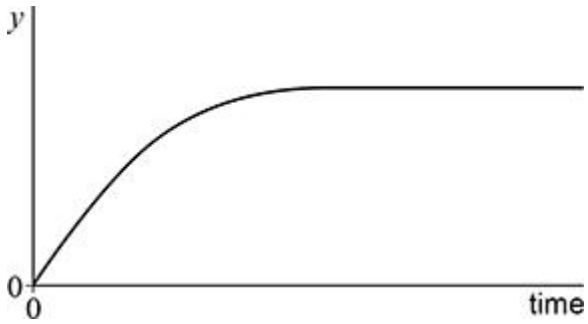
Q1.

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?

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

(Total 1 mark)

Q2.

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

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

What is the useful power of the pump?

A 4.0 W ⬭

B 8.0 W ⬭

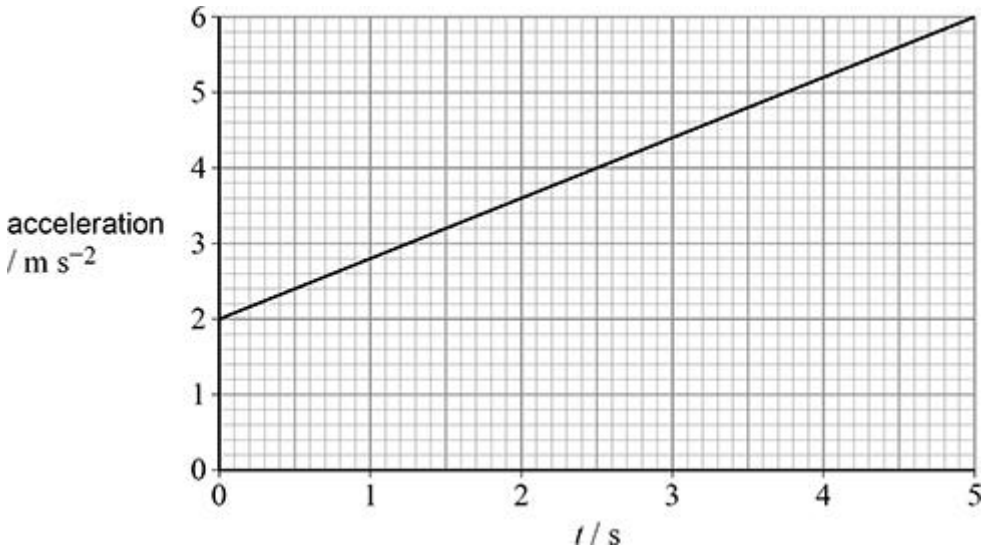
C 16 W ⬭

D 32 W ⬭

(Total 1 mark)

Q3.

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 m s^{-1}.

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

A 10 m s^{-1} ⬭

B 14 m s^{-1} ⬭

C 20 m s^{-1} ⬭

D 24 m s^{-1} ⬭

(Total 1 mark)

Q4.

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

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

A constant. ⬭

B proportional to $\sqrt{t}$ ⬭

C proportional to t ⬭

D proportional to t^2 ⬭

(Total 1 mark)

Q5.

A cricket ball of mass 0.16 kg travels at a speed of 35 m s^{-1} towards a bat.
When the ball is hit, it is in contact with the bat for 52 ms.
As a result, the ball travels in the opposite direction with a speed of 30 m s^{-1}.

What is the average force on the ball from the bat?

A 0.015 N ⬭

B 0.20 N ⬭

C 15 N ⬭

D 200 N ⬭

(Total 1 mark)

Q6.

A horse starts walking from point **X** on a circular track of circumference 60 m.

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

What is the horse's displacement from **X** after 45 s?

