

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname *StemUp Model Solution*

Forename(s)

Candidate signature

I declare this is my own work.

INTERNATIONAL AS PHYSICS

Unit 1 Mechanics, materials and atoms

Tuesday 7 May 2024

07:00 GMT

Time allowed: 2 hours

Materials

For this paper you must have:

- a Data and Formulae Booklet as a loose insert
- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate
- a protractor.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each question or on blank pages.
- All working must be shown.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
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6	
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8	
9	
10	
11–24	
TOTAL	



J U N 2 4 P H 0 1 0 1

Section A

Answer **all** questions in this section.**0 1**

On one occasion, an electron and a positron are created by pair production when a high-energy photon interacts with the nucleus of an atom.

The rest energy of an electron is 0.51 MeV.

0 1 . 1

Show that the photon must have a minimum energy of approximately 1.6×10^{-13} J.

[1 mark]

minimum photon energy = rest energy of electron + positron

$$= 2 \times 0.51 \text{ MeV} = 1.02 \text{ MeV}$$

$$= 1.02 \times 10^6 \times 1.60 \times 10^{-19} \text{ J}$$

$$= 1.63 \times 10^{-13} \text{ J } (\approx 1.6 \times 10^{-13} \text{ J})$$

0 1 . 2

On another occasion, an electron–positron pair is created by a photon with an energy of 2.1×10^{-13} J.

Deduce how energy is conserved on this occasion.

[2 marks]

$$\text{excess energy} = 2.1 \times 10^{-13} - 1.63 \times 10^{-13} = 0.47 \times 10^{-13} \text{ J}$$

$$\text{shared between electron and positron: } 0.47 \times 10^{-13} / 2 = 0.24 \times 10^{-13} \text{ J each}$$

1.63×10^{-13} J becomes the rest energy of the pair. The excess $0.47 \times$

10^{-13} J is shared as kinetic energy between the electron, positron (and

recoiling nucleus): up to 0.24×10^{-13} J of KE each.

3

0 2 . 1

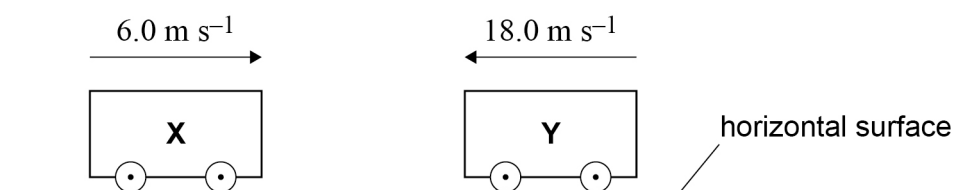
Explain why momentum is a vector quantity.

[1 mark]

*Momentum = mass $\times$ velocity; mass is a scalar and velocity is a vector,
so momentum has both magnitude and direction.*

0 2 . 2

Figure 1 shows two trucks **X** and **Y** that are moving towards each other on a horizontal surface.

Figure 1

X has a mass of 4.8 kg and is moving to the right at a speed of 6.0 m s⁻¹.
Y has a mass of 2.4 kg and is moving to the left at a speed of 18.0 m s⁻¹.

The two trucks collide.

Show that truck **X** changes direction during the collision.

[3 marks]

taking the direction to the right as positive:

$$\text{total momentum before} = (4.8 \times 6.0) + (2.4 \times -18.0)$$

$$= 28.8 - 43.2 = -14.4 \text{ kg m s}^{-1} \text{ (14.4 kg m s}^{-1} \text{ to the left)}$$

momentum is conserved in the collision, so the total momentum

after the collision must also be 14.4 kg m s⁻¹ to the left.

*Y cannot pass through X, so if X still moved right, Y would also move
right and the total momentum would be to the right: not conserved. So
X must move to the left, it changes direction.*

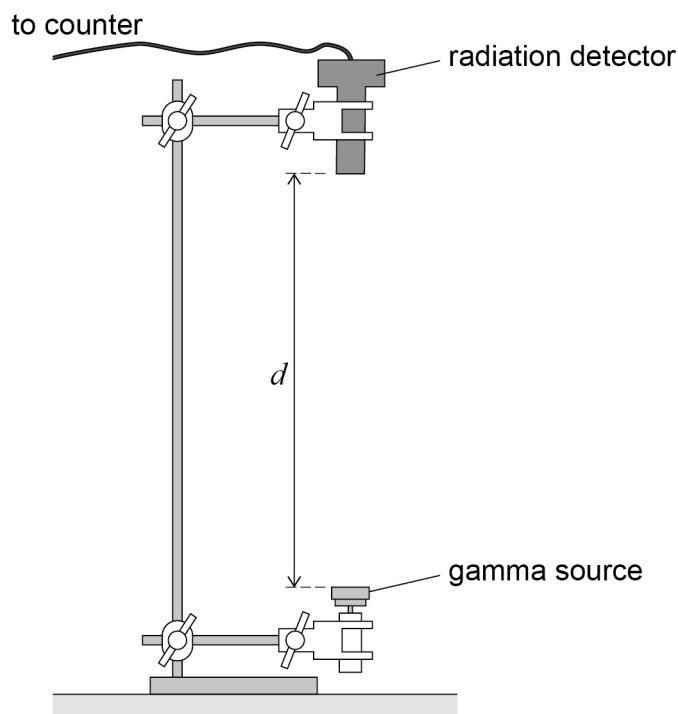
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0 3

