Unit 2: Atoms, molecules and stoichiometry

Subunit 2.1: Relative masses of atoms and molecules

Topical Question No: 1

6 An object has an initial velocity u and an acceleration a. The object moves in a straight line through a displacement s and has final velocity v.

The above quantities are related by the equation shown.

$$v^2 = u^2 + 2as$$

Which condition **must** be satisfied in order for this equation to apply to the motion of the object?

A The direction of a is constant and the direction of a is the same as the direction of s.

B The direction of a is constant and the direction of a is the same as the direction of u.

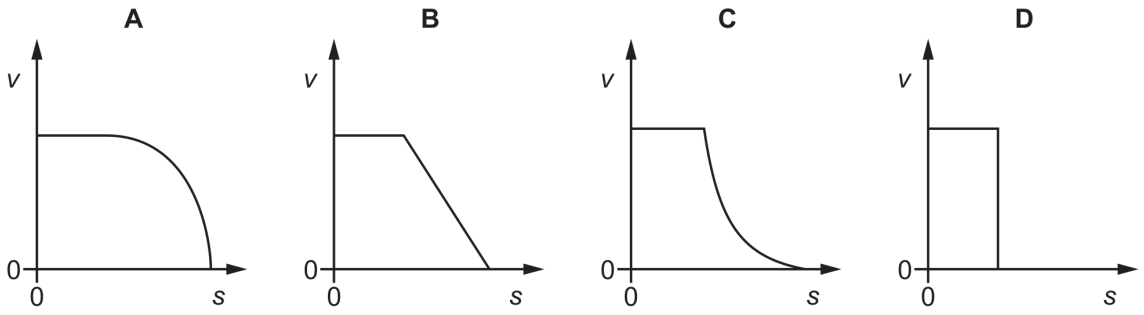
C The magnitude of a is constant and the direction of a is constant.

D The magnitude of a is constant and the direction of a is the same as the direction of v.

Topical Question No: 2

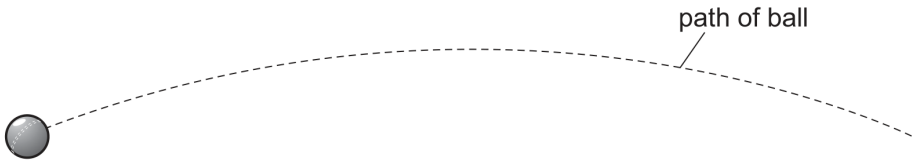
7 A car is travelling at constant velocity. Its brakes are then applied, causing uniform deceleration.

Which graph shows the variation with distance s of the velocity v of the car?



Topical Question No: 3

8 A ball is thrown across a flat field.



Which statement describes the motion of the ball, when the effects of air resistance are ignored?

A The ball lands with the same velocity at which it is thrown.

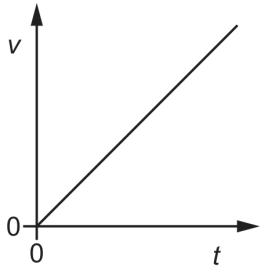
B The horizontal component of acceleration is constant throughout the motion.

C The horizontal and vertical components of acceleration are both zero at the highest point of the motion.

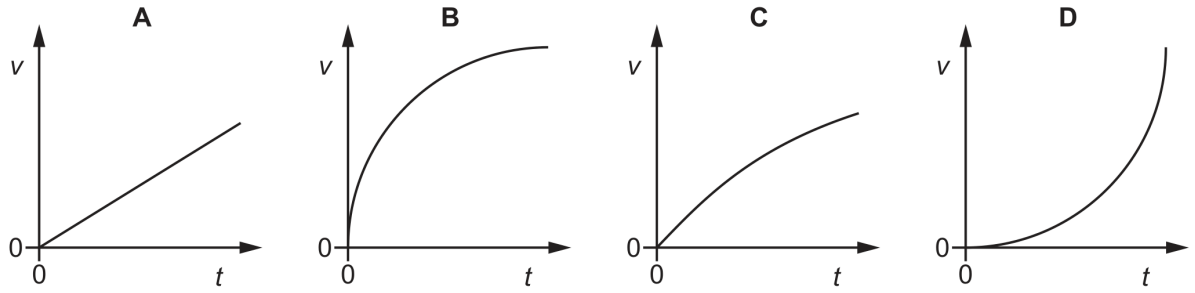
D The horizontal and vertical components of velocity are both zero at the highest point of the motion.

