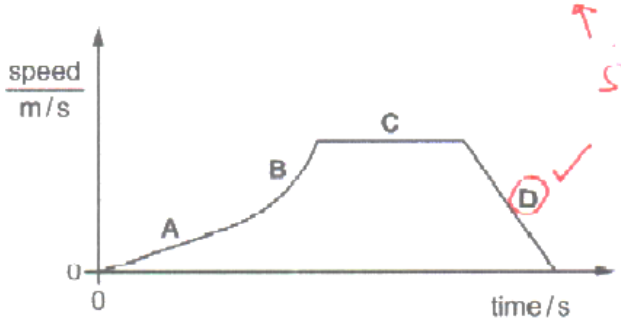
Motion – 2023 IGCSE 0625 Physics

1. Nov/2023/Paper_ 0625/11,21/No.2

The graph shows the speed of a car travelling through a town.

Which section of the graph represents a period when the car is decelerating?

Slowing down.



2. Nov/2023/Paper_ 0625/12/No.2

A student measures the average speed of a cyclist in a race.

Which quantities must she measure?

A the total time taken to complete the race and the time taken for the cyclist to reach her highest speed

B the total time taken to complete the race and the total distance travelled by the cyclist at her highest speed

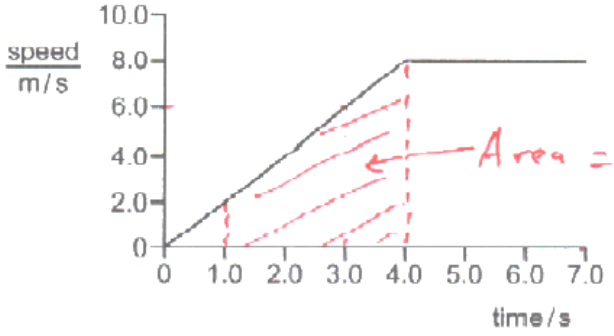
C the total time taken to complete the race and the total distance travelled by the cyclist

D the time taken to reach her highest speed and the total distance travelled by the cyclist

Av. Speed = total distance travelled / total time taken.

3. Nov/2023/Paper_ 0625/12/No.3

The graph shows the motion of a sprinter.



Area = distance travelled

$= \left(\frac{1}{2} \times 3(2 + 8)\right)$

$= \frac{1}{2} \times 3 \times 10$

$= 15\,m$

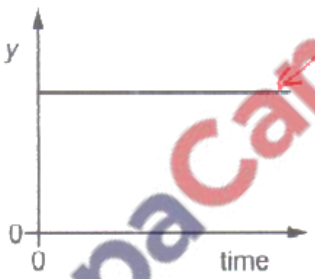
She accelerates steadily from rest to 8.0 m/s in 4.0 s.

How far does she travel in the last three seconds of her acceleration?

A 9.0 m B 15 m C 16 m D 24 m

4. Nov/2023/Paper_ 0625/13/No.2

A train is on a straight track. The graph shows how a quantity *y* varies with time.



Either train is stationary or moving at constant speed.

Which statements can be true?

1 The train is stationary and *y* represents the distance from the last station. ✓

2 The train is moving and *y* represents the distance from the last station. ✓

3 The train is stationary and *y* represents the speed of the train. ✗

4 The train is moving and *y* represents the speed of the train. ✓

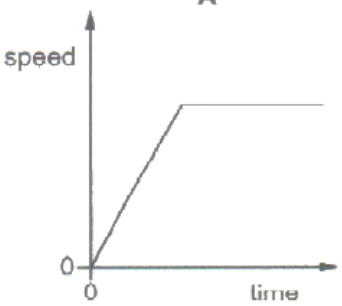
A 1 and 2 B 1 and 4 C 2 and 3 D 3 and 4

5. Nov/2023/Paper_ 0625/21/No.3

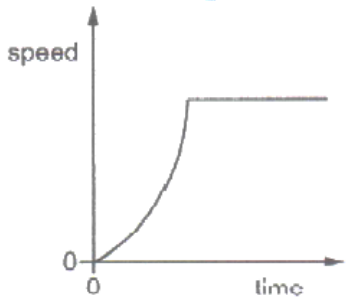
An object reaches terminal velocity after being dropped and falling through air.

Which graph shows how its speed varies with time?

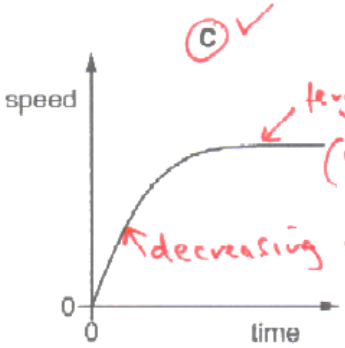
A



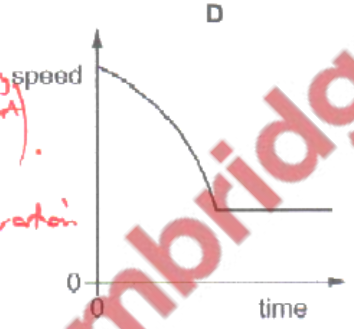
B



C ✓



D



6. Nov/2023/Paper_ 0625/22/No.2

A student measures the average speed of a cyclist in a race.

av. speed = total distance / total time

Which quantities must she measure?

A the total time taken to complete the race and the time taken for the cyclist to reach her highest speed

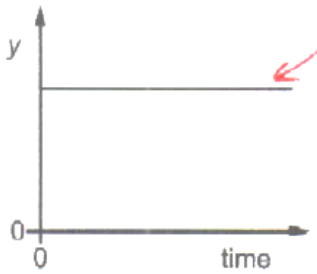
B the total time taken to complete the race and the total distance travelled by the cyclist at her highest speed

C ✓ the total time taken to complete the race and the total distance travelled by the cyclist

D the time taken to reach her highest speed and the total distance travelled by the cyclist

7. Nov/2023/Paper_ 0625/23/No.2

A train is on a straight track. The graph shows how a quantity y varies with time.