Figure 2 shows the apparatus that a student uses to investigate the inverse-square law for gamma radiation. The student uses a source of gamma radiation together with a radiation detector to determine the count rate.

Figure 2



The student uses a ruler to measure the vertical distance d between the **top** of the gamma source and the **bottom** of the radiation detector.

0 3 . 1

Explain how measuring d as shown in **Figure 2** introduces a systematic error.

[2 marks]

The gamma rays are emitted from the radioactive material, which is inside the source holder below its top, and they are detected at a point inside the detector, above its bottom.

So the measured values of d are all shorter than the true source to detector distance by the same amount, a systematic error.



0 3 . 2

Describe the steps needed to make the determination of the count rate accurate.

[2 marks]

*Measure the background count rate (no source present) and subtract it
from every count rate.*

*Repeat each count (or count for a longer time) and calculate a mean
count rate.*

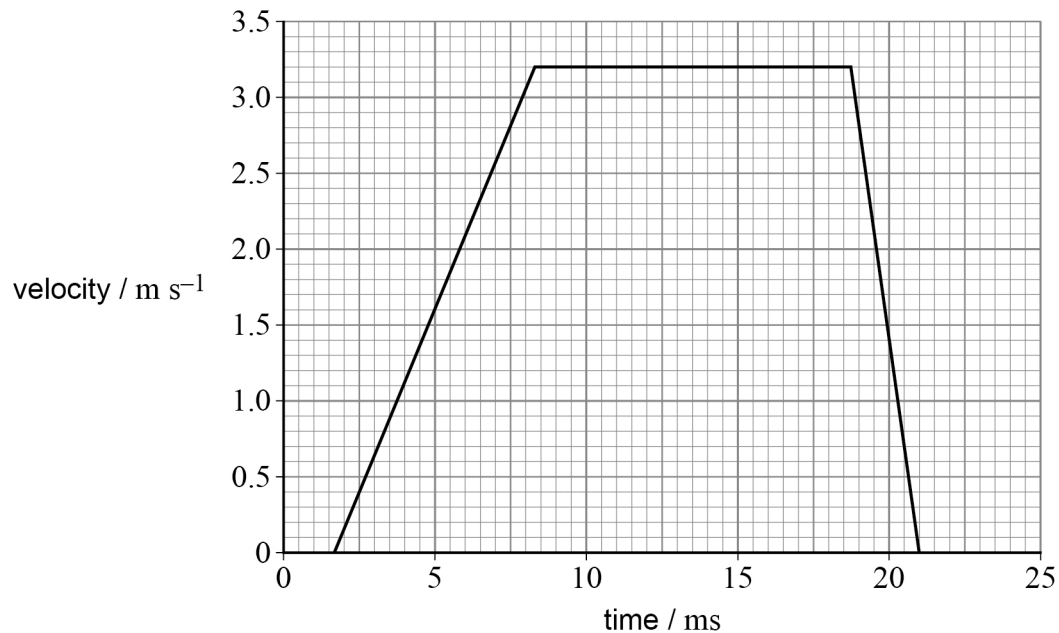
4

Turn over for the next question**Turn over ►**

0 4

Figure 3 is a velocity–time graph for an object travelling in a straight line.

Figure 3



0 4 . 1

Determine the average speed of the object during the time it is moving.

[3 marks]

distance = area under graph (trapezium):

moving from $t = 1.7$ ms to 21.0 ms, so time moving = 19.3 ms

$v = 3.2$ m s⁻¹ from 8.3 ms to 18.7 ms (10.4 ms)

distance = $\frac{1}{2} \times (19.3 + 10.4) \times 10^{-3} \times 3.2 = 0.0475$ m

average speed = distance / time = $0.0475 / 19.3 \times 10^{-3}$

speed = 2.5 m s⁻¹

0 4 . 2

The mass of the object is 0.54 kg.

