1 Which is a scalar quantity?

[1 mark]

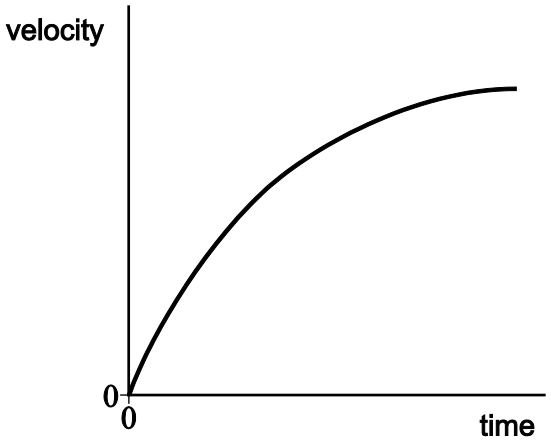
A momentum ⬭

B weight ⬭

C power ⬭

D moment ⬭

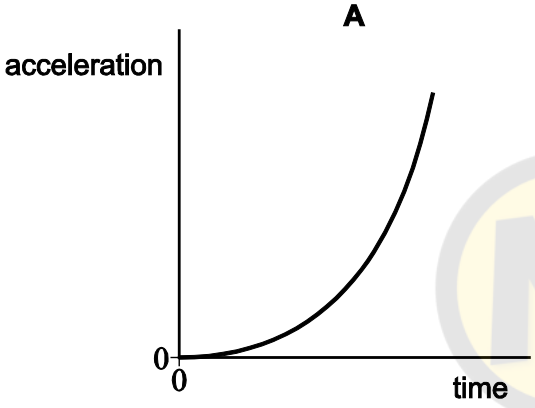
2 The velocity–time graph for a falling object is shown.



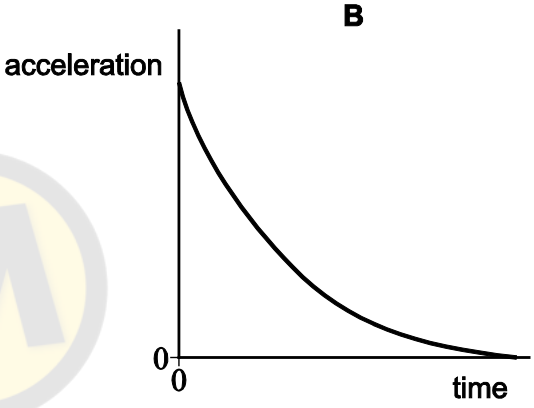
Which of the following shows the corresponding acceleration–time graph?

[1 mark]

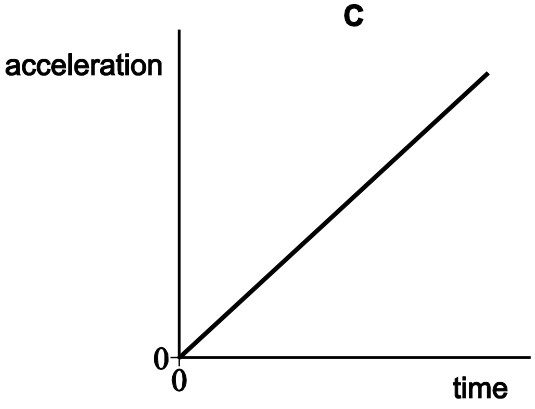
A



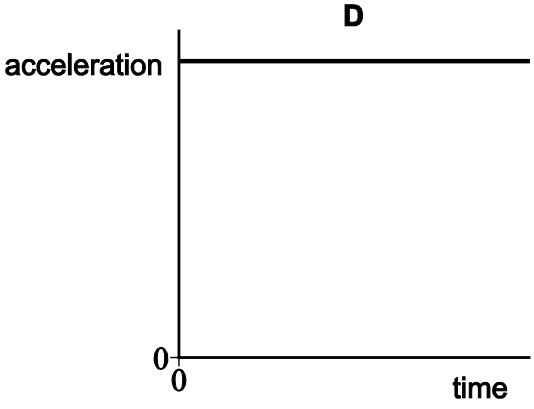
B



C



D



A ⬭

B ⬭

C ⬭

D ⬭

3 A girl jogs at $2.0\ \text{m s}^{-1}$ in a straight line for 30 seconds, turns around and returns to her starting point 20 seconds later.

What is her average velocity and average speed?

[1 mark]

	Average velocity/m s^{-1}	Average speed/m s^{-1}	
A	$0\ \text{m s}^{-1}$	$2.4\ \text{m s}^{-1}$	○
B	$0\ \text{m s}^{-1}$	$2.5\ \text{m s}^{-1}$	○
C	$1.0\ \text{m s}^{-1}$	$2.0\ \text{m s}^{-1}$	○
D	$2.5\ \text{m s}^{-1}$	$2.5\ \text{m s}^{-1}$	○

4 The mass of fuel in a racing car decreases during a race. As a result the lap time decreases.

Which of the following could explain this decrease?

[1 mark]

A There is less friction on the race track. ⬭

B The maximum speed of the car has increased. ⬭

C The maximum acceleration and deceleration are greater. ⬭

D The engine is more efficient. ⬭

5 What is represented by the area under a force–displacement graph?

[1 mark]

A rate of change of kinetic energy ⬭

B change in momentum ⬭

C work done ⬭

D acceleration ⬭

6 Which of the following is **not** a unit of power?

[1 mark]

A $N\ m\ s^{-1}$ ⬭

B $J\ s$ ⬭

C W ⬭

D $kg\ m^2\ s^{-3}$ ⬭

7 A roller coaster car is raised to a height of $65\ \text{m}$ and released from rest.

What is the maximum possible speed of the car?

[1 mark]

A $11\ \text{m s}^{-1}$ ⬭

B $25\ \text{m s}^{-1}$ ⬭

C $36\ \text{m s}^{-1}$ ⬭

D $130\ \text{m s}^{-1}$ ⬭

8 A bullet of mass $10\ \text{g}$ is fired with a velocity of $100\ \text{m s}^{-1}$ from a stationary rifle of mass $4.0\ \text{kg}$. Consider the rifle and bullet to be an isolated system.

What are the recoil velocity of the rifle and the total momentum of the rifle and bullet just after firing?

[1 mark]

	Recoil velocity / m s^{-1}	Total momentum / kg m s^{-1}	
A	0.25	0	⬭
B	0.25	1.0	⬭
C	0.40	0	⬭
D	0.40	1.0	⬭

