Heat	$Q = m c \Delta \theta$
Radioactivity	$A = Z + N$
Other equations	Area of a triangle = $\frac{1}{2} b h$ Area of a trapezium = $\frac{1}{2} (a + b) h$

Section A

Answer ALL questions

1) Water waves are being created in a ripple tank.

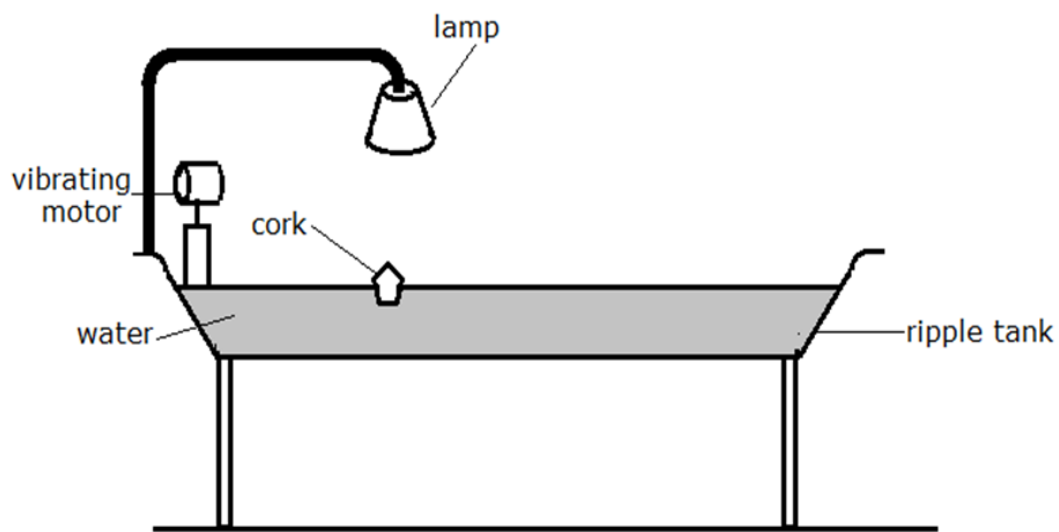
a) Straight water waves are generated from a straight dipper. What type of wave is observed?

_____ (1)

b) A small piece of cork is placed on the water surface. On the diagram below, use arrows to indicate:

i. the movement of the cork; (1)

ii. the flow of the energy in the wave. (1)



c) Describe what happens when plane waves pass through a gap in the ripple tank, if the width of the gap is:

i. approximately equal to the wavelength of the waves;

_____ (2)

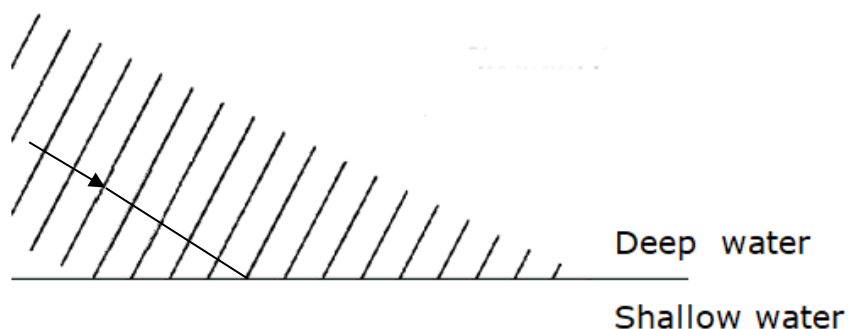
ii. much larger than the wavelength of the waves.

_____ (2)

d) What is this phenomenon called?

_____ (1)

- e) A piece of glass was placed at the bottom the ripple tank to create a shallower region. Complete the following diagram. (4)



- f) What happens to the frequency and the speed as the wave enters the shallow region?

(2)

- g) Explain why the stroboscope is helpful to view the wave pattern in the ripple tank.

(1)

(Total: 15 marks)

- 2) Sophie pours equal amounts of warm water into two identical beakers, A and B. Beaker A is surrounded by cotton wool and beaker B has no insulation. She investigates the temperature change in both beakers. All necessary apparatus is available in the school laboratory.

- a) Underline the correct answer.