Determine the magnitude of the resultant force required to bring the object to rest.

[2 marks]

deceleration $a = \Delta v / \Delta t = 3.2 / (21.0 - 18.7) \times 10^{-3}$

$a = 3.2 / 2.3 \times 10^{-3} = 1390$ m s⁻²

$F = ma = 0.54 \times 1390 = 751$ N

magnitude of resultant force = 750 N

5



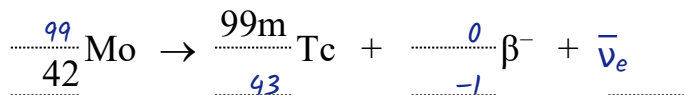
0 5

A solution containing a nuclide of technetium-99m is prepared for use in medical diagnosis.

An isotope of molybdenum (Mo) undergoes beta-minus decay to produce a nucleus of technetium-99m (Tc-99m).

0 5 . 1

Complete the decay equation.

[2 marks]**0 5 . 2**

Technetium-99m is metastable.

Explain what is meant by metastable.

[2 marks]

The technetium nucleus is left in an excited state (it has excess energy) after the beta decay.

It stays in this state for a measurable time; the gamma emission is not immediate.

0 5 . 3

The half-life of technetium-99m is 6.0 hours.

A sample of technetium-99m has an initial activity of 384 MBq.

Calculate the time taken for the activity of the sample to decrease to 1.50 MBq.

[2 marks]

$$A = A_0(\frac{1}{2})^n \text{ so } (\frac{1}{2})^n = 1.50 / 384 = 1/256$$

$$384 \rightarrow 192 \rightarrow 96 \rightarrow 48 \rightarrow 24 \rightarrow 12 \rightarrow 6 \rightarrow 3 \rightarrow 1.5 \text{ MBq}$$

$$n = 8 \text{ half-lives}$$

$$\text{time} = 8 \times 6.0 = 48 \text{ hours}$$

time taken = 48 hours

Question 5 continues on the next page

Turn over ►



0 5 . 4

A patient is injected with the solution containing technetium-99m and the radiation is detected outside of the body.

Explain why technetium-99m is an appropriate nuclide for use in medical diagnosis.

[2 marks]

It emits only gamma radiation, which is weakly ionising and penetrates the body, so it can be detected outside the body and does little damage (no alpha or beta).

Its half-life of 6 hours is long enough for the patient to be examined, but short enough that it does not remain active in the body for long and damage it.

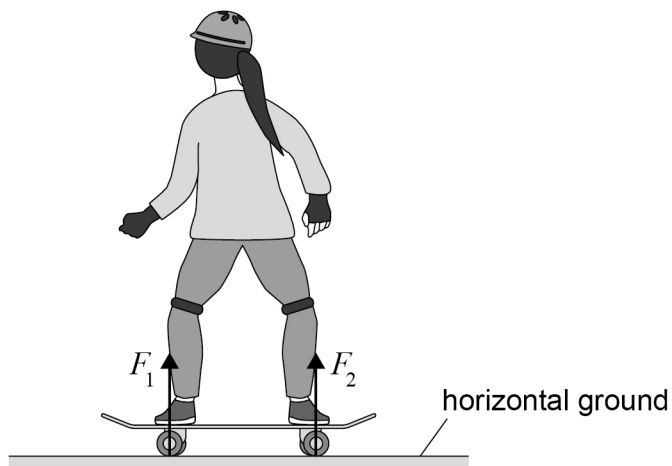
8



0 6 . 1

State the **two** conditions for a body to be in equilibrium.**[2 marks]**1 There is no resultant force acting on the body.2 There is no resultant moment (about any point).

Figure 4 shows a child on a skateboard. The skateboard is in equilibrium. The centre of mass of the skateboard is at its midpoint.

Figure 4

0 6 . 2

 F_1 and F_2 are the normal reaction forces of the ground acting on the skateboard.

The weight of the child is 360 N.

The mass of the skateboard is 4.8 kg.

The centre of mass of the child is directly above the centre of mass of the skateboard.

Calculate F_1 .**[2 marks]**

$$\text{weight of skateboard} = mg = 4.8 \times 9.81 = 47.1 \text{ N}$$

$$\text{total downward force} = 360 + 47.1 = 407 \text{ N}$$

$$\text{centres of mass at the midpoint, so } F_1 = F_2$$

$$F_1 = 407 / 2 = 204 \text{ N}$$

$$F_1 = \underline{204} \text{ N}$$

Question 6 continues on the next page**Turn over ►**

0 6 . 3

The child now changes her position so that the skateboard is balanced on a horizontal bar at **P** as shown in **Figure 5**.