Topical Question No: 4

11 An object falls freely from rest in a vacuum. The graph shows the variation with time t of the velocity v of the object.



Which graph, using the same scales, represents the object falling in air?



Topical Question No: 5

6 An aircraft, initially stationary on a runway, takes off with a speed of 85 km h^{-1} in a distance of no more than 1.20 km.

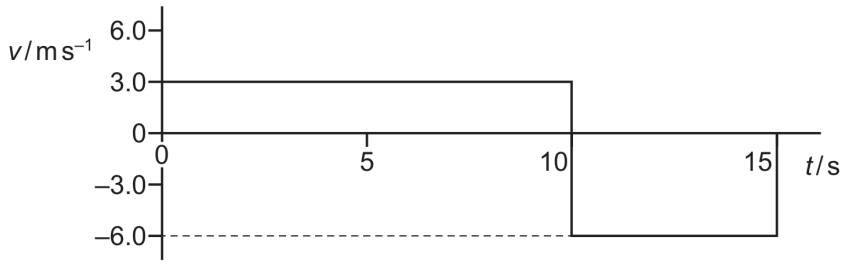
What is the minimum constant acceleration necessary for the aircraft?

A 0.23 m s^{-2} **B** 0.46 m s^{-2} **C** 3.0 m s^{-2} **D** 6.0 m s^{-2}

Topical Question No: 6

7 A radio-controlled toy car travels along a straight line for a time of 15 s.

The variation with time *t* of the velocity *v* of the car is shown.

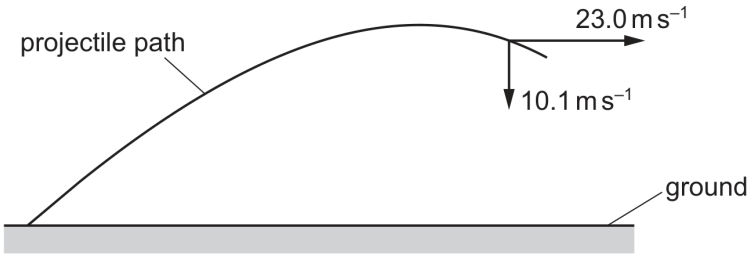


What is the average velocity of the toy car for the journey shown by the graph?

A $-1.5\,m\,s^{-1}$ **B** $0.0\,m\,s^{-1}$ **C** $4.0\,m\,s^{-1}$ **D** $4.5\,m\,s^{-1}$

Topical Question No: 7

18 A projectile is thrown at an angle to the ground.



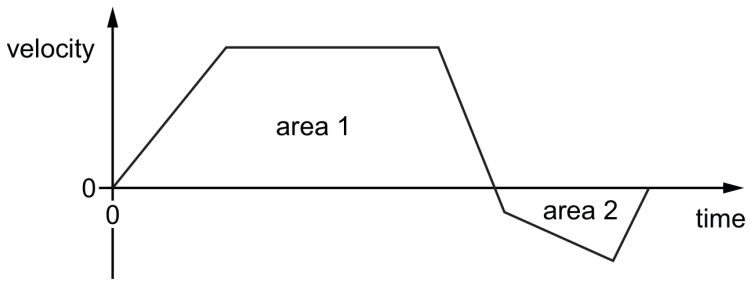
At a certain time, the projectile has a horizontal velocity of $23.0\,m\,s^{-1}$ and a vertical velocity of $-10.1\,m\,s^{-1}$.

What is the speed of the projectile at this time?

A $12.9\,m\,s^{-1}$ **B** $20.7\,m\,s^{-1}$ **C** $25.1\,m\,s^{-1}$ **D** $33.1\,m\,s^{-1}$

Topical Question No: 8

8 The velocity-time graph for an object is shown.



How can the total displacement of the object be determined?