A 19 m ⬭

B 30 m ⬭

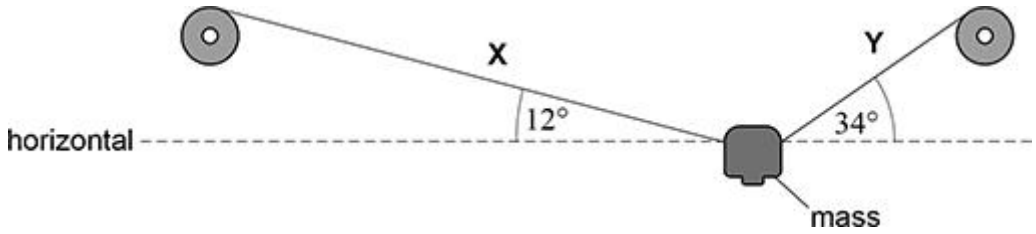
C 38 m ⬭

D 90 m ⬭

(Total 1 mark)

Q7.

A mass is held stationary by two cables **X** and **Y**.



The tension in **X** is 390 N.

What is the tension in **Y**?

A 145 N ⬭

B 380 N ⬭

C 390 N ⬭

D 460 N ⬭

(Total 1 mark)

Q8.

The electric motor of a lift raises a load of 750 N at a constant speed. The load moves through a vertical distance of 3.0 m in 1.5 s. As the load is being raised, the current in the motor is 12 A and the potential difference across the motor is 200 V.

What is the efficiency of the lift?

A 16% ⬭

B 63% ⬭

C 88% ⬭

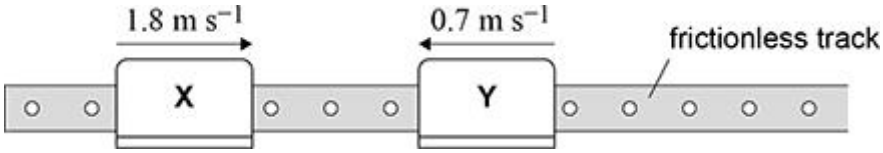
D 94% ⬭

(Total 1 mark)

Q9.

Glider **X** of mass 400 g travels at 1.8 m s^{-1} to the right on a horizontal, frictionless track.

Glider **Y** of mass 300 g travels towards **X** at 0.7 m s^{-1}.



X and **Y** collide.
Immediately after the collision, **Y** travels to the right at a speed of 0.9 m s^{-1}.

What are the speed and direction of movement of **X** immediately after the collision?

A 0.6 m s^{-1} to the left ⬭

B 0.6 m s^{-1} to the right ⬭

C 1.7 m s^{-1} to the left ⬭

D 1.7 m s^{-1} to the right ⬭

(Total 1 mark)

Q10.

Three non-parallel coplanar forces act on a body.

Which is **not** required for the forces to be in equilibrium?

A The sum of the forces in any direction must be zero. ⬭

B The sum of the moments of the forces about any point in the plane must be zero. ⬭

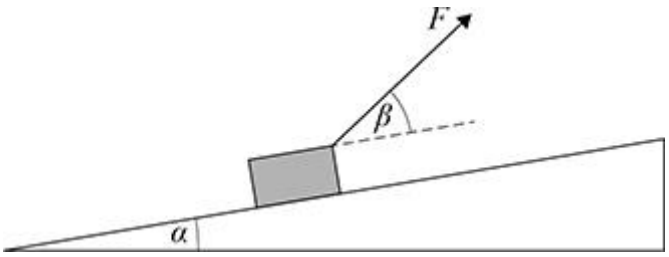
C The lines of action of the forces must pass through the centre of mass of the body. ⬭

D The resultant of any two forces must be the same magnitude as the third force. ⬭

(Total 1 mark)

Q11.

A force of magnitude F acts on a box of mass m that moves along a frictionless slope. The slope is at an angle α to the horizontal and the force acts at an angle β to the slope.



What is the magnitude of the acceleration of the block along the slope?