The skateboard is again in equilibrium.

Figure 5

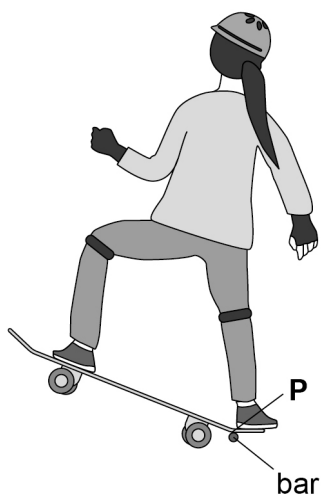
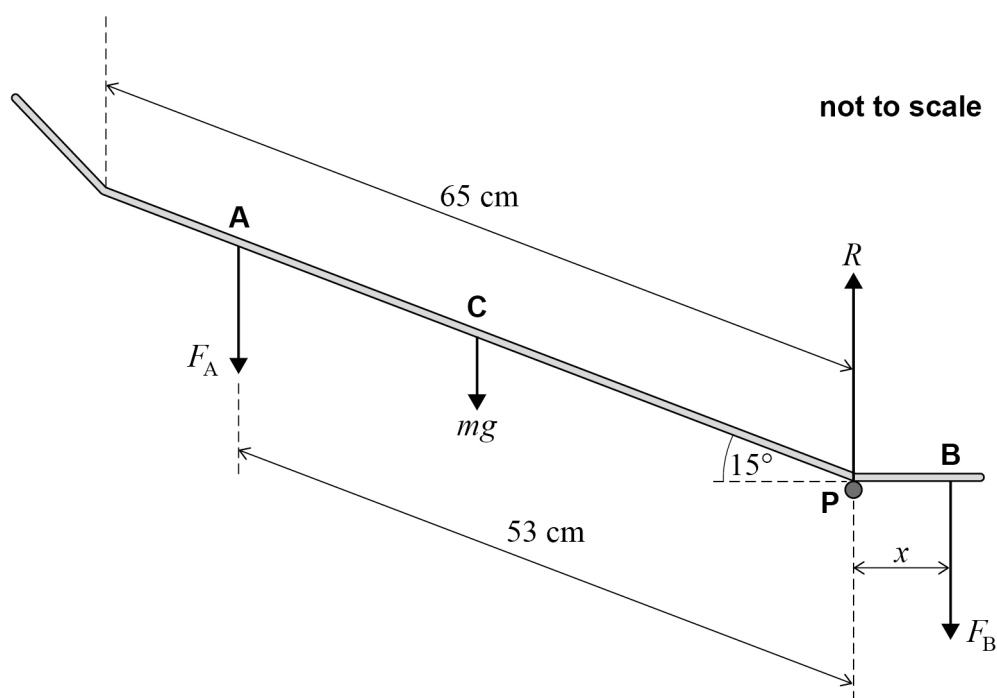


Figure 6 shows the forces acting on the skateboard and the important distances. The bar at **P** exerts a vertical force R on the skateboard. The skateboard is at an angle of 15° to the horizontal.

Figure 6



The child's left foot exerts a vertical force F_A at **A**.

Her right foot exerts a vertical force F_B at **B**.

$$F_B = 11F_A$$

B is a horizontal distance x from **P**.

Calculate x .

[4 marks]

vertical equilibrium of the child: $F_A + F_B = 360 \text{ N}$

$F_A + 11F_A = 360$ so $F_A = 30 \text{ N}$ and $F_B = 330 \text{ N}$

take moments about P (horizontal distances = length $\times \cos 15^\circ$):

clockwise moments = $(4.8 \times 9.81) \times 32.5 \cos 15^\circ + 30 \times 53 \cos 15^\circ$

= $(47.1 \times 31.4) + (30 \times 51.2)$

= $1478 + 1536 = 3014 \text{ N cm}$

anticlockwise moment = $F_B \times x = 330x$

principle of moments: $330x = 3014$

$x = 3014 / 330 = 9.1 \text{ cm}$

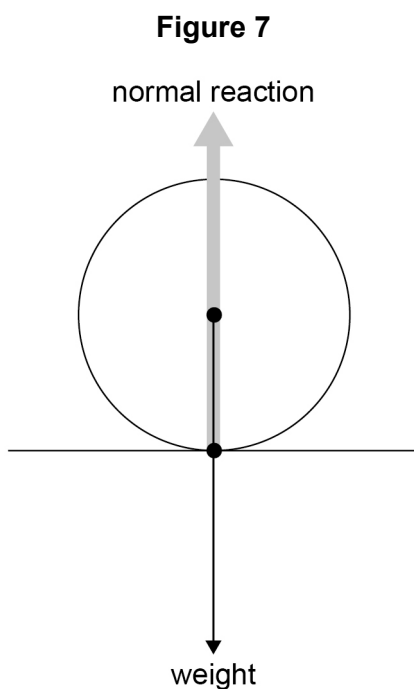
$x = \underline{9.1} \text{ cm}$

Turn over ►



0 7

Figure 7 shows the two forces acting on the wheel of a stationary racing car that is standing on a horizontal surface.



