Oxford Cambridge and RSA

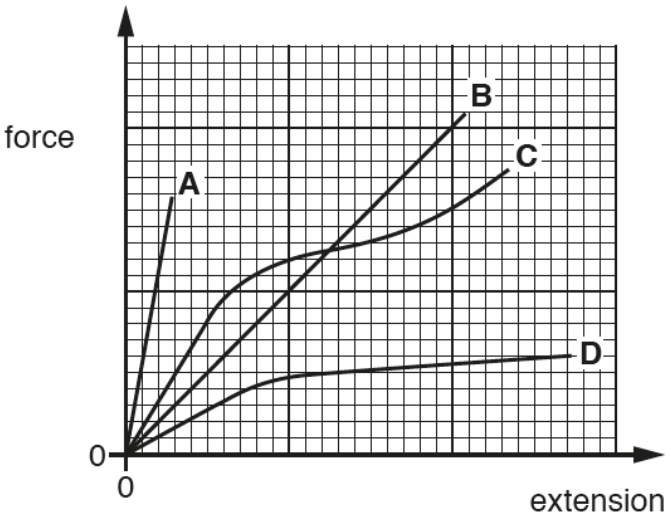
A Level Physics A

H556/01 Modelling physics

Question Set 2

Multiple Choice Questions

1 Four materials **A**, **B**, **C and D** have the same length and cross-sectional area. The force against extension graph for each material up to the breaking point is shown below.



Which material is brittle and has the greatest ultimate tensile strength?

Your answer B **[1]**

2 The braking distance of a car is directly proportional to its initial kinetic energy.

The braking distance of a car is 18 m when its initial speed is 10 $m s^{-1}$.

What is the braking distance of the car, under the same conditions, when its initial speed is 25 ms^{-1}?

A 7.2 m

B 45 m

C 113 m

D 222 m

$d = KE_k$

$18 = k \times (\frac{1}{2} m \times 100)$

$18 = \frac{km}{2} \times 100$ $\quad 18 = 50km$

$\frac{9}{25} = km$

Your answer C **[1]**

$d = k \times \frac{1}{2} m \times 25^2$

$d = \frac{km}{2} \times 625$

$d = \frac{625}{2} km$

$d = \frac{625}{2} \times \frac{9}{25} = 112.5 m \approx 113 m$

3 A ball is dropped from rest above the ground. Air resistance has negligible effect on the motion of the ball.

The speed of the ball is v after it has fallen a distance h from its point of release.

Which graph is correct for this falling ball?

$GPE = E_K$

$mgh = \frac{1}{2}mv^2$

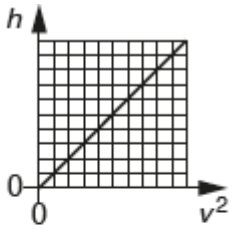
$gh = \frac{1}{2}v^2$

$h = \left(\frac{1}{2g}\right)v^2$

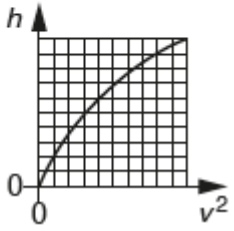
↳ constant +ve gradient

$y = mx + c$

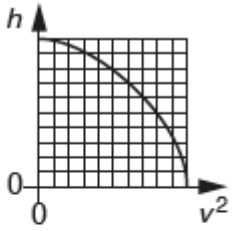
A



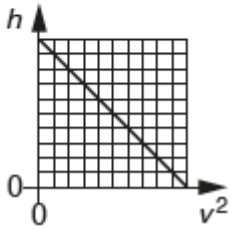
B



C



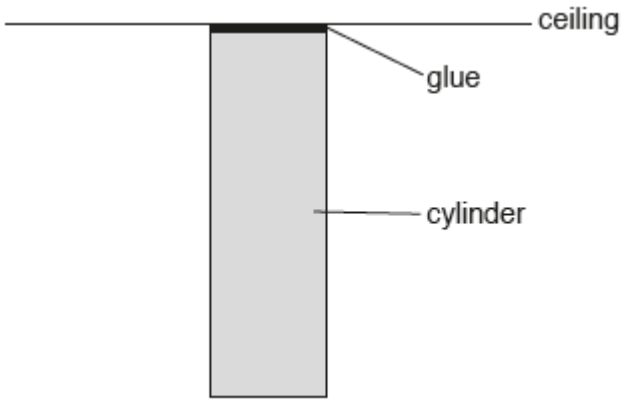
D



Your answer A

[1]

4 The flat end of a uniform steel cylinder of weight 7.8 N is glued to a horizontal ceiling. The cylinder hangs vertically. The breaking stress for the glue is 130 kPa.