A $\frac{F}{m} \sin \alpha - g \sin \beta$ ○

B $\frac{F}{m} \cos \beta - g \sin \alpha$ ○

C $\frac{F}{m} \cos (\alpha + \beta) - g \cos \beta$ ○

D $\frac{F}{m} \cos (\alpha + \beta) - g \sin \beta$ ○

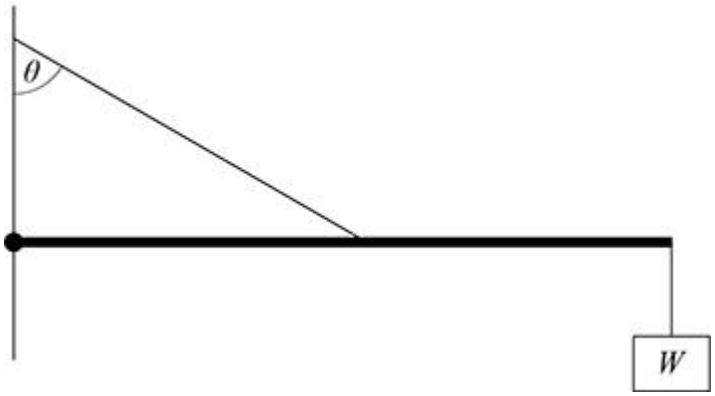
(Total 1 mark)

Q12.

The weight of a uniform bar is W.
An object also of weight W is attached to one end.
The bar is pivoted at the other end and held horizontal by a rope attached to its centre. The tension in the rope is $4W$.

What is angle θ?

not to scale



A 41° ⬭

B 45° ⬭

C 60° ⬭

D 71° ⬭

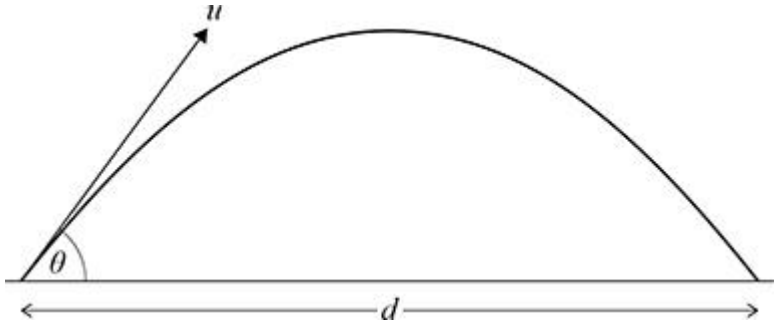
(Total 1 mark)

Q13.

A projectile is fired from ground level over horizontal ground.

Its initial velocity is u at an angle θ to the horizontal.

The range of the projectile is d.



A second projectile is fired with a velocity $2u$ at the same angle.

What is the range of this projectile?
Assume that air resistance is negligible.

A $\sqrt{2}d$ ⬭

B $2d$ ⬭

C $2\sqrt{2}d$ ⬭

D $4d$ ⬭

(Total 1 mark)

Q14.

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

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

A 0.2 m ⬭

B 0.1 m ⬭

C 2×10^{-8} m ⬭

D 0.4×10^{-9} m ⬭

(Total 1 mark)

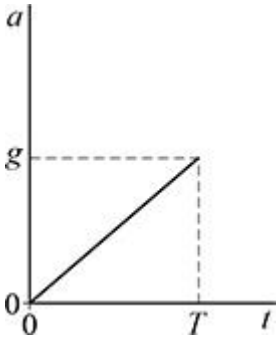
Q15.

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

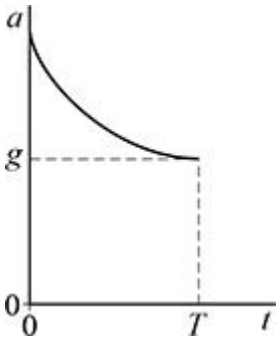
The object reaches its maximum height when $t = T$ and reaches its terminal speed on the way down.

The magnitude of the object's acceleration is a.

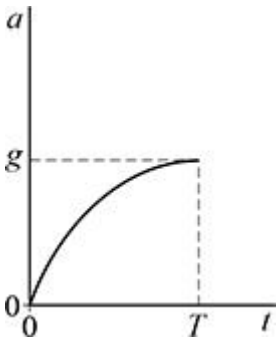
Which graph shows the variation of a with t?

A 

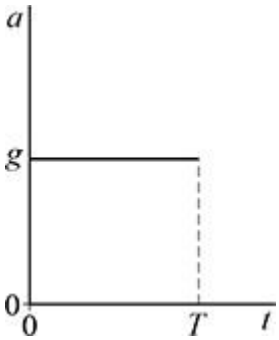
○

B 

○

C 

○

D 

○

(Total 1 mark)

Q16.