Either the train is stationary or moving at constant speed.
- So y = distance or y = speed.

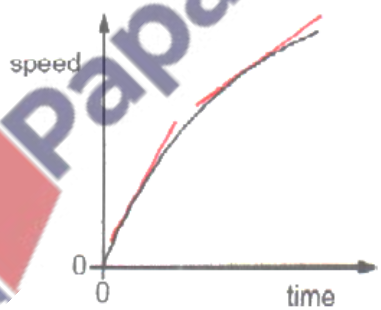
Which statements can be true?

1 The train is stationary and y represents the distance from the last station. ✓
2 The train is moving and y represents the distance from the last station.
3 The train is stationary and y represents the speed of the train.
4 The train is moving and y represents the speed of the train. ✓

A 1 and 2 (B) ✓ 1 and 4 C 2 and 3 D 3 and 4

8. Nov/2023/Paper_ 0625/23/No.3

The diagram shows a speed–time graph for a moving object.



- In speed-time graph, the gradient represent acceleration
- The gradient of the curve is reducing, eg from 4m/s² to 3 m/s² but still accelerating.

Which description of the object's motion is correct? ✓

(A) decreasing acceleration
B decreasing speed
C constant acceleration
D constant speed

9. Nov/2023/Paper_ 0625/31/No.1

Fig. 1.1 shows a distance–time graph for a cyclist.

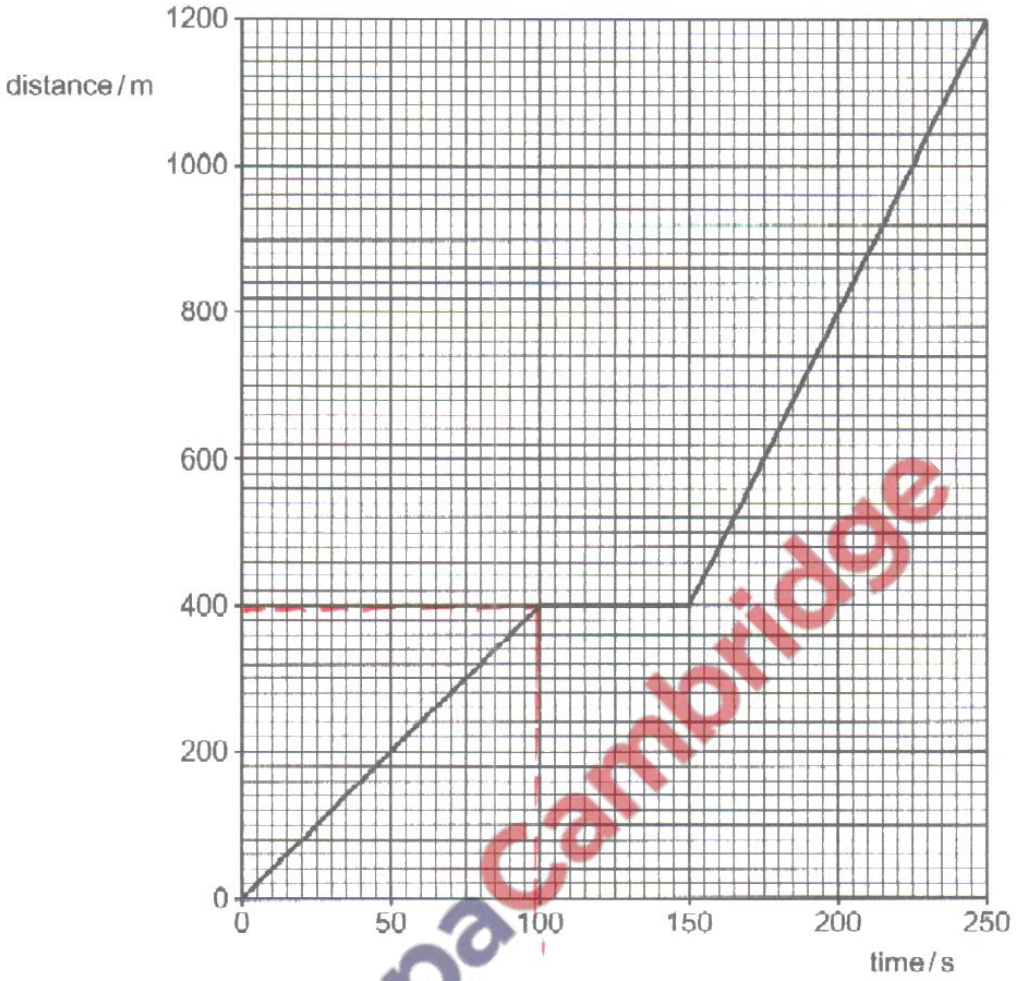


Fig. 1.1

(a) (i) Determine the distance travelled by the cyclist between time = 0 and time = 100 s.

distance travelled = 400 m [1]

(ii) Calculate the speed of the cyclist between time = 0 and time = 100 s.

Speed = gradient

gradient = $\frac{\Delta y}{\Delta x}$

$= \frac{400-0}{100-0}$

= 4 m/s

speed = 4.0 m/s [3]

(iii) Describe the motion of the cyclist between time = 100 s and time = 250 s.

- Was stationary between 100 s and 150 s.
- Then speed was constant btw 150 s and 250 s [2]

(b) Fig. 1.2 shows the cyclist riding along a long straight road.

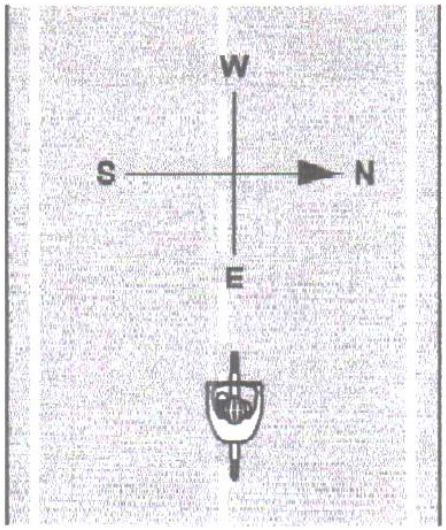


Fig. 1.2

The speed of the cyclist is 15 m/s. Determine the velocity of the cyclist.