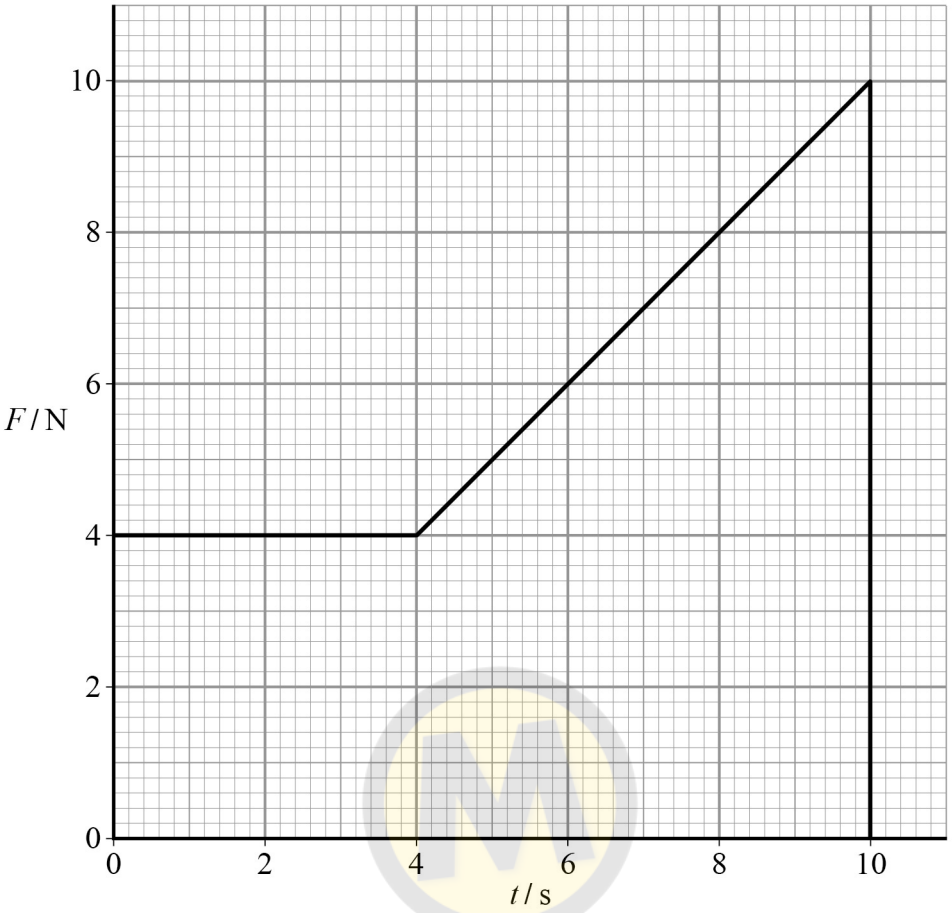
box

9 Which row correctly states whether momentum, mass and velocity are scalar or vector quantities?

[1 mark]

	Momentum	**Mass**	**Velocity**	
A	scalar	scalar	vector	⬭
B	vector	scalar	scalar	⬭
C	scalar	vector	scalar	⬭
D	vector	scalar	vector	⬭

1 0 The graph shows how the force F applied to an object varies with time t.



What is the momentum gained by the object from $t = 0$ to $t = 10$ s?

[1 mark]

A 18 kg m s^{-1} ⬭

B 32 kg m s^{-1} ⬭

C 40 kg m s^{-1} ⬭

D 58 kg m s^{-1} ⬭

Turn over for the next question

1 1 Two identical balls, **X** and **Y**, are at the same height and a horizontal distance of $25\ \text{cm}$ apart.

X is projected horizontally with a velocity of $0.10\ \text{m s}^{-1}$ towards **Y** at the same time that **Y** is released from rest. Both **X** and **Y** move freely in the absence of air resistance.

What is the distance between the balls $1.0\ \text{s}$ later?

[1 mark]

A $0.15\ \text{m}$ ⬭

B $0.25\ \text{m}$ ⬭

C $2.4\ \text{m}$ ⬭

D $4.9\ \text{m}$ ⬭

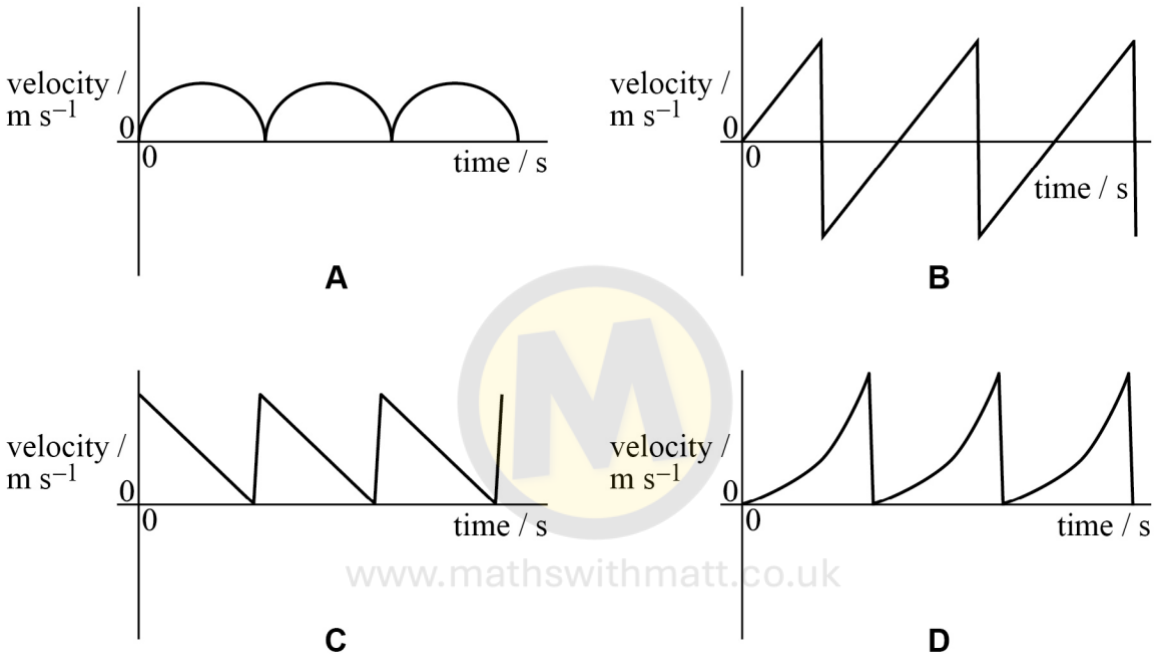
1 2 Which row gives two features of graphs that provide the same information?

[1 mark]

	Feature 1	Feature 2
A	Gradient of a displacement–time graph	Area under a velocity–time graph
B	Gradient of a displacement–time graph	Area under an acceleration–time graph
C	Gradient of a velocity–time graph	Area under a displacement–time graph
D	Gradient of a velocity–time graph	Area under an acceleration–time graph

1 3 Which graph best represents the velocity–time graph for a ball that is dropped from rest and bounces repeatedly?

[1 mark]



A

B ☐

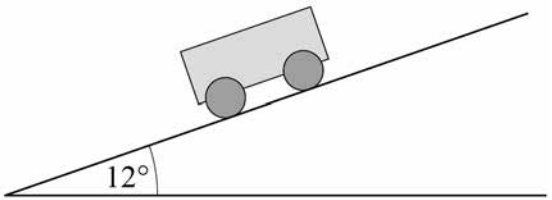
C

D

Do not write outside the box

1 4 A car's engine produces a useful output power of 6.5×10^4 W

The car of mass 950 kg is moving up a hill at a steady speed.
The slope of the hill is 12° to the horizontal. Resistive forces on the car are negligible.



What is the steady speed of the car?

[1 mark]

A $7.0\ \text{m s}^{-1}$ ⬭

B $12\ \text{m s}^{-1}$ ⬭

C $34\ \text{m s}^{-1}$ ⬭

D $68\ \text{m s}^{-1}$ ⬭

1 5 A girl is bouncing on a trampoline.

Assuming that air resistance is negligible, her acceleration

[1 mark]

A is zero when she is at maximum height. ⬭

B is constant when she is in the air. ⬭

C changes direction as she rises and then falls. ⬭

D is maximum just before she lands on the trampoline. ⬭

1 6 Two spheres, **P** and **Q**, have the same volume but **P** has a greater mass. The spheres fall in air at their terminal velocities v_P and v_Q respectively.

