Motion

- **Speed:**

Definition: Speed is the distance travelled by a body in unit time.
Speed is a scalar quantity.
Units: m/s or km/hr

- **Average speed:**

Definition: Average speed is the total distance travelled by a body in total time .
Speed is a scalar quantity.
Units: m/s or km/hr

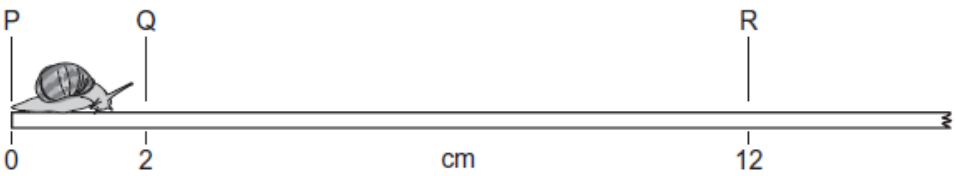
- **Speed and velocity:**

Speed	Velocity
Scalar quantity	Vector quantity
Units: m/s	Units: m/s
Speed=$\frac{distance}{time}$	Velocity= $\frac{displacement}{time}$
Speed of a body can never be negative. it can be zero	Velocity of a body can be positive, negative or zero

Sums-Speed

4 A snail moves along a ruler. It takes 20s to move from Q to R.

0625/11/M/J/10



What is its average speed from Q to R?

A $\frac{12}{20}$ cm/s

B $\frac{12-2}{20}$ cm/s

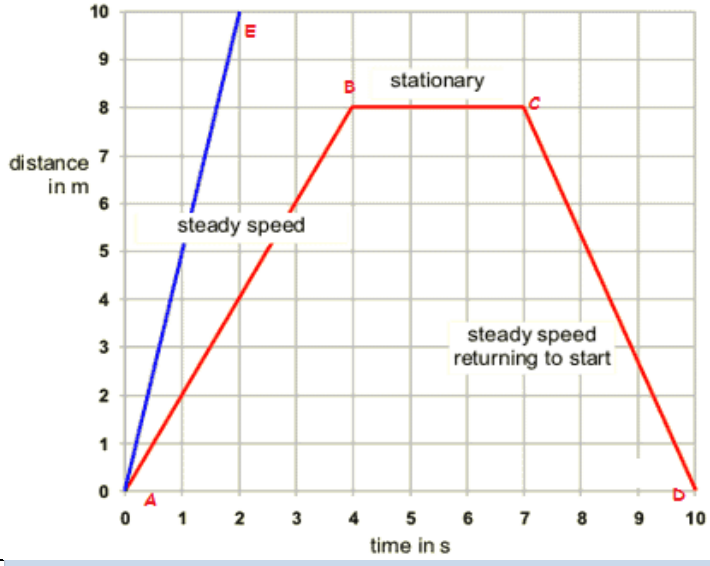
C $\frac{20}{12}$ cm/s

D $\frac{20}{12-2}$ cm/s

The concept of speed can be represented by two kinds of graphs:

- **distance -time graphs**
- **speed-time graphs**

Distance -time graphs:



