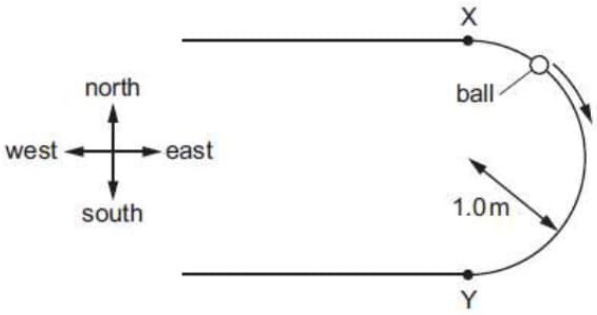
2. Kinematics displacement, distance and velocity

Basics

Q1 (8/M/J/16/13)

A ball travels from point X to point Y around a semi-circular track of radius 1.0 m as shown.



What is the displacement of the ball from X to Y?

A	2.0 m	B	2.0 m due south
C	3.1 m	D	3.1 m due south

Q2 (6/O/N/13/12)

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?

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.

Q3 (9/O/N/12/11)

A ball is thrown vertically in air.

Neglecting air resistance, which property of the ball can never be zero at any time during the flight?

A	acceleration	B	kinetic energy
C	speed	D	velocity

Graphs

Q1 (4/M/J/17/11)

The values of displacement, velocity and acceleration of a vehicle can be deduced from graphs representing its motion. Often the areas under these graphs, or the gradients of the graphs, are used.

What would not give a value for a displacement, a velocity or an acceleration?

A area under a velocity-time graph
B gradient of a displacement-time graph
C gradient of a velocity-time graph
D gradient of an acceleration-time graph

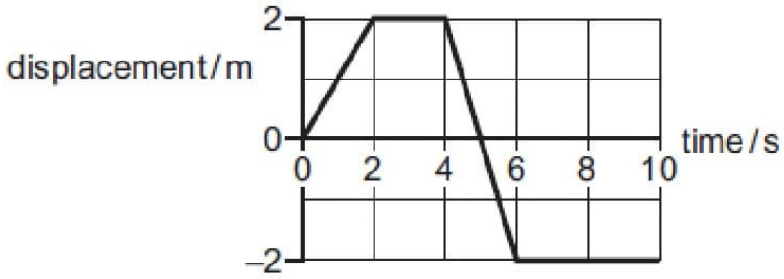
Q2 (6/M/J/07/1)

What gives the value of a body's acceleration?

A the area under its displacement-time graph
B the area under its velocity-time graph
C the gradient of its displacement-time graph
D the gradient of its velocity-time graph

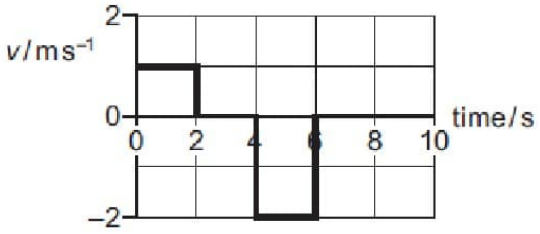
Q3 (6/M/J/17/13)

A displacement-time graph for a toy car is shown.

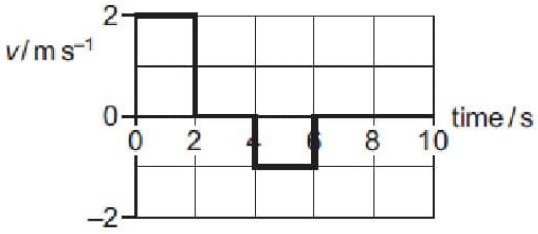


Which graph shows the variation with time of the velocity v of the car?

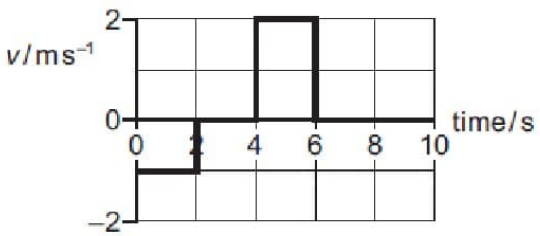
A



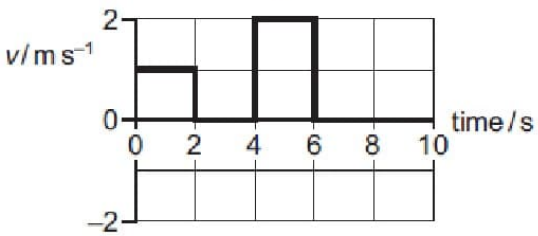
B



C

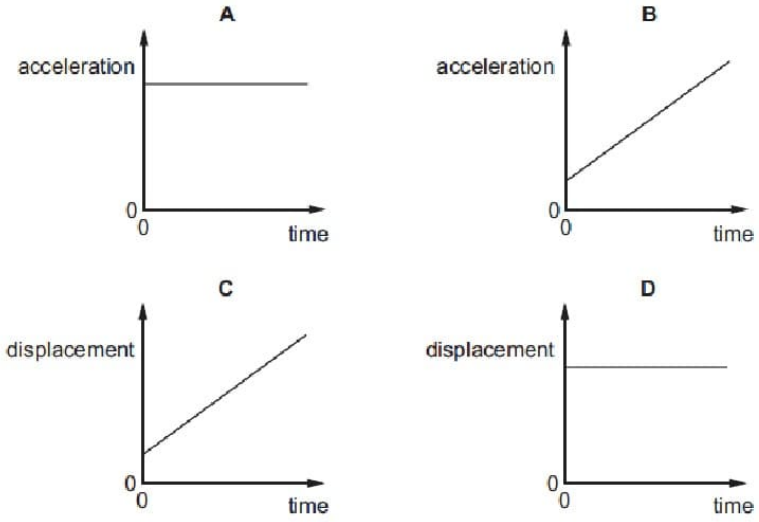


D



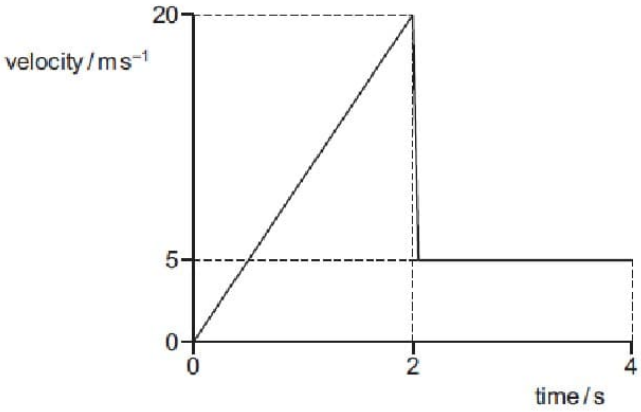
Q4 (6/O/N/14/12)

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



Q5 (8/O/N/15/11)

A stone is dropped from a height of 20 m above water. The graph shows the variation with time of the velocity of the stone.

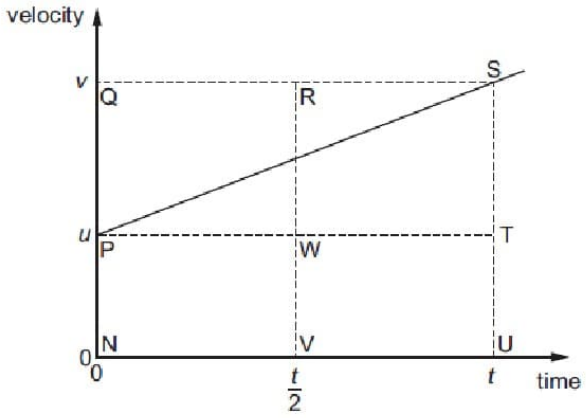


Which statement describes the approximate position of the stone four seconds after it is dropped?

A It is at a distance of 10m above the surface of the water
B it is at a distance of 10m below the surface of the water
C it is at a distance of 20m below the surface of the water
D it is at a distance of 30m below the surface of the water.

Q6 (6/M/J/16/11)

A car accelerates uniformly from velocity u to velocity v in time t.

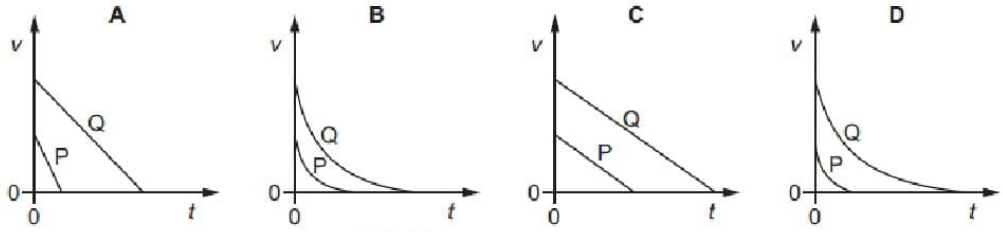


On the graph, which area equals the distance travelled by the car in time t?

A NPTU + PQST
B NPWV + VRSU
C NPWV + WRST
D PST + PQS

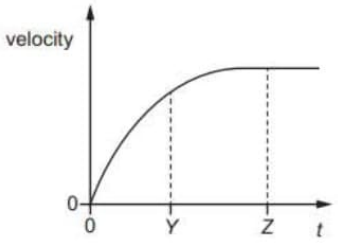
Q7 (7/O/N/17/13)

Two identical cars P and Q are travelling along a straight road. Car Q is travelling at twice the speed of car P. The brakes are applied to both cars, producing the same constant deceleration.
Which graph shows how the velocity v of each car varies with time t?



Q8 (9/O/N/20/12)

An object falls from a tall building.
The graph shows how the velocity of the object changes with time *t*.

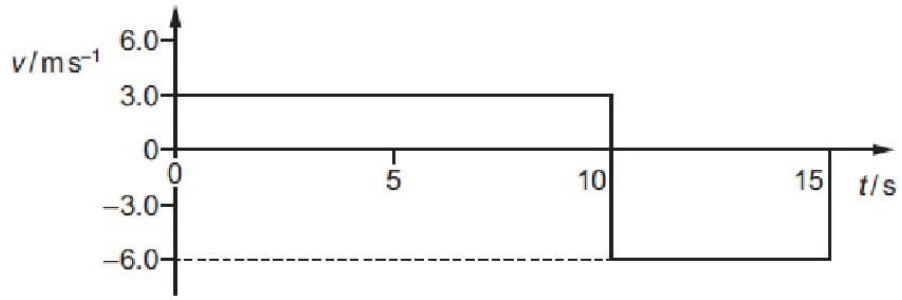


The acceleration of free fall is *g*.
What describes the acceleration of the object at times $t = Y$ and $t = Z$?

	acceleration at $t = Y$	acceleration at $t = Z$
A	decreasing	*g*
B	decreasing	0
C	constant	*g*
D	constant	0

Q9 (6/M/J14/12)

A radio-controlled toy car travels along a straight line for a time of 15s.The variation with time t of the velocity v of the car is shown below.

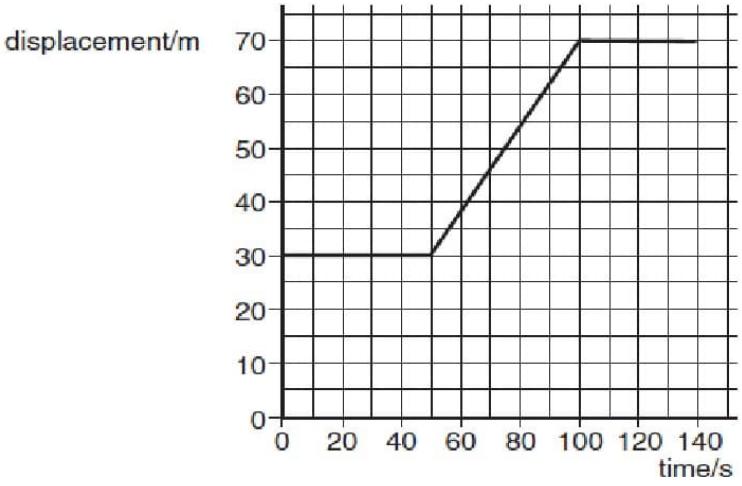


What is the average velocity of the toy car for the journey shown by the graph?

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

Q10 (7/O/N/03/1)

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.

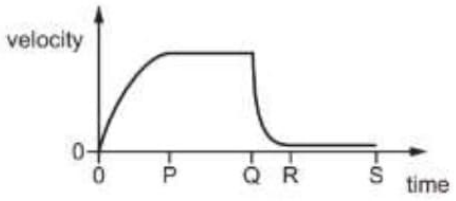


What is its speed while it is moving?

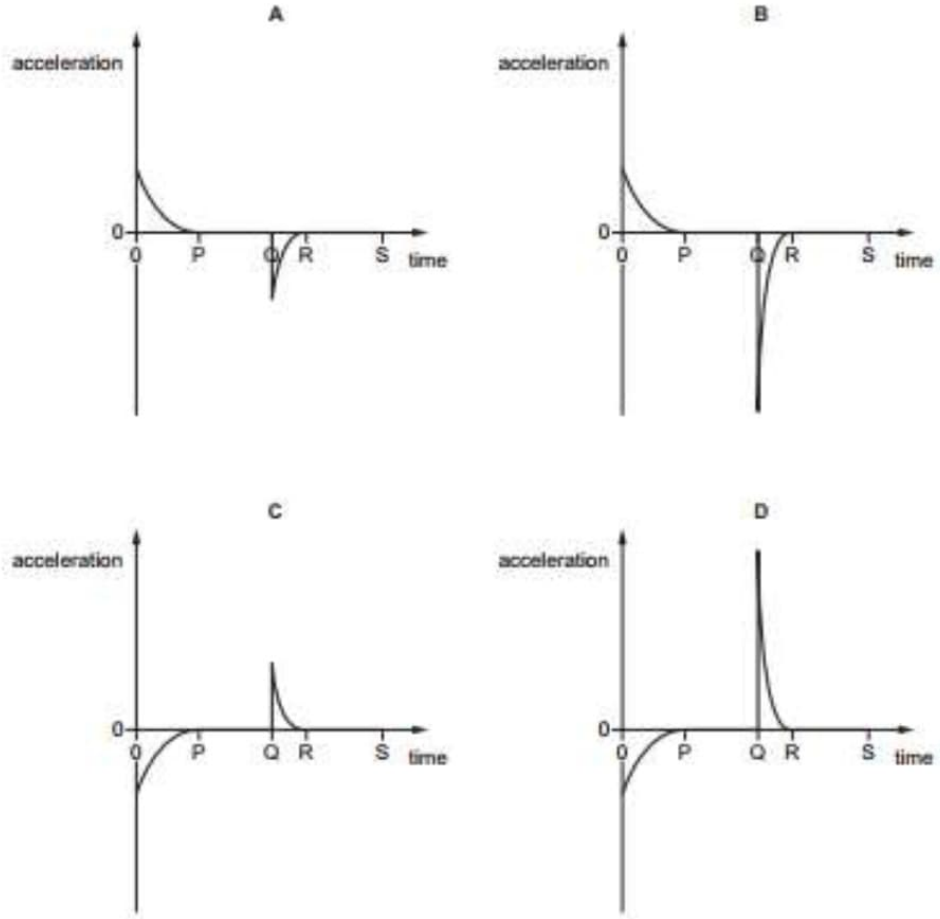
A $0.70\,m\,s^{-1}$ **B** $0.80\,m\,s^{-1}$ **C** $1.25\,m\,s^{-1}$ **D** $1.40\,m\,s^{-1}$

Q11 (5/O/N/23/11)

A parachutist falls from a stationary balloon at time $t = 0$. The velocity–time graph for the parachutist from time $t = 0$ until the time when he is just above the ground is shown.