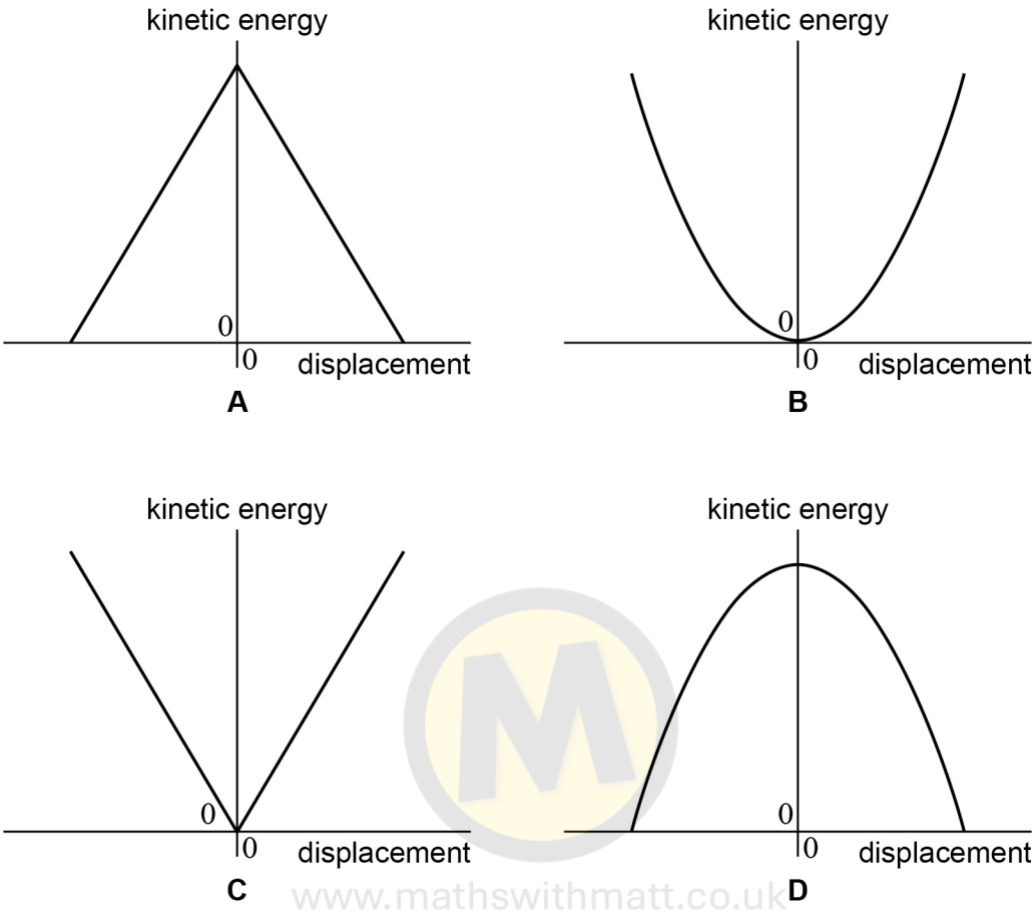
Which row states the relationship between v_P and v_Q and the reason?

[1 mark]

	Relationship between v_P and v_Q	Reason	
A	$v_P = v_Q$	Terminal velocity is unaffected by mass	⬭
B	$v_Q > v_P$	The mass of **Q** is less and it accelerates more	⬭
C	$v_Q > v_P$	**P** reaches equilibrium at a lower terminal velocity	⬭
D	$v_P > v_Q$	**Q** reaches equilibrium at a lower terminal velocity	⬭

1 7 Which graph best shows how the kinetic energy of a simple pendulum varies with displacement from the equilibrium position?

[1 mark]



A

B

C ☐

D

Do not write outside the box

1 8 Objects **P** and **Q** are initially at rest at time $t = 0$
The same resultant force F is applied to **P** and **Q** for time T.
The mass of **P** is 10 times greater than the mass of **Q**.

What is the ratio $\frac{\text{kinetic energy of } \mathbf{P}}{\text{kinetic energy of } \mathbf{Q}}$?

[1 mark]

A 0.1 ⬭

B 1 ⬭

C 10 ⬭

D 100 ⬭

1 9 What is a correct unit for the area under a force–time graph?

[1 mark]

A $\mathrm{N\,m}$ ⬭

B $\mathrm{kg\,m\,s^{-1}}$ ⬭

C $\mathrm{kg\,m\,s^{-2}}$ ⬭

D $\mathrm{N\,s^{-1}}$ ⬭

2 0 Immediately after take-off from the surface of the Earth, a rocket of mass $12\,000\ \text{kg}$ accelerates vertically upwards at $1.4\ \text{m s}^{-2}$

What is the thrust produced by the rocket motor?

[1 mark]

A $1.7 \times 10^4\ \text{N}$ ⬭

B $1.0 \times 10^5\ \text{N}$ ⬭

C $1.3 \times 10^5\ \text{N}$ ⬭

D $1.6 \times 10^5\ \text{N}$ ⬭

Do not write outside the box

2 1 What is the approximate average kinetic energy of a cyclist in a race?

[1 mark]

A 10 J ⬭

B 10 kJ ⬭

C 10 MJ ⬭

D 10 TJ ⬭

Do not write outside the box

2 2 Which row contains vector quantities only?

[1 mark]

A	acceleration	mass	⬭
B	displacement	momentum	⬭
C	energy	force	⬭
D	distance	speed	⬭

2 3 A car of mass $1000\ \text{kg}$ accelerates uniformly from rest to a speed of $25.0\ \text{m s}^{-1}$ in $50.0\ \text{s}$. The car is travelling along a horizontal road.

What is the average useful power output of the car over this period?

[1 mark]

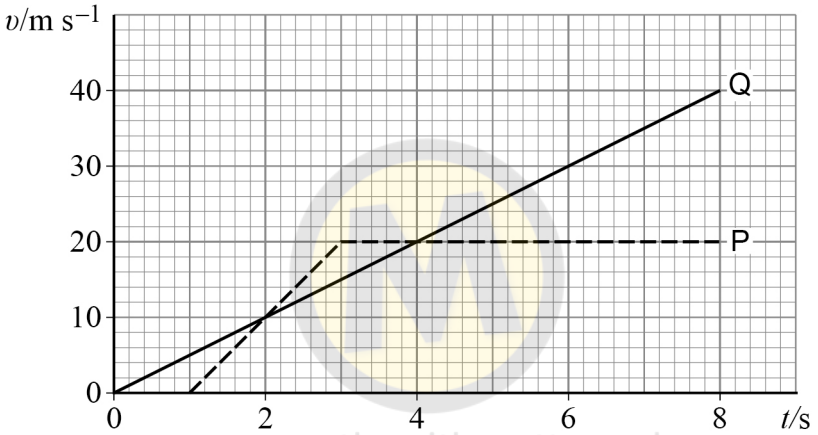
A $0.50\ \text{kW}$ ⬭

B $2.00\ \text{kW}$ ⬭

C $6.25\ \text{kW}$ ⬭

D $12.5\ \text{kW}$ ⬭

2 4 Two cars **P** and **Q** leave from the same point and travel in the same direction.
Q leaves at time $t = 0$ and **P** leaves one second later.
The figure shows the velocity–time graph for **P** and **Q**.



What is the distance between **Q** and **P** when $t = 8$ s?

[1 mark]

A 40 m ⬭

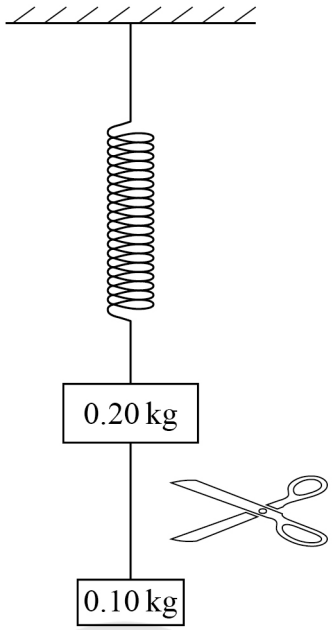
B 80 m ⬭

C 160 m ⬭

D 180 m ⬭

Do not write outside the box

2 5 A $0.20\ \text{kg}$ mass is suspended from a spring. A $0.10\ \text{kg}$ mass is suspended from the $0.20\ \text{kg}$ mass using a thread of negligible mass.
The system is in equilibrium and the thread is then cut.



What is the upward acceleration of the $0.20\ \text{kg}$ mass at the instant that the thread is cut?
[1 mark]

A $3.3\ \text{m s}^{-2}$ ⬭

B $4.9\ \text{m s}^{-2}$ ⬭

C $6.5\ \text{m s}^{-2}$ ⬭

D $9.8\ \text{m s}^{-2}$ ⬭

Do not write outside the box

2 6 A body of constant mass falls freely due to gravity.

The rate of change of momentum of the body is equal to its

[1 mark]

A kinetic energy. ⬭

B mass. ⬭

C gravitational potential energy. ⬭

D weight. ⬭

2 7 An electric vehicle is driven by a motor which produces a constant driving force.
The vehicle travels from rest along a straight horizontal road.
Friction and air resistance are negligible.