A good insulator keeps the water in the beaker warm for a (longer, shorter) period of time. (1)

b) Design a simple experiment to help Sophie compare the temperature change between beakers A and B. Your answer should include:

i. a well-labelled diagram of the set-up for the two beakers used in the space below; (2)

ii. a brief explanation of how the above set up is used to carry out the investigation;

(2)

iii. an explanation of why both beakers are identical;

(1)

iv. a suitable precaution she needs to take.

(1)

c) The following data is recorded during the experiment for the cotton wool insulation.

Temperature / °C	60	50	45	40	38	37	36
Time / minutes	0	5	10	15	20	25	30

i. Plot a graph of Temperature on the y-axis against Time on the x-axis. (4)

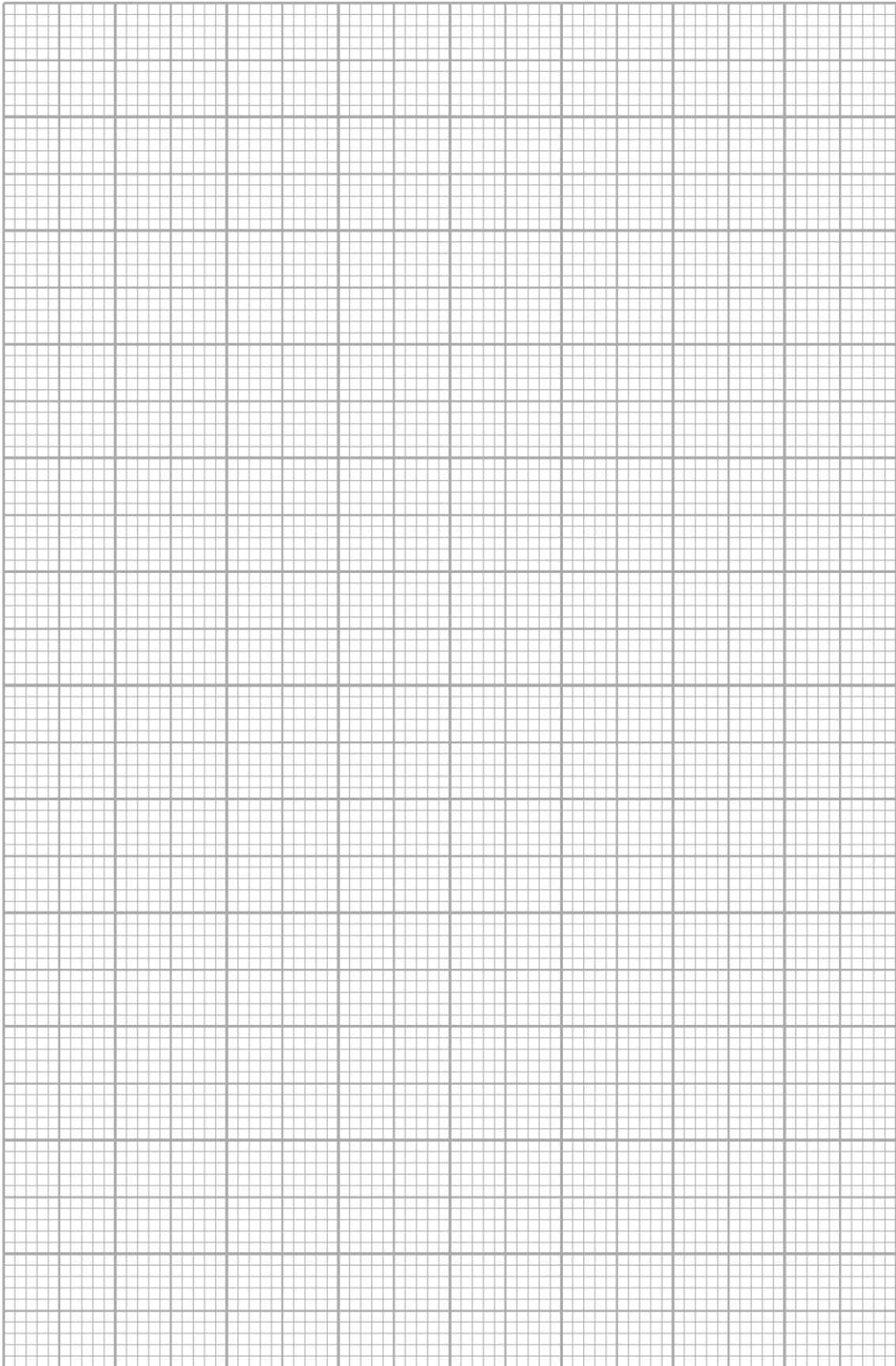
ii. On the same axes, sketch a graph to predict how the temperature in beaker B varies with time. (2)

iii. Explain your answer to part c (ii) above.