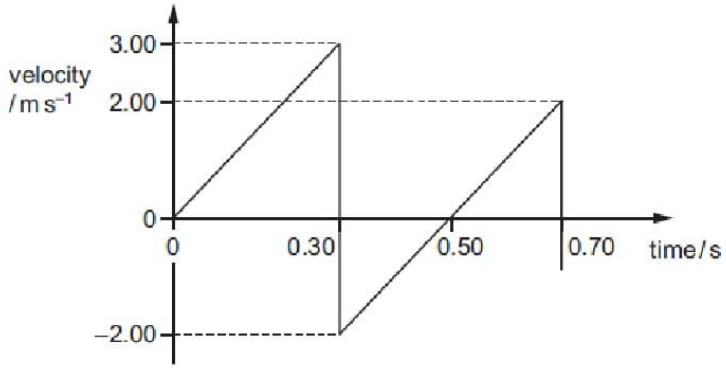


Which graph best shows the variation with time of the acceleration of the parachutist?



Q12 (9/O/N/15/12)

A ball is released from rest above a horizontal surface. It strikes the surface and bounces several times. The velocity-time graph for the first two bounces is shown.

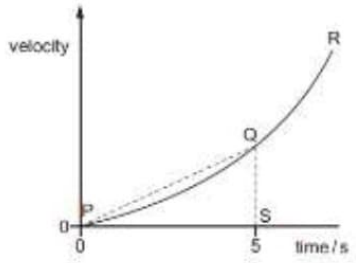


What is the maximum height of the ball after the first bounce?

A 0.20 m B 0.25 m C 0.45 m D 0.65 m

Q13 (8/O/N/15/12)

The curved line PQR is the velocity-time graph for a car starting from rest.

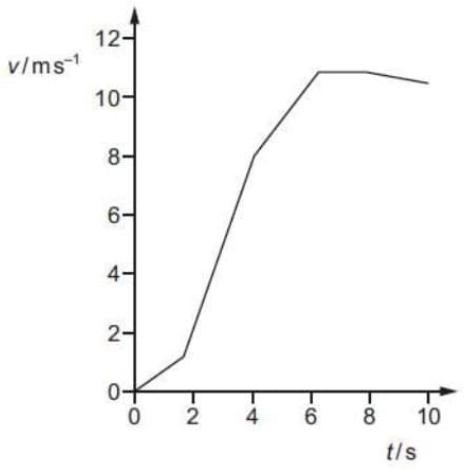


What is the average acceleration of the car over the first 5 s?

A the area below the curve PQ
B the area of the triangle PQS
C the gradient of the straight-line PQ
D the gradient of the tangent at Q

Q14 (9/M/J14/13)

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

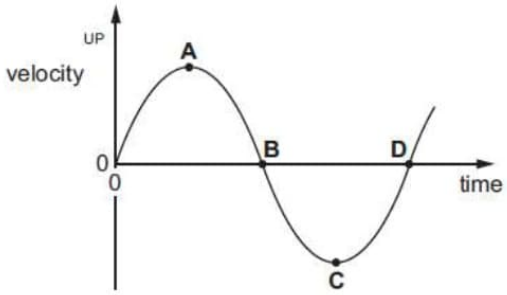


What is the best estimate of the maximum acceleration of the sprinter?

A $0.5\,m\,s^{-2}$ B $1\,m\,s^{-2}$ C $3\,m\,s^{-2}$ D $10\,m\,s^{-2}$

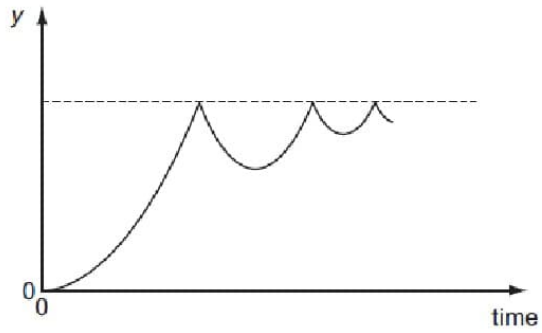
Q15 (7/O/N/14/13)

The diagram shows a velocity-time graph for a mass moving up and down on the end of a spring.
Which point represents the velocity of the mass when at the lowest point of its motion?



Q16 (8/M/J/13/12)

A ball is released from rest over a horizontal surface and bounces several times.
The graph shows how, how far this ball, a quantity varies with time.

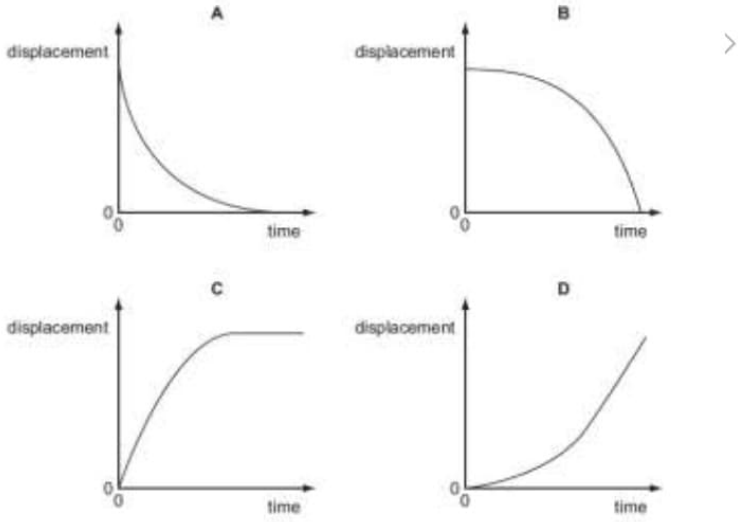


What is the quantity y?

A acceleration B displacement
C kinetic energy D velocity

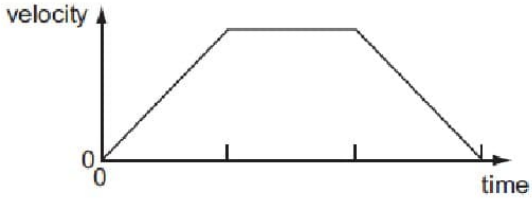
Q17 (7/M/J/15/11)

A sphere is released and falls. Its initial acceleration reduces until it eventually begins to travel at constant terminal velocity. Which displacement-time graph best represents the motion of the sphere?



Q18 (9/O/N/12/12)

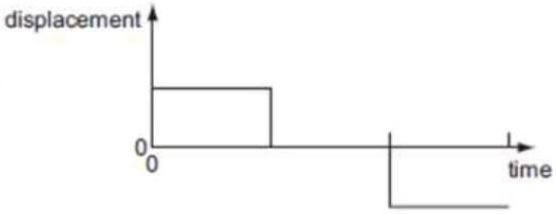
The graph of velocity against time for an object moving in a straight line is shown.



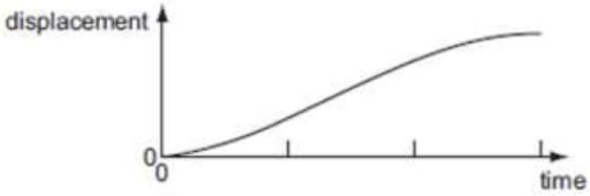
What is the corresponding graph of displacement against time?

A

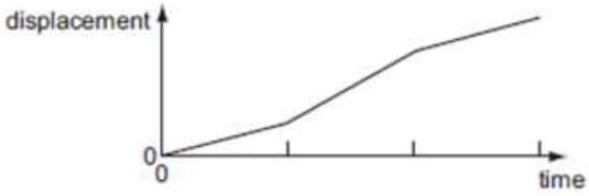
B



C



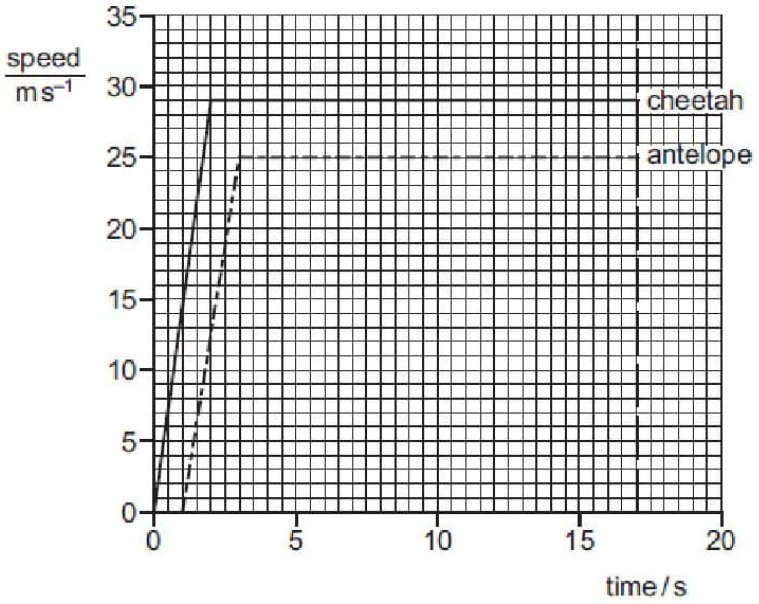
D



Yameen Jadoon

Q19 (8/O/N/15/13)

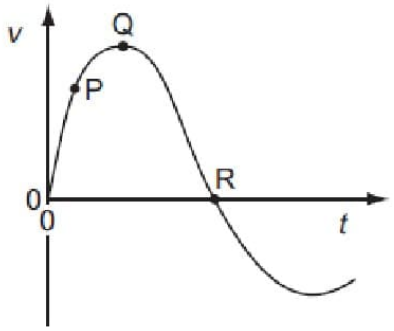
A cheetah and an antelope are 100 m apart. The cheetah spots the antelope and runs towards it. The antelope reacts to the cheetah after one second and runs directly away from the cheetah. Both animals take 2 seconds to reach their top speeds. The graph shows how the speeds of the two animals vary with time.



How far apart are the animals, 17 seconds after the cheetah began running?

A 4 m B 11 m C 54 m D 89 m

Q20 (7/O/N/13/12)



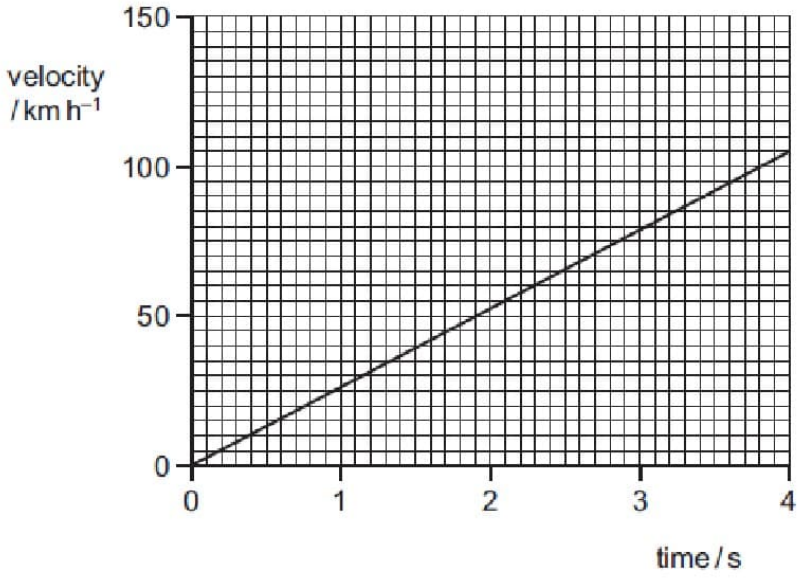
The graph shows how velocity v varies with time t for a bungee jumper.

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

Q21 (8/O/N/12/11)

The velocity of an electric car changes as shown.



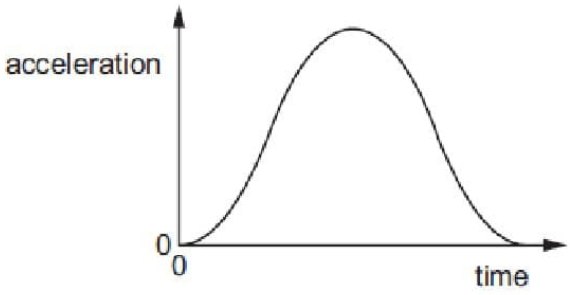
What is the acceleration of the car?