Which statement describes the variation with time of the power developed by the motor?
[1 mark]

A It stays constant. ⬭

B It increases linearly from zero. ⬭

C It increases non-linearly from zero. ⬭

D It increases from zero to a maximum and then decreases. ⬭

2 8 Which is a correct statement about mechanical power?

[1 mark]

A It is a vector quantity. ⬭

B It is measured in J. ⬭

C In fundamental units, its unit is $\mathrm{kg\ m^2\ s^{-3}}$ ⬭

D It can be calculated from force × distance moved. ⬭

2 9 Which row describes charge and impulse?

[1 mark]

	Charge	Impulse	
A	scalar	scalar	⬭
B	scalar	vector	⬭
C	vector	scalar	⬭
D	vector	vector	⬭

3 0 Which quantity is represented by the area under a force–time graph?

[1 mark]

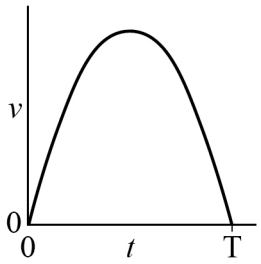
A average power ⬭

B elastic strain energy stored ⬭

C momentum change ⬭

D work done ⬭

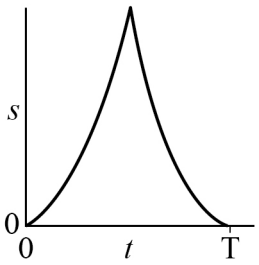
3 1 The diagram shows how the speed v of an object varies with time t.



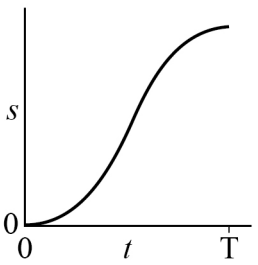
Which graph shows the variation of distance s with t for the object?

[1 mark]

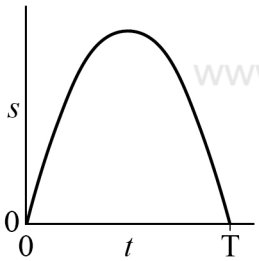
A



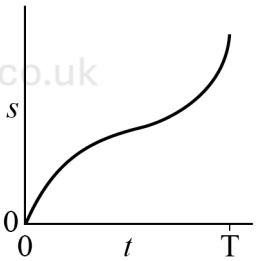
B



C



D



A ⬭

B ⬭

C ⬭

D ⬭

Do not write outside the box

3 2 The drag force on a boat is kv^2, where v is the speed and $k = 64\ \text{kg m}^{-1}$.

The boat's engine has a useful power output of $8000\ \text{W}$.

What is the maximum speed of the boat?

[1 mark]

A $0.2\ \text{m s}^{-1}$ ⬭

B $5\ \text{m s}^{-1}$ ⬭

C $11\ \text{m s}^{-1}$ ⬭

D $125\ \text{m s}^{-1}$ ⬭

3 3 Mechanical power

[1 mark]

A is a vector quantity. ⬭

B is measured in J. ⬭

C has base units of $\mathrm{kg\ m^2\ s^{-3}}$. ⬭

D can be calculated from force × distance moved. ⬭

Do not write outside the box

3 4 Small water drops leave a tap with zero velocity at intervals of 0.20 s.
They then fall freely 0.80 m to reach a horizontal surface.

How far has a drop fallen when the previous drop hits the surface?

[1 mark]

A 0.16 m ⬭

B 0.20 m ⬭

C 0.40 m ⬭

D 0.60 m ⬭

3 5 An electric motor lifts a load of weight W through a vertical height h in time t.
The potential difference across the motor is V and the current in it is I.

What is the efficiency of the motor?

[1 mark]

A $\frac{Wh}{VIt}$ ⬭

B $\frac{VI}{Wht}$ ⬭

C $\frac{Wht}{VI}$ ⬭

D $\frac{VIt}{Wh}$ ⬭

3 6 Which is the shortest distance?

[1 mark]

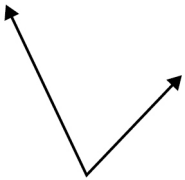
A 10^{-19} Gm ⬭

B 10^{-14} km ⬭

C 10^{-4} μm ⬭

D 10^{7} fm ⬭

3 7 The diagram shows a vector diagram of two forces acting on an object.
The diagram is drawn to scale.
The magnitude of the smaller force is 5.0 N.



What is the magnitude of the resultant force on the object?

[1 mark]

A 3.2 N ⬭

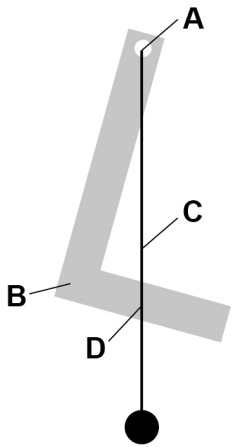
B 7.5 N ⬭

C 8.6 N ⬭

D 9.6 N ⬭

Do not write outside the box

3 8 A uniform piece of card in the shape of the letter L is suspended freely from a horizontal pin.
A plumb line is also suspended from the pin.
The diagram shows the card in its equilibrium position.



What is the position of the centre of mass of the piece of card?

[1 mark]

A ⬭

B ⬭

C ⬭

D ⬭

3 9 A Formula 1 racing car uses up its fuel during the race, causing its lap times to decrease.

The lap times decrease because

[1 mark]

A the acceleration of the car increases. ⬭

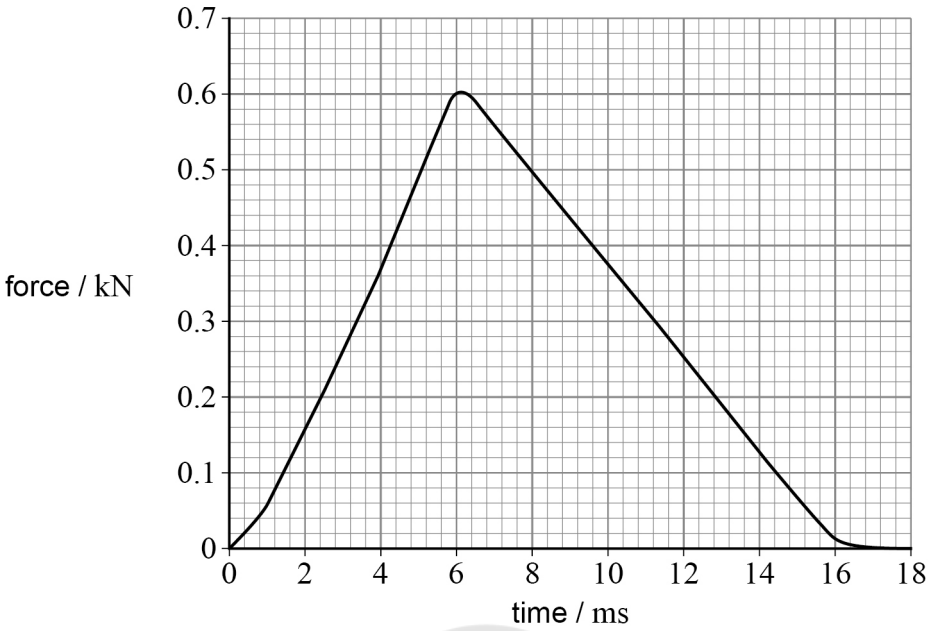
B the drag forces on the car decrease. ⬭

C the maximum speed of the car increases. ⬭

D the tyres become worn, reducing the friction with the road. ⬭

Do not write outside the box

4 0 A golf ball has a mass of 46 g and is initially stationary.
The diagram shows the variation with time of the force acting on the golf ball as it is hit with a golf club.



What is an estimate of the kinetic energy of the golf ball immediately after it is hit?

[1 mark]

A 5 J ⬭

B 50 J ⬭

C 250 J ⬭

D 500 J ⬭

Do not write outside the box

4 1 An object of mass m is accelerated from rest to a velocity v by a constant resultant force F.

What is the work done on the object during this acceleration?