A-B ⇒ Steady speed-Constant slope

B-C⇒Vehicle has stopped-Zero speed-Zero slope

C-D ⇒ Constant speed-Constant slope. Object returning to the starting point

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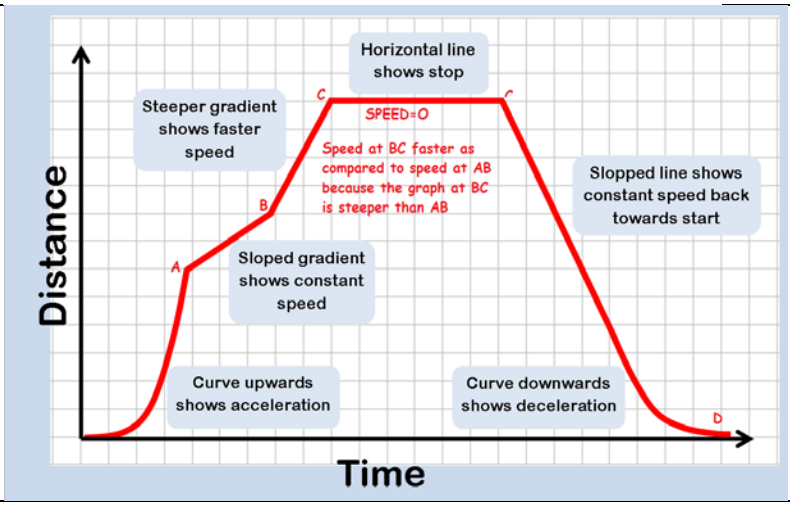
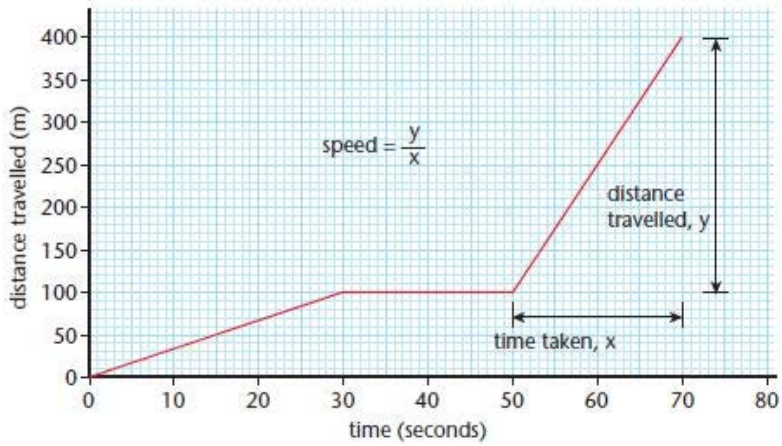
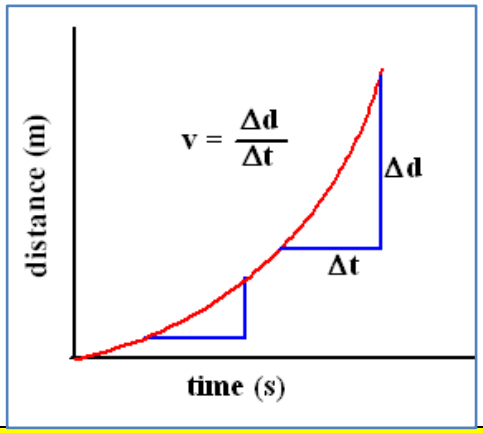


Slope of a distance time graph gives you the speed of the graph



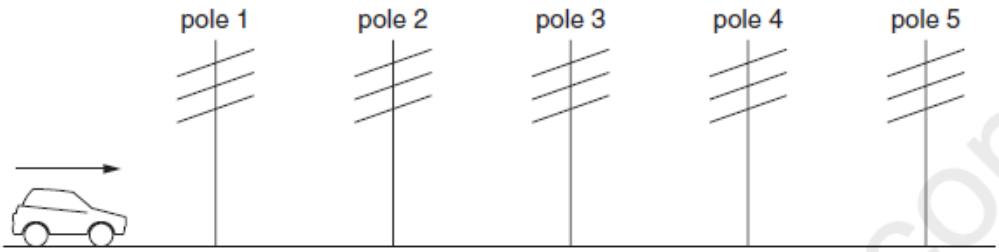


When a body covers unequal distances in equal intervals of time then the graph is a curved graph. Then the speed at a particular time is found by drawing a tangent to the point and calculating its slope.

APPLICATION BASED QUESTIONS:

3 Five telegraph poles are positioned at equal distances along the side of a road.

0625/01/O/N/03



A car accelerates until it is level with pole 4. The car then continues along the road at a steady speed. The times taken to travel between one pole and the next are measured.