A $190\,m\,s^{-2}$ B $53\,m\,s^{-2}$ C $26\,m\,s^{-2}$ D $7.3\,m\,s^{-2}$

Jadoon

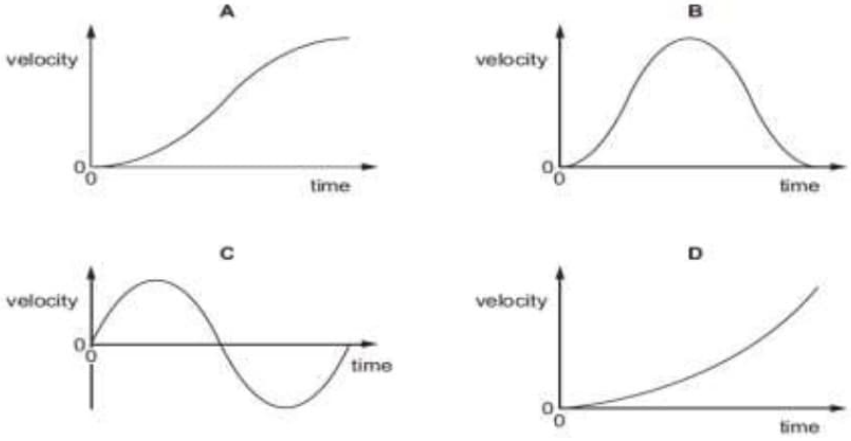
Q22 (8/M/J/14/11)

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



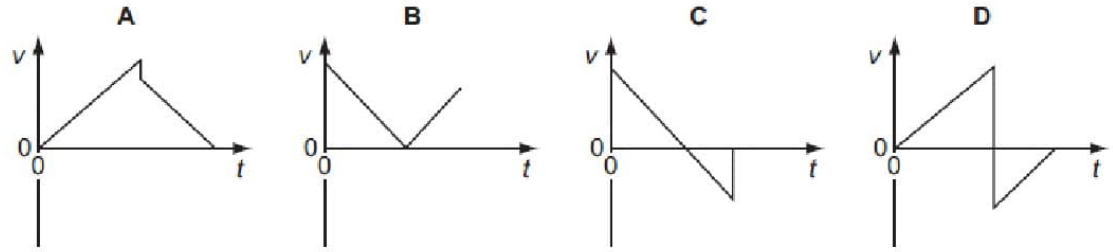
The object starts from rest.

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



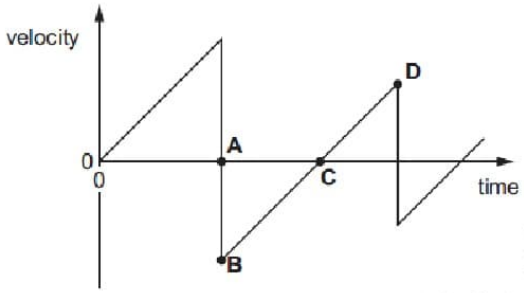
Q23 (9/O/N/12/13)

A ball is released from rest above a horizontal surface. It bounces once and is caught.
Which graph represents the variation with time t of the velocity v of the ball?



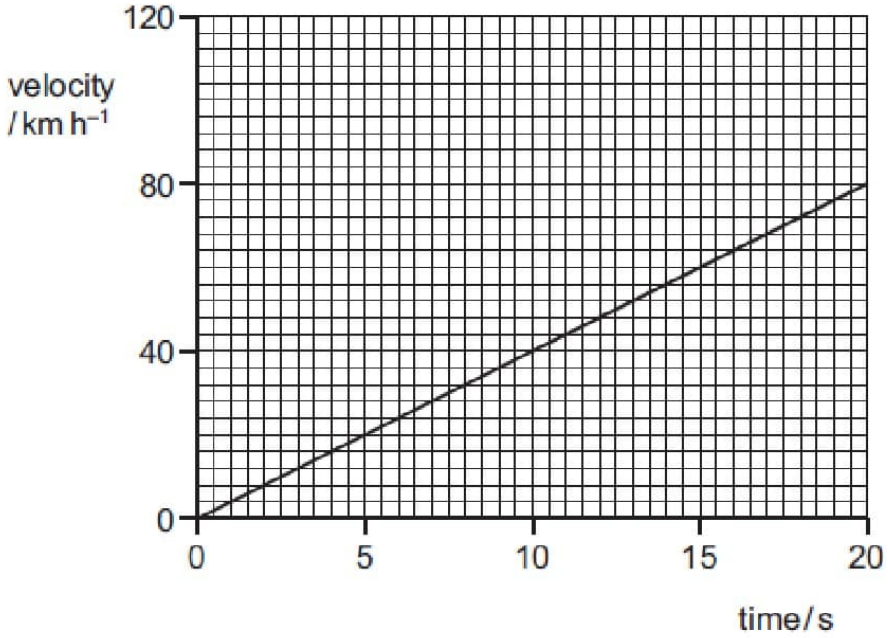
Q24 (5/M/J/17/11)

A ball is released from rest above a hard, horizontal surface. The graph shows how the velocity of the bouncing ball varies with time.
At which point on the graph does the ball reach its maximum height after the first bounce?



Q25 (11/O/N/12/12)

The velocity of a car changes as shown.

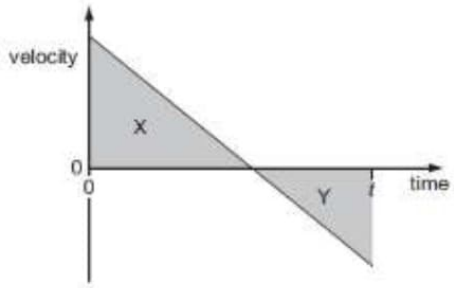


What is the acceleration of the car?

A $1.1\,m\,s^{-2}$ B $4.0\,m\,s^{-2}$ C $224\,m\,s^{-2}$ D $800\,m\,s^{-2}$

Q26 (8/O/N/10/11)

The velocity-time graph below is for a stone thrown vertically up into the air. Air resistance is negligible.

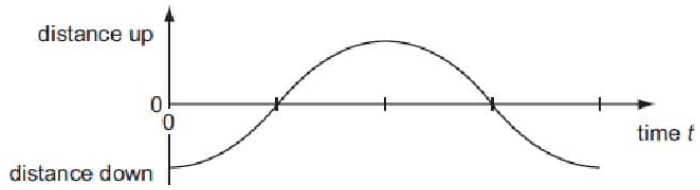


The stone is thrown up at time zero. Area X represents a distance of 5m. Area Y represents a distance of 3m. What is the displacement of the stone from its initial position at time t?

A 2 m B 3 m C 5 m D 8 m

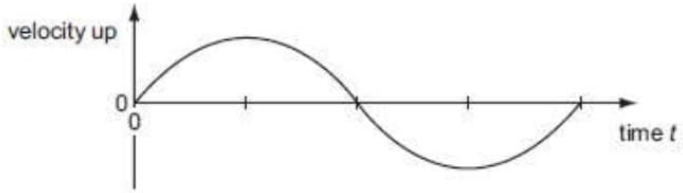
Q27 (10/O/N/12/13)

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

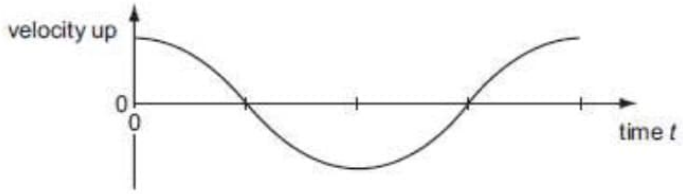


Which graph shows how the velocity varies with time?

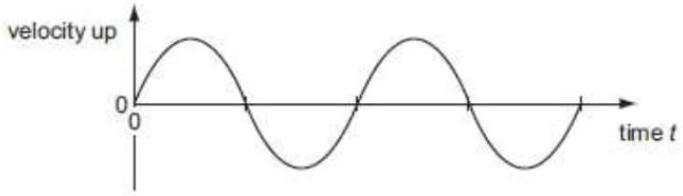
A



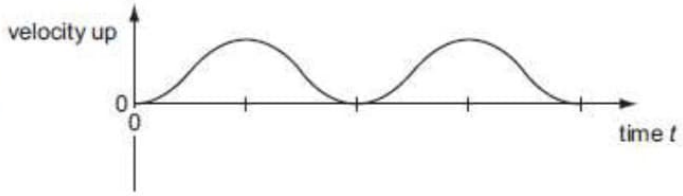
B



C



D



Q28 (7/M/J/12/11)

Which feature of a graph allows acceleration to be determined?

A the area under a displacement-time graph

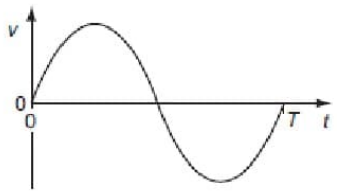
B the area under a velocity-time graph

C the slope of a displacement-time graph

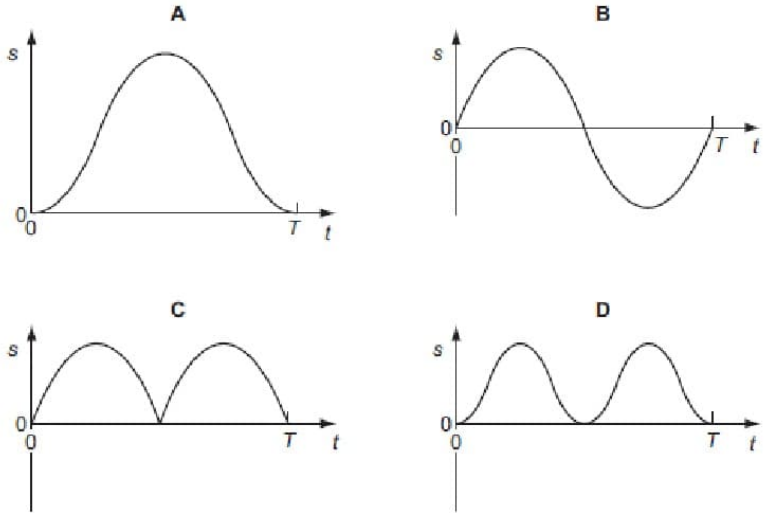
D the slope of a velocity-time graph

Q29 (7/M/J/12/12)

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

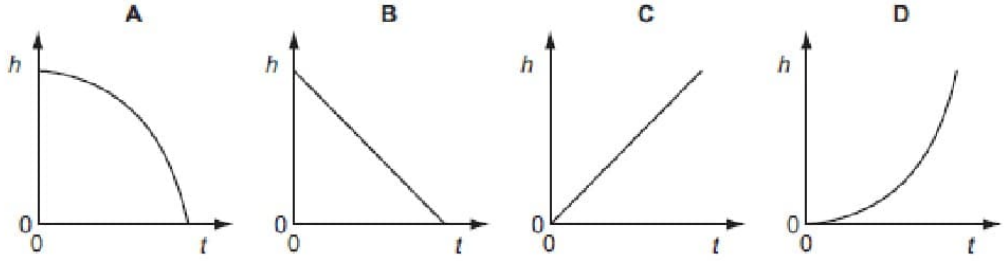


Which graph represents the displacement s of the object in the time t = 0 to t = T ?



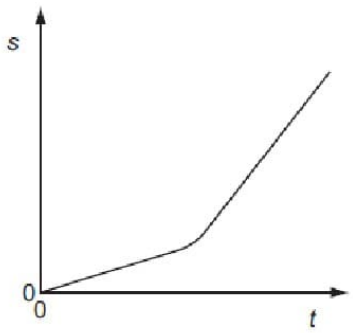
Q30 (9/M/J/12/12)

A brick is dislodged from a building and falls vertically under gravity.
Which graph best represents the variation of its height h above the ground with time t if air resistance is negligible?



Q31 (8/O/N/11/12)

The variation with time t of the distance s moved by a body is shown below.

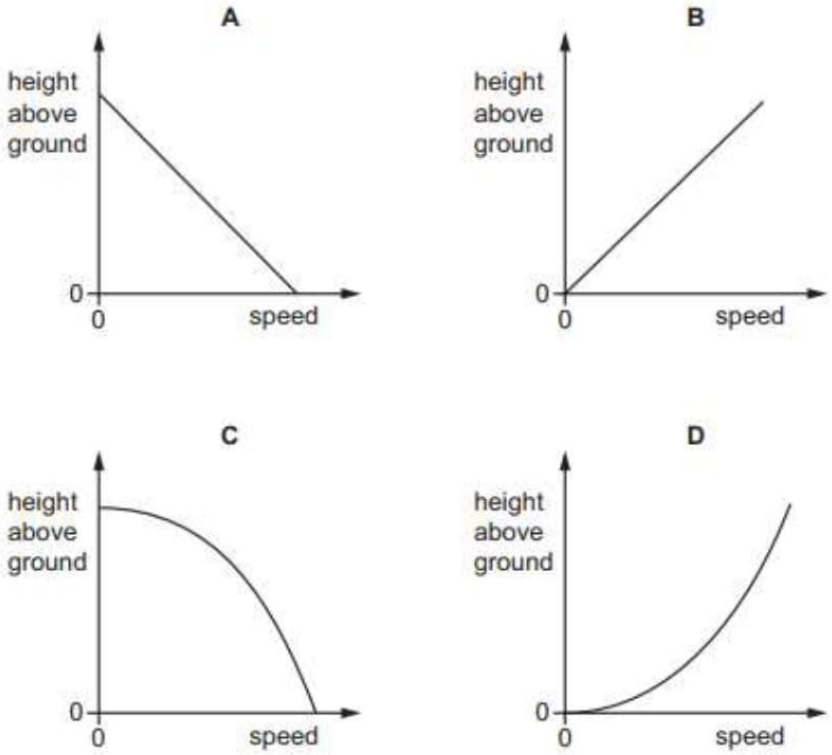


What can be deduced from the graph about the motion of the body?

A It accelerates continuously.
B It starts from rest.
C The distance is proportional to time.
D The speed changes.

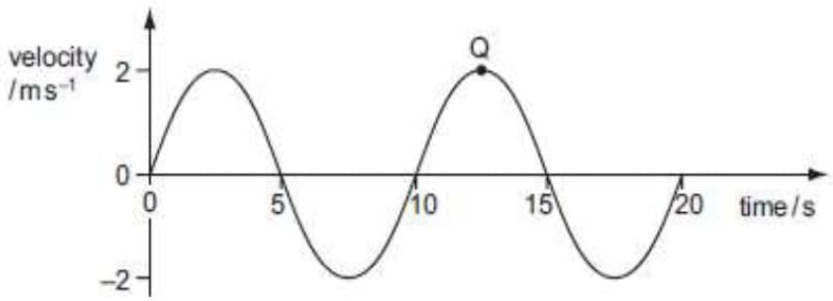
Q32 (18/M/J/20/11)

A ball is dropped from rest and falls towards the ground. Air resistance is negligible.
Which graph shows the variation with speed of the height of the ball above the ground?