[1 mark]

A $\frac{Fv}{2}$ ⬭

B Fv ⬭

C mv^2 ⬭

D $\frac{mv^2}{2}$ ⬭

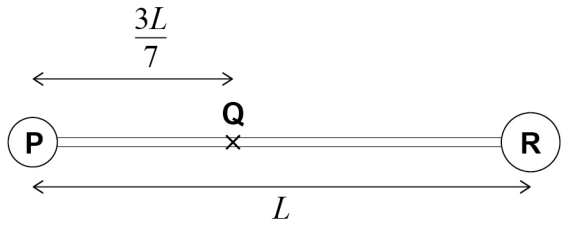
Do not write outside the box

4 2 **P** and **R** are uniform spheres of mass $3\ \text{kg}$ and $4\ \text{kg}$ respectively.
P and **R** are joined by a rod of negligible mass.
The distance between their centres is L.
The centre of mass of this system is at **Q**.

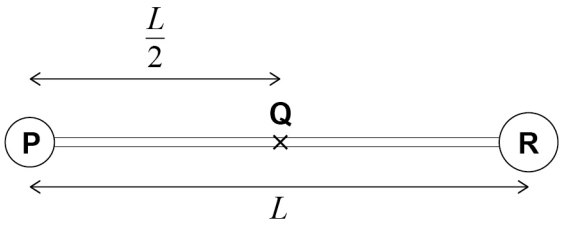
Which diagram shows the position of the centre of mass?

[1 mark]

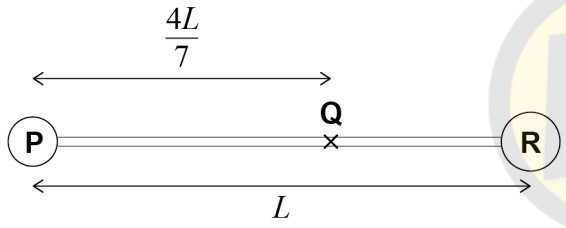
A



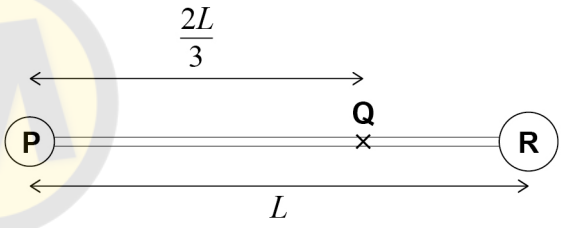
B



C



D



A ⬭

B ⬭

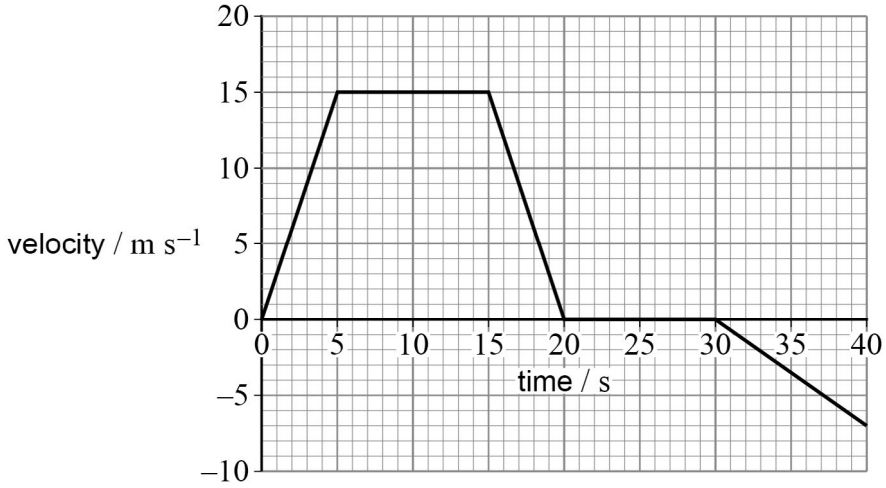
C ⬭

D ⬭

Turn over for the next question

Do not write outside the box

4 3 A vehicle travels on a straight road, starting at time $t = 0$
The graph shows how its velocity varies with time.



What is the distance of the vehicle from its start position when $t = 40$ s?

[1 mark]

A 115 m ⬭

B 190 m ⬭

C 260 m ⬭

D 370 m ⬭

4 4 A suitcase weighing $200\ \mathrm{N}$ is placed on a weighing scale in a lift.
The scale reads $180\ \mathrm{N}$ when the lift is moving.

The lift is

[1 mark]

A moving down at a constant velocity. ⬭

B moving down with a decreasing velocity. ⬭

C moving up at a constant velocity. ⬭

D moving up with a decreasing velocity. ⬭

Do not write outside the box

4 5 A mass m is added to a vertical spring that is initially unextended, as shown in **Diagram 1**.

The mass is then lowered until it hangs stationary on the spring, as shown in **Diagram 2**.

The extension of the spring is now ΔL.

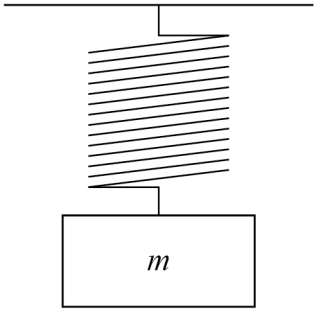


Diagram 1

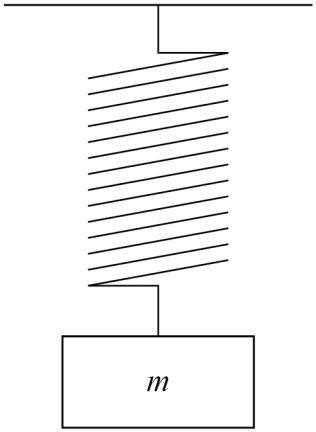


Diagram 2

How much energy is transferred from the mass–spring system?

[1 mark]

A $\frac{mg\Delta L}{2}$ ⬭

B $mg\Delta L$ ⬭

C $\frac{3mg\Delta L}{2}$ ⬭

D $2mg\Delta L$ ⬭

Do not write outside the box

Questions **46** and **47** are about three spheres **X**, **Y** and **Z**.

The relative mass and relative diameter of each sphere are given in the table.

	X	**Y**	**Z**
relative mass	1	5	1
relative diameter	1	1	5

Each sphere is dropped from rest and accelerates to its terminal speed.

4 6 What is true about the accelerations of the spheres at the instant they are released?

[1 mark]

A The acceleration of **X** is less than that of **Y**. ⬭

B The acceleration of **X** is greater than that of **Z**. ⬭

C The acceleration of **X** is the same as that of **Y**. ⬭

D The acceleration of **Y** is less than that of **Z**. ⬭

4 7 What is true about the terminal speeds?

[1 mark]

A The terminal speed of **X** is greater than that of **Y**. ⬭

B The terminal speed of **X** is the same as that of **Y**. ⬭

C The terminal speed of **Y** is greater than that of **Z**. ⬭

D The terminal speed of **X** is less than that of **Z**. ⬭

Turn over for the next question

Do not write outside the box

4 8 A car travels at $100\ \text{km}\ \text{h}^{-1}$ on a motorway.

What is an estimate of its kinetic energy?

[1 mark]

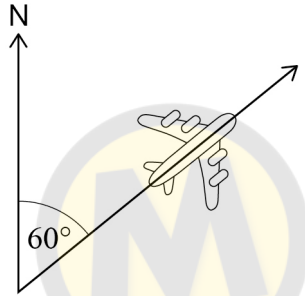
A $10^4\ \text{J}$ ⬭

B $10^6\ \text{J}$ ⬭

C $10^8\ \text{J}$ ⬭

D $10^{10}\ \text{J}$ ⬭

4 9 An aeroplane flies horizontally at $150\ \text{m s}^{-1}$ along a bearing $60°$ east of north.



How far north from its starting position is the aeroplane after one hour?

[1 mark]

A 270 km ⬭

B 470 km ⬭

C 510 km ⬭

D 540 km ⬭

Do not write outside the box

5 0 A ball is thrown vertically upwards and returns to its original position 2.4 s later.
The effect of air resistance is negligible.