The glue only just holds the cylinder to the ceiling.

What is the cross-sectional area of the cylinder?

A $6.0 \times 10^{-2}\,m^2$

B $6.0 \times 10^{-5}\,m^2$

C $1.7 \times 10^{-2}\,m^2$

D $1.7 \times 10^{1}\,m^2$

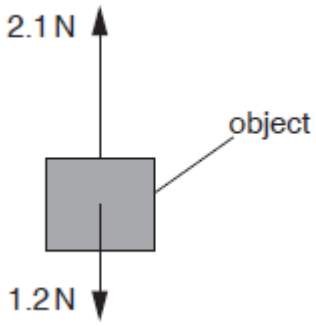
$\sigma = \frac{F}{A}$

$130 \times 10^3 = \frac{7.8}{A}$

$A = \frac{7.8}{130 \times 10^3} = 6 \times 10^{-5}\ m^2$

Your answer B **[1]**

5 The diagram shows two opposite vertical forces of magnitude 1.2 N and 2.1 N acting on an object.



Which of the following statements could be correct?

1 The object is accelerating and moving up.
2 The object is decelerating and moving down.
3 The magnitude of the resultant force is 0.9 N.

A Only 3

B Only 1 and 3

C Only 2 and 3

D 1, 2 and 3

Your answer D **[1]**

6 A tensile force of 4.5 N is applied to a spring. The spring extends elastically by 3.2 cm.

What is the elastic potential energy of the spring?

A 0.072 J

B 0.14 J

C 2.4 J

D 14 J

$E_p = \frac{1}{2} k x^2 = \frac{1}{2} f x$

$E_p = \frac{1}{2} \times 4.5 \times 3.2 \times 10^{-2}$

$= 0.072\ J$

Your answer A **[1]**

7 An object above the ground is released from rest at time $t = 0$.

Air resistance is negligible.

What is the distance travelled by the object between $t = 0.20\,s$ and $t = 0.30\,s$?

A 0.20 m

B 0.25 m

C 0.44 m

D 0.49 m

$s =$
$u = 0$
$v =$
$a = 9.81$
$t = 0.2$

$s = ut + \frac{1}{2}at^2$
$s = \frac{1}{2} \times 9.81 \times 0.2^2 = 0.1962\ m$

$s =$
$u = 0$
$v =$
$a = 9.81$
$t = 0.3$

$s = ut + \frac{1}{2}at^2$
$s = 0 + \frac{1}{2}(9.81)(0.3)^2$
$s = 0.44145m$

$0.44145 - 0.1962$
$= 0.24525m$
$= 0.25m$

Your answer B

[1]

8 A puck of mass 0.16 kg is sliding on ice with a constant velocity of 11.0 m s^{-1}. A hockey stick exerts a force on the puck, for a short period of time, in the **opposite** direction to the velocity of the puck. The momentum of the puck changes by 2.0 kg m s^{-1}.

Ignore friction.

What is the speed of the puck when it leaves the hockey stick?

A 1.5 m s^{-1}

B 3.8 m s^{-1}

C 12.5 m s^{-1}

D 23.5 m s^{-1}

$I = mv - mu$

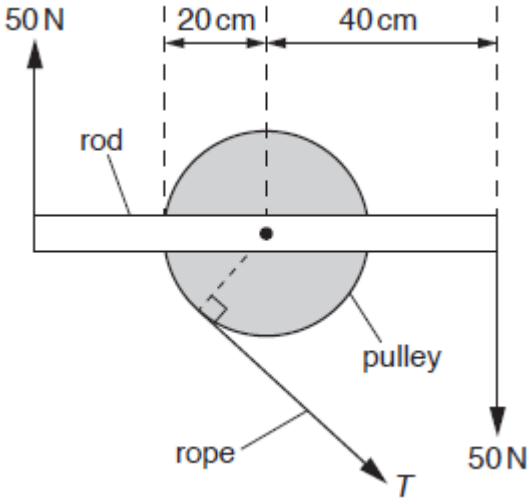
$-2 = 0.16v - 0.16(11)$

$\frac{-2 + 0.16(11)}{0.16} = v = -1.5\ ms^{-1}$

Your answer A

[1]