Q33 (7/M/J/11/12)

A particle moves in the manner shown by the velocity-time graph.
The displacement of the particle has been measured so that it is zero at t = 0. Point Q refers to a point in its motion.

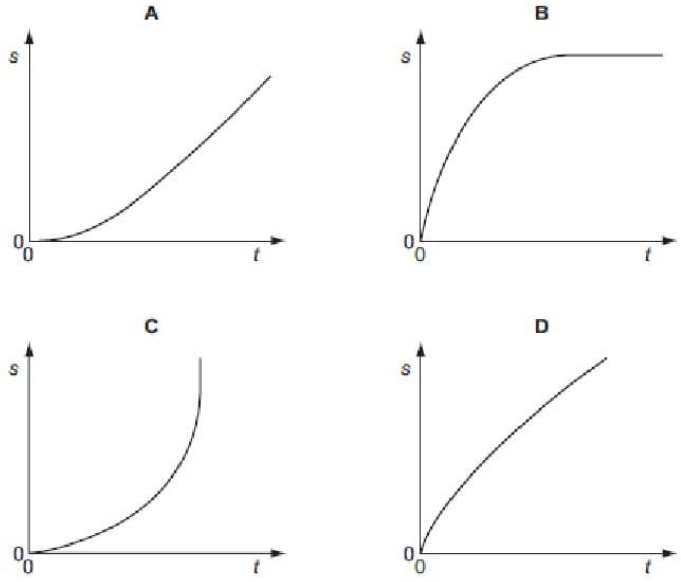


Which row of the table is correct?

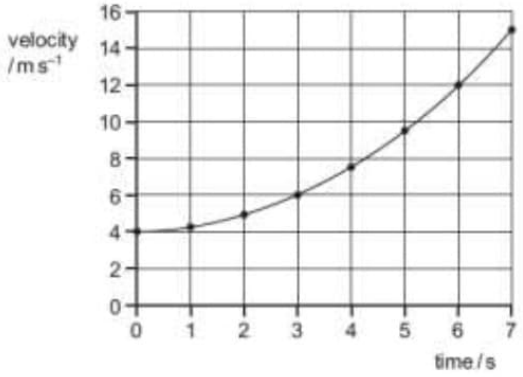
	times for maximum displacement / s		acceleration at point Q / m s^{-2}
A	2.5	12.5	2
B	5	15	2
C	2.5	12.5	0
D	5	15	0

Q34 (8/M/J/11/12)

A tennis ball falls freely, in air, from the top of a tall building.
Which graph best represents the variation of distance s fallen with time t?



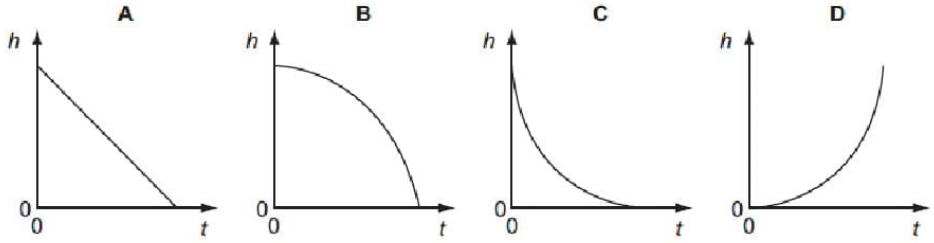
Q35 (8/M/J/10/11)
The diagram shows a velocity-time graph for a vehicle.



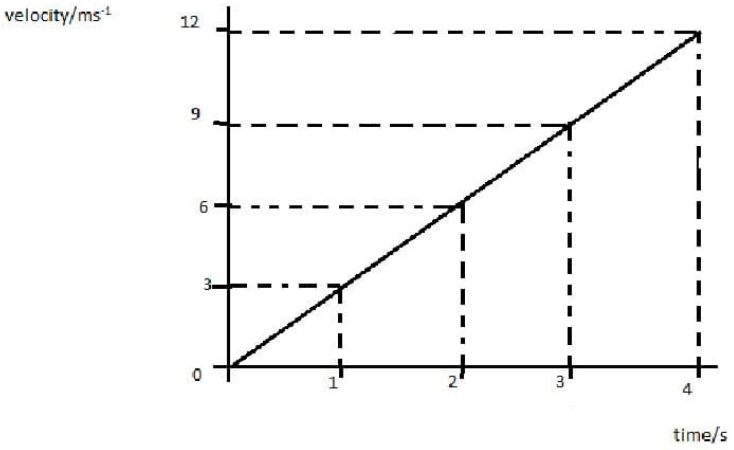
The vehicle, moving at 4.0 ms^{-1}, begins to accelerate at time=0.
What is the vehicle's acceleration at time = 3.0s?

A $0.67\,m\,s^{-2}$ B $1.0\,m\,s^{-2}$ C $1.3\,m\,s^{-2}$ D $2.0\,m\,s^{-2}$

Q36 (9/M/J/10/11)
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?



Q37 (6/O/N/09/12)
The diagram shows a velocity time-graph.

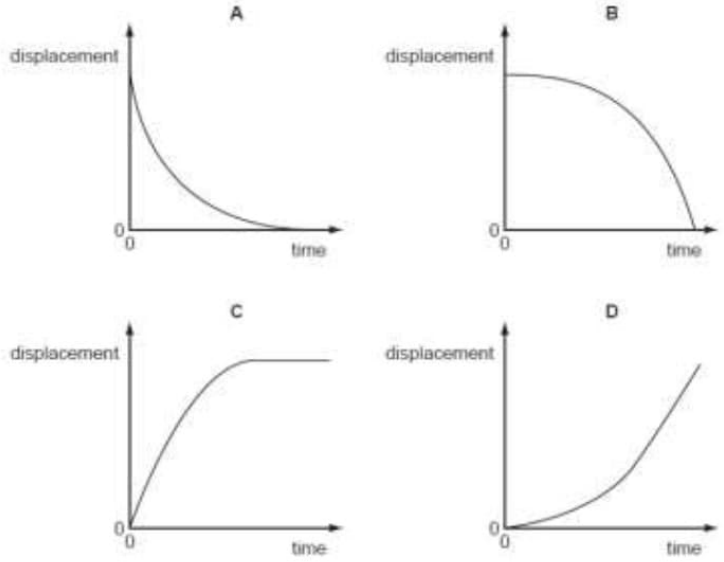


What is the displacement during the last two seconds of the motion?

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

Q38 (5/M/J/09/1)

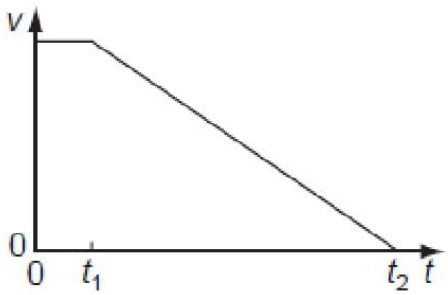
Which displacement-time graph best represents the motion of a falling sphere, the initial acceleration of which eventually reduces until it begins to travel at constant terminal velocity?



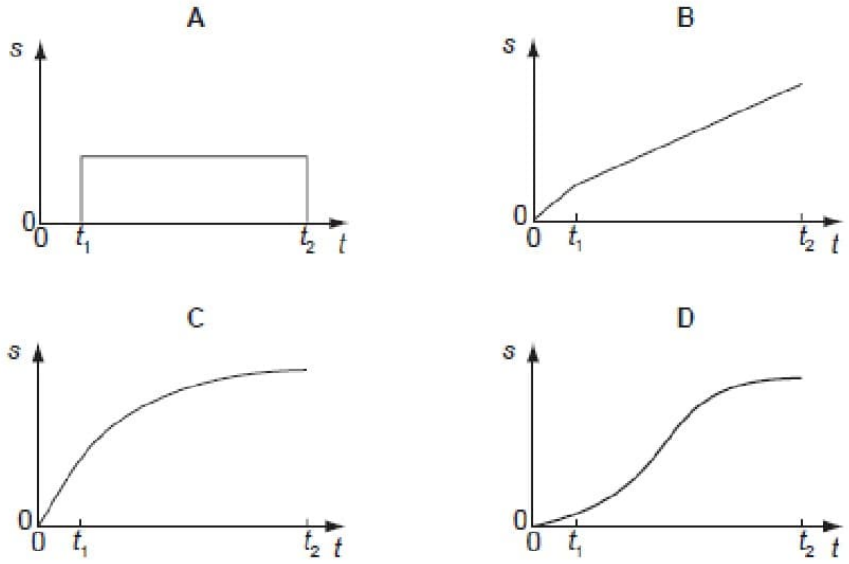
Q39 (6/M/J/09/1)

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 she sees the hazard.

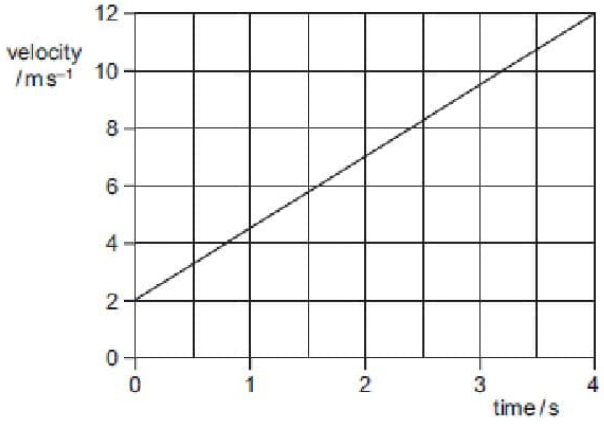


Which graph represents the variation with time t of the distance s travelled by the car after she has seen the hazard?



Q40 (6/O/N/08/1)

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

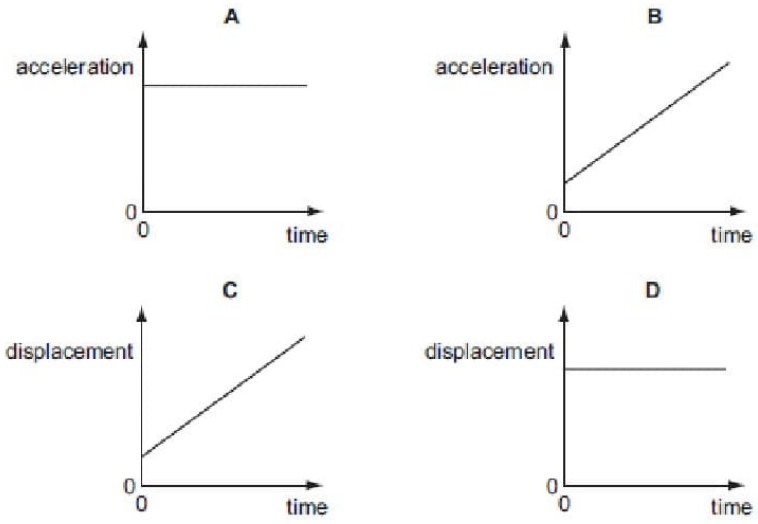


What is the distance travelled during the first 4.0 s?

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

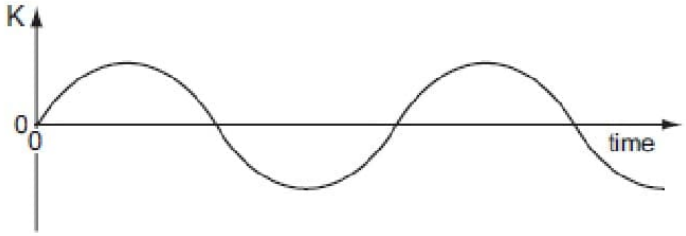
Q41 (8/O/N/08/1)

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



Q42 (8/O/N/07/1)

A particle moves along a straight line. A property of the particle's motion is plotted against time.

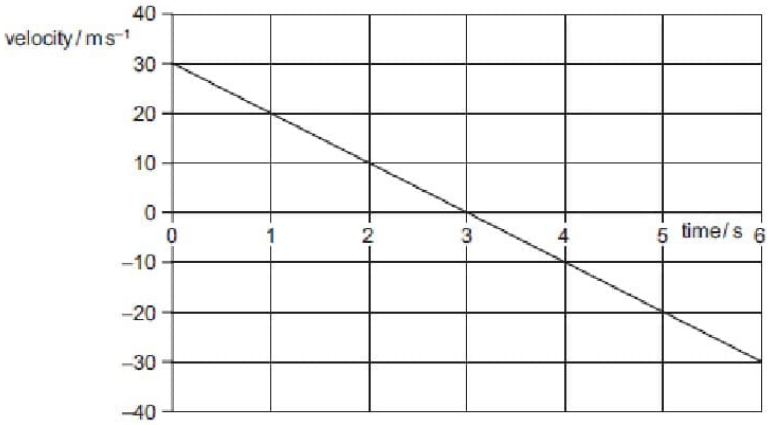


At any time, the slope of the graph is the acceleration of the particle.
What is the property?

A the displacement of the particle
B the distance travelled by the particle
C the speed of the particle
D the velocity of the particle

Q43 (9/O/N/07/1)

A stone is thrown vertically upwards. A student plots the variation with time of its velocity.

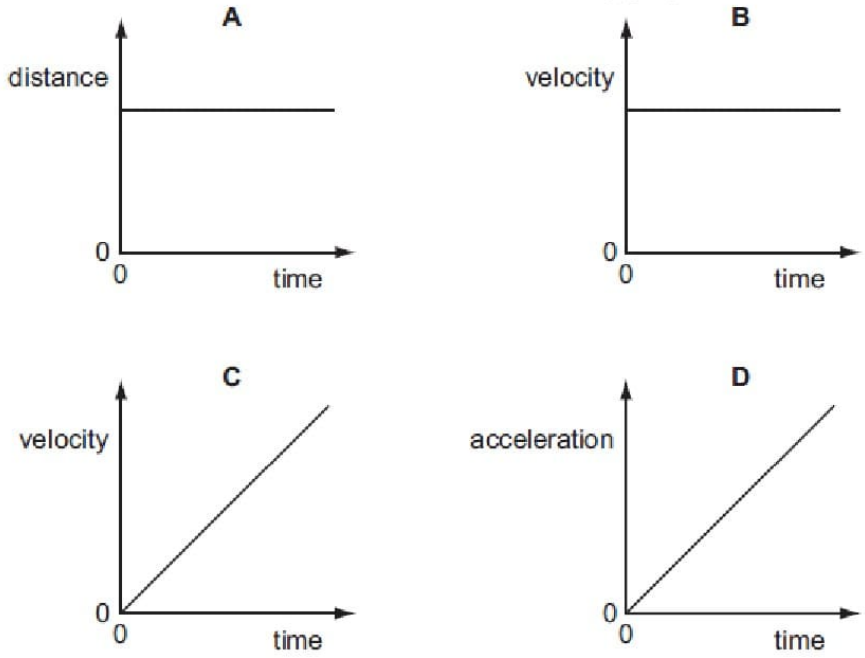


What is the vertical displacement of the stone from its starting point after 5 seconds?