What is the total distance travelled by the ball?

[1 mark]

A 5.9 m ⬭

B 7.1 m ⬭

C 14 m ⬭

D 28 m ⬭

5 1 Which description of a couple and its unit is correct?

[1 mark]

	Description	Unit
A	consists of two equal parallel forces	$\mathrm{N\ m^{-1}}$
B	produces translational motion	$\mathrm{N\ m}$
C	consists of two equal and opposite forces	$\mathrm{N\ m}$
D	produces rotational motion	$\mathrm{N\ m^{-1}}$

Do not write outside the box

5 2 **P** and **Q** are two balls of the same diameter. **P** has a greater mass than **Q**.

Both balls are projected at the same time from the top of a tall building that stands on horizontal ground.
Both balls are projected with the same horizontal velocity.
P reaches the ground after time t_P and at a horizontal distance d_P from the building.
Q reaches the ground after time t_Q and at a horizontal distance d_Q from the building.

The air is still and air resistance is **not** negligible.

Which row is correct?

[1 mark]

	Time	Horizontal distance	
A	$t_P = t_Q$	$d_P = d_Q$	⬭
B	$t_P = t_Q$	$d_P > d_Q$	⬭
C	$t_P < t_Q$	$d_P = d_Q$	⬭
D	$t_P < t_Q$	$d_P > d_Q$	⬭

Do not write outside the box

5 3 A firework rocket moves vertically upwards.
The rocket's fuel burns at a steady rate to produce a constant thrust.
The mass of the rocket decreases with time.

Ignore the effects of air resistance on the rocket.

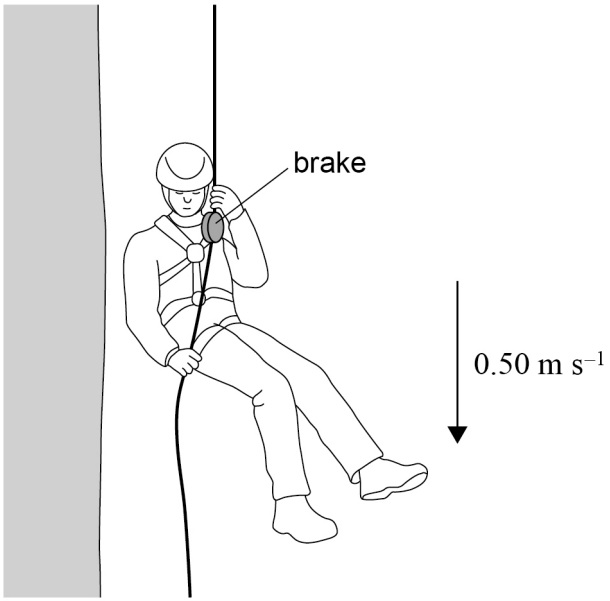
Which row shows the acceleration of the rocket before, and the acceleration immediately after, the fuel has been used up?

[1 mark]

	Acceleration before	**Acceleration immediately after**	
A	increasing upwards	constant downwards	⬭
B	increasing upwards	decreasing upwards	⬭
C	constant upwards	constant downwards	⬭
D	decreasing upwards	constant downwards	⬭

Do not write outside the box

5 4 A climber wears a harness attached to a rope. The rope passes through a brake. There is friction between the rope and the brake.



The climber uses the brake to descend at a steady speed of $0.50\ \text{m s}^{-1}$.
The combined mass of the climber, the harness and the brake is $60\ \text{kg}$.

What is the rate of energy transfer to the brake and rope?

[1 mark]

A 15 W ⬭

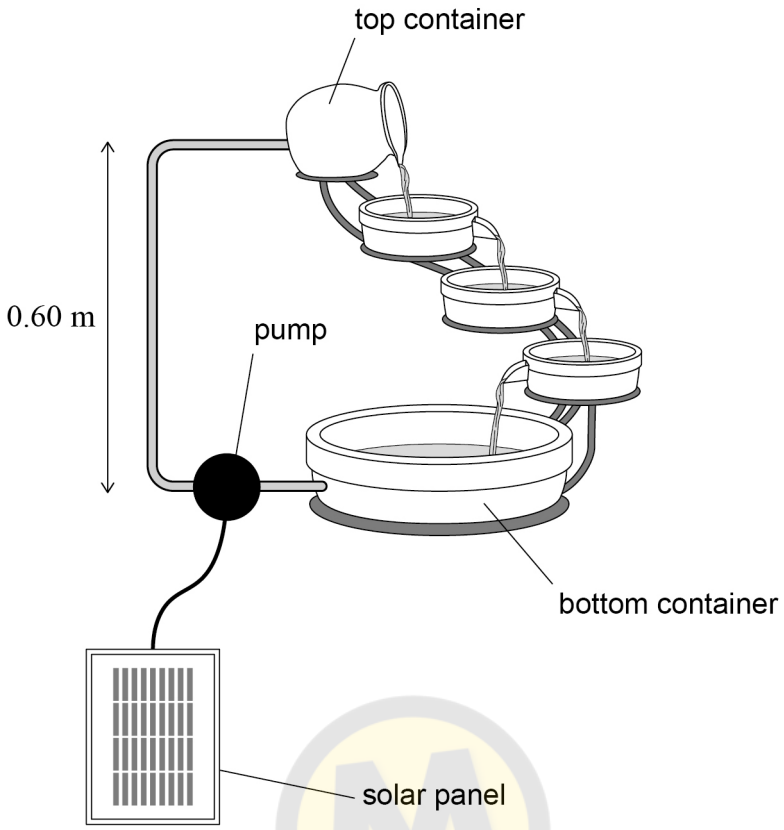
B 29 W ⬭

C 150 W ⬭

D 290 W ⬭

Do not write outside the box

5 5 A solar panel powers a pump for a water feature.



Solar energy is incident on the solar panel at a rate of 1.5 W.
Water from the bottom container is continually pumped through a vertical height of 0.60 m to the top container.

The overall efficiency of the solar panel and the pump is 20%.

What mass of water can be pumped into the top container each second?

[1 mark]

A 5 g ⬭

B 50 g ⬭

C 100 g ⬭

D 250 g ⬭

5 6 **P** and **Q** represent displacements.

What is the resultant displacement when **P** and **Q** are added?

[1 mark]

A  ⬭

B  ⬭

C  ⬭

D  ⬭

Do not write outside the box

5 7 A ball is dropped from a height h. The ball hits the ground with a velocity v.

The ball is now dropped from a height of $2h$.
Air resistance is negligible.

What is the velocity at which the ball hits the ground?

[1 mark]

A v ⬭

B $\sqrt{2v}$ ⬭

C $v\sqrt{2}$ ⬭

D $2v$ ⬭

5 8 Which combination of an object's speed and journey time gives a distance travelled of 1 mm?

[1 mark]

	Speed	Journey time	
A	$10\ \mu m\ s^{-1}$	100 s	○
B	$10\ km\ s^{-1}$	0.01 μs	○
C	$1\ nm\ s^{-1}$	1 Gs	○
D	$0.1\ Mm\ s^{-1}$	100 ns	○

Do not write outside the box

5 9 A person jumps as high as she can from a standing position.

What is a reasonable estimate of her speed just after she leaves the ground?

[1 mark]

A $2\ \text{m s}^{-1}$ ⬭

B $4\ \text{m s}^{-1}$ ⬭

C $8\ \text{m s}^{-1}$ ⬭

D $10\ \text{m s}^{-1}$ ⬭

Do not write outside the box

6 0 An object is moving in a straight line. A graph is plotted to show the variation of the momentum of the object with time.

Which quantities can be calculated from the gradient of the graph and the area under the graph?

[1 mark]

	Gradient of graph	Area under graph	
A	power	mass × displacement	⬭
B	force	work done × time	⬭
C	power	work done × time	⬭
D	force	mass × displacement	⬭

6 1 Which is a pair of vectors?