Which time is the greatest?

The time between

A pole 1 and pole 2.

B pole 2 and pole 3.

C pole 3 and pole 4.

D pole · pole 5.

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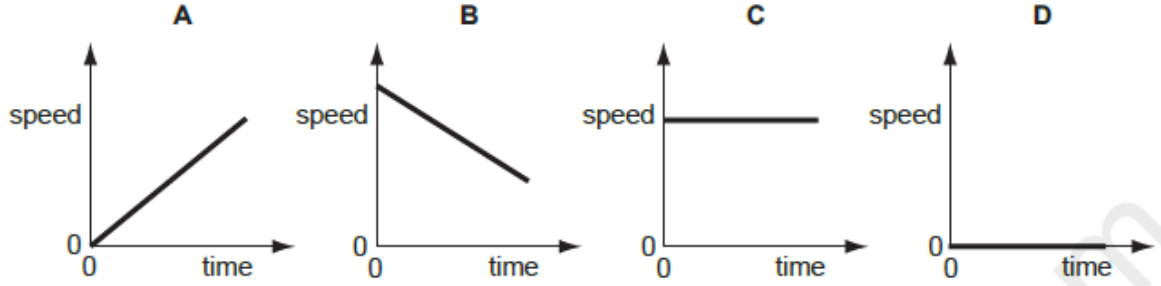
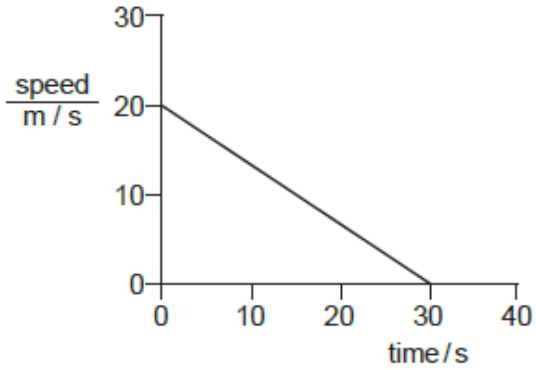
3 Which speed/time graph applies to an object at rest?

0625/01/O/N/04



2 The graph represents part of the journey of a car. **0625/01/O/N/05**



What distance does the car travel during this part of the journey?

A 150 m **B** 300 m **C** 600 m **D** 1200 m

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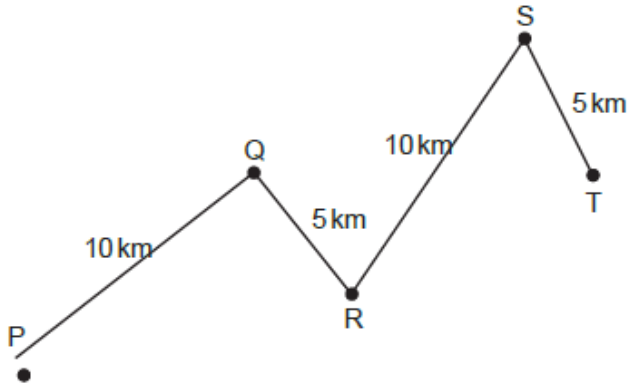
3 A car travels along the route PQRST in 30 minutes. **0625/01/O/N/06**

What is the average speed of the car?