A area 1 – area 2

B $\frac{(\text{area 1} + \text{area 2})}{2}$

C area 1 + area 2

D area 2 – area 1

Topical Question No: 9

9 A girl throws a ball vertically upwards. It takes a time of 3.20 s to return to her hand.

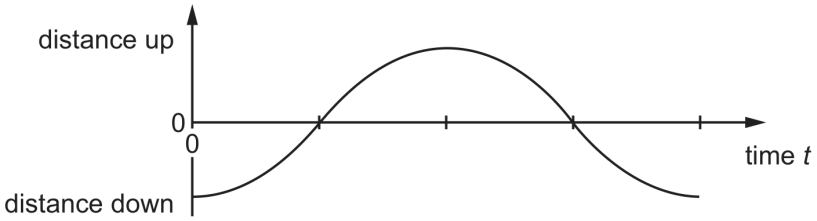
Assume air resistance is negligible.

What is the initial speed with which the ball is thrown?

A $3.07\,m\,s^{-1}$ **B** $7.85\,m\,s^{-1}$ **C** $15.7\,m\,s^{-1}$ **D** $31.4\,m\,s^{-1}$

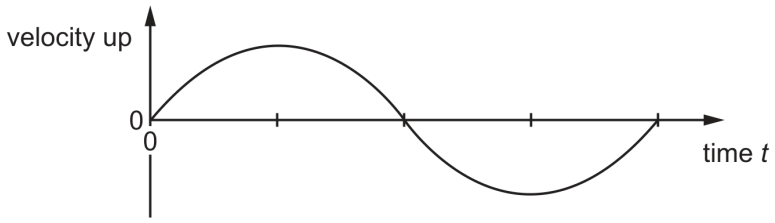
Topical Question No: 10

6 A mass on the end of a spring bounces up and down as shown, after being released at time $t = 0$.

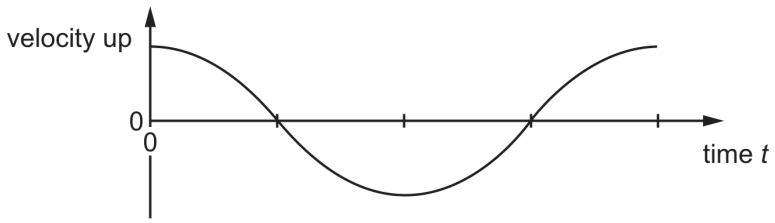


Which graph shows how the velocity varies with time?

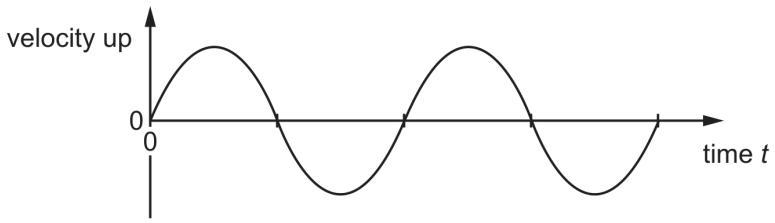
A



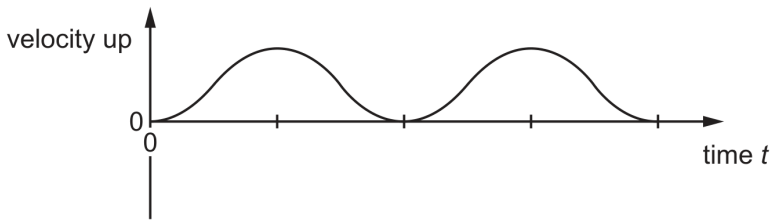
B



C



D



Topical Question No: 11

7 A stone is thrown vertically upwards from a point that is 12 m above the sea. It then falls into the sea below after 3.4 s.

Air resistance is negligible.

At which speed was the stone released when it was thrown?

A $3.5\,m\,s^{-1}$ **B** $6.6\,m\,s^{-1}$ **C** $13\,m\,s^{-1}$ **D** $20\,m\,s^{-1}$

Topical Question No: 12

9 In the absence of air resistance, a ball thrown horizontally from a tower with velocity *v*, will land after time *T* seconds.

