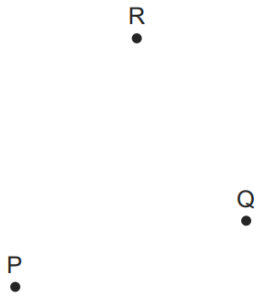
Kinematics

MCQ

Speed, Velocity and Acceleration

1 One object moves directly from P to R.



In a shorter time, a second object moves from P to Q to R.

Which statement about the two objects is correct for the journey from P to R for both objects?

A They have the same average speed.
B They have the same average velocity.
C They have the same displacement.
D They travel the same distance.

2 A truck takes 10 s to travel the first 40 m, and another 20 s to travel a further 110 m. What is its average speed?

A 0.20 m s^{-1} **B** 2.3 m s^{-1} **C** 4.0 m s^{-1} **D** 5.0 m s^{-1}

3 A runner runs 4.0 km towards south in 0.50 hr and 5.0 km towards east in 1.5 hr. What is his average speed in m s^{-1}?

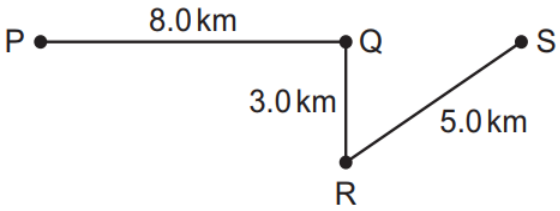
A 0.89 m s^{-1} **B** 1.3 m s^{-1} **C** 3.2 m s^{-1} **D** 12 m s^{-1}

4 An aeroplane travels at an average speed of 600 km h^{-1} on an outward flight and at 400 km h^{-1} on the return flight over the same distance.

What is the average speed of the whole flight?

A 111 m s^{-1} **B** 167 m s^{-1} **C** 480 km h^{-1} **D** 500 km h^{-1}

5 A lorry takes 15 minutes to travel along the path PQRS.

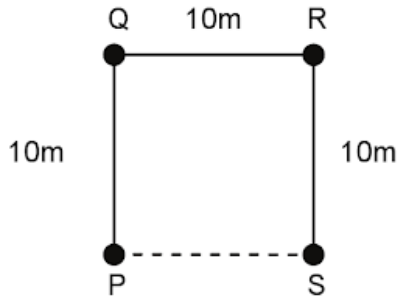


What is the average speed of the lorry?

A 4.0 km h^{-1} **B** 22 km h^{-1} **C** 48 km h^{-1} **D** 64 km h^{-1}

6 A boy takes 5.0 s to walk from point P to point Q, and takes 5.0 s to walk from point Q to point R, and then takes another 5.0 s to walk from point R to point S as show below.

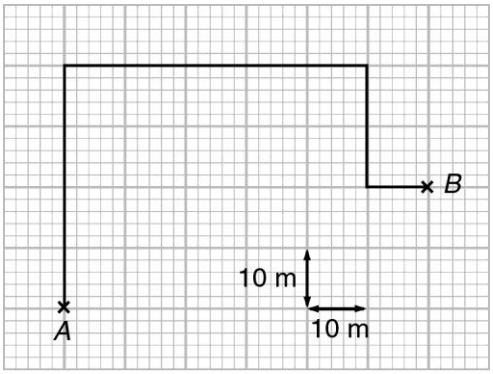
PQRS is a square with side 10 m.



Find the magnitude of his average speed and velocity from P to S.

	speed/m s^{-1}	***velocity/m s^{-1}***
A	2.0	0.50
B	2.0	0.67
C	2.0	2.0
D	6.0	0.67

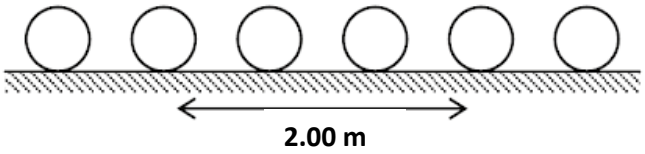
7 Stephen takes the following path and walks for 3.0 minutes from point *A* to point *B.*



What are the average speed and the magnitude of the average velocity of Stephen?

	average speed/m s^{-1}	***average velocity/m s^{-1}***
A	0.67	0.44
B	0.67	0.35
C	0.44	0.67
D	0.35	0.44

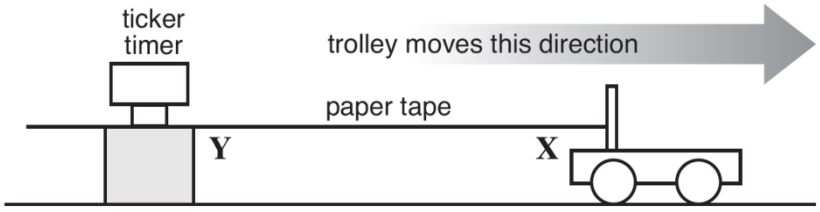
8 The diagram below shows a series of photographs of a ball rolling with constant velocity.



The camera was taking pictures at a constant rate of 20 per second. What was the speed of the ball?

A 9.50 m s^{-1} **B** 10.0 m s^{-1} **C** 12.7 m s^{-1} **D** 13.3 m s^{-1}

9 A ticker timer is a simple timing device that allows one to study motion. Joanne uses one to study the motion of a trolley.