0 7 . 1

The two forces in **Figure 7** are equal in magnitude and act in opposite directions.

Give **one** reason why the two forces are not an action–reaction pair according to Newton's third law.

[1 mark]

Both forces act on the same object (the wheel), and they are different types of force.



During a race, the racing car enters a straight horizontal section of the track and accelerates. The driving force of the racing car is constant.

0 7 . 2

Explain why the racing car reaches a constant speed.
Refer to one of Newton's laws of motion in your answer.

[3 marks]

As the car speeds up, the drag (air resistance) on it increases.

The driving force is constant, so the resultant force (driving force – drag) decreases and the acceleration decreases.

Eventually the drag equals the driving force, so the resultant force is zero. By Newton's first law, with no resultant force the car moves at a constant speed (zero acceleration).

0 7 . 3

The racing car is fitted with a system that helps it to overtake another car.

When the system is not in use, as shown in **Figure 8**, the flaps are positioned so that there is no gap between them.

When the system is in use, as shown in **Figure 9**, the flaps rotate so that there is an air gap between them.

Figure 8

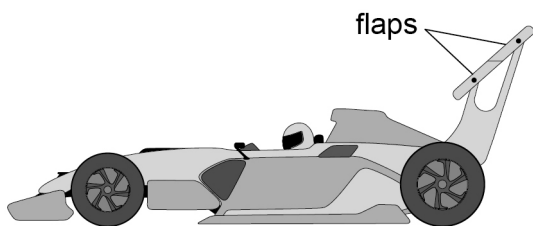
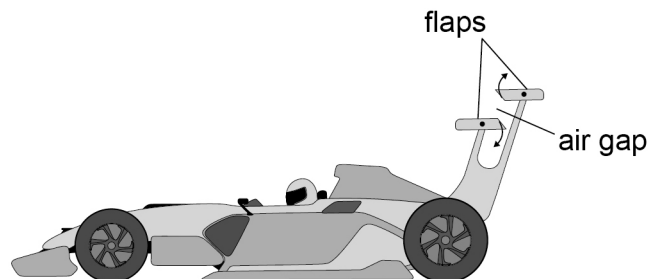


Figure 9



Explain why using the system enables the racing car to overtake the other car.

[2 marks]

Opening the gap reduces the effective surface area of the flaps facing the air, so the drag on the car decreases.

The driving force is now greater than the drag, so there is a resultant forward force and the car accelerates to a greater (terminal) speed, letting it overtake.

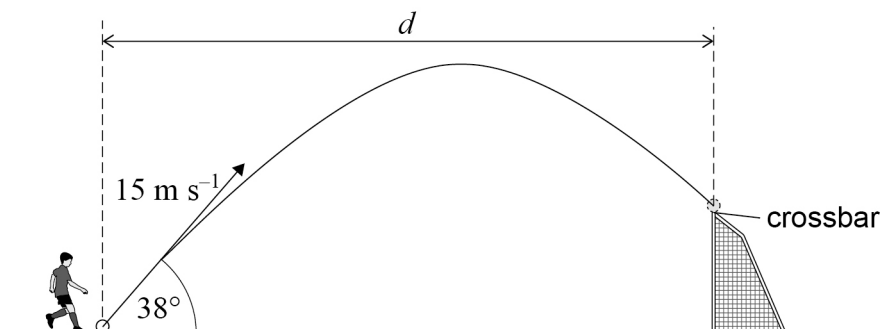


0 8

Figure 10 shows a football player kicking a football. The initial velocity of the ball is 15 m s^{-1} at an angle of 38° to the horizontal.

The bottom of the ball hits the top of the crossbar. Assume that air resistance is negligible.

Figure 10



0 8 . 1

Calculate the vertical component of the initial velocity of the ball.

[1 mark]

$$\text{vertical component} = 15 \sin 38^\circ$$

$$= 9.23 \text{ m s}^{-1}$$

$$\text{vertical component of initial velocity} = \underline{9.2} \text{ m s}^{-1}$$

0 8 . 2

Show that the maximum height gained by the ball is approximately 4.3 m.