If, however, air resistance is taken into account, which statement is correct?

A The ball lands with a horizontal velocity less than *v* after more than *T* seconds.

B The ball lands with a horizontal velocity less than *v* after *T* seconds.

C The ball lands with a horizontal velocity *v* after more than *T* seconds.

D The ball lands with a horizontal velocity *v* after *T* seconds.

Topical Question No: 13

5 How can the acceleration of an object be determined?

A from the area under a displacement–time graph

B from the area under a velocity–time graph

C from the gradient of a displacement–time graph

D from the gradient of a velocity–time graph

Topical Question No: 14

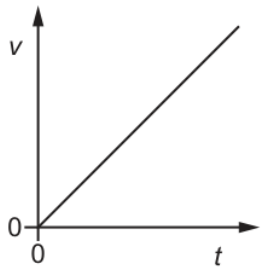
6 A sprinter takes a time of 11.0 s to run a 100 m race. She first accelerates uniformly from rest, reaching a speed of $10\,m\,s^{-1}$. She then runs at a constant speed of $10\,m\,s^{-1}$ until the finish line.

What is the uniform acceleration of the sprinter for the first part of the race?

A $0.5\,m\,s^{-2}$ **B** $0.91\,m\,s^{-2}$ **C** $1.7\,m\,s^{-2}$ **D** $5.0\,m\,s^{-2}$

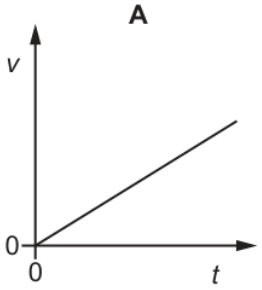
Topical Question No: 15

9 An object falls freely from rest in a vacuum. The graph shows the variation with time t of the velocity v of the object.

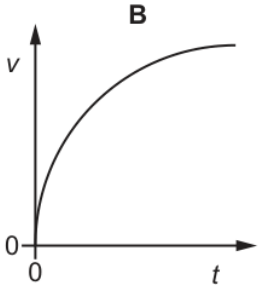


Which graph, **using the same scales**, represents the object falling in air?

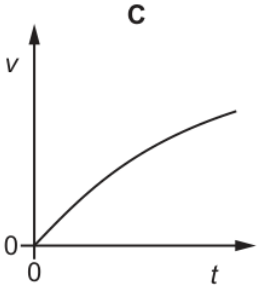
A



B



C



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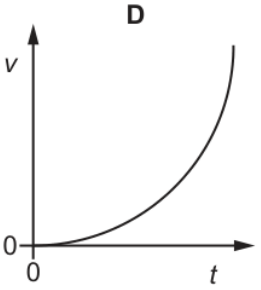
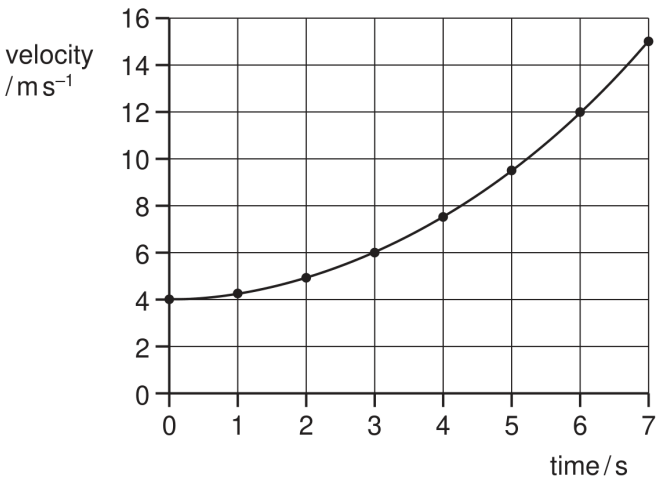


Topical Question No: 16

8 The diagram shows a velocity-time graph for a vehicle.



The vehicle, moving at 4.0 m s^{-1}, begins to accelerate at time = 0.