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

What is the reading on the scales during the acceleration?

A 195 N ○

B 541 N ○

C 736 N ○

D 931 N ○

(Total 1 mark)

Q17.

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

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

A 7.7 × 10^{-2} kg ○

B 4.7 kg ○

C 78 kg ○

D 4700 kg ○

(Total 1 mark)

Q18.

An object of mass 0.20 kg moves with an initial velocity u. It collides with a stationary object of mass 0.30 kg.

The objects stick together when they collide.
No external forces act on the objects.

What is the final velocity of the two objects after the collision?

A 0.40u ○

B 0.67u ○

C 1.5u ○

D 2.5u ○

(Total 1 mark)

Q19.

P and **Q** represent displacements.

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

A  ⬭

B  ⬭

C  ⬭

D  ⬭

(Total 1 mark)

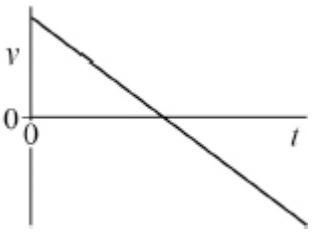
Q20.

A girl kicks a football vertically upwards at time $t = 0$

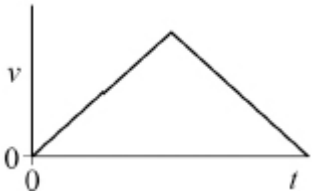
Air resistance is negligible.

What is the variation of the vertical component of velocity v of the football with t until it reaches the ground?

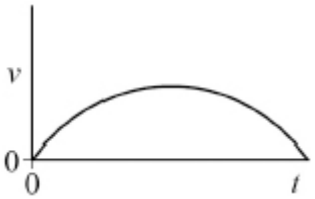
A



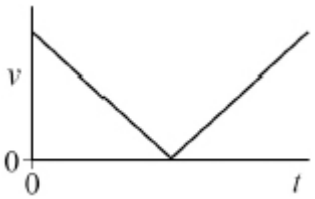
B



C



D



(Total 1 mark)

Q21.

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?

A v ○

B $\sqrt{2v}$ ○

C $v\sqrt{2}$ ○

D $2v$ ○

(Total 1 mark)

Q22.

A pellet of mass 25 g travelling horizontally at 40 m s^{-1} enters a fixed wooden block. The pellet stops after travelling a horizontal distance of 2.5 cm in the block.

What is the average resistive force acting on the pellet?