Velocity is speed in a specified direction
– so speed is 15 m/s
East–west direction

velocity = 15 m/s

direction due west

[1]

[Total: 7]

10. Nov/2023/Paper_ 0625/32/No.1

Fig. 1.1 shows the speed–time graph for a cyclist beginning a race. The motion of the cyclist changes at points A, B and C.

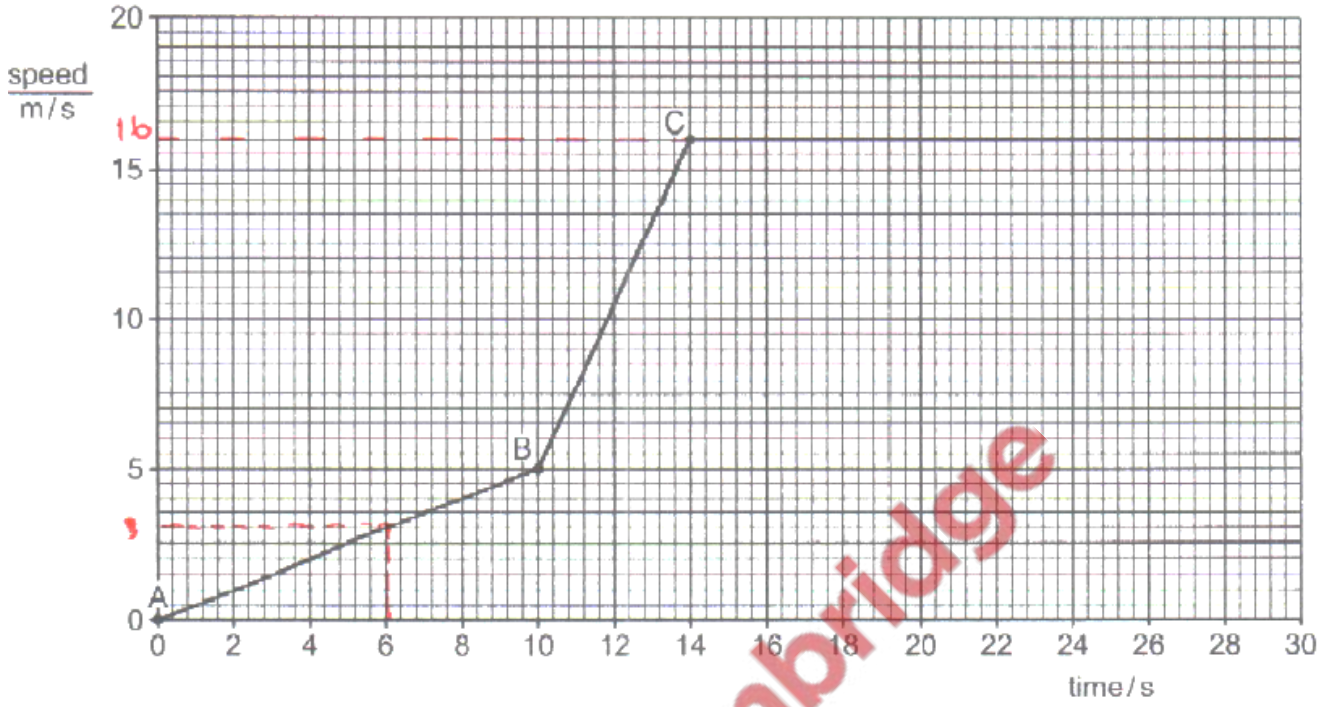


Fig. 1.1

(a) Using information from Fig. 1.1, determine:

(i) the speed of the cyclist at time = 6.0 s

speed = 3.0 m/s [2]

(ii) the maximum speed of the cyclist.

maximum speed = 16 m/s [1]

(b) **(i)** Describe the motion of the cyclist between point A and point B.

Speed is increasing at constant rate. [1]

(ii) Describe how the motion of the cyclist between points B and C differs from the motion between points A and B.

Give a reason for your answer.

difference greater acceleration

reason steeper gradient between BC.

[2]

(c) Determine the distance travelled by the cyclist between point A and point B.

distance = Area under graph,

$= \frac{1}{2} \times 10 \times 5$

$= 25\,m$

distance = ... 25 ..... m [3]

[Total: 9]

11. Nov/2023/Paper_ 0625/33/No.1

Fig. 1.1 shows the speed–time graph for a bus journey.

Fig. 1.1

(a) Using the information in Fig. 1.1, determine:

(i) the maximum speed of the bus during the journey

maximum speed = 18 m/s [1]

(ii) the speed of the bus at time = 65 s. On Fig. 1.1, show how you obtained this information.

speed = 12 m/s [2]

(b) Describe how the speed of the bus changes between time = 60 s and time = 80 s.

- Slows down until it stops at 75 s

[2]

(c) Determine the distance travelled by the bus between time = 0 and time = 10 s.

d = area under graph

$= \frac{1}{2} \times 10 \times 18$

= 90 m

distance travelled = 90 m [3]

(d) Fig. 1.2 shows the speed–time graph for another bus journey.