A 20m B 25m C 45m D 65m

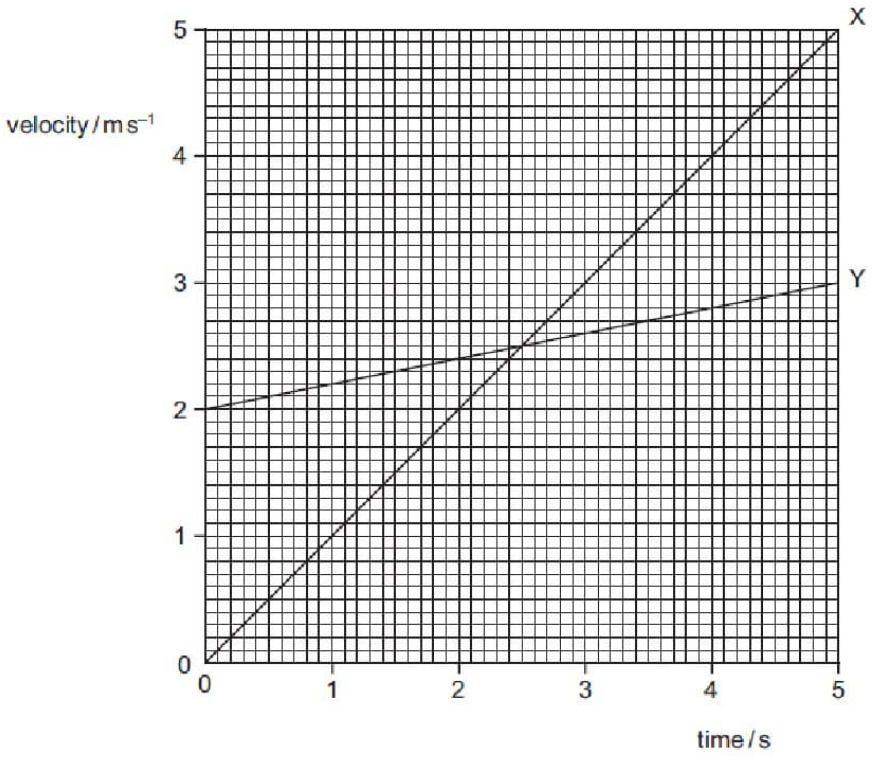
Q44 (7/O/N/06/1)

A particle is moving in a straight line with uniform acceleration.
Which graph represents the motion of the particle?



Q45 (8/O/N/06/1)

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.

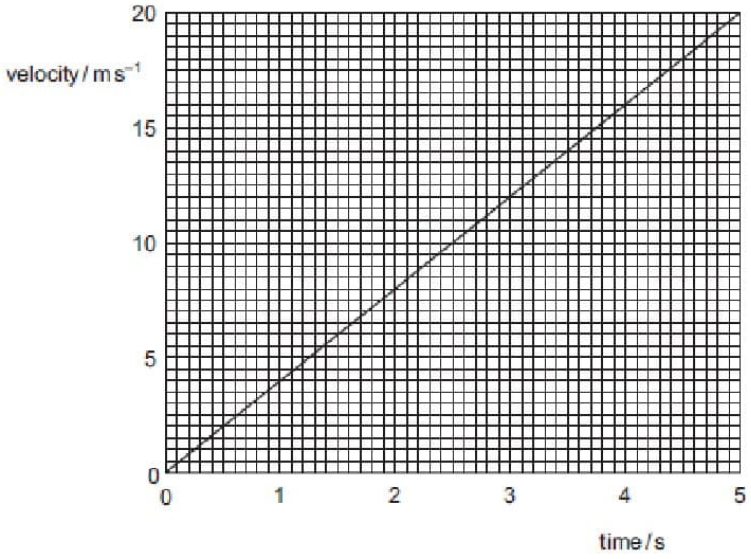


Which statement is correct?

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.

Q46 (8/M/J/06/1)

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

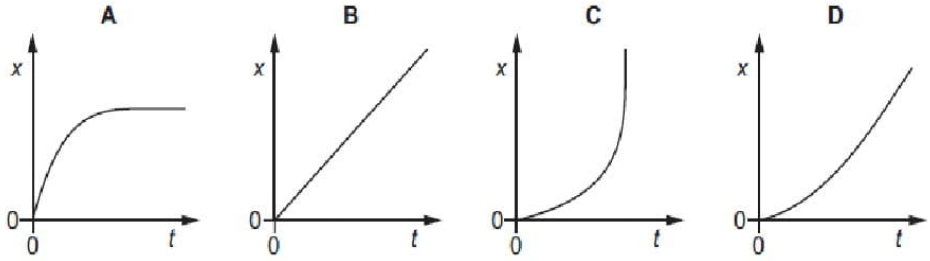


What is the distance travelled by the object in this time?

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

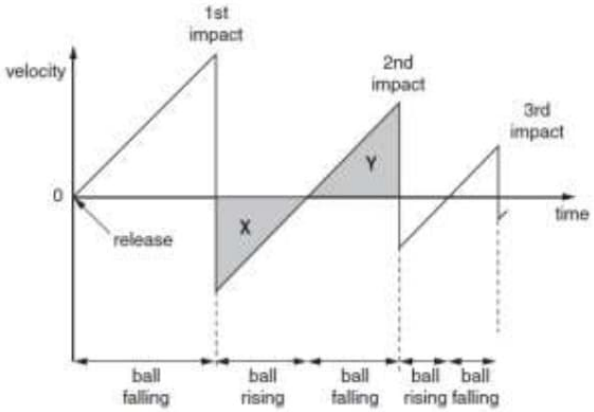
Q47 (6/O/N/17/13)

A football falls from the top of a tall building.
Which graph best represents the way in which the distance x fallen varies with time t?



Q48 (9/M/J/03/1)

A ball is released from rest above a horizontal surface. The graph shows the variation with time of its velocity.

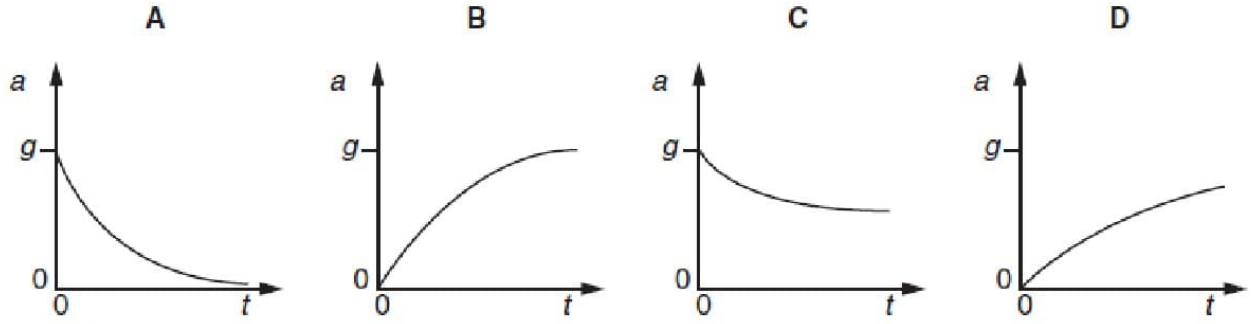


Areas **X** and **Y** are equal. This is because

A the ball's acceleration is the same during its upward and downward motion.
B the speed at which the ball leaves the surface after an impact is equal to the speed at which it returns to the surface for the next impact.
C for one impact, the speed at which the ball hits the surface equals the speed at which it leaves the surface.
D the ball rises and falls through the same distance between impacts.

Q49 (8/O/N/03/1)

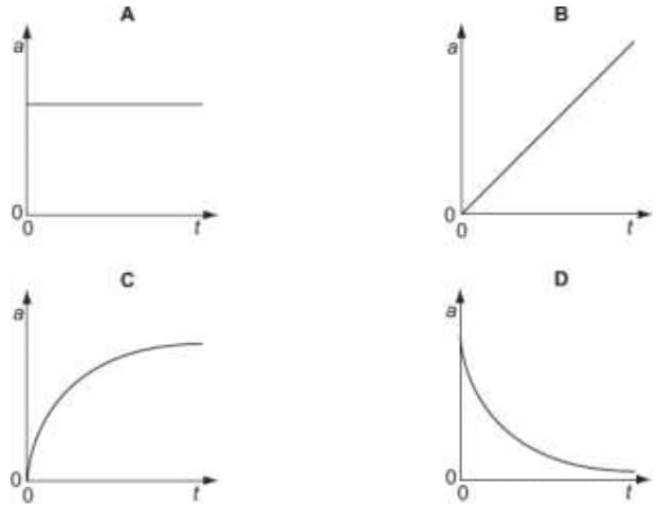
An object is dropped from a great height and falls through air of uniform density.
The acceleration of free fall is *g*.
Which graph could show the variation with time *t* of the acceleration *a* of the object?



Q50 (8/M/J/04/1)

A tennis ball is released from rest at the top of a tall building.

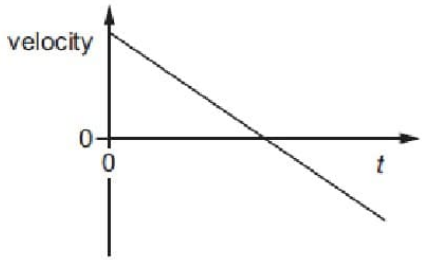
Which graph best represents the variation with time t of the acceleration a of the ball as it falls, assuming that the effects of air resistance are appreciable?



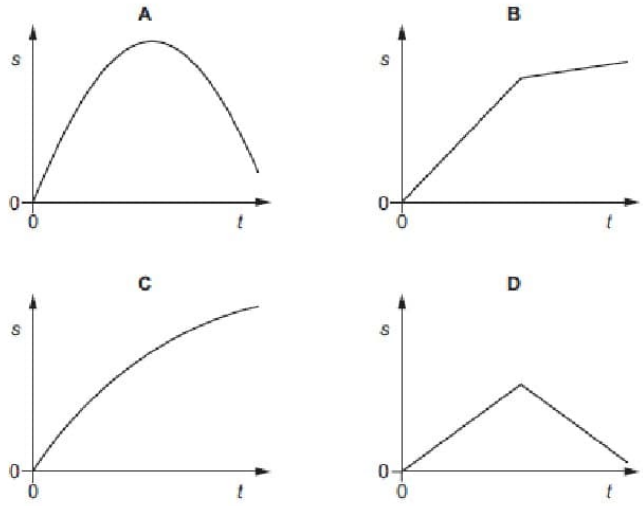
Yameen Jadoon

Q51 (M/J/18/12)

The velocity of an object changes with time *t* as shown.



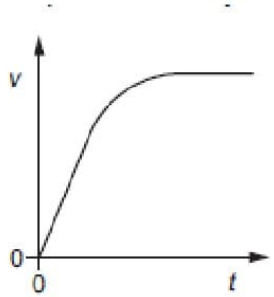
Which graph best shows the variation with time *t* of the displacement *s* of the object?



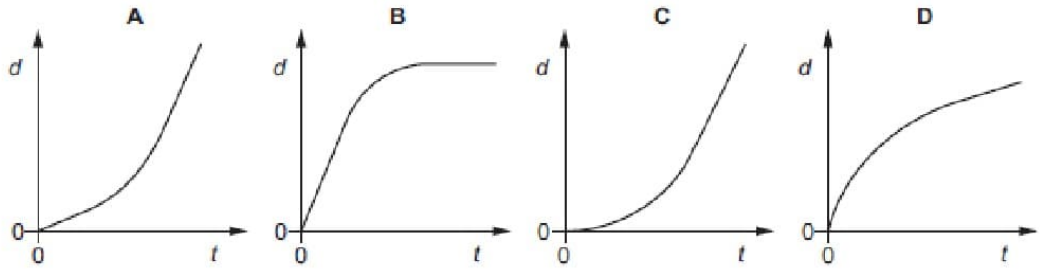
Yameen

Q52 (7/M/J/18/12)

A sky-diver falls vertically from a helicopter and reaches constant (terminal) velocity. The graph shows the variation with time *t* of the speed *v* of the sky-diver.

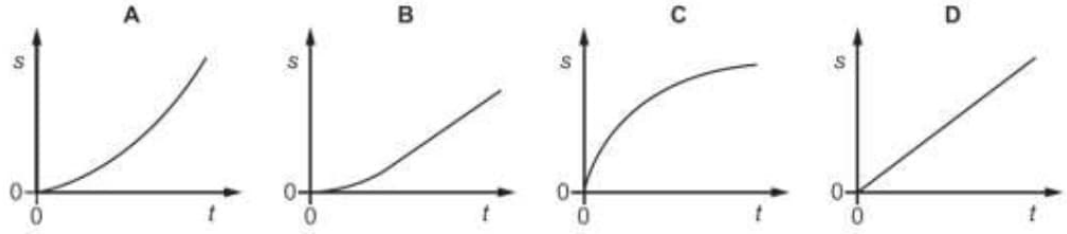


Which graph shows the variation with time *t* of the distance *d* fallen by the sky-diver?



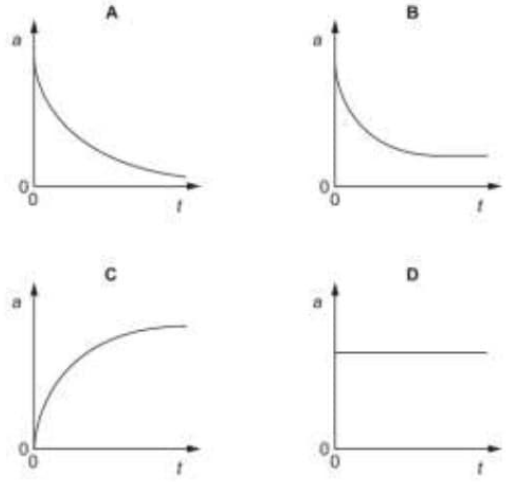
Q53 (7/M/J/18/13)

A sky-diver falls from a stationary balloon at time $t = 0$. As the sky-diver falls, her speed and the air resistance increase until the force of the air resistance is equal to her weight.
Which graph best shows the variation with time t of the displacement s for the motion of the sky-diver?