A 10 km / hour

B 20 km / hour

C 30 km / hour

D 60 km / hour

APPLICATION BASED QUESTIONS-EXTENDED THEORY:

1 Fig. 1.1 is a distance/time graph showing the motion of an object. 20

M/J/2-P32

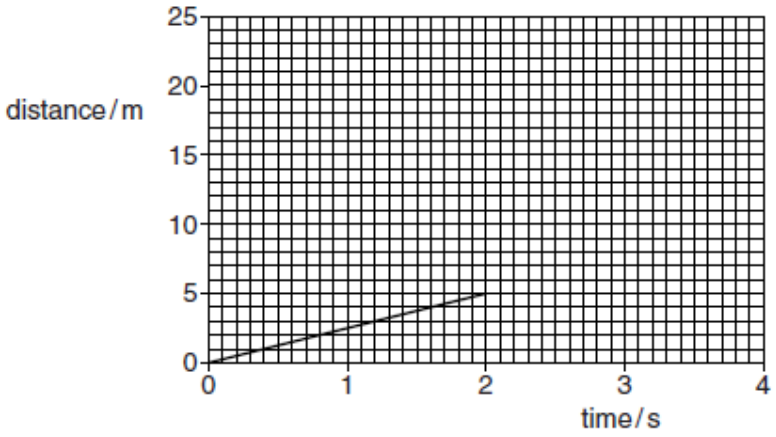


Fig. 1.1

(a) (i) Describe the motion shown for the first 2 s, calculating any relevant quantity.

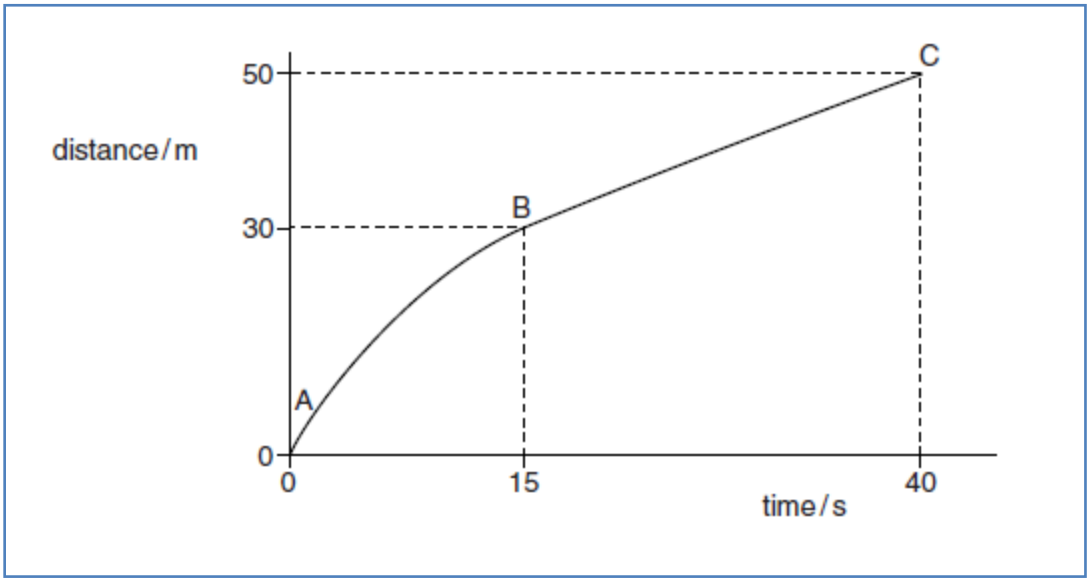
The journey during the first two seconds is described using the words:constant/steady or uniform(Speed or velocity)
You may also mathematically decribe the speed or tlee velocity as being 2.5m/s .
So remember you may decribe the graph in words or in figures through calculations , both are equally acceptabe

(ii) After 2 s the object accelerates.
On Fig. 1.1, sketch a possible shape of the graph for the next 2 s. [2]

The word accelerate means to speed up. So the graph has to be drwan as curving upwards
Rejected: If u draw a straight line going upwards. [1]
Note Next 2 seconds is mentioned . So u need to extend your graph to this distance. (Ms says either graph should touch 25m or upto 3.5s)

(b) Describe how a distance/time graph shows an object that is stationary.