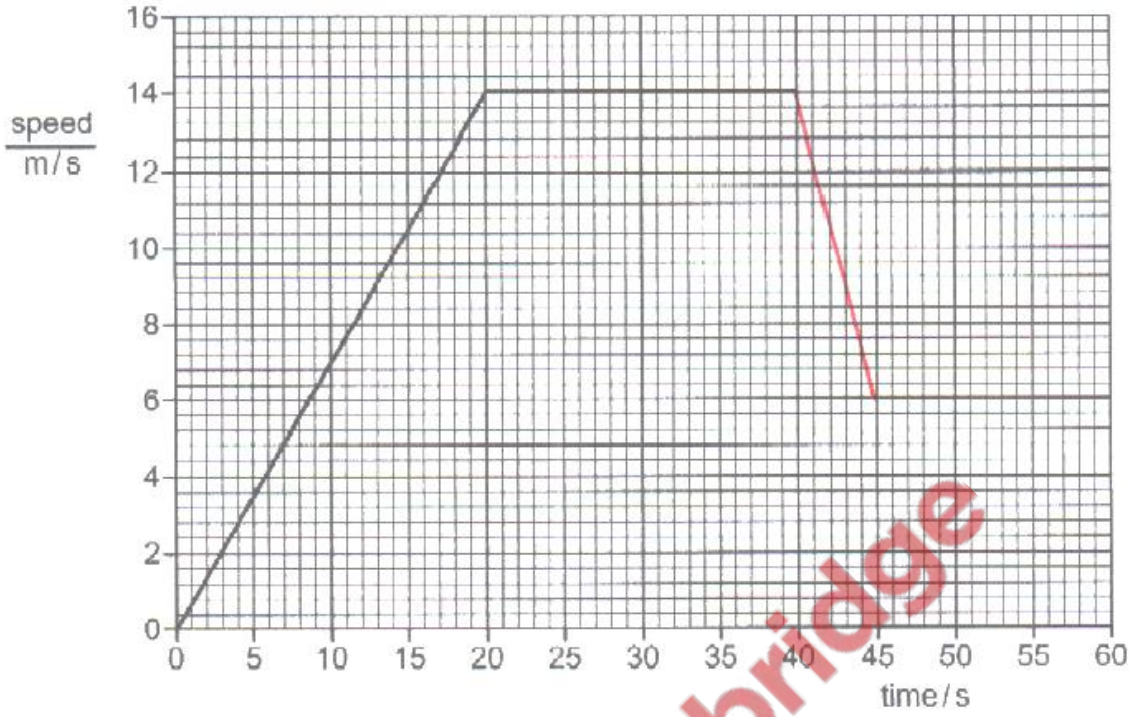


Fig. 1.2

The driver sees a hazard ahead and applies the brakes at time = 40 s.

The bus reduces its speed from 14.0 m/s to 6.0 m/s in a time of 5.0 s.

On Fig. 1.2, draw the speed–time graph for the bus as it reduces its speed. [2]

[Total: 10]

12. Nov/2023/Paper_ 0625/41/No.1

A girl holds a rubber ball out of a window of a tall building. The mass of the ball is 0.20 kg. The ball is at rest 10 m above a concrete path.

(a) Calculate the gravitational potential energy of the ball relative to the concrete path.

$\Delta E_p = mg\Delta h$

$= 0.20 \times 9.81 \times 10$

$= 19.62\,J$

$\therefore \Delta E_p = 20\,J$

gravitational potential energy = 20 J. [2]

(b) The girl releases the ball and it falls towards the path. The ball strikes the path and bounces vertically upwards.

Fig. 1.1 shows the ball falling towards the path.

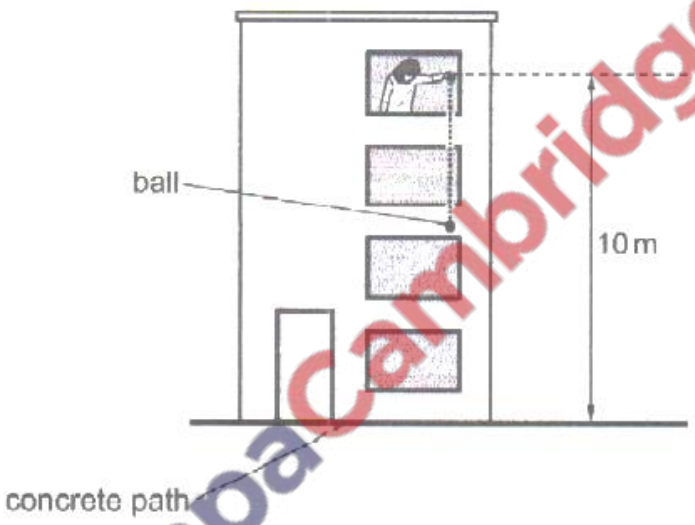


Fig. 1.1

The speed of the ball immediately **before** it strikes the path is 14 m/s.

The speed of the ball immediately **after** it strikes the path is 12 m/s.

(i) Calculate the kinetic energy of the ball immediately **after** it strikes the concrete path.

$K.E = \frac{1}{2}mv^2$

$= \frac{1}{2} \times 0.2 \times 12^2$

$= 14.4\,J$

$\simeq 14\,J$ (2 s.f.)

kinetic energy = 14 J [2]

(ii) Show that the change in momentum of the ball when it bounces off the path is 5.2 kg m/s.

$\Delta p = mv - mu$

$= 0.20(-12 - 14)$

$= -5.2$ kg m/s upwards.

[3]

(iii) The ball is in contact with the path for 0.25 s.

Calculate the average resultant force on the ball when it is in contact with the path.

$f = \frac{\Delta p}{t}$

$= \frac{5.2}{0.25}$

$= 20.8$

$\simeq 21 N$

force = ... 21 N ..... [2]

[Total: 9]

13. Nov/2023/Paper_ 0625/42/No.1

A car accelerates uniformly in a straight line from rest at time $t = 0$. At $t = 3.2$ s, the speed of the car is 13.0 m/s.

(a) (i) Calculate the acceleration of the car.