(1)

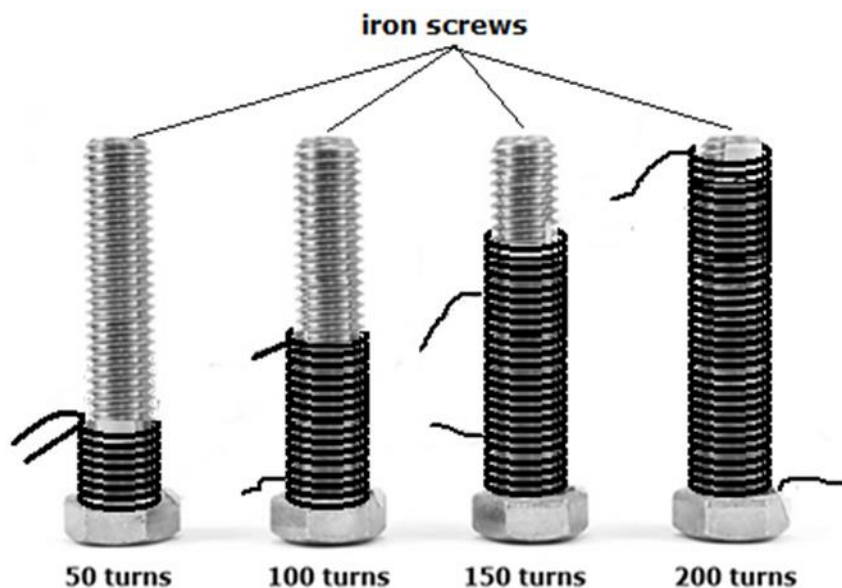
d) After three hours, the temperature of both beakers was measured and found to be 22 °C. Give **ONE** reason for this.

(1)



(Total: 15 marks)

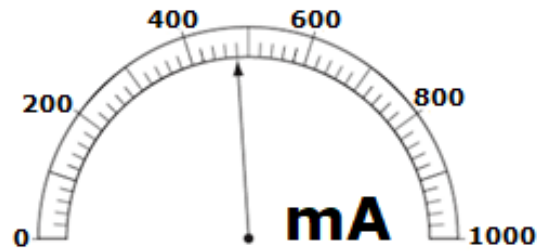
- 3) Paul and Sarah want to investigate how the strength of an electromagnet changes as the number of turns in the coil changes. They are provided with a d.c. supply of 12 V, an ammeter, a box of paper clips, a retort stand and 4 coils of wire of different lengths, each wound around an iron screw.



Source: <https://d1ca4yhhe0xc0x.cloudfront.net/Files/8220/6/electromagnets.jpg>

- a) In the space below, draw a labelled diagram to show how the apparatus mentioned above is assembled in order for the students to perform the experiment. (You may include only one coil of wire in your diagram). (3)

- b) The student records the current that flows in the circuit when it is assembled. The switch is turned on and the ammeter gives the following reading.



- i. What is the reading on the ammeter? _____ mA (1)
- ii. Convert this reading to Amps.

_____ (1)

- c) Describe the method that Sarah and Paul need to carry out so as to investigate how the number of turns in the coil effect the strength of the electromagnet.

 _____ (3)

- d) During the experiment, Sarah kept monitoring the ammeter reading to ensure that it remains constant.

- i. Explain why this was an important precaution in this experiment.

 _____ (2)

- ii. Mention another precaution, other than the one mentioned above, that needs to be taken by the students.

 _____ (1)

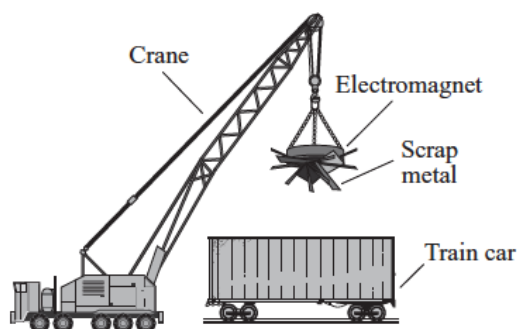
e) The following data was recorded by the students at the end of the experiment.