A 20 N ○

B 800 N ○

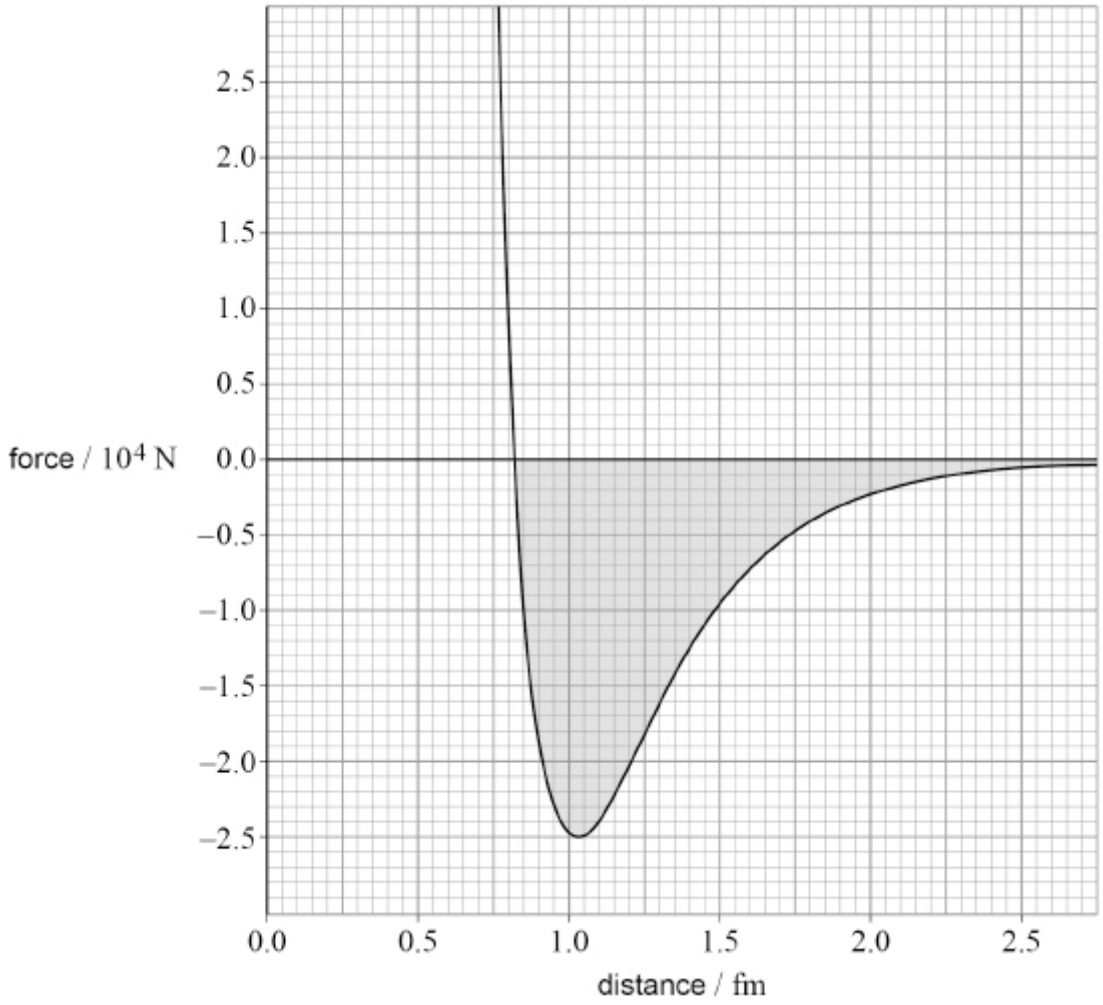
C 1600 N ○

D 8000 N ○

(Total 1 mark)

Q23.

The graph shows the variation of force with distance between a proton and a neutron.



The shaded area represents

A acceleration. ⬭

B impulse. ⬭

C rate of change of kinetic energy. ⬭

D work done. ⬭

(Total 1 mark)

Q24.

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

	Speed	Journey time	
A	10 μm 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	○

(Total 1 mark)

Q25.

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?

A 2 m s^{-1} ○

B 4 m s^{-1} ○

C 8 m s^{-1} ○

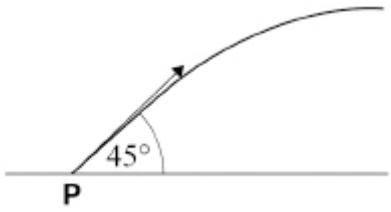
D 10 m s^{-1} ○

(Total 1 mark)

Q26.

A ball is kicked from point **P** on level ground. The ball initially travels at 45° to the horizontal.

The ball reaches its maximum height after a time of 2.0 s.
Air resistance can be ignored.



What is the displacement of the ball from **P** when at its maximum height?

A 20 m ⬭

B 40 m ⬭

C 45 m ⬭

D 60 m ⬭

(Total 1 mark)

Q27.

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?

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

(Total 1 mark)

Q28.

Which is a pair of vectors?