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

but $v = 0$

$\therefore a = \frac{13.0 \text{ m/s}}{3.2 \text{ s}}$

$= 4.0625$

$\therefore a = 4.1 \text{ m/s}^2$

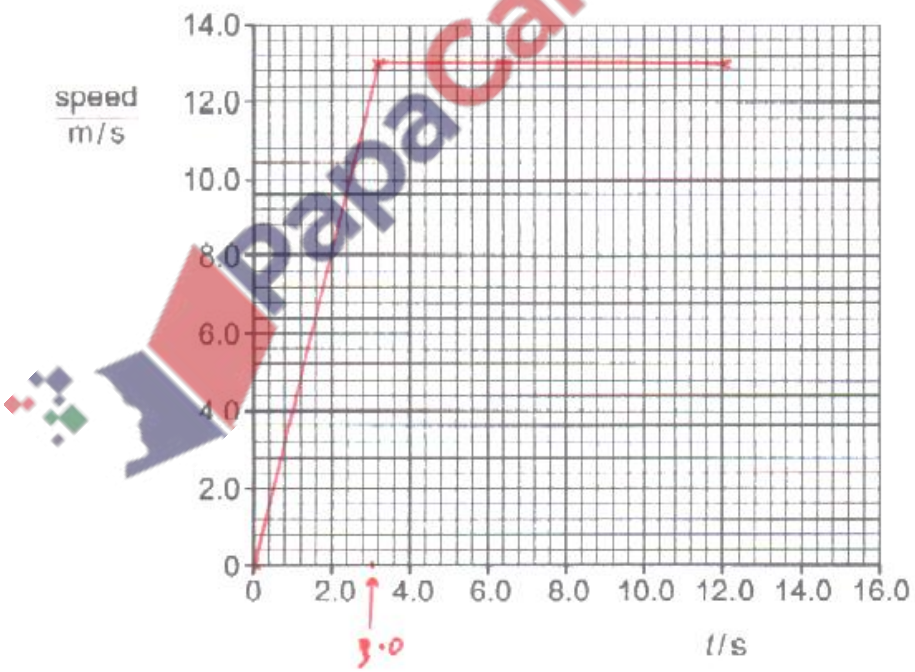
acceleration = 4.1 [2]

(ii) Explain in words what is meant by the term acceleration.

Acceleration is the increase of velocity per unit time. [1]

(b) The car travels at 13.0 m/s from $t = 3.2$ s to $t = 12.0$ s.

(i) Plot the speed–time graph for the car from $t = 0$ to $t = 12.0$ s.



[2]

(ii) Determine the distance travelled by the car between $t = 0$ and $t = 3.2$ s.

distance = area under graph

$= \frac{1}{2} \times 3.2 \times 13$

$= 20.8$ m

$\simeq 21$ m

distance = ... 21 m. ..... [2]

(c) The car decelerates from 13.0 m/s to 0 m/s at a constant deceleration. The mass of the car is 1350 kg. The car travels 13 m in 2.0 s as it decelerates.

Show that the work done by the car as it decelerates is approximately 1.1×10^5 J.

$W \cdot d = F \times d$

$F = m \times a$

$= 1350 \times 6.5 = 8775$ N

$a = \frac{0 - 13}{2}$

$= -6.5$ m/s^2

$W \cdot d = 8775 \times 13$

$= 114075$ J

$\simeq 1.1 \times 10^5$ J

[4]

(d) On another day, the car in (c) travels a longer distance while it decelerates from 13.0 m/s to 0 m/s. The deceleration is constant.

Suggest and explain what causes the stopping distance to increase.

suggestion ..... It has worn out tyres .....

.....

explanation ..... There is less friction between tyre

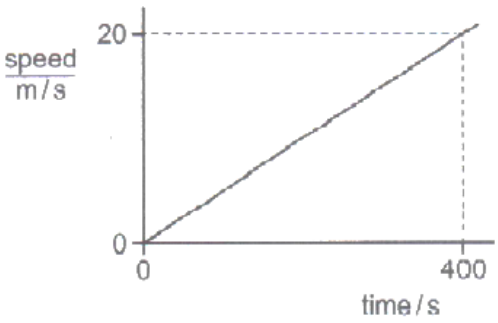
and road surface .....

[2]

[Total: 13]

14. June/2023/Paper_0625/11/No.2

The graph represents the motion of a vehicle.



In s-t graph, the distance travelled = area under the graph

$A = \frac{1}{2} \times b \times h$

$= \frac{1}{2} \times 400 \times 20$

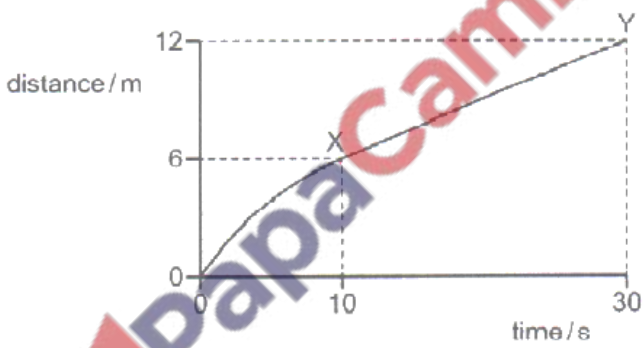
$= 4000\,m$

What is the distance travelled by the vehicle in 400 s?

A 20 m B 400 m C 4000 m D 8000 m

15. June/2023/Paper_0625/11/No.3

The diagram shows a distance–time graph for an object moving in a straight line.



What is the average speed between X and Y?

A 0.20 m/s B 0.30 m/s C 0.40 m/s D 0.60 m/s

av. speed = total distance / total time

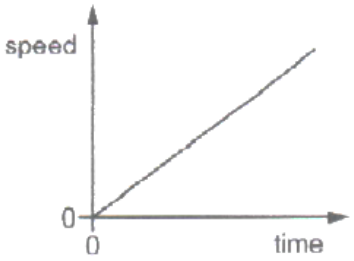
$= \frac{12-6}{30-10}$

$= \frac{6}{20}$

$= 0.3\,m/s$

16. June/2023/Paper_0625/12/No.2

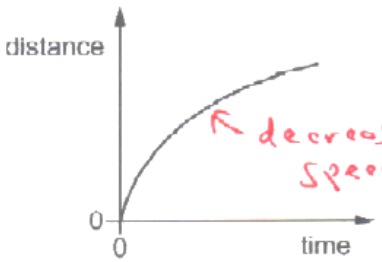
The speed–time graph represents a short journey.



← Speed is increasing with time - so distance increases with time also.