No. of turns in electromagnet coil	No. of paper clips
50	14
100	26
150	43
200	57

Use the data obtained to reach a conclusion about the way the number of turns in the coil effect the strength of the electromagnet.

_____ (2)

f) Electromagnets are used in scrap yards to lift heavy loads. The crane operator notices that not all scrap metal is picked up by the electromagnet.



i. Mention **ONE** metal that is definitely picked up by the electromagnet.

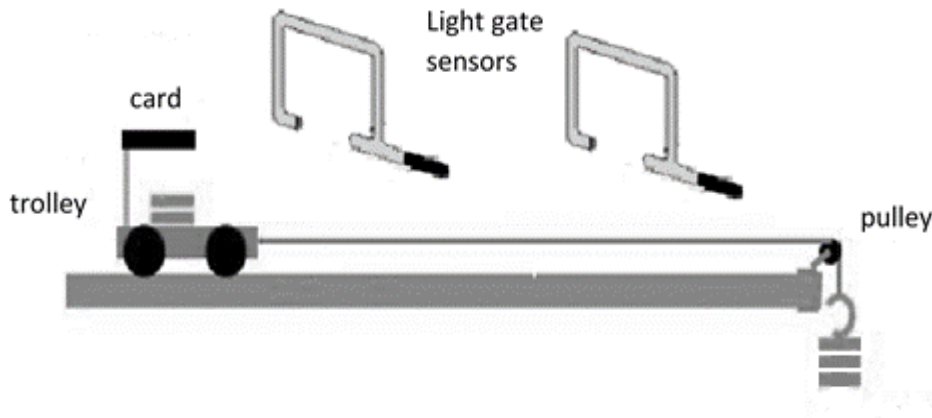
_____ (1)

ii. Aluminium scrap is not picked up by the electromagnet. Give **ONE** reason for this.

_____ (1)

(Total: 15 marks)

- 4) An experiment was carried out to investigate the relationship between force and acceleration. A pair of light gate sensors attached to a datalogger were used to collect data from a moving trolley. A force was applied on the trolley using weights attached to the trolley by means of a string, as shown in diagram below.



a)

- i. Explain how the force pulling the trolley is varied.

_____ (1)

- ii. The trolley moves across the plane, initially triggering the first and then the second light gate sensor. Explain why two light gates are required for this experiment.

_____ (2)

- iii. One precaution for this experiment is to use the appropriate length of string. Explain.

_____ (2)

- iv. Name another precaution that should be taken during this experiment to obtain good results.

_____ (1)

b)

- i. The width of the card is 0.06 m. It takes 0.1 s to pass across the first light gate. Calculate the average velocity of the trolley at that point.

_____ (2)

- ii. The velocity of the trolley at the second light gate is 0.8 m/s. Given that the time registered between the two light gates is 0.2 s, calculate the acceleration of the trolley between the light gates.

_____ (2)

c)

- i. Sketch the expected graph of Force against Acceleration for the system. (2)

- ii. Complete the following statement: The shape of the graph shows that the acceleration of the system is _____ to the force. (1)

- iii. On the same axes as part c (i) above, sketch the graph for a similar system with a larger mass. Label this graph with the letter P. (2)

(Total: 15 marks)

- 5) Two students want to perform an experiment to prove the principle of moments.

- a) State the principle of moments.

b)

- i. Label A, B and C in Figure 1 below for the apparatus set up. (3)