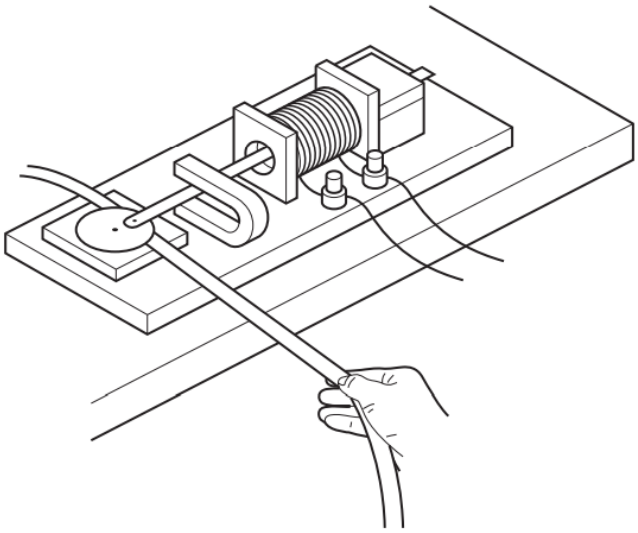
Every second, the ticker timer prints 50 dots on a piece of paper tape. The tape looks like this.

The ticker tape shows that the trolley

A accelerates throughout the journey.
B moves with uniform velocity all the time.
C speeds up and maintains its speed at the later part of its journey.
D travels at uniform speed before it slows down.

10 A student pulls a piece of tape through a ticker-tape timer. Every 0.02 s, the timer prints a dot on the tape.

First the tape is pulled quickly, then slowly, then quickly again.



Which piece of tape does the student obtain?

A

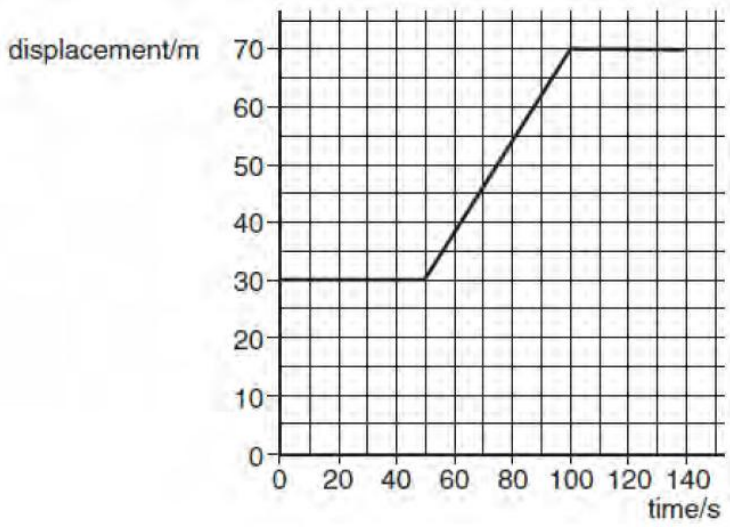
B

C

D

Graphical Analysis of Motion

11 A car at rest in a traffic queue moves forward in a straight line and then comes to rest again. The graph shows the variation with time of its displacement.

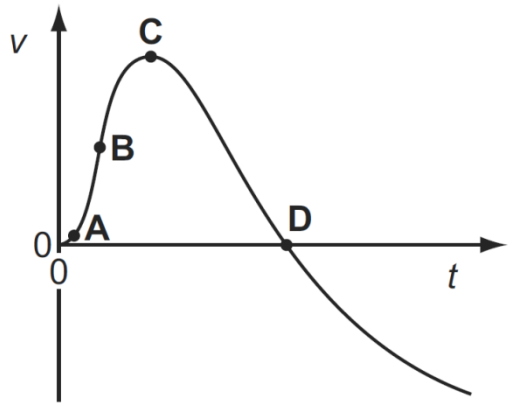


What is its speed while it is moving?

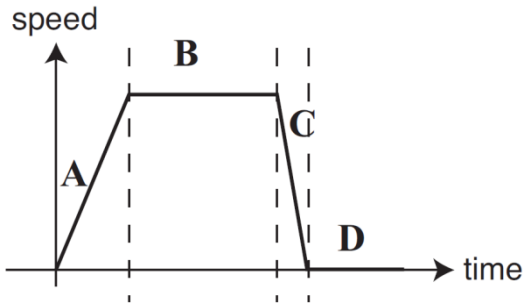
A 0.70 m s^{-1} **B** 0.80 m s^{-1} **C** 1.25 m s^{-1} **D** 1.40 m s^{-1}

12 The graph shows how the velocity *v* of a firework rocket changes with time *t*.

At which point on the graph does the rocket have the greatest acceleration?