[2 marks]

$$\text{at maximum height vertical velocity } v = 0$$

$$v^2 = u^2 + 2as: 0 = 9.2^2 + 2 \times (-9.81) \times s$$

$$s = 9.2^2 / (2 \times 9.81) = 84.6 / 19.62$$

$$s = 4.31 \text{ m } (\approx 4.3 \text{ m})$$

$$\text{maximum height} = \underline{4.31} \text{ m}$$



0 8 . 3

Show that the time between the ball being kicked and it reaching its maximum height is approximately 0.94 s.

[2 marks]

$$v = u + at \text{ with } v = 0 \text{ at maximum height:}$$

$$0 = 9.2 - 9.81t$$

$$t = 9.2 / 9.81 = 0.938 \text{ s}$$

$$(\text{check: } s = \frac{1}{2}(u + v)t \text{ so } t = 2 \times 4.31 / 9.2 = 0.937 \text{ s})$$

$$t \approx 0.94 \text{ s}$$

0 8 . 4

The top of the crossbar is at a height of 2.56 m.

Calculate the time between the ball being kicked and it hitting the crossbar.

[3 marks]

$$\text{from maximum height the ball falls } 4.31 - 2.56 = 1.75 \text{ m from rest}$$

$$s = ut + \frac{1}{2}at^2: 1.75 = 0 + \frac{1}{2} \times 9.81 \times t^2$$

$$t = \sqrt{(2 \times 1.75 / 9.81)} = 0.597 \text{ s}$$

$$\text{total time} = 0.937 + 0.597 = 1.53 \text{ s}$$

time = 1.5 s

Question 8 continues on the next page

Turn over ►



0 8 . 5

The ball travels a horizontal distance d before hitting the crossbar.

Calculate d .

[2 marks]

$$\text{horizontal component} = 15 \cos 38^\circ = 11.8 \text{ m s}^{-1} \text{ (constant)}$$

$$d = 11.8 \times 1.53 = 18.1 \text{ m}$$

$$d = \underline{\quad 18 \quad} \text{ m}$$

0 8 . 6

To calculate d , it was assumed that air resistance was negligible.

Describe the effect that air resistance will have on the flight of the ball.

[2 marks]

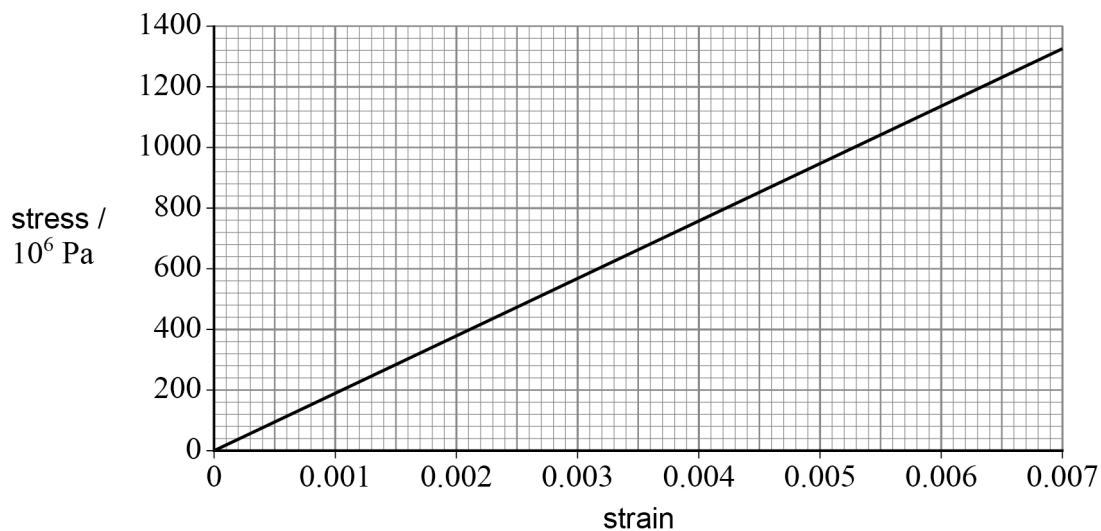
Air resistance opposes the motion, so the ball reaches a lower maximum height and reaches it at an earlier time.

The horizontal velocity also decreases, so the ball travels a shorter horizontal distance: it would hit the crossbar lower down or pass under it.

12

END OF SECTION A



Section BAnswer **all** questions in this section.**0 9****Figure 11** shows the variation of stress with strain for a type of steel.**Figure 11****0 9 . 1**

Show that the Young modulus of the steel is approximately 200 GPa.