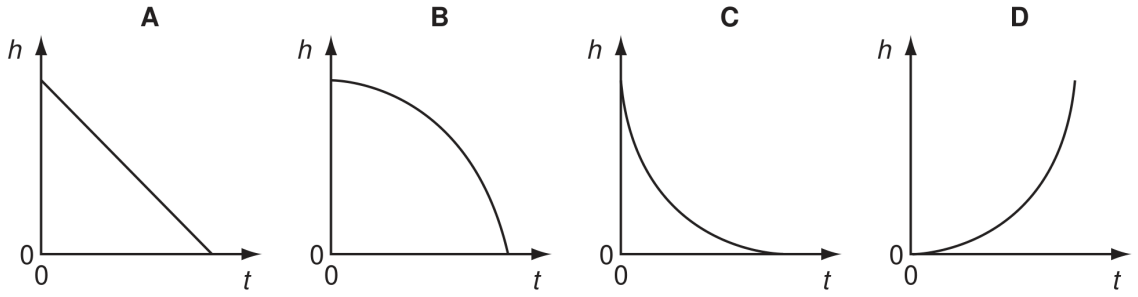
What is the vehicle's acceleration at time = 3.0 s?

A 0.67 m s^{-2} **B** 1.0 m s^{-2} **C** 1.3 m s^{-2} **D** 2.0 m s^{-2}

Topical Question No: 17

9 A small steel ball falls freely under gravity after being released from rest.

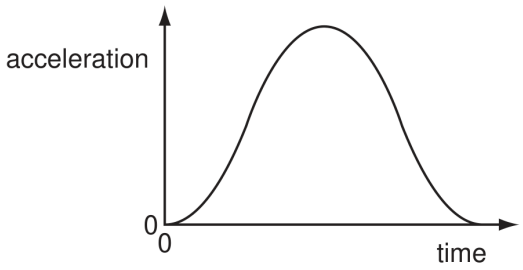
Which graph best represents the variation of the height *h* of the ball with time *t*?