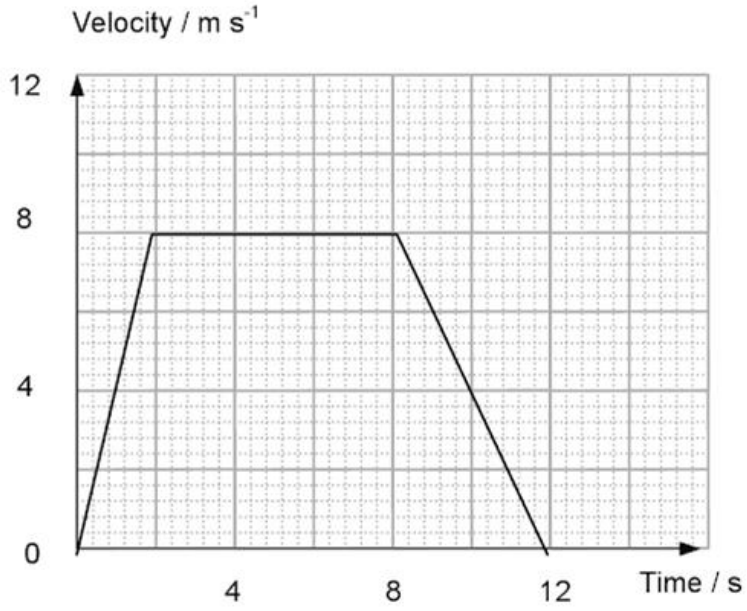


13 The diagram shows how the speed of Mr Tan's car changes with time.



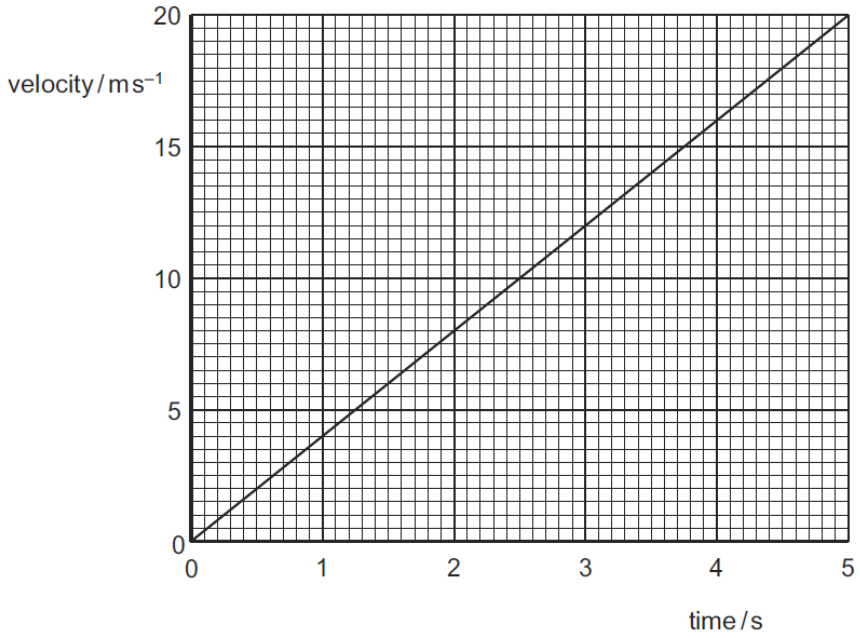
Which section of the graph shows his car at rest?

14 The diagram below shows a velocity-time graph for a motor car. What is the average speed of the car in the first 5 s?



A 6.4 s **B** 14.4 s **C** 32.0 s **D** 72.0 s

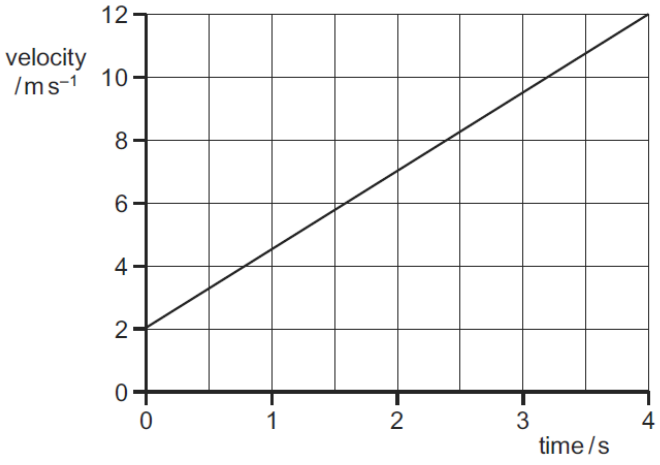
15 The velocity of an object during the first five seconds of its motion is shown on the graph.



What is the distance travelled by the object in this time?

A 4 m **B** 20 m **C** 50 m **D** 100 m

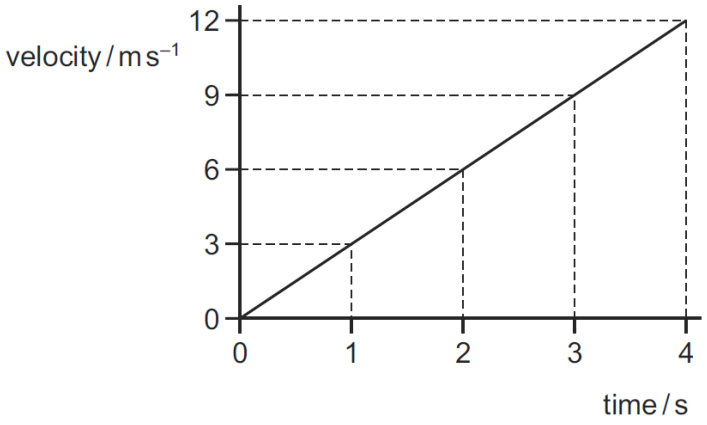
16 The diagram shows a velocity-time graph for a car.



What is the distance travelled during the first 4.0 s?