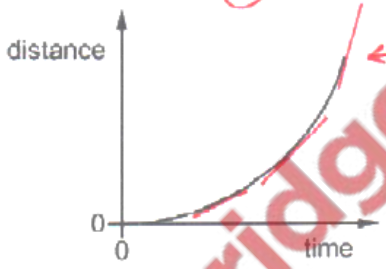
Which distance–time graph represents the same journey?

A



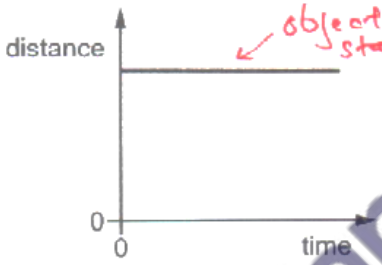
↖ decreasing speed

B ✓



← Increasing gradient means increasing speed.

C



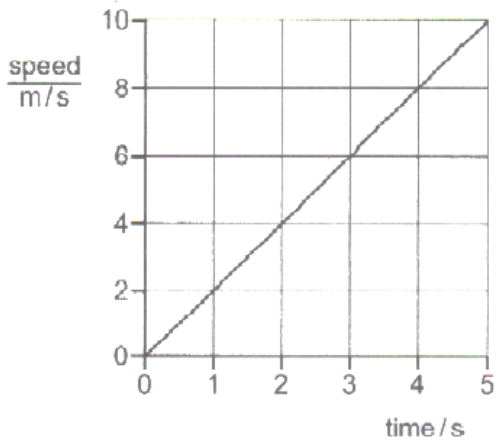
← object is stationary

D

← Speed is constant since gradient is same.

17. June/2023/Paper_0625/12/No.3

The graph represents the motion of a car.



distance travelled = Area under the graph.

$A = \frac{1}{2} \times b \times h$

$= \frac{1}{2} \times 5 \times 10$

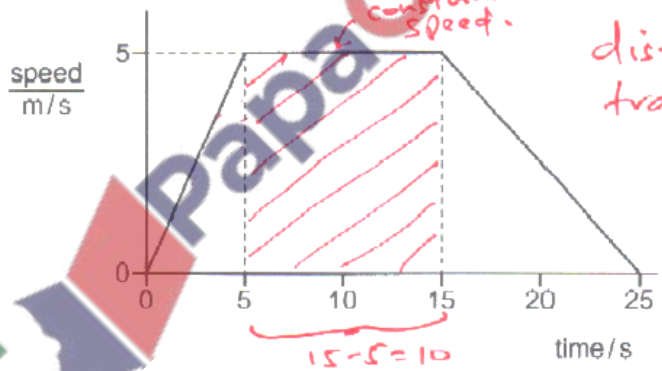
$= 25\ m$

How far has the car moved between 0 and 5 s?

A 2 m B 10 m C 25 m D 50 m

18. June/2023/Paper_0625/13,23/No.2

The speed–time graph shows the motion of an object.



distance travelled = Area under graph

$A = l \times w$

$= 10 \times 5$

$= 50\ m$

How far does the object travel at constant speed?

A 25 m B 50 m C 75 m D 125 m

19. June/2023/Paper_0625/13/No.3

A rock falls off a cliff onto a beach. The effect of air resistance on the rock is negligible.

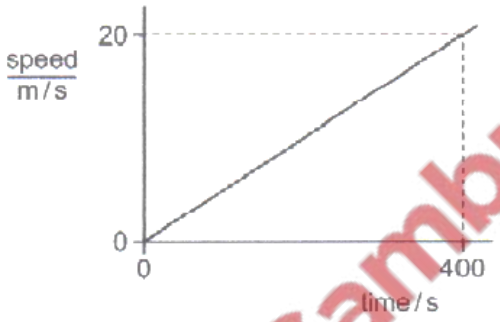
Which row describes the acceleration and speed of the rock as it falls?

	acceleration	speed
A	constant ✓	constant
(B)	constant ✓	increasing ✓
C	increasing	constant
D	increasing	increasing

- Acceleration is $9.8\ m/s^2$ which is constant, since there is no air resistance to oppose motion
- Since rock is accelerating, its speed increases.

20. June/2023/Paper_0625/21/No.3

The graph represents the motion of a vehicle.



In s-t graph,
distance travelled = Area under graph

Area $= \frac{1}{2} \times b \times h$.

$= \frac{1}{2} \times 400 \times 20$

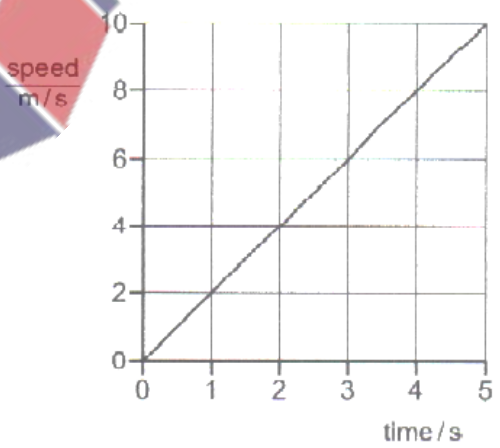
$= 4000\ m$

What is the distance travelled by the vehicle in 400 s?

A 20 m B 400 m (C) 4000 m D 8000 m

21. June/2023/Paper_0625/22/No.3

The graph represents the motion of a car.



distance travelled = Area under graph

Area $= \frac{1}{2} \times b \times h$

$= \frac{1}{2} \times 5 \times 10\ m/s$

$= 25\ m$

How far has the car moved between 0 and 5 s?

A 2 m B 10 m (C) 25 m D 50 m

22. June/2023/Paper_0625/23/No.3

An aircraft is moving at 60 m/s in a northerly direction when a cross-wind from the east starts to blow. The speed of the wind is 13 m/s.

What is the magnitude of the aircraft's velocity when the wind is blowing?

A 47 m/s B 59 m/s C 61 m/s D 73 m/s

13 m/s
60 m/s
$m = \sqrt{13^2 + 60^2}$
$= 61$ m/s North West

23. June/2023/Paper_0625/31/No.1

A cyclist is travelling along a straight road. Fig. 1.1 shows the speed–time graph for the cyclist. The graph is divided into four sections labelled P, Q, R and S.