9 The centre of a rod is fixed to a pulley. Two 50 N forces are applied to the ends of the rod as shown. The tension in the rope attached to the pulley is *T*. The system is in equilibrium.



Not to scale

What is the moment of the tension *T* about the centre of the pulley?

A 10 N m

B 20 N m

C 30 N m

D 40 N m

$M_{\circlearrowleft} = M_{\circlearrowright}$

$50(0.4) + 50(0.4) = \text{Moment from } T$

$100(0.4) = \text{Moment from } T$

$40\ \text{Nm} = \text{Moment from } T$

Your answer D

[1]

10 One end of a spring is fixed and a force F is applied to its other end. The elastic potential energy in the extended spring is E. The spring obeys Hooke's law.

What is the extension x of the spring?

$E = \frac{1}{2}kx^2$ $\quad \frac{2E}{x^2} = k$

$F = kx$ $\quad 1 = \frac{Fx}{2E}$

$x = \frac{F}{k}$ $\quad \frac{1}{x} = \frac{F}{2E}$

$x = \frac{F}{\left(\frac{2E}{x^2}\right)}$ $\quad x = \frac{2E}{F}$

$x = \frac{Fx^2}{2E}$

A $x = \frac{E}{F}$

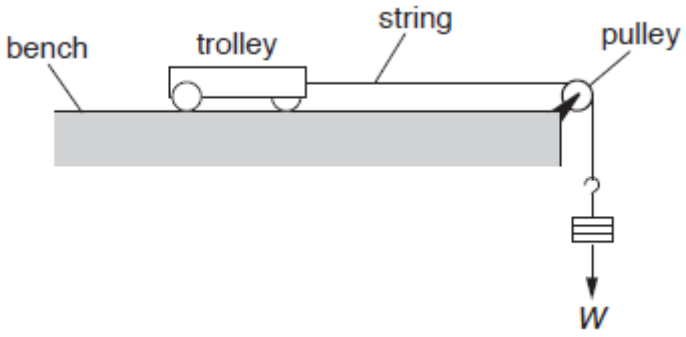
B $x = \frac{F}{E}$

C $x = \frac{2E}{F}$

D $x = \frac{F}{2E}$

Your answer C **[1]**

11 A trolley of mass M is pulled along a horizontal table by a force W provided by a mass hanging from the end of a string as shown.



Frictional forces are negligible. The acceleration of free fall is g.

What is the correct equation for the acceleration a of the trolley?

$F = ma$

Only force moving system = W

System moves as a whole, so consider TOTAL mass

$W = \left(M + \frac{W}{g}\right)a \rightarrow a = \frac{W}{M + \frac{W}{g}}$

A $a = \frac{W}{M}$

B $a = g$

C $a = \frac{W}{2M}$

D $a = \frac{W}{M + \frac{W}{g}}$

Your answer D **[1]**

12 The table below shows some data on two wires **X** and **Y**.

Wire	Young modulus of material / GPa	Cross-sectional area of wire / mm^2
X	120	1.0
Y	200	2.0

The wires **X** and **Y** have the same original length. The tension in each wire is the same. Both wires obey Hooke's law.

What is the value of the ratio $\frac{\text{extension of X}}{\text{extension of Y}}$?