A 2.5 m **B** 3.0 m **C** 20 m **D** 28 m

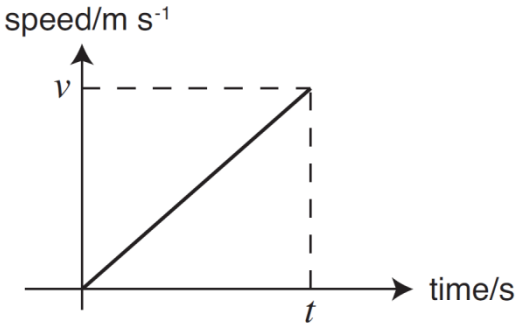
17 The diagram shows a velocity-time graph.



What is the displacement during the last 2 seconds of the motion?

A 6 m **B** 12 m **C** 18 m **D** 24 m

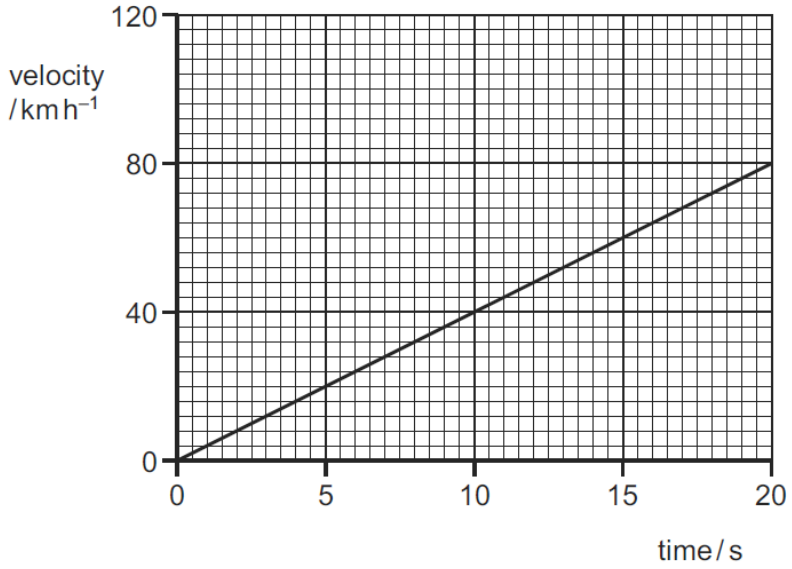
18 A sports car accelerates uniformly from rest at 5.0 m s^{-2}, covering a distance of 250 m at the end of *t* s.



Determine the value of *t*, and its speed *v* at the end of *t* s.

	***t*/s**	**v/m s^{-1}**
A	5.0	50
B	10	50
C	50	10
D	1.0	250

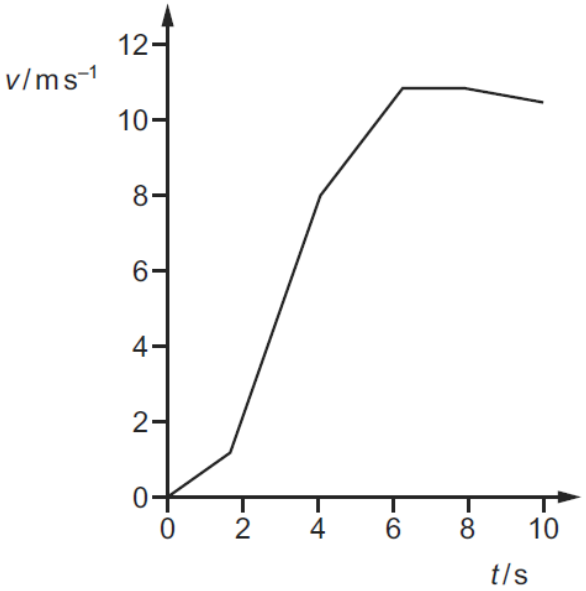
19 The velocity of a car changes as shown.



What is the acceleration of the car?

A 1.1 m s^{-2} **B** 4.0 m s^{-2} **C** 224 m s^{-2} **D** 800 m s^{-2}

20 The graph shows how the speed *v* of a sprinter changes with time *t* during a 100 m race.

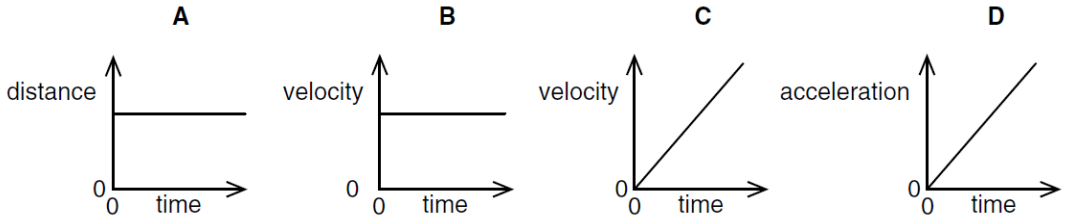


What is the best estimate of the maximum acceleration of the sprinter?