Horizontal straight line or a line parallel to x axis or time axis is the vocab to be used. [1]



Speed of the objects between points AB can be described as:

1. Decreasing or
2. Average speed =2m/s. (The word average is important as it is the total distance /total time taken $=\frac{30}{15}=2m/s$
3. Acceleration=negative

Speed of the objects between points BC can be described as:

1. Constant or
2. Speed =0.8m/s. (distance / time taken $=\frac{50-30}{40-15}=0.8m/s$
3. Acceleration=Zero (Because: Velocity is constant, so change in velocity is zero)

Calculate the average speed of the object during the first 40s:

Must show calculation as = Velocity=d/t=50/40-=1.25m/s

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OBSERVATIONS:

- Describe a section of a graph: You may describe using words or even through calculations.
- Calculate means to show the formula and the steps.

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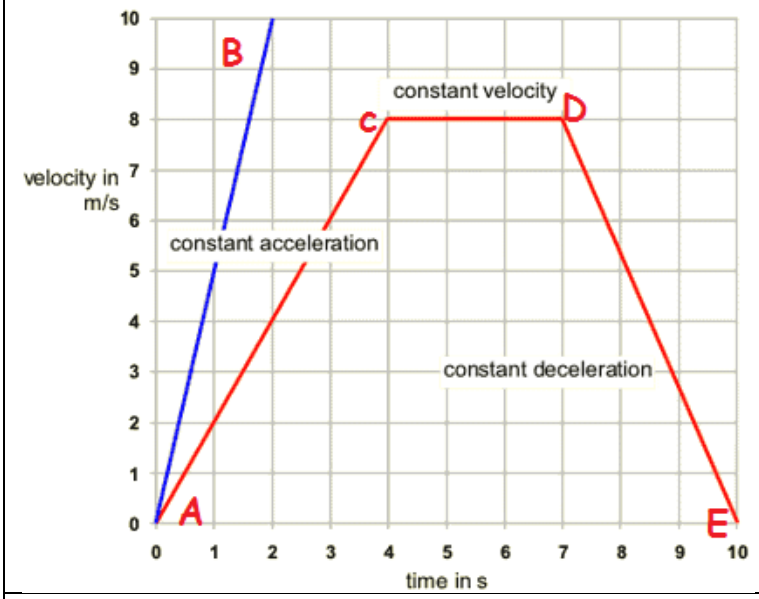
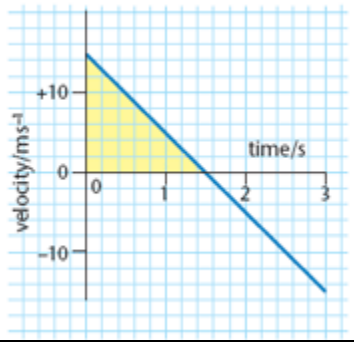
Speed/Velocity- time graph:



AB shows the journey with greater constant acceleration compared to part AC.

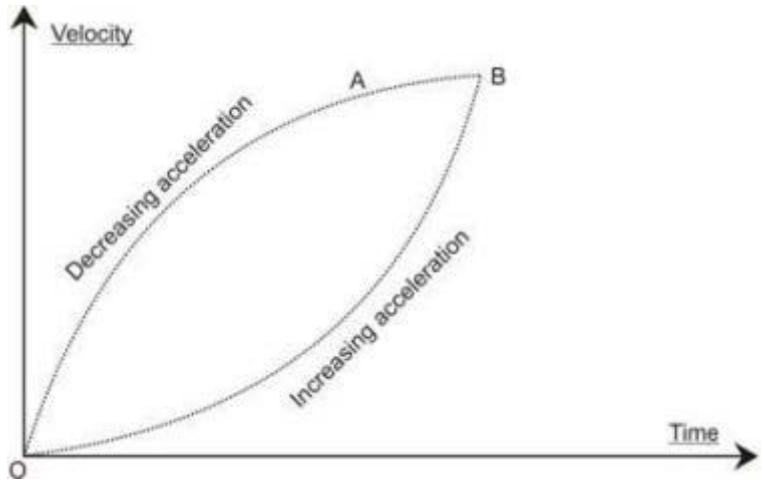
CD shows constant velocity as value of the value of velocity does not change

DE shows constant deceleration because the graph is sloping downwards.