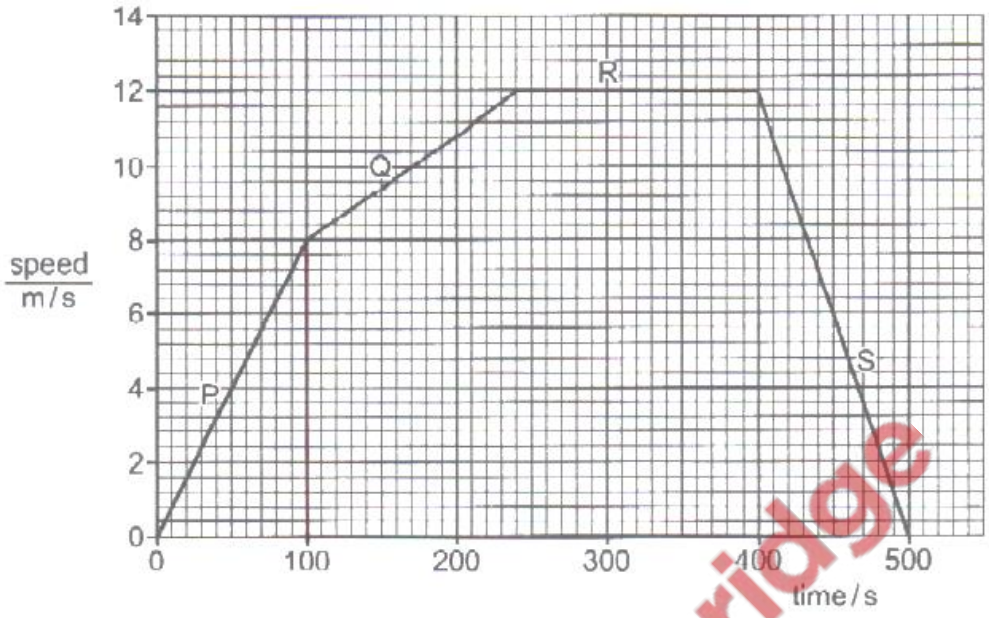


Fig. 1.1

(a) Calculate the distance travelled by the cyclist in section P from time = 0 to time = 100 s.

distance travelled = Area under graph

$A = \frac{1}{2} \times 100 \times 8$

$= 400\,m$

distance travelled = 400 m [3]

(b) Describe the motion of the cyclist in each of sections Q, R and S shown in Fig. 1.1.

Q Cyclist is accelerations

R cyclist is at constant speed

S cyclist is decelerating

[3]

(c) The cyclist is moving north along the road.

Determine the velocity of the cyclist at time = 300 s. Include the unit.

velocity of cyclist = 12 m/s North. [2]

Velocity is a vector, so it has a size and direction

[Total: 8]

24. June/2023/Paper_0625/32/No.2(a, b)

Fig. 2.1 shows the speed–time graph for a cyclist.

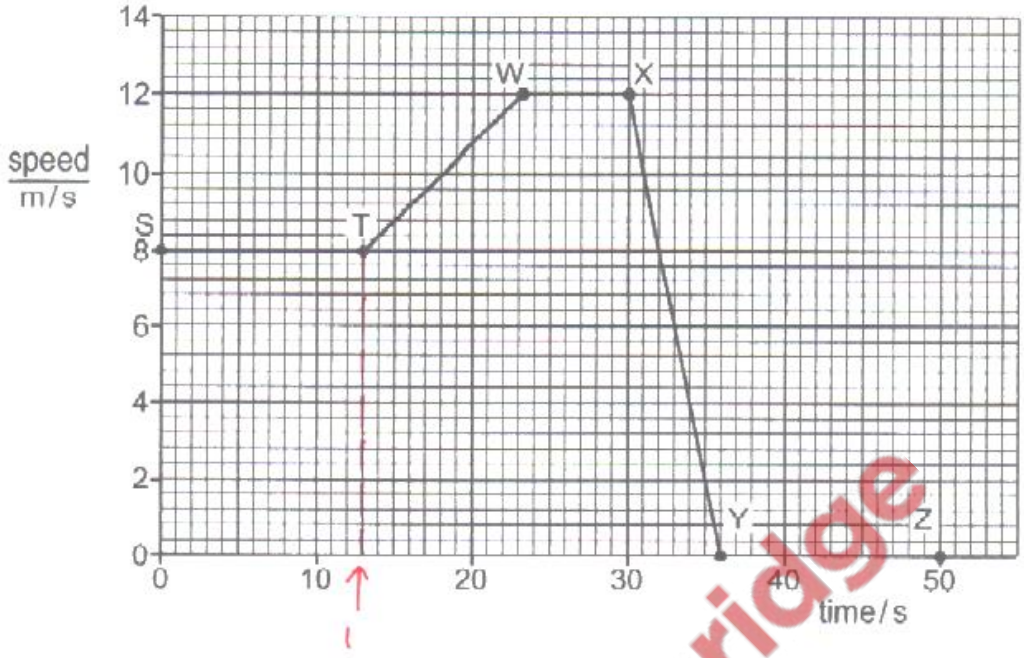


Fig. 2.1

(a) In Fig. 2.1, the sections ST, TW, WX, XY and YZ indicate stages of the cyclist's journey.

State **one** section which shows the cyclist moving with:

(i) constant speed

ST or WX ..... [1]

(ii) constant deceleration

XY ..... [1]

(iii) constant non-zero acceleration.

TW or XY ..... [1]

(b) Calculate the distance travelled by the cyclist in section ST.

distance travelled = Area under graph

Area = l × w

= 13 × 8

= 104 m

distance travelled = 104 m [3]

≈ 100 m (2 s.f).

25. June/2023/Paper_0625/33/No.1

Fig. 1.1 shows the distance–time graph for an engineer's journey.
She drives from her home directly to her office and parks the car.
She then drives from her office to her friend's house and parks the car.