$Y = \frac{\sigma}{\varepsilon} \rightarrow \varepsilon = \frac{\sigma}{Y}$

$e = \frac{\sigma}{LY}$ $\sigma = F/A$

$e_1 = \frac{\sigma_1}{LY_1}$ $e_2 = \frac{\sigma_2}{LY_2}$

$\frac{e_x}{e_y} = \frac{\frac{\sigma_x}{LY_x}}{\frac{\sigma_y}{LY_y}} = \frac{\sigma_x}{LY_x} \times \frac{LY_y}{\sigma_y} = \frac{\sigma_x Y_y}{\sigma_y Y_x}$

A 0.30

B 1.7

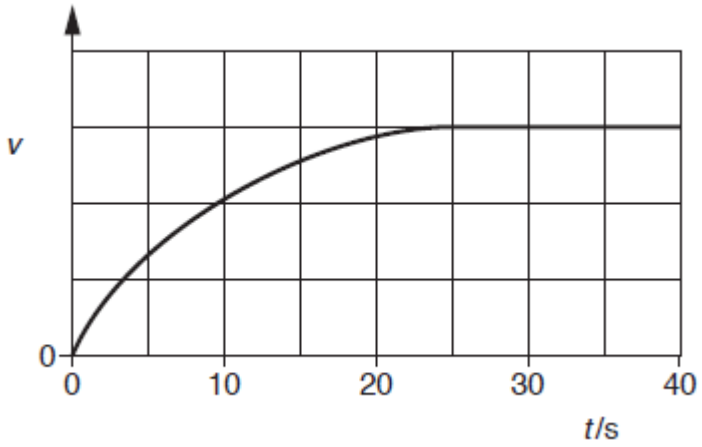
C 2.0

D 3.3

Your answer D

$\frac{e_x}{e_y} = \frac{F/A_x Y_y}{F/A_y Y_x} = \frac{Y_y/A_x}{Y_x/A_y} = \frac{Y_y}{A_x} \times \frac{A_y}{Y_x} = \frac{Y_y A_y}{Y_x A_x} = \frac{200 \times 2}{120 \times 1} = 3.33$ **[1]**

13 An object is dropped from rest at time $t = 0$. It falls vertically through the air. The variation of the velocity v with time t is shown below.



Which statement is correct about this object?

A It has constant acceleration.

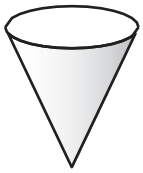
B It experiences zero drag at $t = 30$ s.

C It has an acceleration of 9.81 m s^{-2} at $t = 0$ s.

D It travels the same distance in every successive 10 s.

Your answer C **[1]**

14 A paper cone is held above the ground and dropped. It falls vertically and reaches terminal velocity before it hits the ground.



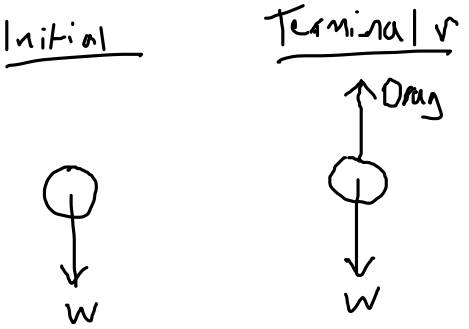
Which statement correctly describes the **resultant** force on the falling cone before it reaches terminal velocity?

A decreasing and upwards

B decreasing and downwards

C increasing and downwards

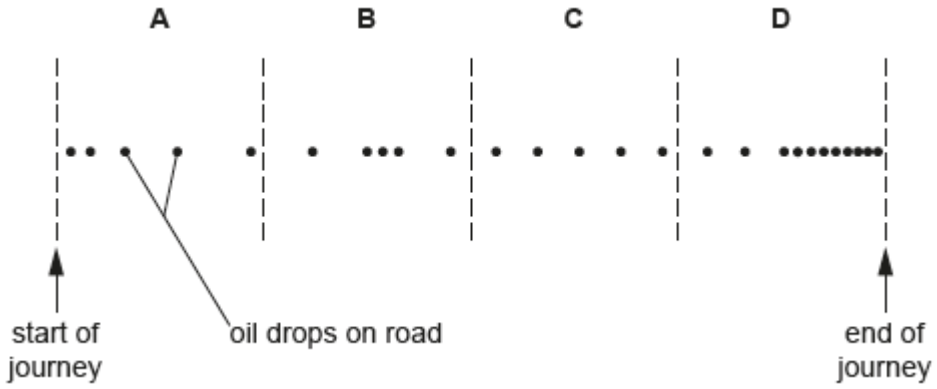
D increasing and upwards



Your answer B

[1]

15 A car is dripping oil at a steady rate on a straight road.
The road is divided into four sections **A**, **B**, **C**, and **D**.