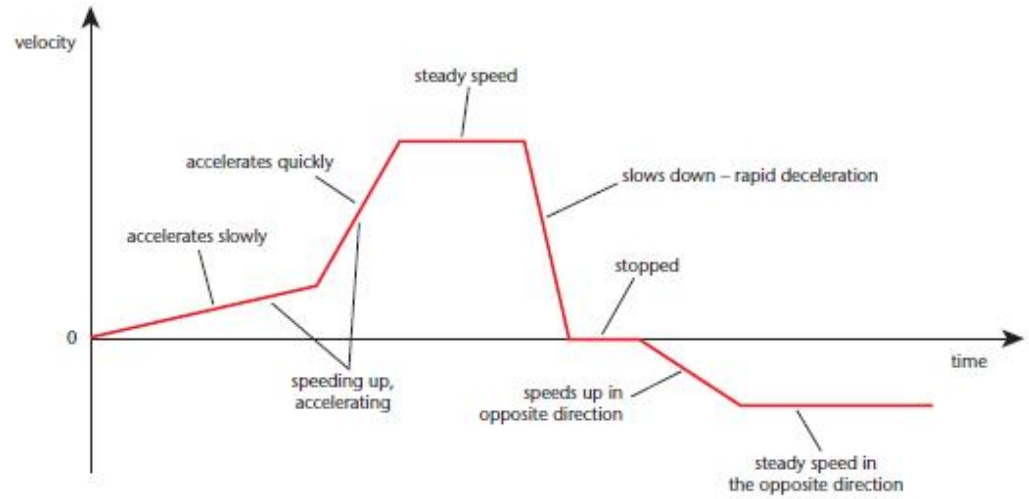


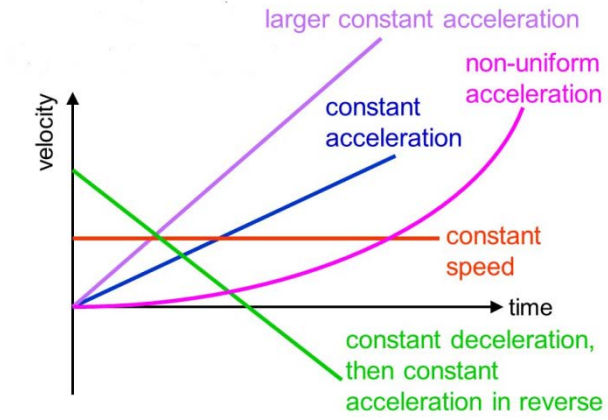
The positive and negative velocity means that the motion is in the opposite direction.

The graph shows decreasing and increasing acceleration.



In addition to the other features described in the previous graphs the following graph tells you how to represent a stopped vehicle (velocity=0)