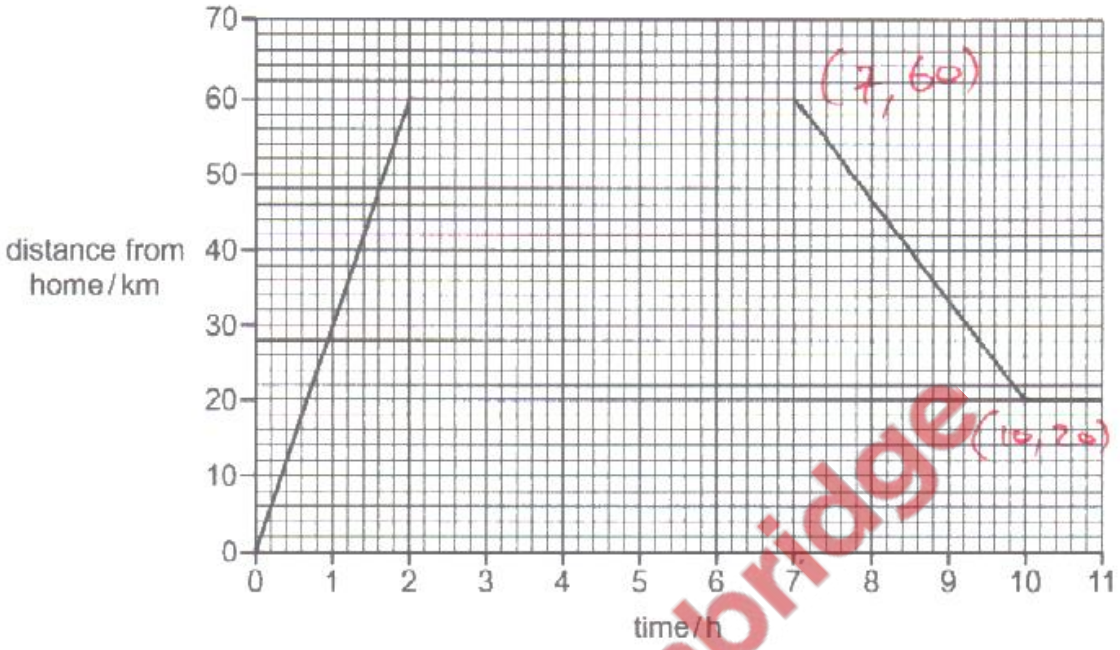


Fig. 1.1

(a) Determine the distance between:

(i) the engineer's home and her office ..... 60 km ..... km [1]

(ii) the engineer's office and her friend's house. ..... 60 − 20 = 40 km ..... km [1]

(b) Determine the time taken to travel between:

(i) the engineer's home and her office ..... 2 h ..... h [1]

(ii) the engineer's office and her friend's house. ..... 10 − 7 = 3 h ..... h [1]

(c) Calculate the speed of the car between time = 7 h and time = 10 h.

Gradient = Speed

$G = \frac{\Delta y}{\Delta x}$

$= \frac{60-20}{10-7}$

$= \frac{40}{3}$

$= 13 \text{ km/s}$

speed = ... 13 ..... km/h [3]

[Total: 7]

26. June/2023/Paper_0625/41/No.2

Fig. 2.1 shows a motorcyclist accelerating along a straight horizontal section of track.

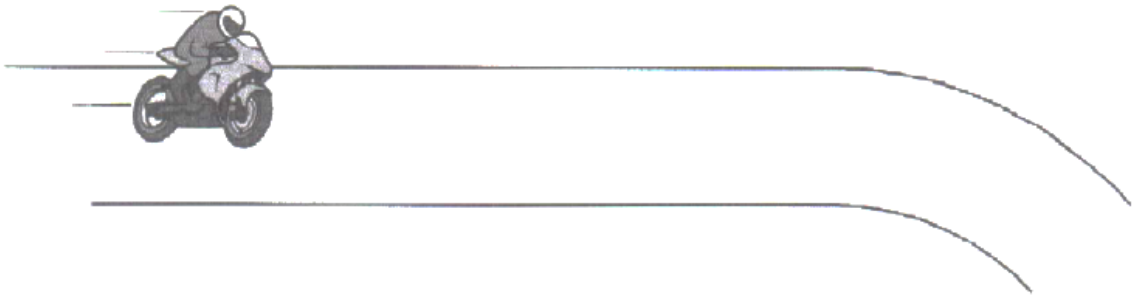


Fig. 2.1

The motorcyclist and motorcycle have a combined mass of 240 kg.

(a) On the straight horizontal section of the track, the motorcyclist accelerates from rest at $7.2\,m/s^2$.

(i) The motorcyclist reaches the end of the straight section of track in 5.3 s.

Calculate the speed of the motorcyclist at the end of the straight section.

$V = u + at$

$= 0 + (7.2 \times 5.3)$

$= 38\ m/s$

speed = 38 m/s [2]

(ii) Calculate the resultant force on the motorcyclist and motorcycle on the straight section of track.

$R.f = m \times a$

$= 240\ kg \times 7.2\ m/s^2$

$= 1728\ N$

$= 1700\ N$

resultant force = 1700 N [2]

27. June/2023/Paper_0625/43/No.1(c, d)

(c) The balloon accelerates upwards from rest at 0.45 m/s^2 for 8.0 s.

Calculate the velocity of the balloon after 8.0 s.

$u = 0$
$a = 0.45\ m/s^2$
$v = ?$
$t = 8.0\ s$
$v = u + at$

$v = 0 + (0.45 \times 8.0)$
$= 3.6\ m/s$

velocity = 3.6 m/s [2]

(d) Calculate the distance travelled by the balloon in the first 8.0 s.

$av.\ speed = \frac{3.6}{2}$
$= 1.8\ m/s$

$av.\ speed = \frac{distance}{time}$

$distance = av.\ speed \times time$
$= 1.8 \times 8$
$= 14.4\ m$
$\approx 14\ m$

distance = 14m. [2]