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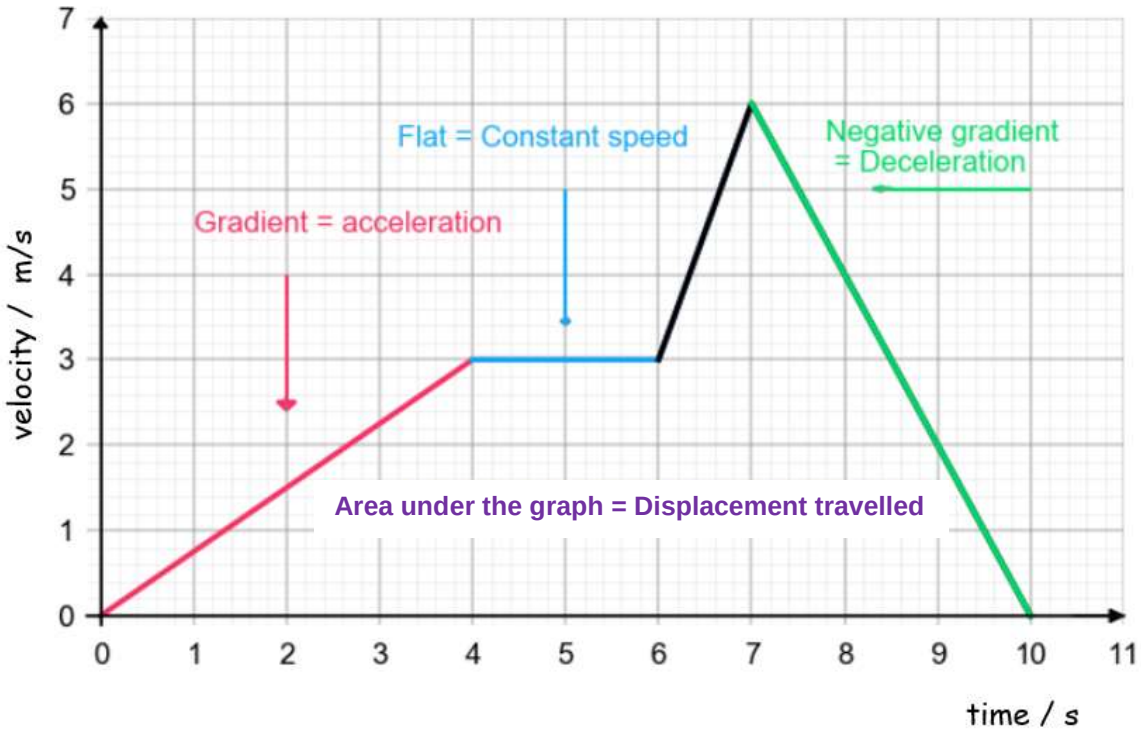
Velocity-Time Graphs

With velocity on the *y*-axis and time on the *x*-axis, velocity-time graph tells us how someone/something's speed has changed over a period of time.

1) The gradient of the line = Acceleration
2) Negative gradient = Deceleration
3) Flat section means constant velocity
4) Area under the graph = Displacement travelled



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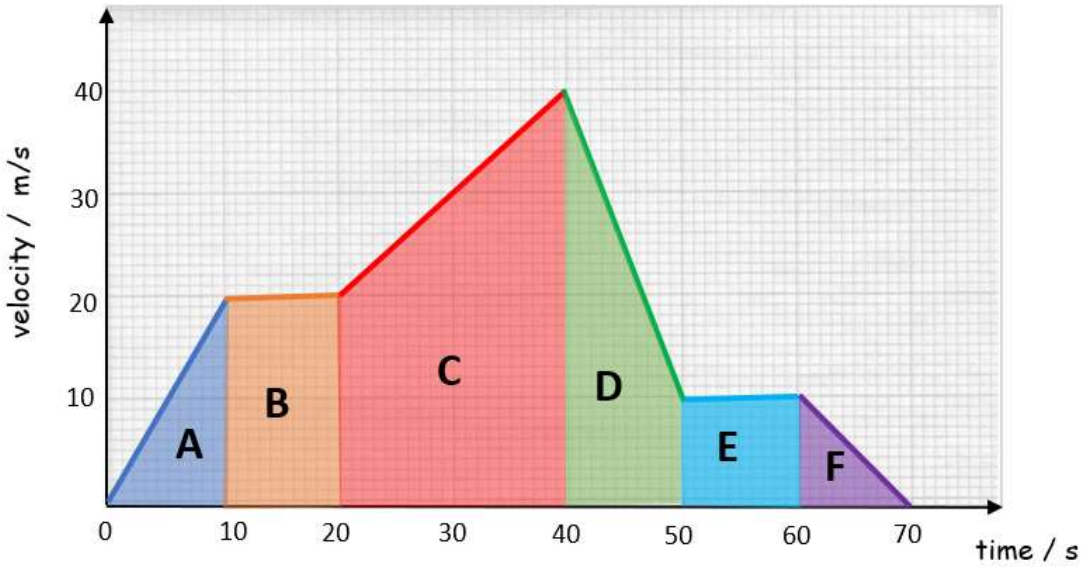
1. The velocity-time graph shows a 70-second car trip. Describe this trip.



Section A: The car _____ from _____to _____ m/s over the first _____ seconds.

Section B: The car _____ did not change for _____ seconds – meaning it was moving at a **constant speed**.

Section C: The car _____ up to_____ m/s over the next _____ seconds

Section D: The car _____ over next _____ seconds from _____ m/s to _____ m/s.

Section E: The car didn't _____ during next _____ seconds.

Section F: Finally, the car _____ from _____ m/s to _____ m/s during next _____ seconds.

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2. Calculate the acceleration for each sector.

Section A:

Acceleration between _____s and _____s = gradient= $\frac{20-0}{10-0} = 2$ m/s^2

Section B:

This section is flat, meaning the acceleration will be _____.

Section C:

Acceleration between _____s and _____s = gradient =

_____

Section D: Deceleration between _____s and _____s = gradient=

_____

Section E:

This section is flat, meaning the acceleration will be _____.

Section F:

_____ between _____ s and _____ s = gradient =

_____

3. Which section has the largest acceleration?

Section _____ has the largest acceleration, so the **maximum acceleration** is _____ m/s^2.

4. How can you answer question 3, without the calculation of the acceleration for each section?

_____

_____

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5. Calculate the total displacement travelled over the 70 seconds.

Remember! The area under the graph = Displacement travelled

To work out the area under this graph, we will break it into 6 shapes: A, B, C, D, E and F. This gives two triangles, two rectangles, and two trapeziums, which are all shapes that we can work out the area of.

Area of right-angle triangle:  $A = \frac{ab}{2}$

Area of rectangle:  A = ab

Area of trapezium:  $A = \frac{a+b}{2}h$

Area (A) = _____

_____

Area (B) =_____

_____

Area (C) = _____

_____

Area (D) = _____

_____

Area (E) = _____

_____

Area (F) = _____

_____

Total displacement = Area (A) + Area (B) + Area (C) + Area (D) +Area (F) + Area (D) =

_____

_____

_____

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6. A car starts moving from **rest** and accelerates at a constant rate of **2 m/s²** for the first **8 seconds**. It reaches a velocity of **16 m/s**. Then the car decelerates at a rate **of 1 m/s²** for the next **10 seconds**. After that, it maintains a constant velocity for another **15 seconds**.
Draw the Velocity – Time graph of car's movement.