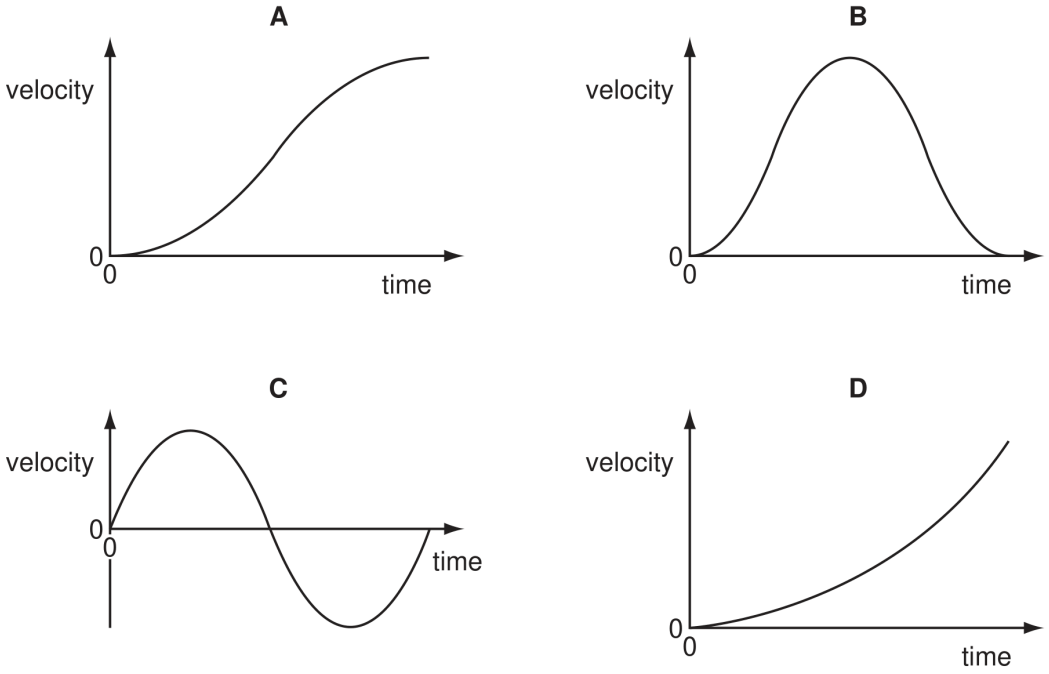
Space for working

Topical Question No: 18

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

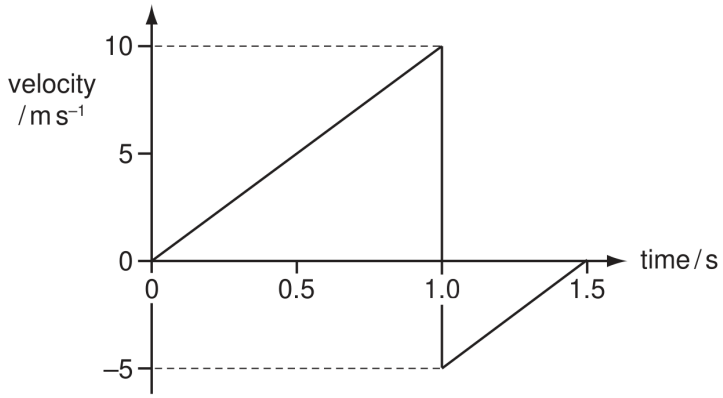


Which graph shows the variation with time of the velocity of the object?



Space for working

7 A ball is released from rest at time zero. After 1.0 s it bounces inelastically from a horizontal surface and rebounds, reaching the top of its first bounce after 1.5 s.



What is the total displacement of the ball from its original position after 1.5 s?

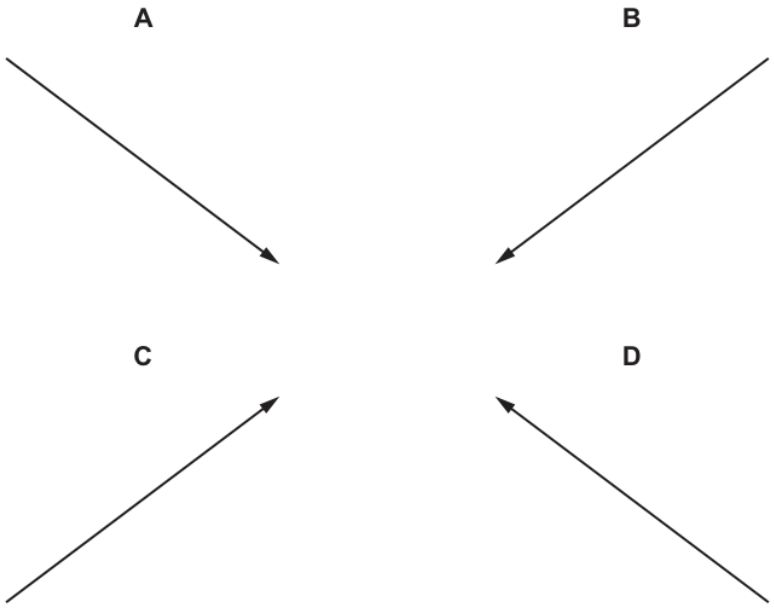
A 1.25 m **B** 3.75 m **C** 5.00 m **D** 6.25 m

Space for working

Topical Question No: 20

4 An object is moving with an initial velocity of $4.0\,m\,s^{-1}$ to the right. The velocity of the object changes so that its final velocity is $3.0\,m\,s^{-1}$ downwards, as shown.

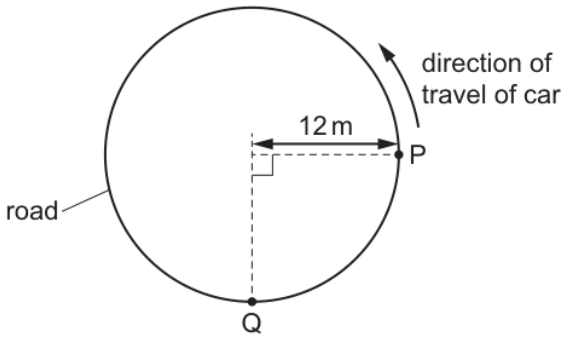
Which arrow represents the change in velocity of the object?