A weight and work ⬭

B force and energy ⬭

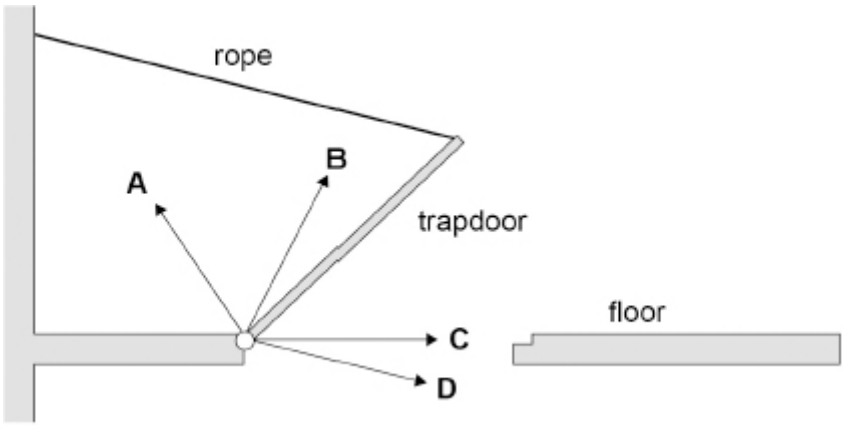
C displacement and momentum ⬭

D acceleration and power ⬭

(Total 1 mark)

Q29.

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?

A ⬭

B ⬭

C ⬭

D ⬭

(Total 1 mark)

Q30.

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?

A $\frac{mg}{k}$ ⬭

B $\frac{km}{g}$ ⬭

C kmg ⬭

D $\frac{k}{mg}$ ⬭

(Total 1 mark)

Q31.

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?

A The accelerating force is unchanged. ⬭

B The accelerating force is halved. ⬭

C The acceleration is unchanged. ⬭

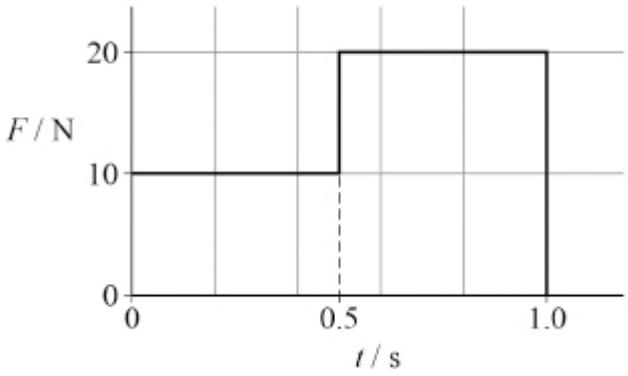
D The acceleration is halved. ⬭

(Total 1 mark)

Q32.

A variable force F acts on an object of mass 2.0 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 s?

A 3.75 $\mathrm{m\ s^{-1}}$ ⬭

B 5.00 $\mathrm{m\ s^{-1}}$ ⬭

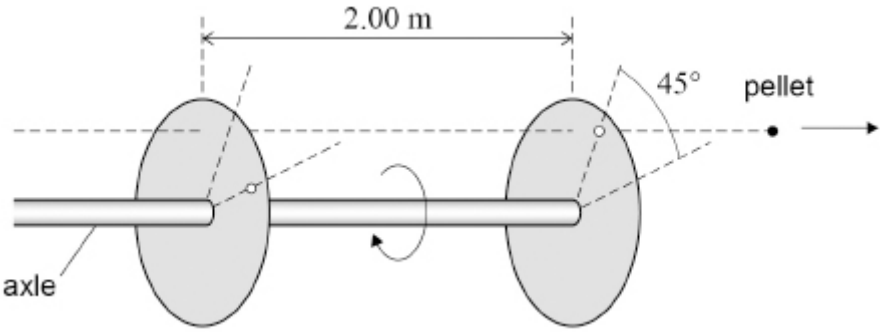
C 7.50 $\mathrm{m\ s^{-1}}$ ⬭

D 15.0 $\mathrm{m\ s^{-1}}$ ⬭

(Total 1 mark)

Q33.

Two circular discs made of card rotate at constant speed on a common axle.



The discs are 2.00 m apart.

An air-gun pellet is fired parallel to the axle. The pellet makes holes in the discs.
The holes are separated by an angle of 45°.
The speed of the pellet between the discs is 300 $\mathrm{m\ s^{-1}}$.

How many revolutions does each disc complete in one second?

A 19 ⬭

B 118 ⬭

C 740 ⬭

D 1074 ⬭

(Total 1 mark)

Q34.

A mass **M** hangs in equilibrium from a vertical spring that obeys Hooke's law.
M is pulled down by $10\ \text{cm}$ and then released to oscillate about the equilibrium position.
M returns to the equilibrium position for the first time $0.50\ \text{s}$ after release.