[1 mark]

Young modulus = stress / strain = gradient of the graph

from the line: at strain = 0.0032, stress = 600×10^6 Pa

$$E = 600 \times 10^6 / 0.0032 = 1.88 \times 10^{11} \text{ Pa}$$

$$= 188 \text{ GPa} \approx 200 \text{ GPa}$$

Question 9 continues on the next page

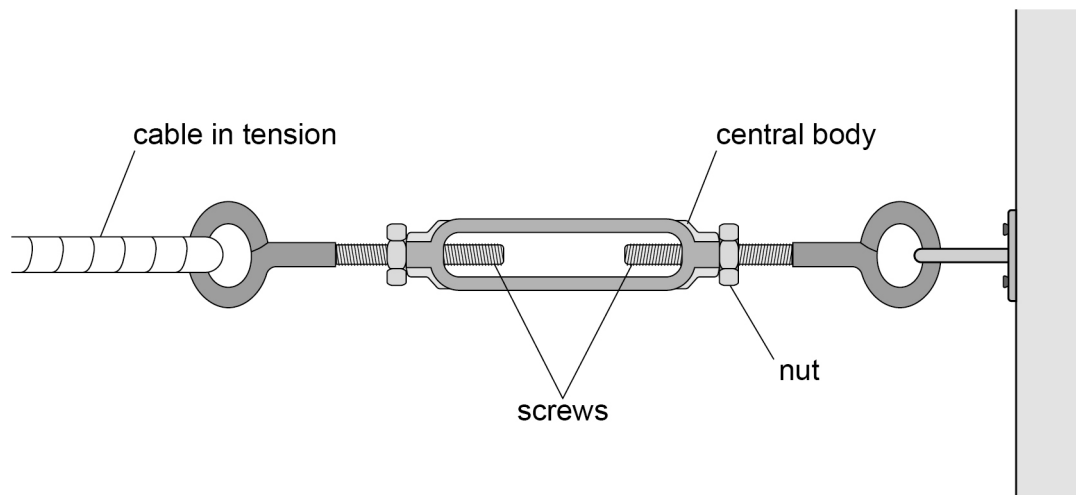
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A length of steel cable is attached to a wall using a device called a turnbuckle. The other end of the cable is also fixed.

Figure 12 shows the turnbuckle.

Figure 12



The turnbuckle is used to adjust the tension in the cable. As the central body is rotated, the separation of the screws changes. This change depends on the direction of rotation and the amount of rotation of the central body.

0 9 . 2

State and explain what must be done to the turnbuckle to increase the tension in the cable.

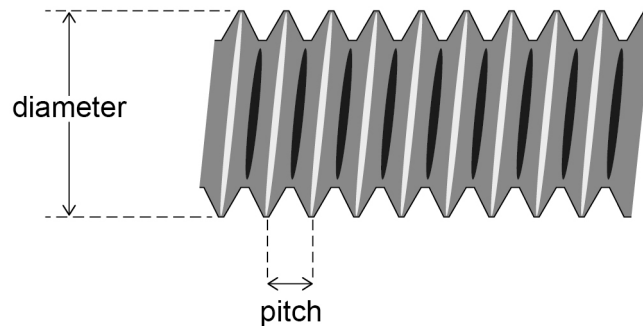
[1 mark]

Rotate the central body so that the screws move closer together; this increases the extension (strain) of the cable, so the tension increases.



Figure 13 shows a section of one screw from the turnbuckle. With one complete rotation of the central body, both screws move through a distance of one pitch relative to the central body.

Figure 13



Both screws have the same diameter and the same pitch.

The diameter of each screw is 14 mm.

0 9 . 3 For one complete rotation of the central body, the extension of the cable is 1.3 mm.

Determine the ratio $\frac{\text{diameter}}{\text{pitch}}$.

[1 mark]

both screws move one pitch, so extension = 2 × pitch

pitch = 1.3 / 2 = 0.65 mm

diameter / pitch = 14 / 0.65 = 21.5

$\frac{\text{diameter}}{\text{pitch}} = \underline{\quad 22 \quad}$

The cable is initially under tension with a stress of 210 MPa. The unstretched length of the cable is 1.8 m.

0 9 . 4 Determine, using **Figure 11**, the initial strain in the cable.

[1 mark]

from Figure 11, at stress = 210 MPa:

strain = 210 × 10⁶ / 1.88 × 10¹¹ = 0.0011

strain = 0.0011

Question 9 continues on the next page

Turn over ►



The central body is now turned through eight complete rotations.

0 9 . 5

Calculate the new strain in the cable.