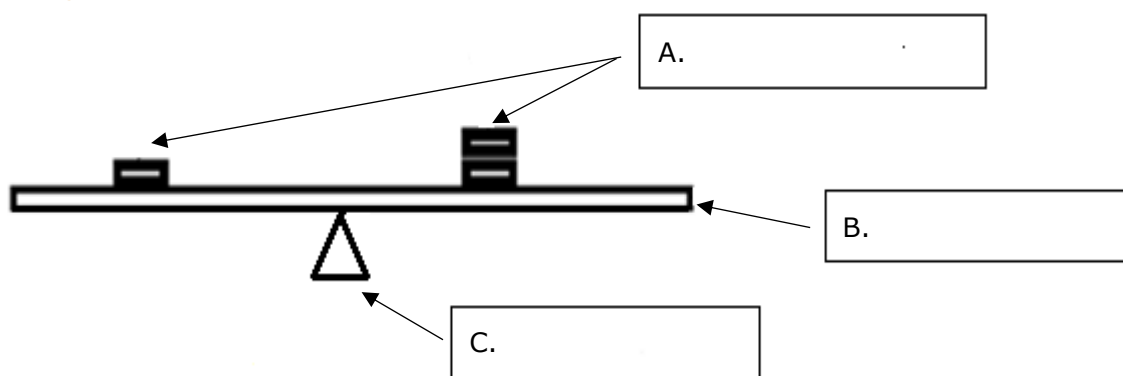


Figure 1

ii. Describe how they have to carry out the experiment.

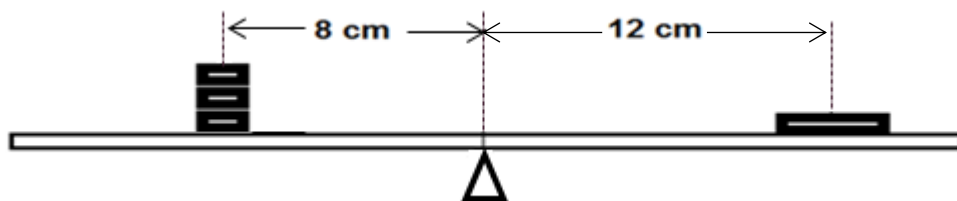
(4)

iii. Complete the table below indicating the quantities that have to be recorded.

Anticlockwise moments		Clockwise moments	

(2)

c) This time the students perform the experiment to prove the principle of moments using a 30 cm ruler and some coins. They found that the 30 cm ruler balanced at its mid-point.



i. They put one large coin of weight 10 N on the right, 12 cm from the pivot, and three small coins on the left, 8 cm from the pivot. The ruler was again balanced. Calculate the weight of each of the three coins on the left.

(3)

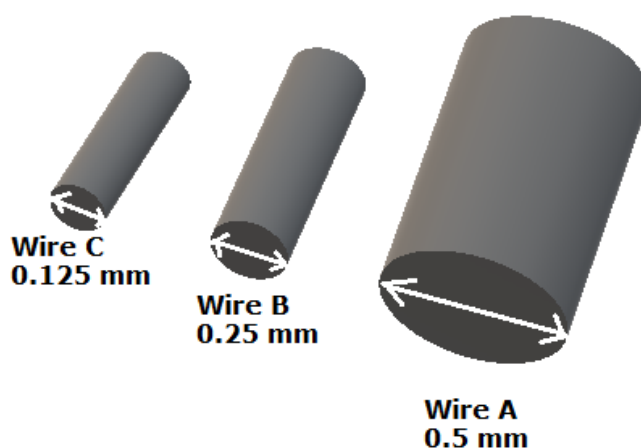
ii. The 10 N coin on the right is moved further away from the pivot. How can the ruler be made to balance again?

(1)

(Total: 15 marks)

Section B**Answer ALL questions**

- 6) The diagram shows three wires of different thicknesses but of the same length (1 metre). Wire A has a diameter of 0.5 mm, Wire B a diameter of 0.25 mm and Wire C a diameter of 0.125 mm. You are asked to investigate how the thickness of each wire affects its resistance.



- a) List **THREE** pieces of apparatus you need, other than the wires, to set up an experiment to calculate the resistance of Wire A, B and C.

(3)

- b) Briefly explain how you would carry out the investigation.

(2)

c) What measurements need to be recorded to find the resistance of Wires A, B and C?

- Fill the table below with the appropriate measurements and units in the first two columns
- Show how resistance can be found in the third column.

Thickness of Wires Unit: mm	Measurement 1: Unit: _____	Measurement 2: Unit: _____	Resistance
Wire A 0.5			
Wire B 0.25			
Wire C 0.125			

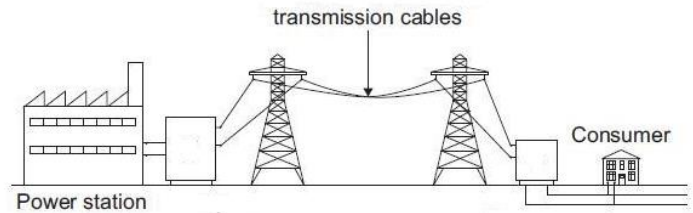
(3)

d) In the space below, sketch a graph of Thickness of wires against Resistance to show how the two variables depend on each other.