Which row gives the amplitude and the period of the oscillations?

	Amplitude / cm	Period / s	
A	10	1.0	⬭
B	10	2.0	⬭
C	20	2.0	⬭
D	20	1.0	⬭

(Total 1 mark)

Q35.

Which is a scalar quantity?

A force ⬭

B kinetic energy ⬭

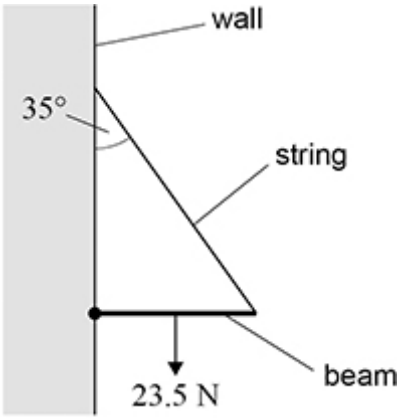
C momentum ⬭

D velocity ⬭

(Total 1 mark)

Q36.

A uniform beam of weight $23.5\ \text{N}$ is attached by a hinge to a vertical wall and supported by a string.
The string makes an angle of $35°$ to the wall.



What is the tension in the string?

A $14\ \text{N}$ ⬭

B $21\ \text{N}$ ⬭

C $29\ \text{N}$ ⬭

D $41\ \text{N}$ ⬭

(Total 1 mark)

Q37.

Which description of a couple and its unit is correct?

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

(Total 1 mark)

Q38.

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?

	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	$t_P < t_Q$	$d_P > d_Q$	⬭

(Total 1 mark)

Q39.

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?

	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	⬭

(Total 1 mark)

Q40.

Object **P** has a mass of $7500\ \text{kg}$ and travels at $12\ \text{m s}^{-1}$.
Object **Q** has a mass of $2500\ \text{kg}$ and travels at $20\ \text{m s}^{-1}$ in the same direction as **P**.
P and **Q** collide and remain together after the collision.

What is the total kinetic energy of **P** and **Q** immediately after the collision?

A 70 kJ ⬭

B 140 kJ ⬭

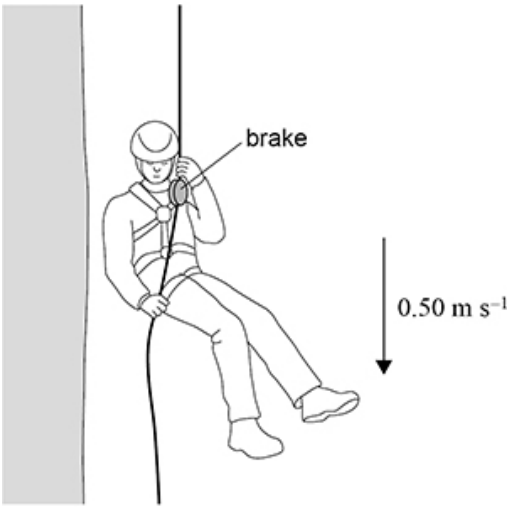
C 980 kJ ⬭

D 2.0 MJ ⬭

(Total 1 mark)

Q41.

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?