[1 mark]

A weight and work

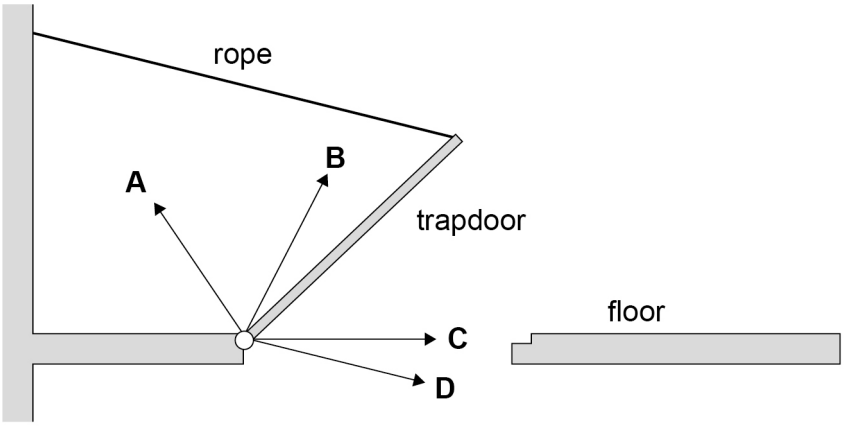
B force and energy

C displacement and momentum

D acceleration and power

Do not write outside the box

6 2 A heavy uniform trapdoor is hinged to the floor. It is held open by a rope as shown.



Which arrow shows the direction of the reaction force of the hinge on the trapdoor?

[1 mark]

A ⬭

B ⬭

C ⬭

D ⬭

6 3 A sphere of mass m falls with speed v.
The resistive force on the sphere is kv, where k is a constant.

What is the terminal speed of the sphere?

[1 mark]

A $\frac{mg}{k}$ ⬭

B $\frac{km}{g}$ ⬭

C kmg ⬭

D $\frac{k}{mg}$ ⬭

Do not write outside the box

6 4 A trolley moves down a slope with constant acceleration.
The mass of the trolley is doubled and the trolley moves down the same slope again.
Air resistance and friction are negligible.

Which is correct?

[1 mark]

A The accelerating force is unchanged. ⬭

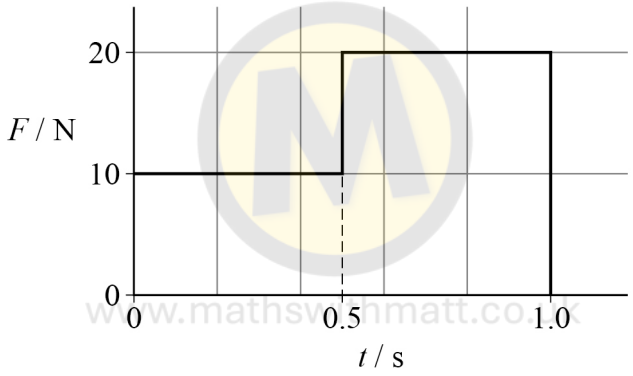
B The accelerating force is halved. ⬭

C The acceleration is unchanged. ⬭

D The acceleration is halved. ⬭

6 5 A variable force F acts on an object of mass $2.0\ \text{kg}$. The object is at rest at time $t = 0$

The graph shows the variation of F with t.



What is the speed of the object when $t = 1.0\ \text{s}$?

[1 mark]

A $3.75\ \text{m s}^{-1}$ ⬭

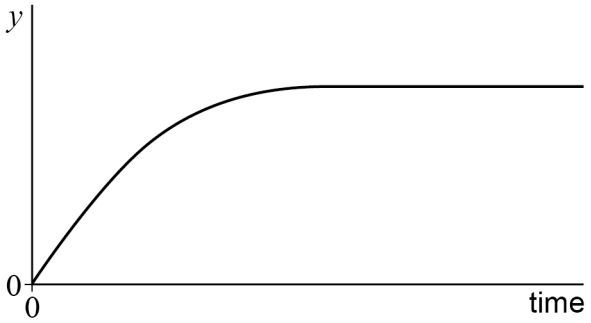
B $5.00\ \text{m s}^{-1}$ ⬭

C $7.50\ \text{m s}^{-1}$ ⬭

D $15.0\ \text{m s}^{-1}$ ⬭

Do not write outside the box

6 6 The graph shows the variation with time of a quantity y for an object as it falls through the air.



Which row gives y and the amount of air resistance?

[1 mark]

	y	**Air resistance**	
A	distance	negligible	⬭
B	distance	not negligible	⬭
C	speed	negligible	⬭
D	speed	not negligible	⬭

6 7 An electric pump forces water continually through a horizontal pipe at a speed of $4.0\ \text{m s}^{-1}$.

cross-sectional area of the pipe $= 5.0 \times 10^{-4}\ \text{m}^2$
density of water $= 1.0 \times 10^{3}\ \text{kg m}^{-3}$

What is the useful power of the pump?

[1 mark]

A 4.0 W ⬭

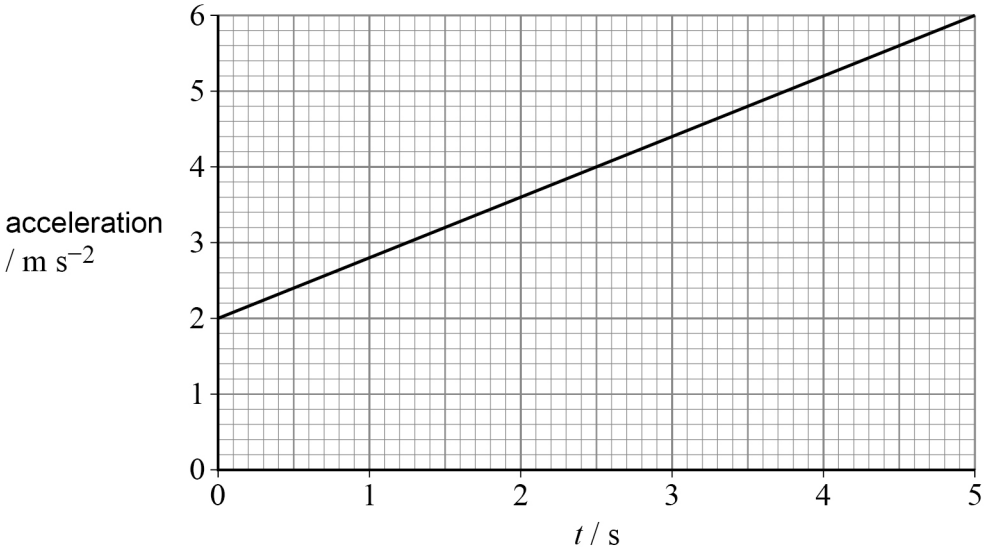
B 8.0 W ⬭

C 16 W ⬭

D 32 W ⬭

Do not write outside the box

6 8 The graph shows the variation with time t of the acceleration of an object moving in a straight line.



When $t = 0$ the speed of the object is $4.0\ \text{m s}^{-1}$.

What is the speed of the object when $t = 5.0$ s?

[1 mark]

A $10\ \text{m s}^{-1}$ ⬭

B $14\ \text{m s}^{-1}$ ⬭

C $20\ \text{m s}^{-1}$ ⬭

D $24\ \text{m s}^{-1}$ ⬭

6 9 An object is released and falls from rest.
Air resistance is negligible.

After falling for time t, the momentum of the object is

[1 mark]

A constant. ⬭

B proportional to $\sqrt{t}$. ⬭

C proportional to t. ⬭

D proportional to t^2. ⬭

7 0 A horse starts walking from point **X** on a circular track of circumference $60\ \text{m}$.

The speed of the horse is a constant $2.0\ \text{m s}^{-1}$.

What is the horse's displacement from **X** after $45\ \text{s}$?

[1 mark]

A $19\ \text{m}$ ⬭

B $30\ \text{m}$ ⬭

C $38\ \text{m}$ ⬭

D $90\ \text{m}$ ⬭

7 1 A particle travelling horizontally at $1.0 \times 10^{7}\ \text{m s}^{-1}$ enters a region where it has a constant vertical acceleration of $4 \times 10^{14}\ \text{m s}^{-2}$.