Topical Question No: 21

5 A car travels anticlockwise along a horizontal circular road of radius 12 m, as shown.

The car takes a time of 4.0 s to move from position P to position Q.

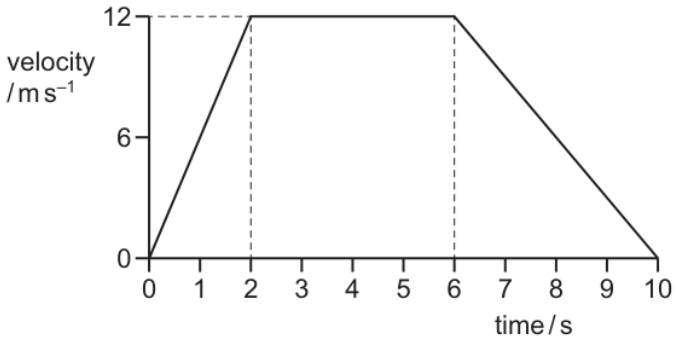


What is the magnitude of the average velocity of the car for the journey from P to Q?

A $4.2\,m\,s^{-1}$ **B** $4.7\,m\,s^{-1}$ **C** $6.0\,m\,s^{-1}$ **D** $14\,m\,s^{-1}$

Topical Question No: 22

6 The graph shows the variation with time of the velocity of a car.



Which statement is correct?

A The car accelerates for 2 s, then stops for 4 s and then reverses.

B The car accelerates at 12 m s^{-2} for 2 s.

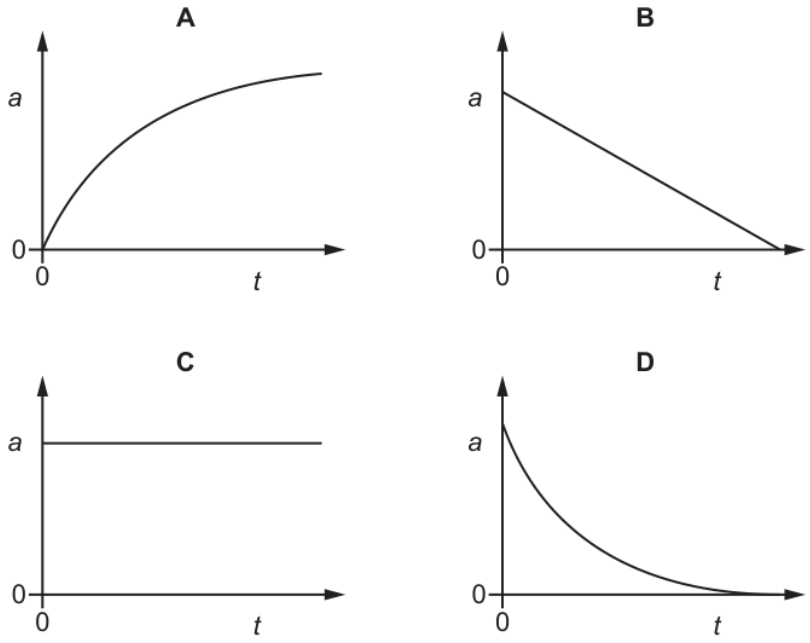
C The car travels a distance of 36 m in the first 4 s.

D The car travels a distance of 48 m in the last 4 s.

Topical Question No: 23

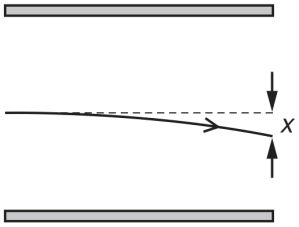
12 A stone is released from rest and falls a long distance in air.

Which graph could show the variation with time *t* of the acceleration *a* of the stone?



Topical Question No: 24

32 The path of an electron with initial speed v in the uniform electric field between two parallel plates is shown.



The vertical deflection x is measured at the right-hand edge of the plates.