A 15 W ⬭

B 29 W ⬭

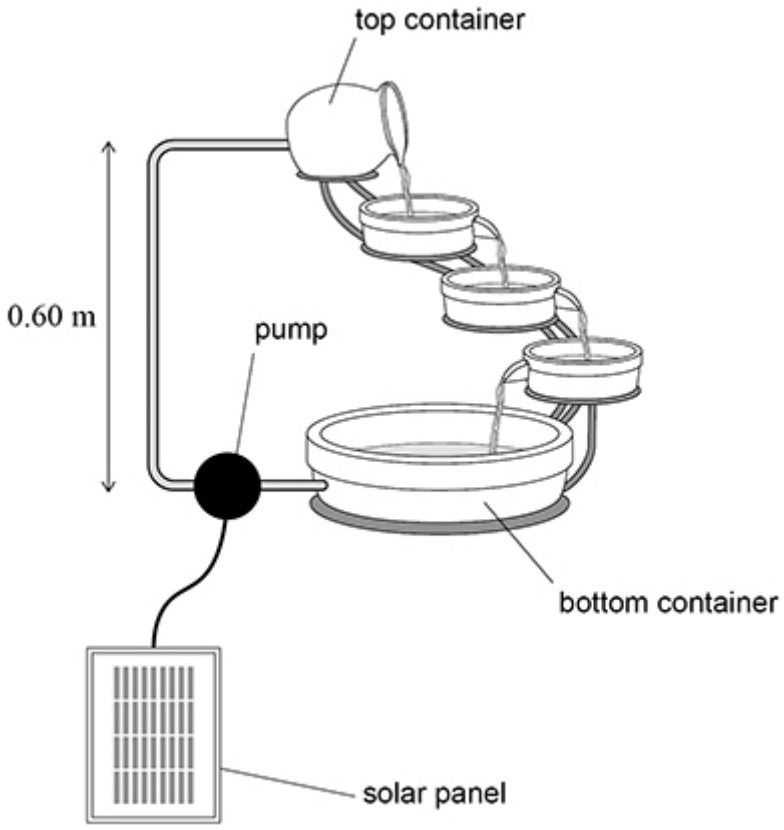
C 150 W ⬭

D 290 W ⬭

(Total 1 mark)

Q42.

A solar panel powers a pump for a water feature.



Solar energy is incident on the solar panel at a rate of $1.5\ \text{W}$.
Water from the bottom container is continually pumped through a vertical height of $0.60\ \text{m}$ 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?

A $5\ \text{g}$ ⬭

B $50\ \text{g}$ ⬭

C $100\ \text{g}$ ⬭

D $250\ \text{g}$ ⬭

(Total 1 mark)

Q43.

Which two quantities have the base unit $\mathrm{kg\ m^2\ s^{-2}}$?

A kinetic energy and momentum ⬭

B kinetic energy and Young modulus ⬭

C work done and the moment of a couple ⬭

D work done and pressure ⬭

(Total 1 mark)

Q44.

A car travels at $\mathrm{100\ km\ h^{-1}}$ on a motorway.
What is an estimate of its kinetic energy?

A 10^4 J ⬭

B 10^6 J ⬭

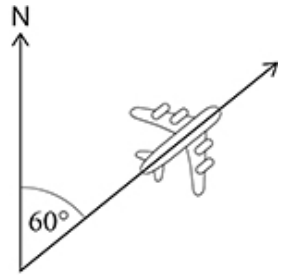
C 10^8 J ⬭

D 10^{10} J ⬭

(Total 1 mark)

Q45.

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



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

A 270 km ⬭

B 470 km ⬭

C 510 km ⬭

D 540 km ⬭

(Total 1 mark)

Q46.

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?

A 5.9 m ⬭

B 7.1 m ⬭

C 14 m ⬭

D 28 m ⬭

(Total 1 mark)

Q47.

A truck of mass 2.1×10^3 kg tows a car of mass 1.3×10^3 kg along a horizontal road.
The total resistive force on the car is 1100 N.
The acceleration of the car and truck is 2.3 m s^{-2}.

What is the tension in the tow rope?

A 3000 N ⬭

B 4100 N ⬭

C 7800 N ⬭

D 8900 N ⬭

(Total 1 mark)

Q48.

A parachutist descends to the ground at a constant speed with the parachute open.

Which force, together with the parachutist's weight, makes a pair according to Newton's third law of motion?

A the drag force on the parachutist from the air ⬭

B the tension in the strings of the parachute ⬭

C the gravitational force of the parachutist on the Earth ⬭

D the lift force on the parachute from the air ⬭

(Total 1 mark)

Q49.

A tennis ball has a mass of $58\ \text{g}$.
The ball is dropped from rest from a height of $1.8\ \text{m}$ above the ground and falls vertically.
The ball rebounds vertically to a height of $1.1\ \text{m}$.
The effect of air resistance is negligible.

What is the change in momentum of the ball during its collision with the ground?

A $0.040\ \text{N s}$ ⬭

B $0.075\ \text{N s}$ ⬭

C $0.215\ \text{N s}$ ⬭

D $0.614\ \text{N s}$ ⬭

(Total 1 mark)