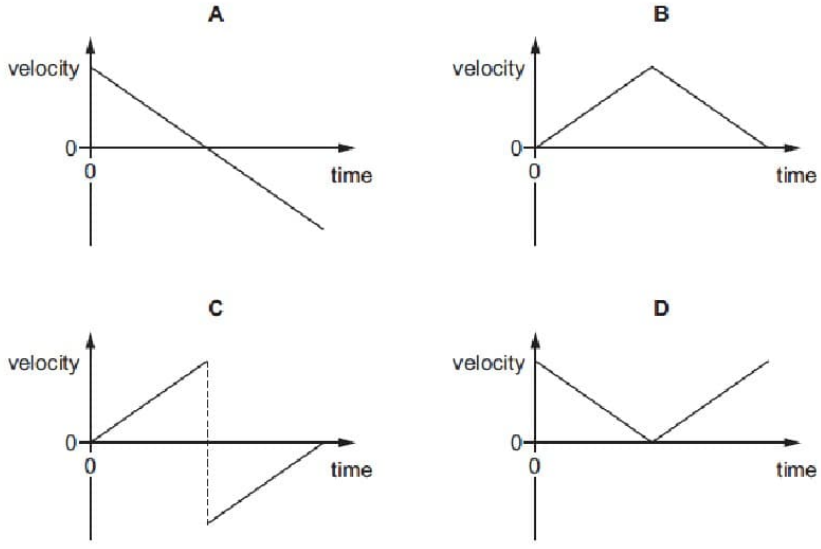
Q54 (7/M/J/16/12)

A tennis ball is released from rest at the top of a tall building.
Which graph best represents the variation with time t of the acceleration a of the ball as it falls, assuming that the effect of air resistance is not negligible?



Q55 (6/M/J/16/13)

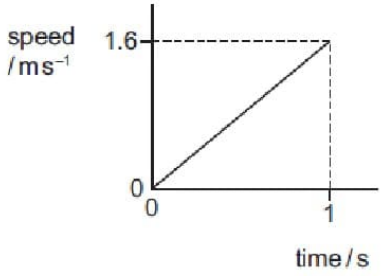
A ball rolls in a straight line up a ramp and then back down the ramp along its original path.
Which graph shows the variation with time of the ball's velocity?



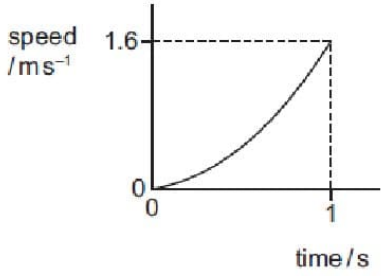
Q56 (6/M/J/16/12)

The acceleration of free fall on the Moon is $1.6\,m\,s^{-2}$. The Moon has no atmosphere. An astronaut standing on the surface of the Moon drops a feather.
Which graph shows the variation with time of the speed of the feather during the first second of its fall?

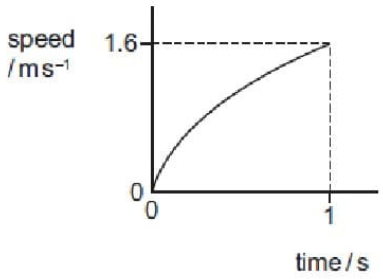
A



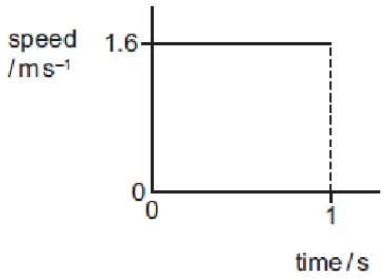
B



C



D

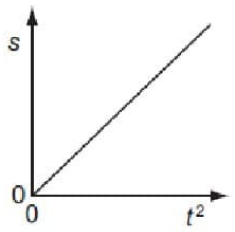


Yameen

Equations of motion

Q1 (8/M/J/13/13)

At time t = 0, a body moves from rest with constant acceleration in a straight line. At time t, the body is distance s from its rest position.A graph is drawn of s against t^2, as shown.



Which statement describes the acceleration of the body?

A It is equal to half the value of the gradient of the graph.
B It is equal to the value of the gradient of the graph.
C It is equal to twice the value of the gradient of the graph.
D It is equal to the reciprocal of the gradient of the graph.

Q2 (18/O/N/17/11)

A stone is projected vertically upwards from the ground at an initial speed of $15\,m\,s^{-1}$. Air resistance is negligible. What is the maximum height reached by the stone?

A 0.76 m B 11 m C 23 m D 110 m

Q3 (18/M/J/03/1)

A motorist travelling at $10\,m\,s^{-1}$ can bring his car to rest in a distance of 10 m.
If he had been travelling at $30\,m\,s^{-1}$, in what distance could he bring the car to rest using the same braking force?

A 17 m **B** 30 m **C** 52 m **D** 90 m

Yameen Jadoon

Q4 (8/O/N/13/12)

An Aeroplan 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 $500\,km\,h^{-1}$

Q5 (9/O/N/13/13)

A person, travelling on a motorway a total distance of 200 km, travels the first 90 km at an average speed of $80\,km\,h^{-1}$. Which average speed must be obtained for the rest of the journey if the person is to reach the destination in a total time of 2 hours 0 minutes?

A $110\,km\,h^{-1}$ B $120\,km\,h^{-1}$ C $122\,km\,h^{-1}$ D $126\,km\,h^{-1}$

Q6 (7/O/N/15/12)

A boy throws a ball vertically upwards. It rises to a maximum height, where it is momentarily at rest, and then falls back to his hands. Which row gives the acceleration of the ball at various stages in its motion? (Take vertically upwards as positive. Ignore air resistance.)

	rising	at maximum height	falling
A	$-9.81\,m\,s^{-2}$	0	$+9.81\,m\,s^{-2}$
B	$-9.81\,m\,s^{-2}$	$-9.81\,m\,s^{-2}$	$-9.81\,m\,s^{-2}$
C	$+9.81\,m\,s^{-2}$	$+9.81\,m\,s^{-2}$	$+9.81\,m\,s^{-2}$
D	$+9.81\,m\,s^{-2}$	0	$-9.81\,m\,s^{-2}$

Q7 (8/M/J/15/11)

An aspect of jumps with an initial vertical velocity of 1.0 ms^{-1}, reaching a maximum height of 3.5 x 10^{-2} m. Assume the deceleration is uniform.
What is the magnitude of the deceleration?

A $3.6\,m\,s^{-2}$ B $9.8\,m\,s^{-2}$ C $14\,m\,s^{-2}$ D $29\,m\,s^{-2}$

Q8 (9/M/J/15/11)

A body having uniform acceleration a increases its velocity from u to v in time t.
Which expression would not give a correct value for the body's displacement during time t?

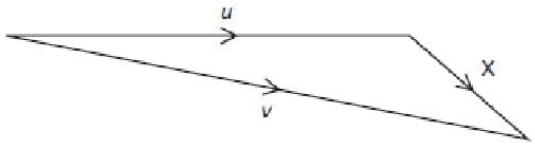
A $ut + \frac{1}{2}at^2$ **B** $vt - \frac{1}{2}at^2$

C $\frac{(v+u)(v-u)}{2a}$ **D** $\frac{(v-u)t}{2}$

Yameen Jadoon

Q9 (7/M/J/07/1)

An object has an initial velocity u. It is subjected to a constant force F for t seconds, causing a constant acceleration a. The force is not in the same direction as the initial velocity.
A vector diagram is drawn to find the final velocity v.



What is the length of side X of the vector diagram?

A *F* **B** *Ft* **C** *at* **D** *u + at*

Q10 (5/O/N/14/12)

The acceleration of free fall on the Moon is one-sixth of that on Earth.
On Earth it takes time t for a stone to fall from rest a distance of 2 m.
What is the time taken for a stone to fall from rest a distance of 2 m on the Moon?

A 6t B $\frac{t}{6}$ C $t\sqrt{6}$ D $\frac{t}{\sqrt{6}}$

Q11 (7/M/J/14/11)

An object is thrown with velocity $5.2\,m\,s^{-1}$ vertically upwards on the Moon. The acceleration due to gravity on the Moon is $1.62\,m\,s^{-2}$.

What is the time taken for the object to return to its starting point?

A 2.5 s B 3.2 s C 4.5 s D 6.4 s

Q12 (8/O/N/12/12)

A science museum designs an experiment to show the fall of a feather in a vertical glass vacuum tube.
The time of fall from rest is to be close to 0.5s.
What length of tube is required?

A 1.3 m B 2.5 m C 5.0 m D 10.0 m

Q13 (9/O/N/15/11)

The water surface in a deep well is 78.0 m below the top of the well. A person at the top of the well drops a heavy stone down the well.

Air resistance is negligible. The speed of sound in the air is $330\,m\,s^{-1}$.
What is the time interval between the person dropping the stone and hearing it hitting the water?

A 3.75 s **B** 3.99 s **C** 4.19 s **D** 4.22 s

Q14 (9/M/J/15/12)

A sprinters runs a 100m race in a straight line. He accelerates from the starting block at a constant acceleration of $2.5 ms^{-2}$ to reach his maximum speed of $10\,m\,s^{-1}$. He maintains this speed until he crosses the finish line.
Which time does it take the sprinter to run the race?

A 4 s B 10 s C 12 s D 20 s

Q15 (6/O/N/14/13)

In an experiment to determine the acceleration of free fall g, a ball-bearing is held by an electromagnet. When the current to the electromagnet is switched off, a clock starts and the ball-bearing falls. After falling a distance h, the ball-bearing strikes a switch to stop the clock which measures the time t of the fall.
Which expression can be used to calculate the value of g?

A $\frac{ht^2}{2}$ **B** $\frac{th^2}{2}$ **C** $\sqrt{\frac{2t}{h^2}}$ **D** $\frac{2h}{t^2}$

Q16 (8/O/N/13/13)

On a railway, a train driver applies the brake of the train at a yellow signal, a distance of 1.0 km from a red signal, where the train stops.

The maximum deceleration of the train is$0.20\ ms^{-2}$.
Assuming uniform deceleration, what is the maximum safe speed of the train at the yellow signal?

A $14\,m\,s^{-1}$ B $20\,m\,s^{-1}$ C $40\,m\,s^{-1}$ D $400\,m\,s^{-1}$

Yameen Jadoon

Q17 (7/M/J/13/12)

The diagram shows an arrangement to stop trains that are travelling too fast

Train coming from left travel at a speed of 50 ms^{-1}. At marker 1, driver must apply brakes so that the train decelerates uniformly to pass marker 2 at no more than 10 ms^{-1}.A train carries a detector that notes the time when the train passes each marker and will apply an emergency brake if the time between passing marker 1 and marker 2 is less than 20s.How far from marker 2 should marker 1 be placed?

A 200m B 400m C 500m D 600m

Q18 (8/O/N/12/13)

A bicycle brakes so that it undergoes uniform deceleration from a speed of 8 m s^{-1} to 6 m s^{-1} over a distance of 7 m. If the deceleration of the bicycle remains constant, what further distance will it travel before coming to rest?

A 7 m B 9 m C 16 m D 21 m

Q19 (6/M/J/12/11)

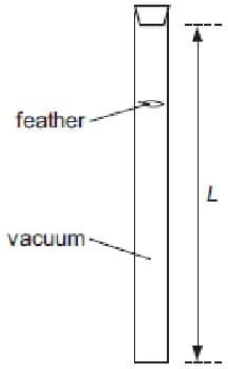
In an experiment to determine the acceleration of free fall using a falling body, what would lead to a value that is too large?

A air resistance B dimensions of the body are too large

C measured distance longer than true distance D measured time longer than true times

Q20 (8/M/J/12/11)

The diagram shows a laboratory experiment in which a feather falls from rest in a long evacuated vertical tube of length L.



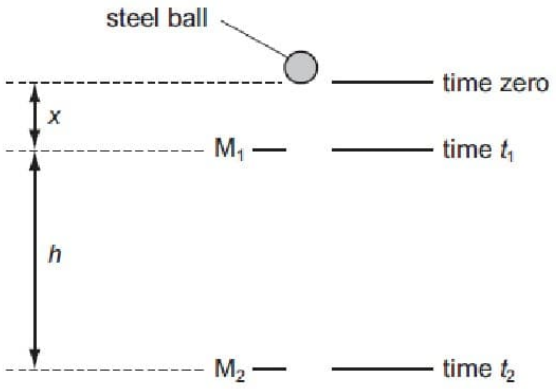
The feather takes time T to fall from the top to the bottom of the tube.
How far will the feather have fallen from the top of the tube in time 0.50 T?

A 0.13 L B 0.25 L C 0.38 L D 0.50 L

Yameen Jadoon

Q21 (8/M/J/12/12)

Two markers M_1 and M_2 are set up a vertical distance h apart.

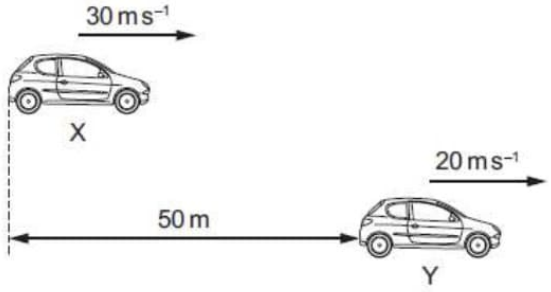


A steel ball is released at time zero from a point a distance x above M_1. The ball reaches M_1 at time t_1 and reaches M_2 at time t_2. The acceleration of the ball is constant.
Which expression gives the acceleration of the ball?