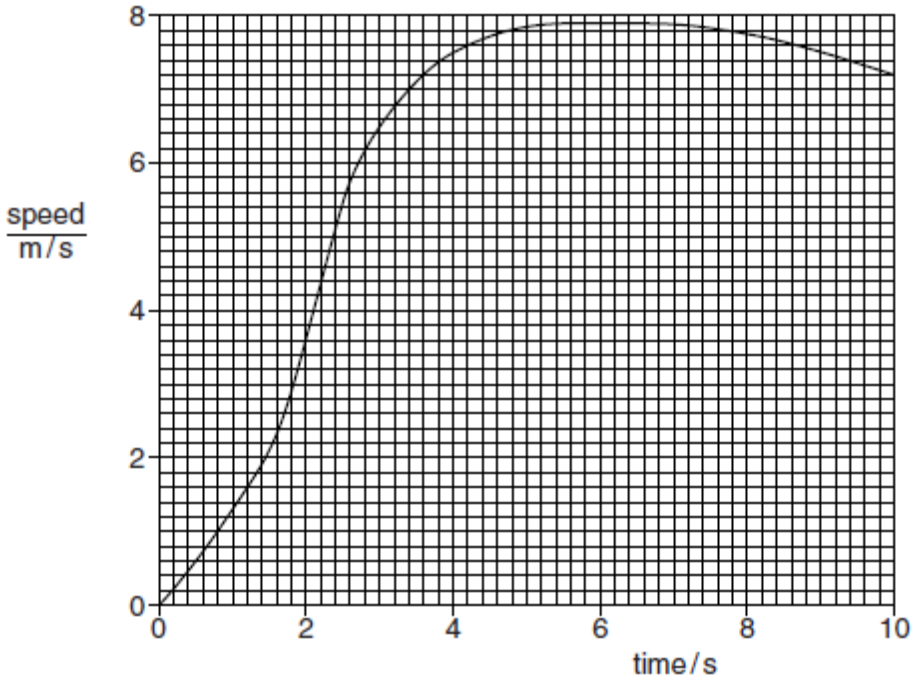




The changing acceleration is better described as non-uniform acceleration.

Application based concepts discussed

Graph of an athlete's race:



Calculate the distance that the athlete runs:

Found by calculating the area under the graph.

Maximum acceleration of the athlete: [4m] Observe the graph carefully and draw a tangent to the steepest part of the curve[1m]. Draw a tangent at this point and show the calculation of $\frac{\Delta v}{\Delta t}$ [1m].Plug in values[1m].State the final answer[1m]

If she runs a distance of 62m . Calculate her average speed:

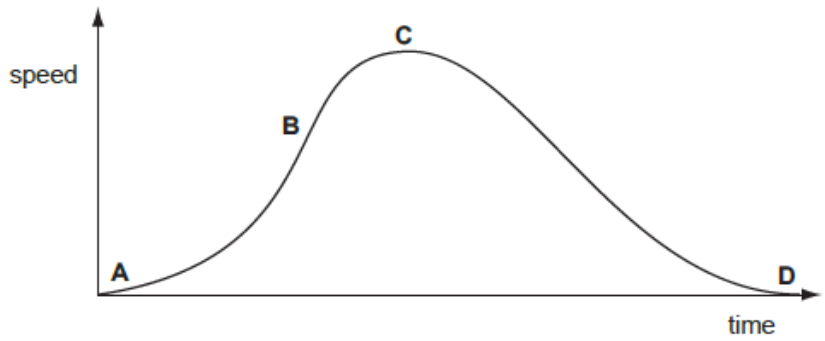
Average speed $= \frac{Total\ distance}{Total\ time}$

$$\Rightarrow \frac{62}{10} = 6.2m/s$$

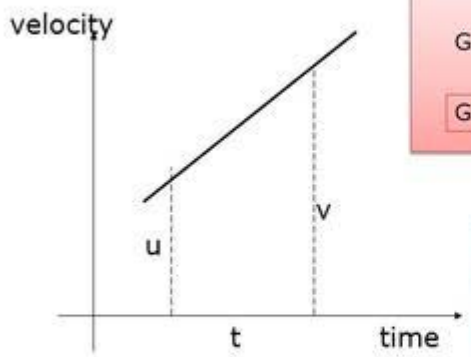
Application based questions-MCQ:

1 The speed-time graph shown is for a bus travelling between stops.

Where on the graph is the acceleration of the bus greatest? **0625/12/O/N/11**



Properties of a velocity time graph



Gradient = $\frac{v-u}{t}$

Gradient = Acceleration

Area under graph = $\frac{1}{2}(u+v)t$

Area = Distance travelled

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1 A comet, travelling in space, enters the atmosphere of a planet.