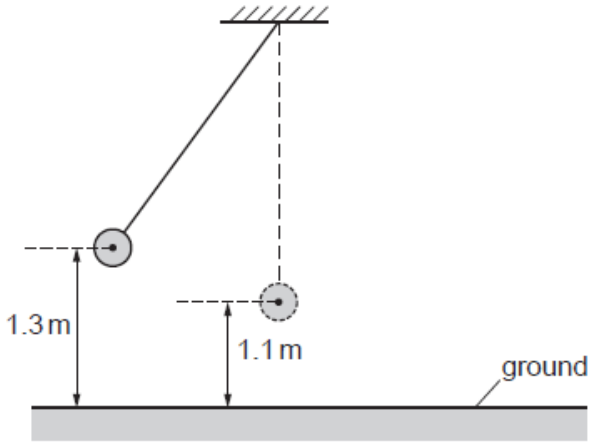


Which section of the road shows the car travelling at a constant speed?

Your answer C

[1]

16 A pendulum bob is oscillating in a vacuum.
The maximum height of the bob from the ground is 1.3 m and its minimum height is 1.1 m.



What is the maximum speed of the pendulum bob?

A $2.0\,m\,s^{-1}$

B $3.9\,m\,s^{-1}$

C $5.1\,m\,s^{-1}$

D $26\,m\,s^{-1}$

$\Delta GPE = \Delta E_k$

$mg\Delta h = \frac{1}{2} m (\Delta v)^2$

$g\Delta h = \frac{1}{2} (\Delta v)^2$

$9.81(1.3 - 1.1) = \frac{1}{2} (\Delta v)^2$

$\sqrt{2 \times 9.81 \times 0.2} = \Delta v$

$\Delta v = 1.98 \approx 2.0\ ms^{-1}$

Your answer A

[1]

17 Which of the following shows the correct base units for pressure?

A $kg\,m^{-2}$

B $kg\,m^{-2}\,s^{-2}$

C $kg\,m^{-1}\,s^{-2}$

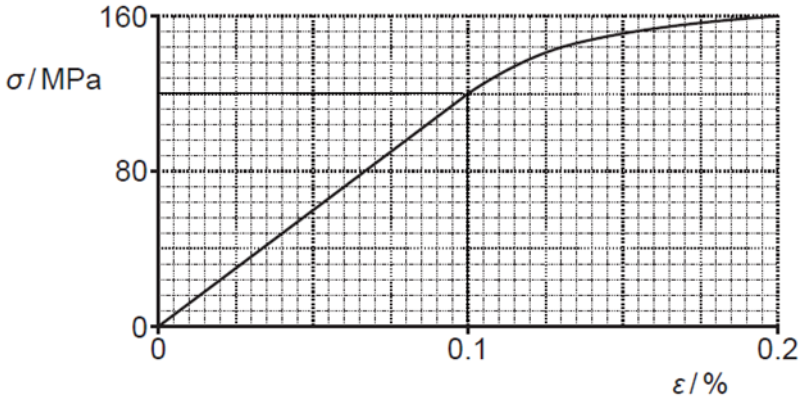
D $kg\,m^{2}\,s^{-3}$

$P = \frac{F}{A} = \frac{kg\,ms^{-2}}{m^2} = kgm^{-1}s^{-2}$

Your answer C

[1]

18 A graph showing the variation of the stress σ with strain ε for a material is shown below.



What is the Young modulus of the material?

$\frac{0.1}{100} = 0.001 = \varepsilon$

$Y = \frac{\sigma}{\varepsilon} = \frac{120 \times 10^6}{0.001} = 1.2 \times 10^{11}$ Pa

A 6.0×10^4 Pa

B 1.2×10^9 Pa

C 8.0×10^{10} Pa

D 1.2×10^{11} Pa

Your answer D

[1]

Total Marks for Question Set 2: 18