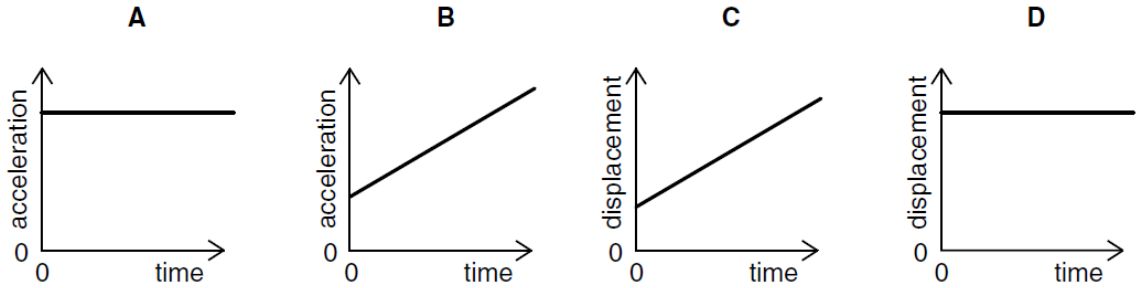
A 0.5 m s^{-2} **B** 1.0 m s^{-2} **C** 3.5 m s^{-2} **D** 10 m s^{-2}

21 A particle is moving in a straight line with uniform acceleration.

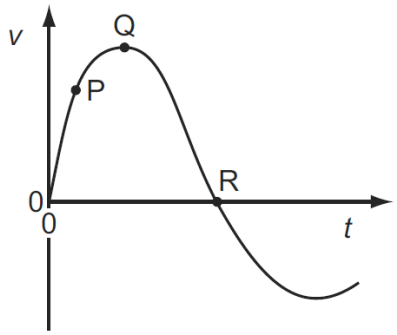
Which graph represents the motion of the particle?



22 Which graph represents the motion of a car that is travelling along a straight road with a uniformly increasing speed?



23 The graph shows how velocity *v* varies with time *t* for a bungee jumper.

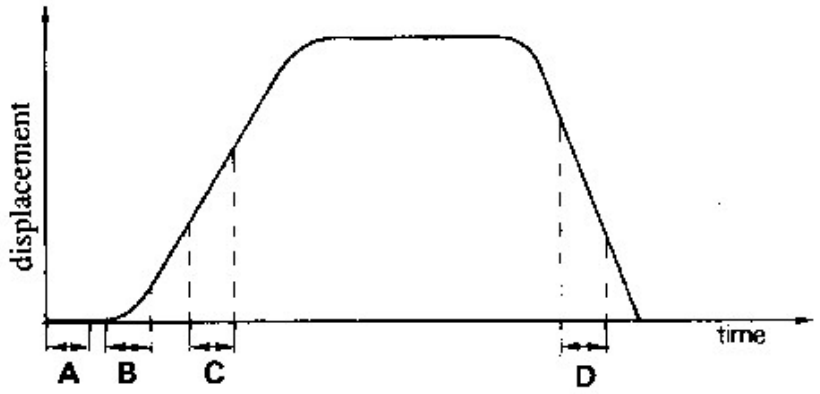


At which point is the bungee jumper momentarily at rest and at which point does she have zero acceleration?

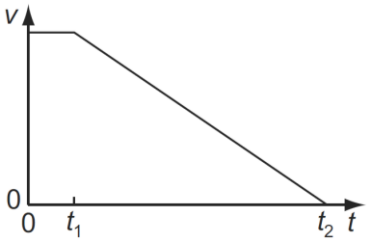
	jumper at rest	**jumper with zero acceleration**
A	Q	P
B	Q	R
C	R	Q
D	R	R

24 The graph represents how displacement varies with time for a vehicle moving along a straight line.

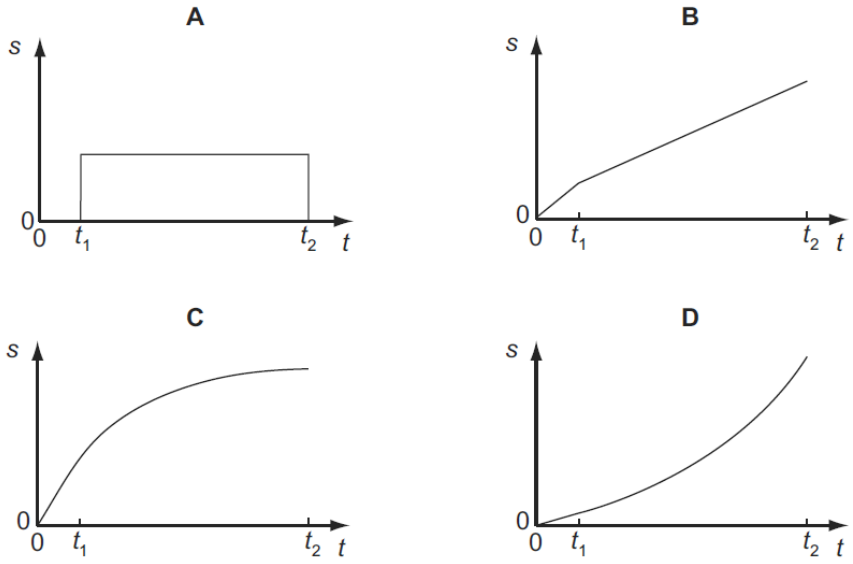
During which time interval does the acceleration of the vehicle have its greatest value?



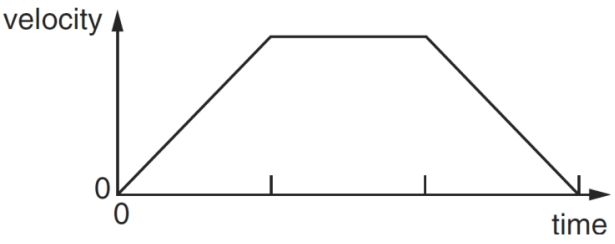
25 When a car driver sees a hazard ahead, she applies the brakes as soon as she can and brings the car to rest. The graph shows how the speed v of the car varies with time t after the hazard is seen.