What is the horizontal distance the particle has travelled in the region when its vertical displacement is $8 \times 10^{-2}\ \text{m}$?

[1 mark]

A $0.2\ \text{m}$ ⬭

B $0.1\ \text{m}$ ⬭

C $2 \times 10^{-8}\ \text{m}$ ⬭

D $0.4 \times 10^{-9}\ \text{m}$ ⬭

Do not write outside the box

7 2 An object is thrown vertically upwards at time $t = 0$

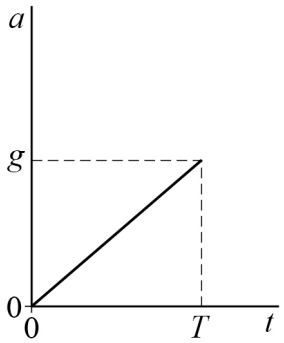
The object reaches its maximum height when $t = T$ and reaches its terminal speed on the way down.

The magnitude of the object's acceleration is a.

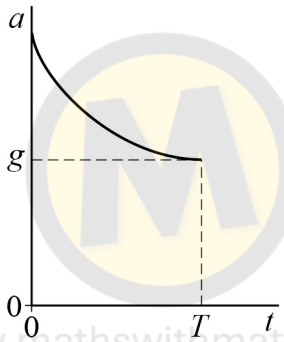
Which graph shows the variation of a with t?

[1 mark]

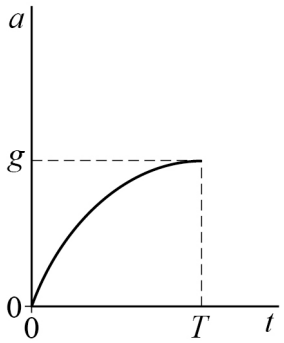
A



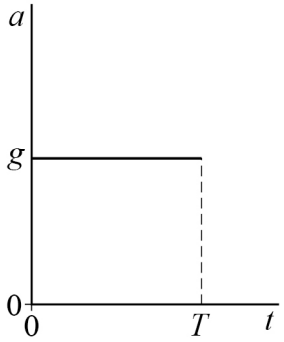
B



C



D



Do not write outside the box

7 3 A man has a mass of $75.0\ \text{kg}$.
He stands on weighing scales in a lift that accelerates upwards at $2.60\ \text{m s}^{-2}$.

What is the reading on the scales during the acceleration?

[1 mark]

A 195 N ⬭

B 541 N ⬭

C 736 N ⬭

D 931 N ⬭

7 4 An average force of $42\ \text{kN}$ acts on the air passing through a jet engine. This force causes the speed of the air to increase by $540\ \text{m s}^{-1}$.

What mass of air passes through the engine in one minute?

[1 mark]

A $7.7 \times 10^{-2}\ \text{kg}$ ⬭

B $4.7\ \text{kg}$ ⬭

C $78\ \text{kg}$ ⬭

D $4700\ \text{kg}$ ⬭

7 5

A ballbearing $\mathbf{X}$ of mass $2m$ is projected vertically upwards with speed u. A ballbearing $\mathbf{Y}$ of mass m is projected at 30° to the horizontal with speed $2u$ at the same time. Air resistance is negligible. Which of the following statements is correct?

[1 mark]

A The horizontal component of $\mathbf{Y}$'s velocity is u.

B The maximum height reached by $\mathbf{Y}$ is half that reached by $\mathbf{X}$

C $\mathbf{X}$ and $\mathbf{Y}$ reach the ground at the same time.

D $\mathbf{X}$ reaches the ground first.

7 6

What is the relationship between the distance y travelled by an object falling freely from rest and the time x the object has been falling?

[1 mark]

A y is proportional to x^2

B y is proportional to $\sqrt{x}$

C y is proportional to $\frac{1}{x}$

D y is proportional to $\frac{1}{x^2}$

7 7

A car exerts a driving force of 500 N when travelling at a constant speed of $72\ \text{km h}^{-1}$ on a level track. What is the work done in 5 minutes?

[1 mark]

A 3.0×10^6 J ⬭

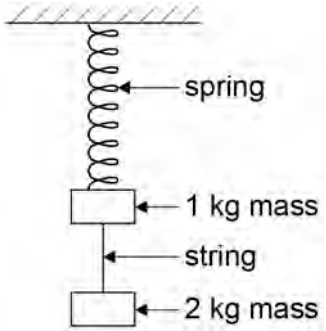
B 2.0×10^6 J ⬭

C 2.0×10^5 J ⬭

D 1.1×10^5 J ⬭

7 8

Two masses hang at rest from a spring, as shown in the diagram. The string separating the masses is burned through.



Which of the following gives the accelerations of the two masses as the string breaks?

acceleration of free fall = g

[1 mark]

	acceleration of 1 kg mass upwards in m s^{-2}	acceleration of 2 kg mass downwards in m s^{-2}	
A	$3\,g$	$1\,g$	⬭
B	$2\,g$	$2\,g$	⬭
C	$2\,g$	$1\,g$	⬭
D	$1\,g$	$1\,g$	⬭

7 9

An object falls freely from rest. After falling a distance d its velocity is v. What is its velocity after it has fallen a distance $2d$?

[1 mark]

A $2\,v$

B $4\,v$

C $2\,v^2$

D $\sqrt{2}\,v$

8 0

An electric motor of input power 100 W raises a mass of 10 kg vertically at a steady speed of 0.5 $\mathrm{m\ s^{-1}}$. What is the efficiency of the system?

[1 mark]

A 5% ⬭

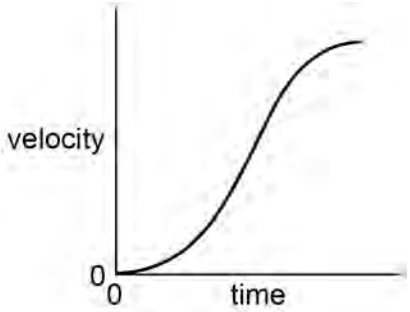
B 12% ⬭

C 50% ⬭

D 100% ⬭

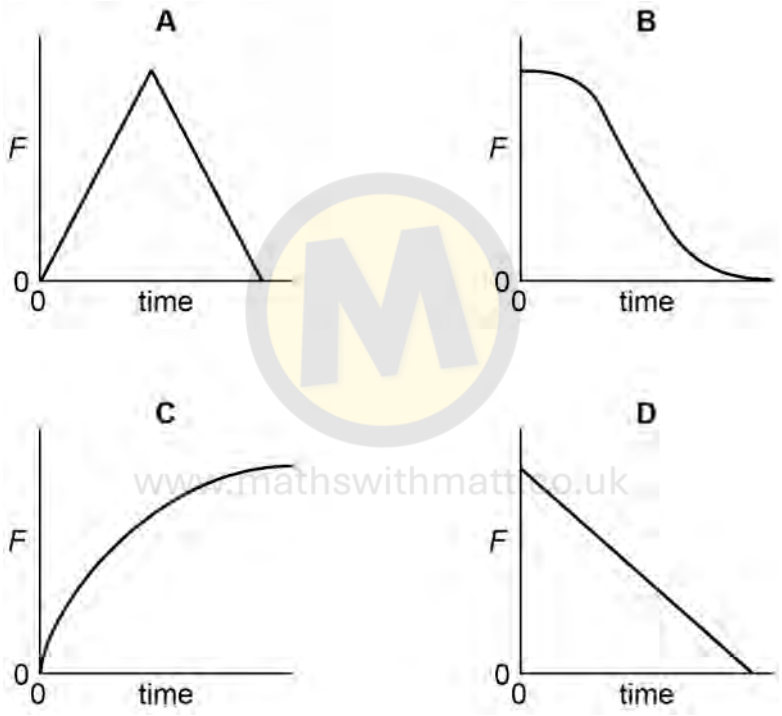
8 1

The velocity of a vehicle varies with time as shown by the following graph.



Which graph below represents how the resultant force F on the car varies during the same time?

[1 mark]



A ⬭

B ⬭

C ⬭

D ⬭