(2)

(Total: 10 marks)

- 7) In Malta we rely mostly on fossil fuels for our electrical energy demands. When electrical energy is delivered to Maltese homes from the Delimara Power Station, energy conversions take place.



- a) The four energy processes that occur in the power station are given in the table below.

Stage	Process	Type of energy
1	Energy of fossil fuel	
2	Energy of boiling water	
3	Energy of rotating blades	
4	Energy in the transmission cables	

- i. In the last column, state the type of energy resulting at each stage. (4)
- ii. The rotating blades mentioned above turn a coil of wire in a magnetic field and generate electricity. State the physics principle being applied here to generate electricity to our homes.

_____ (1)

- iii. Michael Faraday presented a law linked with this principle. State Faraday's law.

_____ (2)

- b) An engineer needs to transmit 1 MW of power from Delimara to Maltese villages and towns at voltages of 33 kV. Determine the current flowing in the transmission cables at this voltage.

_____ (2)

- c) In a town or village, a transformer located at the sub-station changes the voltage from 33,000 V to 240 V.

i. What type of transformer would be needed to do this?

_____ (1)

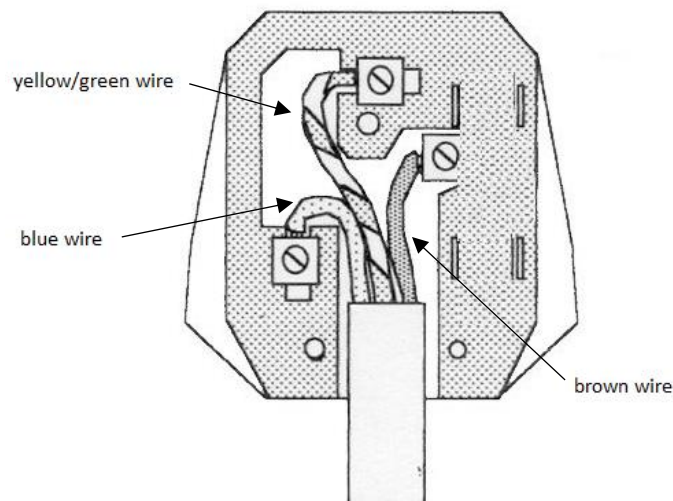
ii. The Msida sub-station provides a voltage of 240 V to the homes. What is the ratio of the number of turns in the primary to the number of turns in the secondary if the voltage input at the sub-station is 33,000 V?

_____ (1)

iii. In transmitting energy from Delimara to Maltese homes, one needs to make use of a high voltage and low current. Why is this necessary?

_____ (2)

- d) Look at the following diagram of an unsafe three-pin plug.



State **TWO** ways how the plug can be made safe to use.

_____ (2)

(Total: 15 marks)

END OF PAPER

Specimen Assessments: Private Candidates Paper MQF 2-3 Marking Scheme

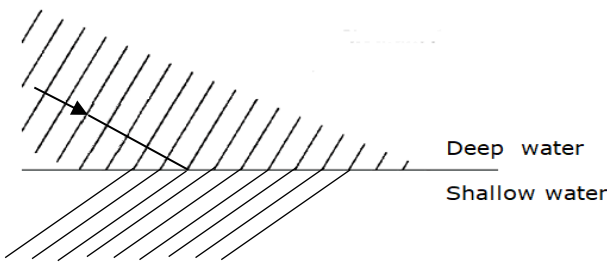
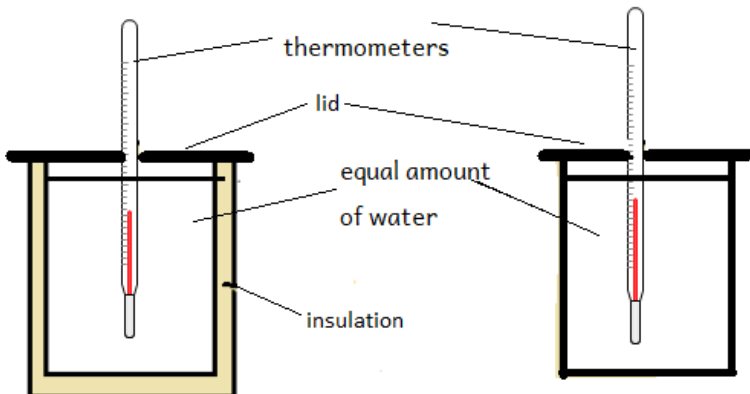