Which graph represents the variation with time t of the distance s travelled by the car after the hazard has been seen?

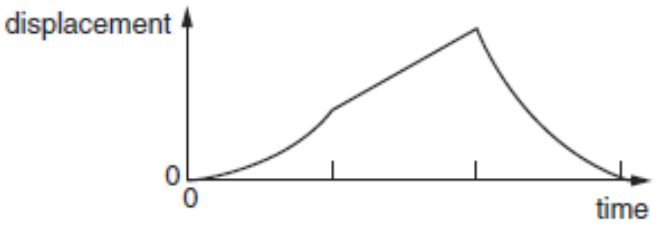


26 The graph of velocity against time for an object moving in a straight line is shown.

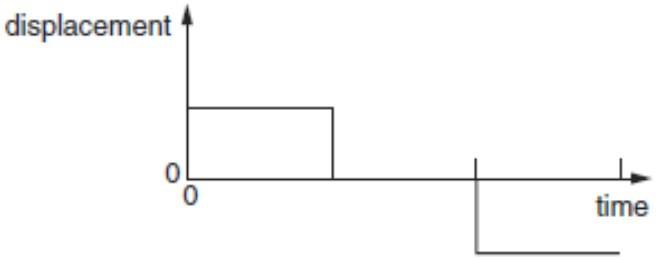


Which of the following is the corresponding graph of displacement against time?

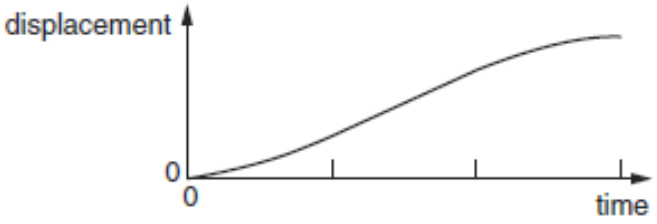
A



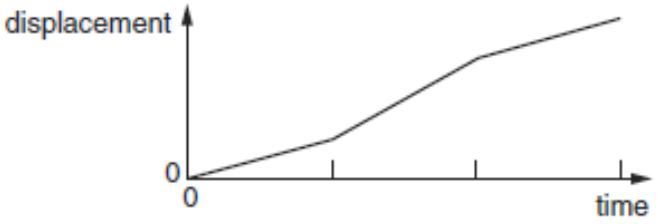
B



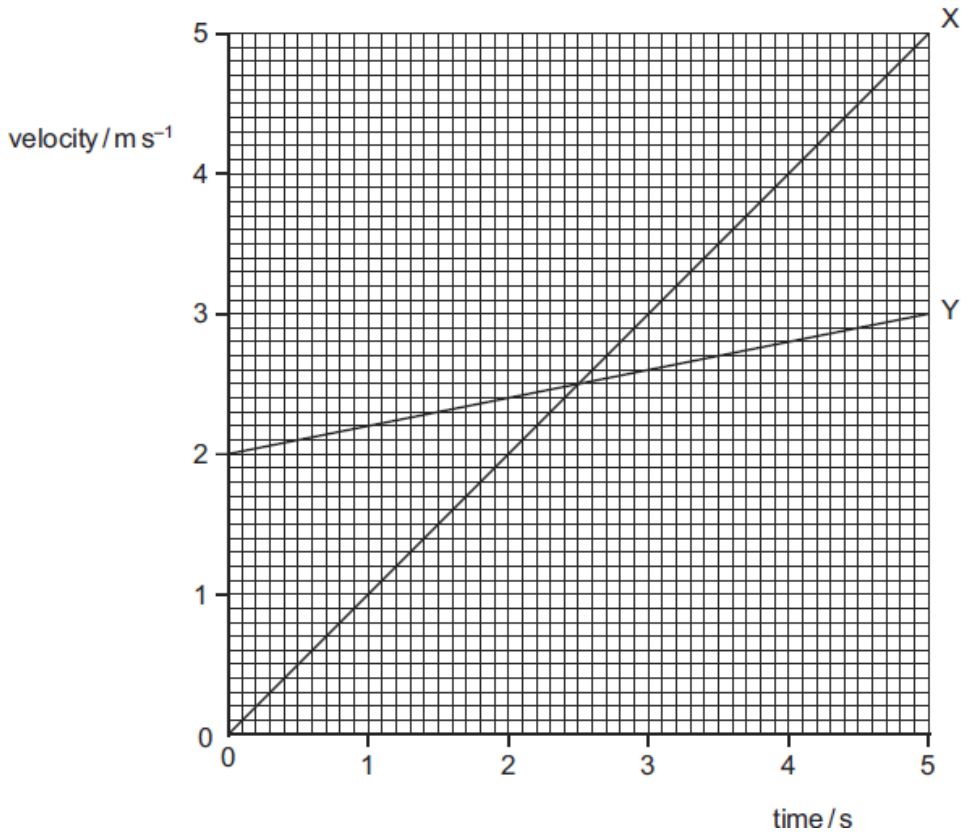
C



D



27 The graph shows velocity-time plots for two vehicles X and Y. The accelerations and distances travelled by the two vehicles can be estimated from these plots.



Which statement is correct?