Fig. 1.1 is the speed-time graph for the comet from time $t = 0$ s. O/N/15-P32-Q1

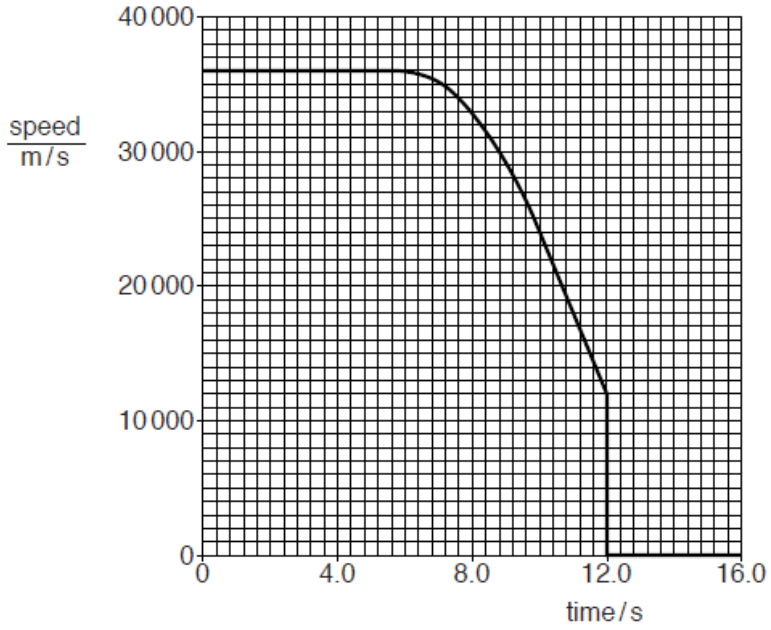

Fig. 1.1

(a) (i) During the period $t = 0$ s to $t = 6.0$ s, both the speed of the comet and the velocity of the comet remain constant.

State what this suggests about the motion of the comet.

.....

.....[1]

(ii) Determine the distance travelled during the period $t = 0$ s to $t = 6.0$ s.

distance = ...[2]

(b) Explain what the graph shows about the motion of the comet during the period $t = 6.0\,s$ to $t = 10.0\,s$.

.....

.....

.....[2]

(c) Determine the acceleration of the comet at $t = 11.0\,s$.

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acceleration = ...[2]

(d) Suggest what happens to the comet at $t = 12.0\,s$.

.....

.....[1]

[Total: 8]

1 Fig. 1.1 shows a smooth metal block about to slide down BD, along DE and up EF. BD and DE are friction-free surfaces, but EF is rough. The block stops at F.

O/N/2002-P3-Q1

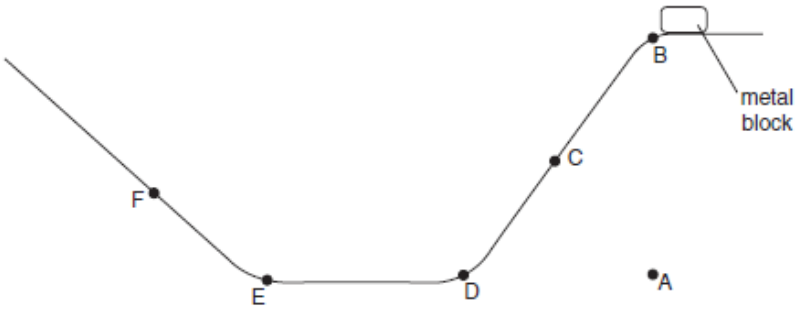

Fig. 1.1

(a) On Fig. 1.2, sketch the speed-time graph for the journey from B to F. Label D, E and F on your graph. [3]

(c) As it passes D, the speed of the block remains almost constant but the velocity changes. Using the terms *vector* and *scalar*, explain this statement.

.....

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.....[2]