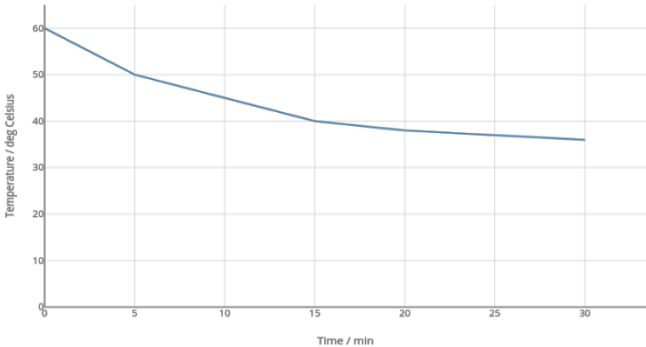
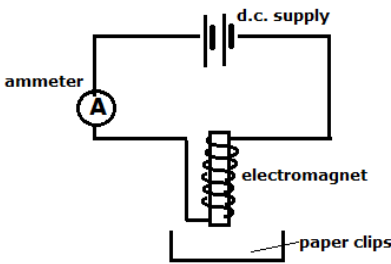
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MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS
BOARD

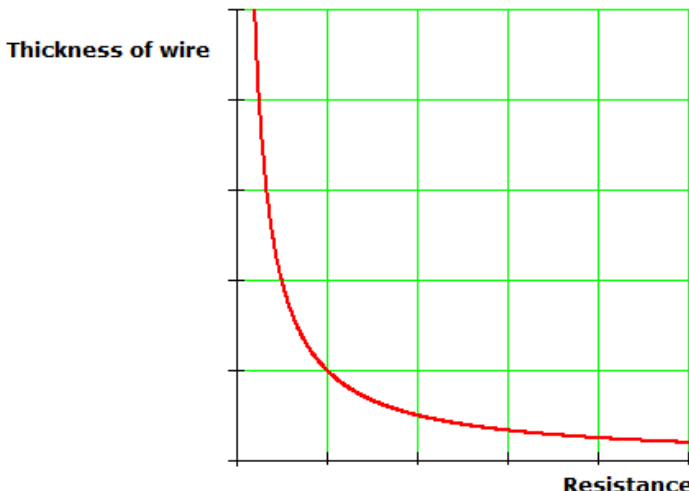
**SECONDARY EDUCATION CERTIFICATE LEVEL
PRIVATE CANDIDATES SAMPLE PAPER MARKING SCHEME**

SUBJECT: **Physics**
PAPER NUMBER: **Level 2 - 3**
DATE:
TIME: 2 Hours

Qn no.	Suggested answers		Marks	Additional remarks
1	a	transverse	1	
	b	i Arrow showing cork moving up and down	1	
		ii Arrow at right angles showing motion of the wave energy	1	
	c	i Waves passing through a narrow gap will spread out In a circular manner	1 1	
		ii Waves passing through a wide gap will not spread out And exhibit slight bending at the edges	1 1	
	d	Diffraction	1	
	e		4	
	f	Frequency remains the same Speed decreases	1 1	
	g	The stroboscope makes the waves appear to be stationary, thus easier to view the pattern	1	
		Total	15	
2	a	longer	1	
	b	i 	2	1 mark for thermometer labelled and in the right position; 1 mark for insulation including lid