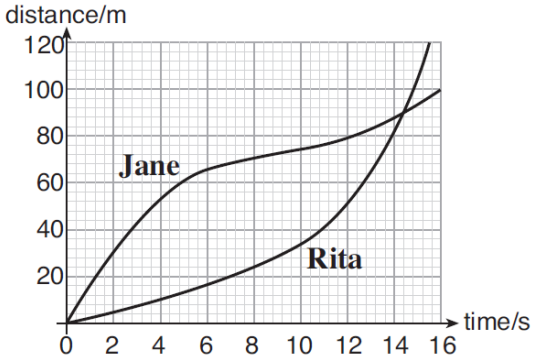
A The accelerations of X and Y are the same at 2.5 s.

B The initial acceleration of Y is greater than that of X.

C The distance travelled by X is greater than that travelled by Y in the 5 s period.

D The distances travelled by X and Y in the 5 s period are the same.

28 The graph below shows the variation of distance and time for Rita and Jane as they compete in a 100 m race.

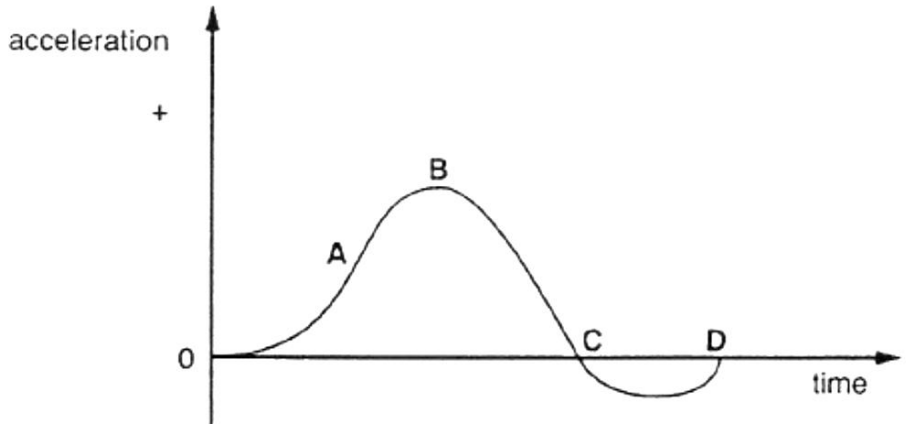


Which of the following statements is correct?

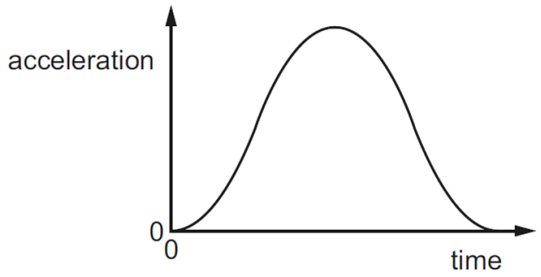
A Rita is faster than Jane throughout the race.
B Jane is faster than Rita throughout the race.
C Rita has a higher average speed than Jane.
D Jane won the race.

29 A car is travelling along a straight road. The graph shows the variation with time of its acceleration during part of the journey.

At which point on the graph does the car have its greatest velocity?



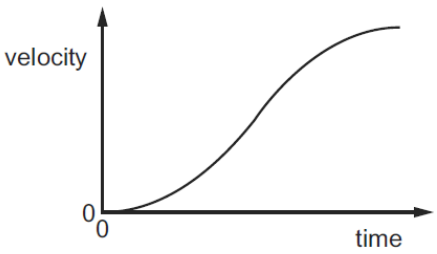
30 The graph shows how the acceleration of an object moving in a straight line varies with time.



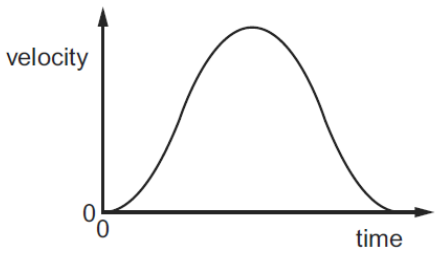
The object starts from rest.

Which graph shows the variation with time of the velocity of the object over the same time interval?