A $\frac{2h}{t_2^2}$ B $\frac{2h}{(t_2+t_1)}$ C $\frac{2h}{(t_2-t_1)^2}$ D $\frac{2h}{(t_2^2-t_1^2)}$

Q22 (8/M/J/16/11)

Two cars X and Y are positioned as shown at time t = 0.
They are travelling in the same direction.
X is 50 m behind Y and has a constant velocity of 30 m s^{-1}. Y has a constant velocity of 20 m s^{-1}.



What is the value of t when X is level with Y?

A 1.0 s B 1.7 s C 2.5 s D 5.0 s

Q23 (9/O/N/10/11)

In order that a train can stop safely, it will always pass a signal showing a yellow light before it reaches a signal showing a red light. Drivers apply the brake at the yellow light and this results in a uniform deceleration to stop exactly at the red light. The distance between the red and yellow lights is x. What must be the minimum distance between the lights if the train speed is increased by 20 %, without changing the deceleration of the trains?

A 1.20 x B 1.25 x C 1.44 x D 1.56 x

Q24 (8/O/N/10/12)

A moving body undergoes uniform acceleration while travelling in a straight line between points X, Y and Z. The distances XY and YZ are both 40 m. The time to travel from X to Y is 12 s and from Y to Z is 6.0 s. What is the acceleration of the body?

A 0.37 m s^{-2} B 0.49 m s^{-2} C 0.56 m s^{-2} D 1.1 m s^{-2}

Q25 (8/M/J/07/1)

A stone is dropped from the top of a tower of height 40 m. The stone falls from rest and air resistance is negligible.
What time is taken for the stone to fall the last 10 m to the ground?

A 0.38 s B 1.4 s C 2.5 s D 2.9 s

Q26 (17/M/J/06/1)

A motorist travelling at $10\,m\,s^{-1}$ can bring his car to rest in a braking distance of 10 m.
In what distance could he bring the car to rest from a speed of $30\,m\,s^{-1}$ using the same braking force?

A 17 m B 30 m C 52 m D 90 m

Q27 (7/M/J/04/1)

A car is travelling with uniform acceleration along a straight road. The road has marker posts every 100 m. When the car passes one post, it has a speed of $10\,m\,s^{-1}$ and, when it passes the next one, its speed is $20\,m\,s^{-1}$.
What is the car's acceleration?

A $0.67\,m\,s^{-2}$ B $1.5\,m\,s^{-2}$ C $2.5\,m\,s^{-2}$ D $6.0\,m\,s^{-2}$

Q28 (5/M/J/17/13)

On a planet, a vertically-launched projectile takes 12.5 s to return to its starting position. The projectile gains a maximum height of 170 m. The planet does not have an atmosphere.
What is the acceleration of free fall on this planet?

A $2.2\,m\,s^{-2}$ B $8.7\,m\,s^{-2}$ C $27\,m\,s^{-2}$ D $54\,m\,s^{-2}$

Q29 (6/O/N/17/12)

A hot-air balloon is moving vertically upwards with a constant speed of $3.00\,m\,s^{-1}$. A sandbag is dropped from the balloon. It takes 5.00 s for the sandbag to fall to the ground.
What was the height of the balloon when the sandbag was released?

A 29 m B 108 m C 123 m D 138 m

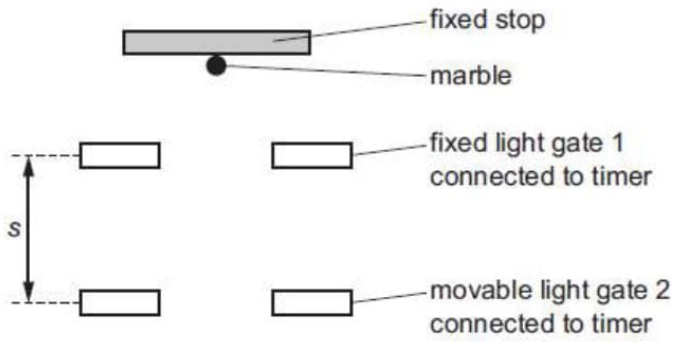
Yameen Jadoon

Q30 (7/O/N/15/11)

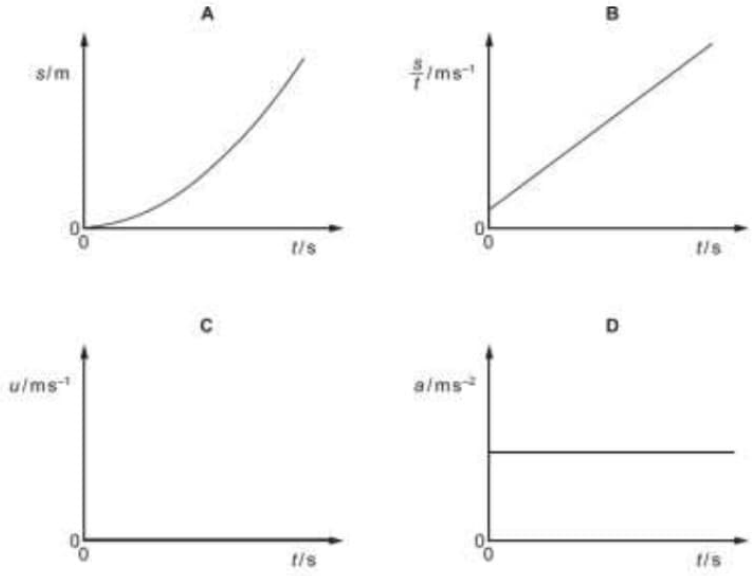
One of the equations of uniformly accelerated motion is shown.

$$s = ut + \frac{1}{2}at^2$$

Apparatus is arranged to record the time t taken for a marble to fall between two light gates connected to timers. The marble touches the stop before it is released. The vertical distance s between the light gates is measured.



Which graph does not show a correct relationship when light gate 2 moves up to light gate 1 which is fixed?



Q31(7/F/M/20/12)

A car moves with uniform acceleration along a straight road. Oil leaks from the car at the rate of one drop every two seconds. The diagram shows the distances between three successive oil drops on the road.

What is the acceleration of the car?

A $0.75\,m\,s^{-2}$ **B** $1.5\,m\,s^{-2}$ **C** $3.0\,m\,s^{-2}$ **D** $6.0\,m\,s^{-2}$

Projectile Motion

Q1 (9/M/J/12/11)

In the absence of air resistance, a stone is thrown from P and follows a parabolic path in which the highest point reached is T. The stone reaches point Q just before landing.

The vertical component of acceleration of the stone is

A zero at T.
B larger at T than at Q.
C larger at Q than at T.
D the same at Q as at T.

Q2 (7/O/N/08/1)

A stone is thrown upwards and follows a curved path.

Air resistance is negligible.
Why does the path have this shape?

A The stone has a constant horizontal velocity and constant vertical acceleration.

B The stone has a constant horizontal acceleration and constant vertical velocity.

C The stone has a constant upward acceleration followed by a constant downward acceleration.

D The stone has a constant upward velocity followed by a constant downward velocity

Yameen Jadoon

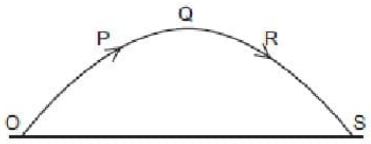
Q3 (6/M/J/14/11)

A tennis ball is thrown horizontally in air from the top of a tall building. If the effect of air resistance is not negligible, what happens to the horizontal and vertical components of the ball's velocity?

	horizontal component of velocity	vertical component of velocity
A	constant	constant
B	constant	increases at a constant rate
C	decreases to zero	increases at a constant rate
D	decreases to zero	increases to a maximum value

Q4 (10/M/J/12/12)

Projectile is launched at point O and follows the path OPQRS, as shown. Air resistance may be neglected.

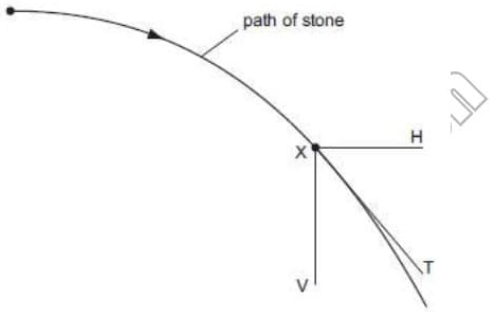


Which statement is true for the projectile when it is at the highest point Q of its path?

A The horizontal component of the projectile's acceleration is zero.
B The horizontal component of the projectile's velocity is zero.
C The kinetic energy of the projectile is zero.
D The momentum of the projectile is zero.

Q5 (14/M/J/11/12)

A stone is projected horizontally in a vacuum and moves along the path shown.

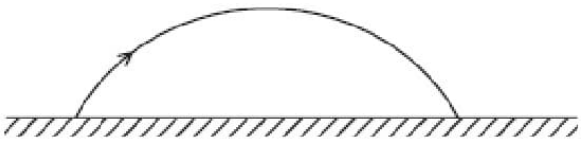


X is a point on this path. XV and XH are vertical and horizontal lines respectively through X. XT is the tangent to the path at X. Along which directions do forces act on the stone at X?

A XV only B XH only C XV and XH D XT only

Q6 (8/M/J/09/1)

The diagram shows the path of a golf ball.

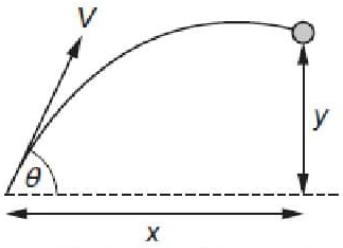


row describes changes in the horizontal and vertical components of the golf ball's velocity when air resistance forces are ignored?

	horizontal	vertical
A	constant deceleration	constant acceleration downwards
B	constant deceleration	acceleration decreases upwards then increases downwards
C	constant velocity	constant acceleration downwards
D	constant velocity	acceleration decreases upwards then increases downwards

Q7 (7/M/J/16/13)

A ball is thrown with velocity V at an angle θ to the horizontal.

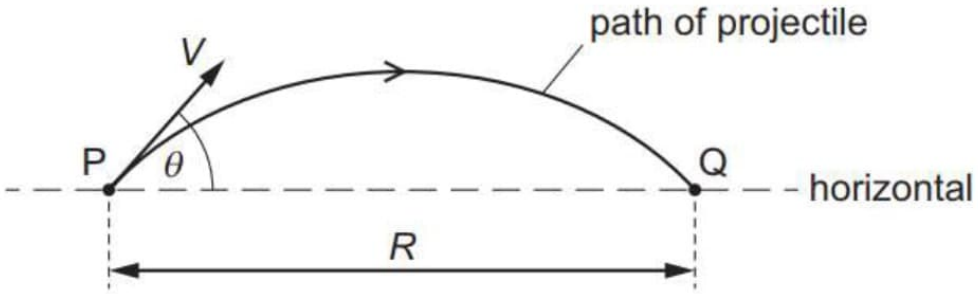


The acceleration of free fall is g. Assume that air resistance is negligible.
What are the horizontal displacement x and the vertical displacement y after time t?

	X	Y
A	Vtcos θ	$V\sin\theta + \frac{1}{2}gt^2$
B	Vtcos θ	$V\sin\theta - \frac{1}{2}gt^2$
C	Vtsin θ	$V\cos\theta + \frac{1}{2}gt^2$
D	Vtsin θ	$V\cos\theta - \frac{1}{2}gt^2$

Q8 (7/M/J/20/11)

A projectile is fired from point P with velocity V at an angle θ to the horizontal. It lands at point Q, a horizontal distance R from P, after time T.



The acceleration of free fall is *g*. Air resistance is negligible.
Which equation is correct?

A. $\boldsymbol{R = VT\cos\theta}$

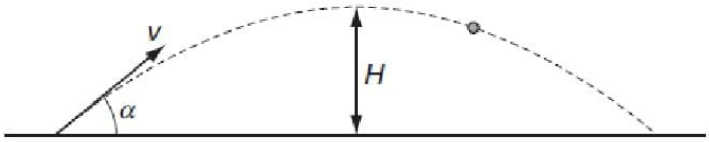
B $\boldsymbol{R = VT\sin\theta}$

C $\boldsymbol{R = VT\cos\theta - \frac{1}{2}gT^2}$

D $\boldsymbol{R = VT\sin\theta - \frac{1}{2}gT^2}$

Q9 (3/M/J/13/11)

A cannon fires a cannonball with an initial speed v at an angle α to the horizontal.

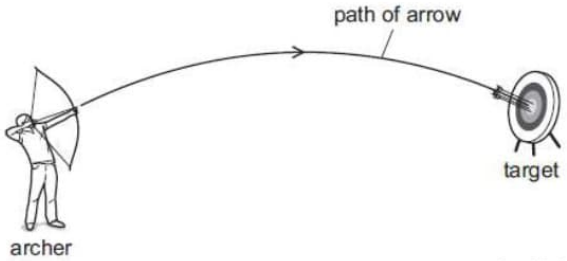


Which equation is correct for the maximum height H reached?

A $H = \frac{v \sin a}{2g}$ **B** $H = \frac{g \sin a}{2v}$ **C** $h = \frac{(v \sin a)^2}{2g}$ **D** $H = \frac{g^2 \sin a}{2v}$

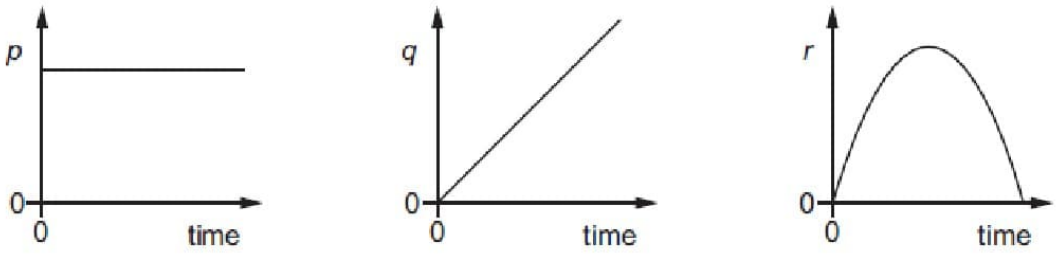
Q10 (7/O/N/17/11)

An archer shoots an arrow at a target. The diagram shows the path of the arrow.



Air resistance is assumed to be negligible.

The graphs show how three different quantities p, q and r, relating to the motion of the arrow, vary with time.