The distance between the plates is halved. The potential difference between the plates remains the same.

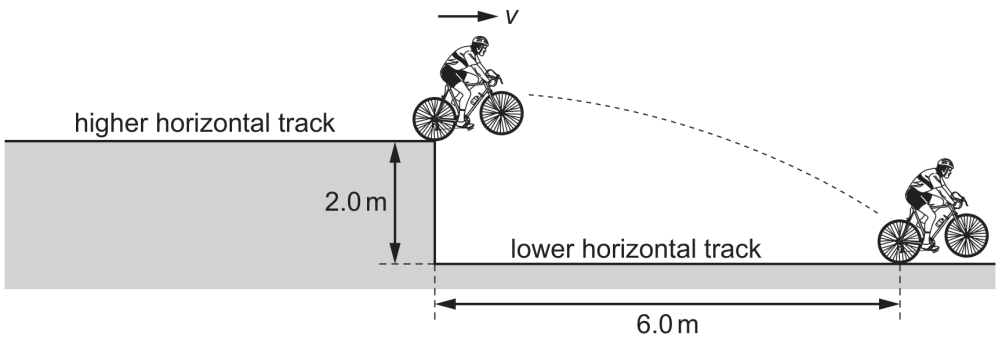
What will be the new deflection of the electron with the same initial speed v?

A x **B** $\sqrt{2}x$ **C** $2x$ **D** $4x$

Space for working

Topical Question No: 25

6 A cyclist pedals along a raised horizontal track. At the end of the track, he travels horizontally into the air and onto a track that is vertically 2.0 m lower.



The cyclist travels a horizontal distance of 6.0 m in the air. Air resistance is negligible.

What is the horizontal velocity v of the cyclist at the end of the higher track?

A $6.3\,m\,s^{-1}$ **B** $9.4\,m\,s^{-1}$ **C** $9.9\,m\,s^{-1}$ **D** $15\,m\,s^{-1}$

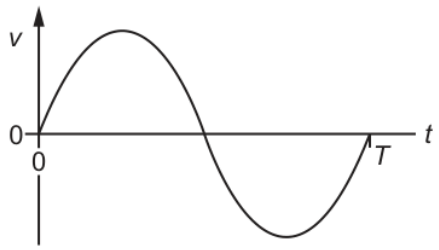
Topical Question No: 26

6 A lead sphere is released from rest at point X, a long way above the surface of a planet. The sphere falls in a vacuum. After a time of 4.0 s, it has fallen through a vertical distance of 3.0 m. Assume the acceleration of free fall is constant.

How far will the sphere have fallen from point X at a time of 20 s after its release?

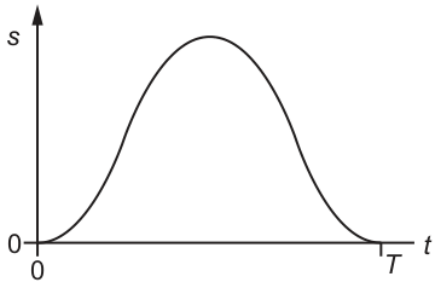
A 15 m **B** 75 m **C** 80 m **D** 2000 m

6 The graph shows how the velocity v of an object moving in a straight line varies with time t from $t = 0$ to $t = T$.

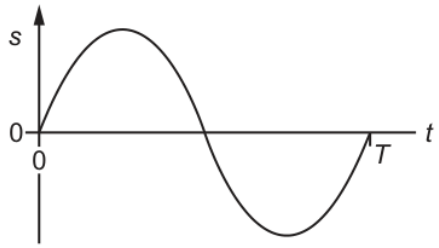


Which graph could represent the displacement s of the object from time $t = 0$ to $t = T$?

A



B



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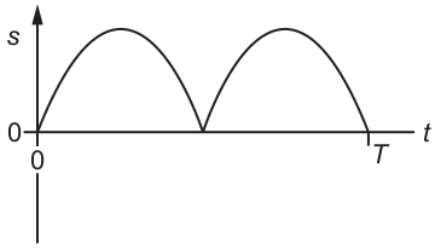

D