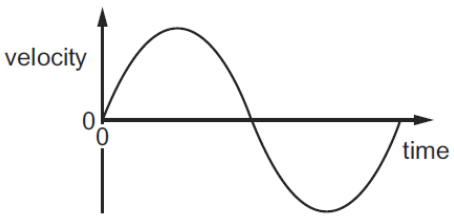
A



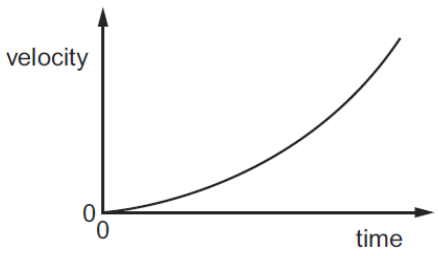
B



C

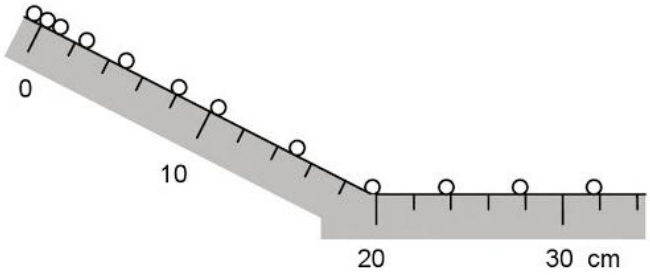


D



Structured Questions

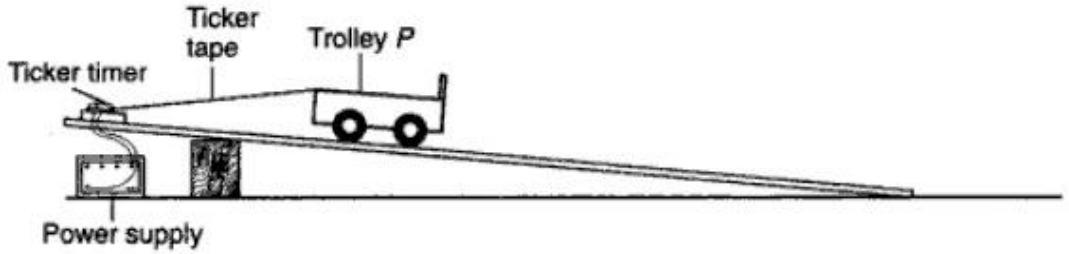
31 A ball rolls down a hill on to a frictionless horizontal surface in the way shown below. The position of the object is shown every 0.050 s and the distances are marked in cm.



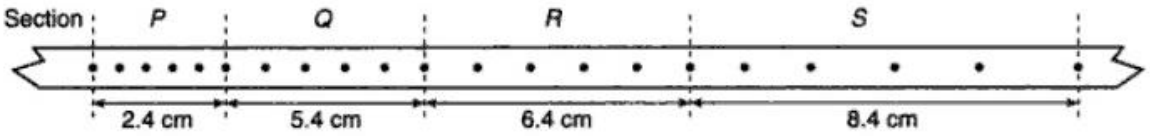
(a) The ball is accelerating when it is travelling along the hill. Explain how you can see from the figure above that this is so.

(b) Taking readings from the figure above, calculate the velocity of the object on the horizontal surface.

32 The diagram below shows a trolley on a runway which is tilted to an angle so that when the trolley is released, it will accelerate down the runway. A length of paper tape is attached to the trolley and the tape passes through a ticker timer which prints a dot on the tape every 0.020 s.



The diagram below shows the tape produced as the trolley ran down the slope. The tape has been divided into four sections, each section contains 5 spaces between adjacent dots.



(a) Which section of the tape is closest to the trolley?

(b) How does the tape indicate that the trolley accelerated as it ran down the runway?

(c) Calculate the average velocity in section *P*.

(d) What is the average velocity of the trolley during section S?

(e) Define acceleration.

(f) Calculate the acceleration of the trolley.

33 The minimum separation between two moving cars is determined by the reaction time of the drivers, speed and deceleration produced by the braking systems of the car

Car A in the figure below was moving at 12 m s^{-1} initially.

When the driver in car A noticed that car B stopped suddenly, he applied the brake only after car A had travelled a distance of 18 m. Car A then came to a complete stop after travelling another 30 m.

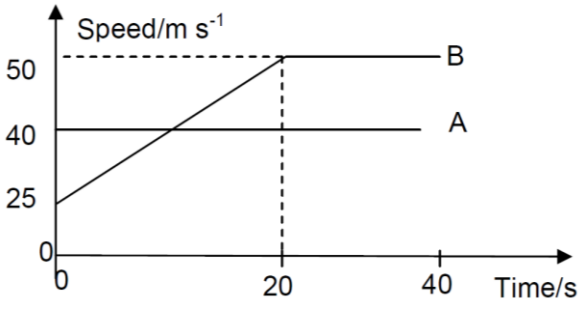
(a) Sketch a speed-time graph to show the motion of car A, starting from the instant the driver noticed the danger to the moment it stopped.

(b) Find the reaction time of the driver of car A.

(c) What was the average deceleration of car A?

(d) Find the time taken to stop car A after the driver applied the brake.

34 The graph below shows the speeds of two cars A and B which are travelling in the same direction over a period of time of 40 s. Car A, travelling at a constant speed of 40 m s^{-1} overtakes car B at time t = 0 s. In order to catch up with car A, car B immediately accelerates uniformly for 20 s to reach a constant speed of 50 m s^{-1}.



(a) At what time would car B catch up with car A?

(b) What is the maximum distance between the cars before car B catches up with car A?

Answers

MCQ

Speed, Velocity and Acceleration
CDBCD BBDCB

Graphical Analysis of Motion
BBDAC DCBAC CACBC CDCCA

Structured Questions

31 (a) The distance between each position of the ball increases down along the slope, implying that the distance travelled every 0.50 s increases and that the ball is accelerating.

(b) 0.80 m s^{-1}

32 (a) P

(b) The dotes are increasingly further apart

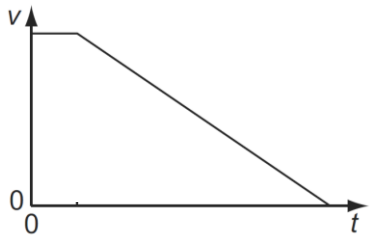
(c) 0.24 m s^{-1}

(d) 0.84 m s^{-1}

(e) It is the rate of change of velocity.

(f) 2.0 m s^{-2}

33 (a)



(b) 1.5 s

(c) 2.4 m s^{-2}

(d) 5.0 s

34 (a) 25 s

(b) 90 m