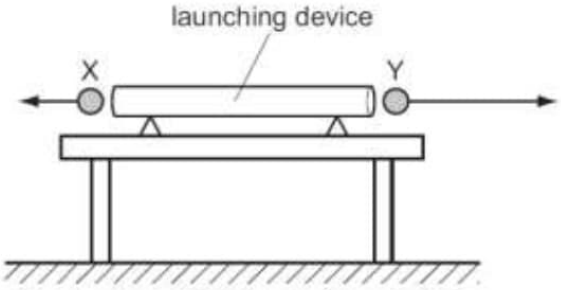


Which quantity is the horizontal component of displacement and which quantity is the vertical component of displacement of the arrow?

	horizontal component of displacement	vertical component of displacement
A	p	q
B	q	r
C	r	p
D	r	q

Q11 (7/M/J/13/13)

A double-ended launching device fires two identical steel balls X and Y at the same time.
The diagram shows the initial velocities of the balls. They are both launched horizontally, but Y has greater speed.

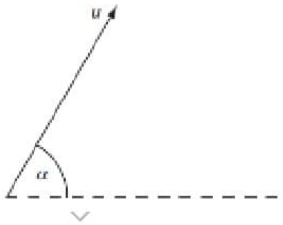


Which statement explains what an observer would see?

A Both X and Y reach the ground simultaneously, because air resistance will cause both to have the same final speed.
B Both X and Y reach the ground simultaneously, because gravitational acceleration is the same for both.
C X reaches the ground before Y, because X lands nearer to the launcher.
D Y reaches the ground before X, because Y has greater initial speed.

Q12 (9/O/N/06/1)

A projectile is fired at an angle α to the horizontal at a speed u, as shown.



What are the vertical and horizontal components of its velocity after a time t?
Assume that air resistance is negligible. The acceleration of free fall is g.

	vertical component	horizontal component
A	u sin α	u cos α
B	u sin α – gt	u cos α – gt
C	u sin α – gt	u cos α
D	u cos α	u sin α – gt

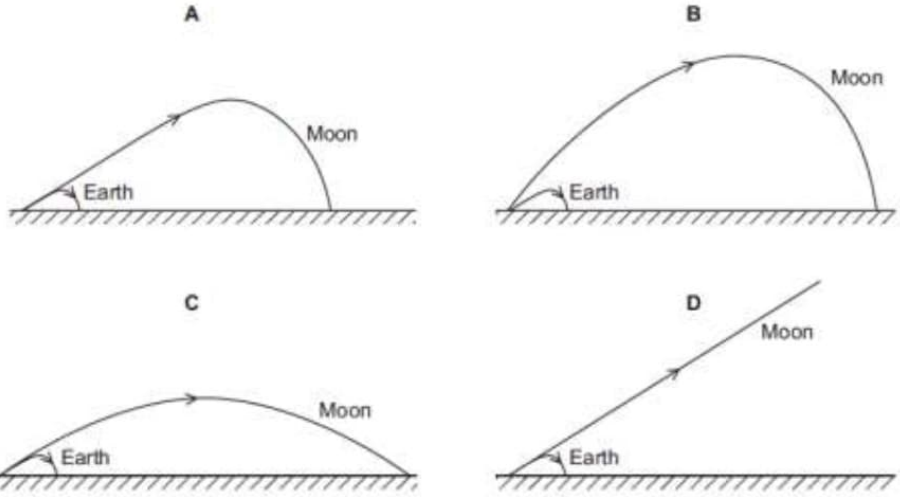
Q13 (6/M/J/17/11)

A ball is kicked upwards at an angle of 45° to horizontal ground. After a short flight, the ball returns to the ground. It may be assumed that air resistance is negligible. What is never zero during the flight of the ball?

A the horizontal component of the ball's acceleration
B the horizontal component of the ball's velocity
C the vertical component of the ball's momentum
D the vertical component of the ball's velocity

Q14 (10/O/N/12/11)

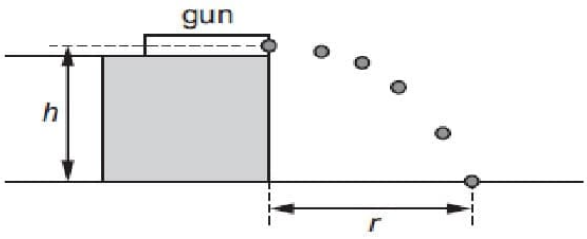
A golf ball is hit with the same force and direction on the Earth and on the Moon.
Which diagram best represents the shapes of the paths taken by the golf ball?



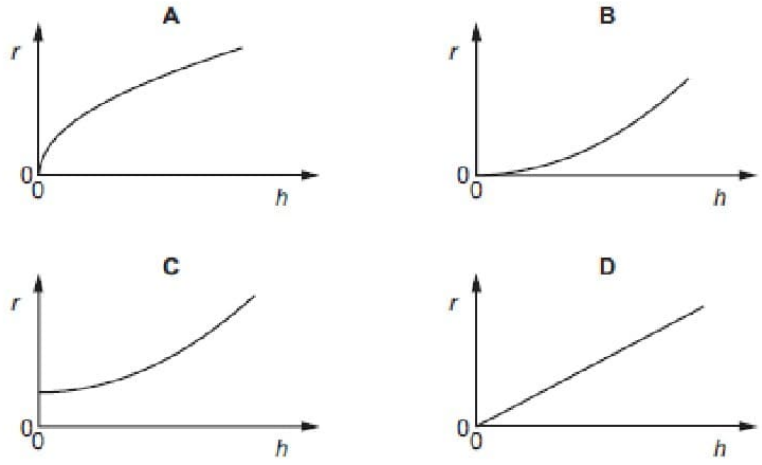
Space for working

Q15 (7/M/J/16/11)

A student uses a spring gun to launch a steel ball with a constant horizontal velocity. He varies the height h of the gun and measures the horizontal displacement r of the ball when it hits the ground.

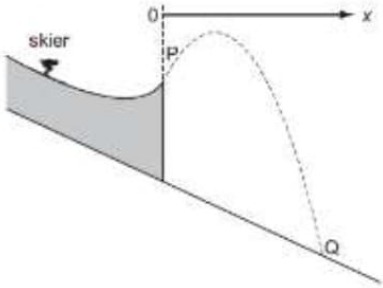


Which graph shows the variation with height h of the horizontal displacement r ?

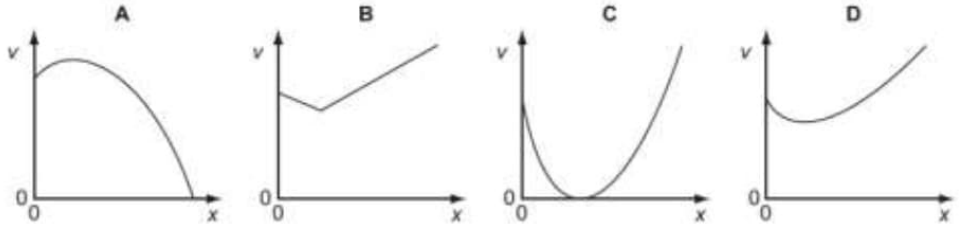


Q16 (10/O/N/12/12)

The dotted line shows the path of a competitor in a ski-jumping competition.



Ignoring air resistance, which graph best represents the variation of his speed v with the horizontal distance x covered from the start of his jump at P before landing at Q?



Q17 (6/O/N/18/11)

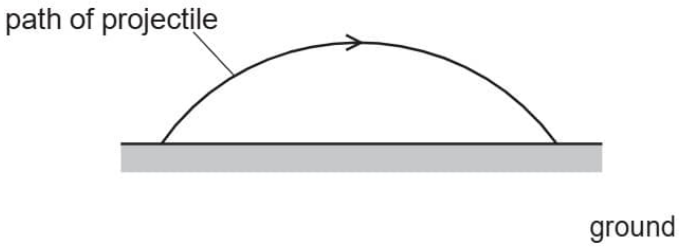
A tennis ball is thrown horizontally in air from the top of a tall building. The effect of air resistance is **not** negligible. What happens to the horizontal and to the vertical components of the ball's velocity?

	horizontal component of velocity	vertical component of velocity
A	constant	constant
B	constant	increases at a constant rate
C	decreases to zero	increases at a constant rate
D	decreases to zero	increases to a maximum value

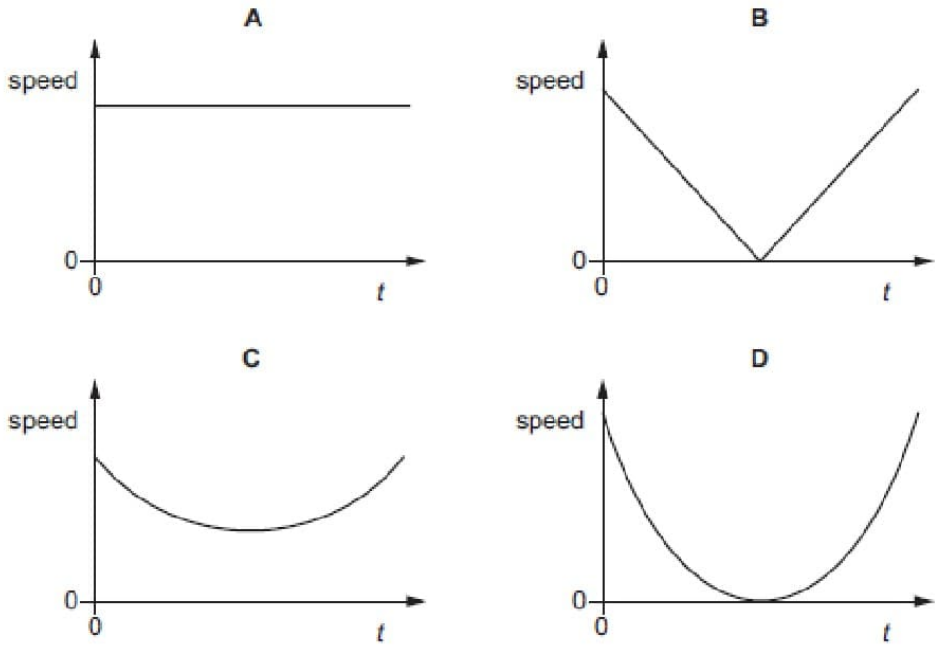
Yameen Jadoon

Q 18 (6/M/J/18/12)

A projectile is launched at an angle to the horizontal at time $t = 0$. It travels over horizontal ground, as shown.

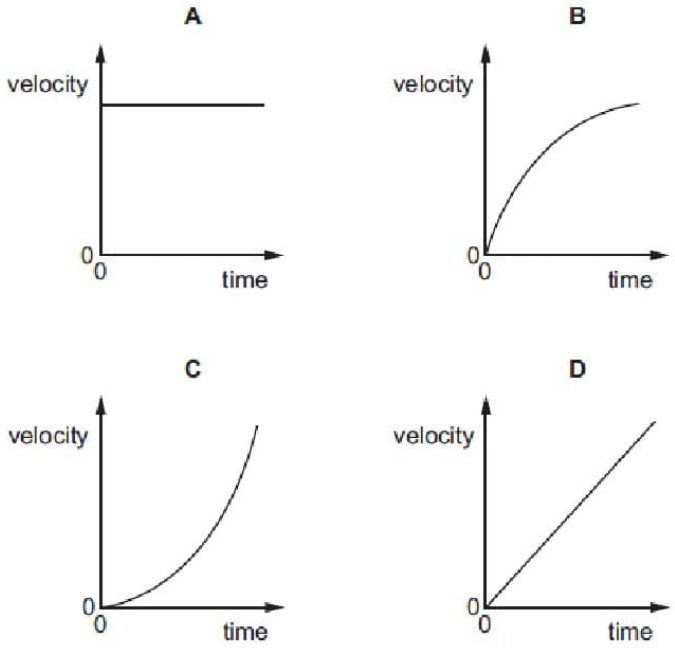


Assume that air resistance is negligible.
Which graph best shows the variation with t of the speed of the projectile from when it is launched to when it lands on the ground?



Q19 (8/M/J/15/12)

A stone is thrown horizontally from the top of a cliff. Air resistance is negligible.
Which graph shows the variation with time of the vertical component of the stone's velocity?



Q20 (12/M/J/15/12):

An astronaut throws a stone with a horizontal velocity near to the Moon's surface.
Which row describes the horizontal and vertical forces acting on the stone after release?

	horizontal force	vertical force
A	constant	constant
B	constant	decreasing
C	zero	constant
D	zero	decreasing

Q21(7/M/J/20/13)

Two students each throw a ball horizontally from the top of a tower. The two balls are released at the same time. The first student throws her ball with a speed of 20 m s^{-1} and the second student throws his ball with a speed of 10 m s^{-1}. Assume air resistance is negligible and that the balls land on horizontal ground. Which row describes the horizontal distances travelled and the landing times of the two balls on the ground?

	horizontal distances	landing times
A	same	same
B	same	different
C	different	same
D	different	different

Q22 (18/F/M/2025/12)

A projectile is launched at 45° to the horizontal with initial kinetic energy E.
Assuming air resistance to be negligible, what will be the kinetic energy of the projectile when it reaches its highest point?

A 0.50E **B** 0.71E **C** 0.87E **D** E

Yameen Jadoon

Basics

1	B	3	A
2	C	4	

Graphs

1	D	16	B	31	D	46	C
2	D	17	D	32	C	47	D
3	A	18	C	33	D	48	D
4	A	19	B	34	A	49	A
5	B	20	C	35	B	50	D
6	A	21	D	36	B	51	A
7	C	22	A	37	C	52	C
8	B	23	D	38	D	53	B
9	B	24	C	39	C	54	A
10	B	25	A	40	D	55	A
11	B	26	A	41	A	56	A
12	A	27	A	42	D		
13	C	28	D	43	B		
14	C	29	A	44	C		
15	D	30	A	45	D		

Equations

1	C	11	D	21	D	31	A
2	B	12	A	22	D		
3	D	13	D	23	C		
4	C	14	C	24	A		
5	D	15	D	25	A		
6	B	16	B	26	D		
7	C	17	D	27	B		
8	D	18	B	28	B		
9	C	19	C	29	B		
10	C	20	B	30	C		

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Projectile Motion

1	D	9	C	17	D
2	A	10	B	18	C
3	D	11	B	19	D
4	A	12	B	20	C
5	A	13	B	21	C
6	C	14	C	22	A
7	B	15	A		
8	A	16	D		