		ii	The above apparatus was arranged with equal amount of (boiling) water in both cans. Take readings of temperature simultaneously every minute . Repeat this for about 15 minutes .	2	
		iii	For a fair investigation	1	
		iv	Place both beakers on a wooden surface	1	Other acceptable precautions
		c	i	4	1 mark or axes labels 1 mark for title of graph 1 mark for plot 1 mark for suitable drawing of curve
			The graph of Temperature / deg Celsius vs Time / min 		
		ii	Graph below		
		iii	Due to cotton wool having more entrapped air	1	
	d		They both reached room temperature	1	
			Total	15	
3	a			3	1 mark for ammeter 1 mark for proper diagram of electromagnet 1 mark for paper clips under electromagnet
		b	0.48A		
		c	- The first electromagnet is attached to the circuit and the number of turns is recorded. - The circuit is switched on and the number of paper clips attracted is recorded. - The experiment is repeated for the other 2 electromagnets.	1 1 1	
	d	i	Current needs to remain constant since it is another factor that effects the strength of the electromagnet. This ensures fair testing.	1 1	
		ii	Any one of:- - Distance from electromagnet to paper clips - Size and material of the screw (metal) - Size and weight of paperclips	1	
	e		The More coil in the electromagnet, the stronger the magnetism	2	
	f	i	Any from:- Iron / Steel / cobalt / Nickel	1	
		ii	Aluminium is not a ferromagnetic material.	1	
			Total	15	

4	a	i	By varying the number of weights at the end of the string	1	
		ii	To measure the initial and The final velocity of the trolley	1 1	
		iii	So that the trolley does not reach the ground Before the trolley passes through both light gates	1 1	
		iv	Repeated readings /frictionless pulley	1	Any other acceptable precaution
	b	i	$s = d/t$ $s = 0.06/0.1$ $s = 0.6\text{m/s}$	1 1	
		ii	$a = (v - u)/t$ $a = (0.8 - 0.6)/0.2$ $a = 1\text{ m/s}^2$	1 1	
	c	i	Appropriate drawing of graph	2	1 mark for drawing and labelling of axes incl. units 1 mark for linear plot passing through origin
		ii	Directly proportional	1	
		iii	Graph P with a steeper gradient due to a larger mass	2	
			Total	15	
5	a		For a system which is in equilibrium Clockwise moments are equal to anticlockwise moments	1 1	
	b	i	A: weights; B: ruler; C: pivot.	1,1,1	
		ii	- One weight (P) is placed on one side of the ruler at a known distance away from the pivot - Two weights(Q) are placed on the other side of the pivot such that the ruler balances - The distance between the pivot and the two weights(Q) is measured - The clockwise moments and the anticlockwise moments are calculated	1 1 1 1	
		iii	Anticlockwise moments: Weight/N; distance from pivot/m Clockwise moments: Weight/N; distance from pivot/m	2	1 mark for weight/N 1 mark for distance from pivot/m
	c	i	Clockwise moments – Anticlockwise moments $10\text{N} \times 0.12 = \text{Weight of 3 coins} \times 0.08\text{m}$ $\text{Weight of 3 coins} = 1.2/0.24 = 5\text{N}$ $\text{Weight of 1 coin} = 5/3 = 1.67\text{N}$	1 1 1	
		ii	Add more coins on the other side OR Move the three coins further away	1	
			Total	15	

6	a	DC supply/battery, ammeter, voltmeter	1,1,1										
	b	- The thickness of the wire is noted and the current through the wire and the voltage across it are recorded. The resistance is worked out. - The experiment is repeated using the other two wires	1 1										
	c	<table><tr><td>Measurement 1</td><td>Measurement 2</td><td>Resistance</td></tr><tr><td>Current</td><td>Voltage</td><td>$R = \frac{\text{Voltage}}{\text{Current}}$</td></tr><tr><td>Unit Amperes/Amps</td><td>Unit Volts</td><td></td></tr></table>	Measurement 1	Measurement 2	Resistance	Current	Voltage	$R = \frac{\text{Voltage}}{\text{Current}}$	Unit Amperes/Amps	Unit Volts		1 1 1	
	Measurement 1	Measurement 2	Resistance										
Current	Voltage	$R = \frac{\text{Voltage}}{\text{Current}}$											
Unit Amperes/Amps	Unit Volts												
d		2											
Total			10										
7	a	i	1: Chemical energy 2: Thermal energy 3: Kinetic energy 4: Electrical energy	1 1 1 1									
		ii	Electromagnetic Induction	1									
		iii	When a current carrying conductor cuts through magnetic field lines An emf is induced	1 1									
	b		$P = I V$ $1,000,000 = I \times 33,000$ $I = 30.3 \text{ A}$	1 1									
	c	i	Step down	1									
		ii	Ratio of turns is equal to $33,000 : 240 = 137.5 : 1$	1									
		iii	Low current results in less resistance in the cables And therefore less energy is lost as heat energy	1 1									
	d		Put a fuse Hold the wire with a cord grip	1 1									
	Total			15									