[2 marks]

$$\text{additional extension} = 8 \times 1.3 = 10.4 \text{ mm} = 10.4 \times 10^{-3} \text{ m}$$

$$\text{additional strain} = 10.4 \times 10^{-3} / 1.8 = 0.0058$$

$$\text{new strain} = 0.0011 + 0.0058$$

$$\text{strain} = \underline{0.0069}$$

0 9 . 6

The cross-sectional area of the cable is $3.7 \times 10^{-5} \text{ m}^2$.

Calculate the new tension in the cable.

[3 marks]

$$E = \text{stress} / \text{strain} \quad \text{so} \quad \text{stress} = E \times \text{strain}$$

$$\text{stress} = 1.88 \times 10^{11} \times 0.0069 = 1.30 \times 10^9 \text{ Pa}$$

$$\text{stress} = F / A \quad \text{so} \quad F = \text{stress} \times A$$

$$T = 1.30 \times 10^9 \times 3.7 \times 10^{-5} = 4.8 \times 10^4 \text{ N}$$

$$\text{tension} = \underline{4.8 \times 10^4} \text{ N}$$

9



Turn over for the next question

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box*

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ANSWER IN THE SPACES PROVIDED**

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1 0

A student investigates the friction on a block that slides across a horizontal surface.

The student places the block onto the surface as shown in **Figure 14**.

The student compresses the spring by moving the block a distance x to the left, as shown in **Figure 15**.

When the student releases the block, it accelerates across the surface. Friction then causes the block to decelerate and come to rest as shown in **Figure 16**.

Figure 14

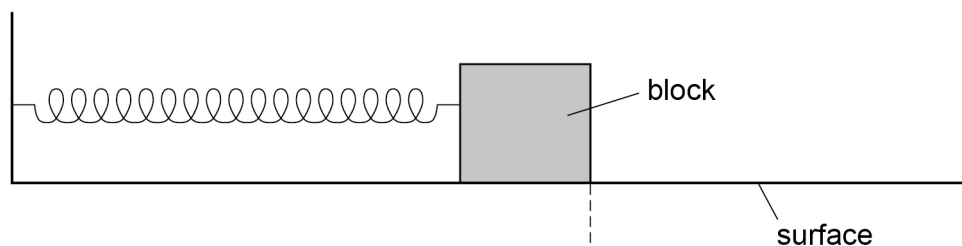


Figure 15

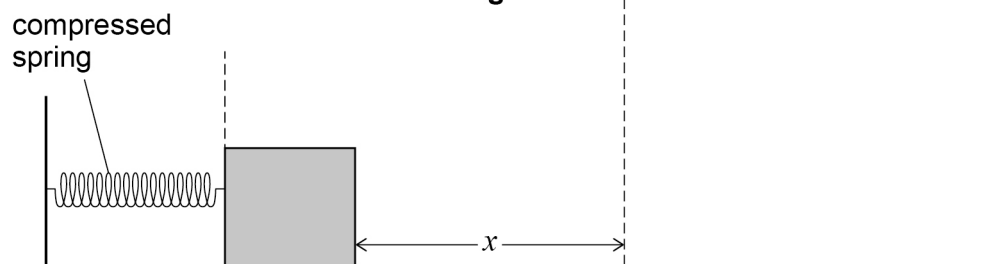
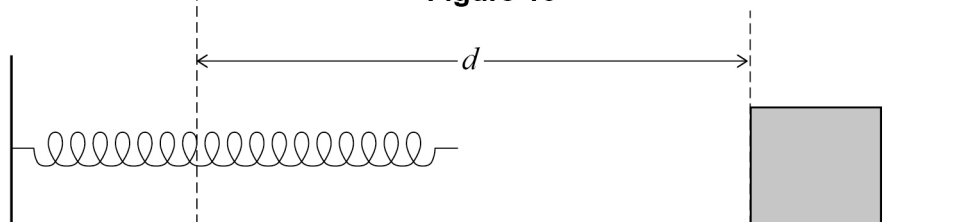


Figure 16



The student makes repeated measurements of distance d .

Table 1 shows the recorded values of d for one particular value of x .

Table 1

d / mm	79	82	81	79	80
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1 0 . 1

Calculate the percentage uncertainty in the mean value of d .

[2 marks]

$$\text{mean } d = (79 + 82 + 81 + 79 + 80) / 5 = 80.2 \text{ mm}$$

$$\text{uncertainty} = \text{half the range} = (82 - 79) / 2 = 1.5 \text{ mm}$$

$$\% \text{ uncertainty} = 1.5 / 80.2 \times 100 = 1.9 \%$$

percentage uncertainty = 2 %

Question 10 continues on the next page

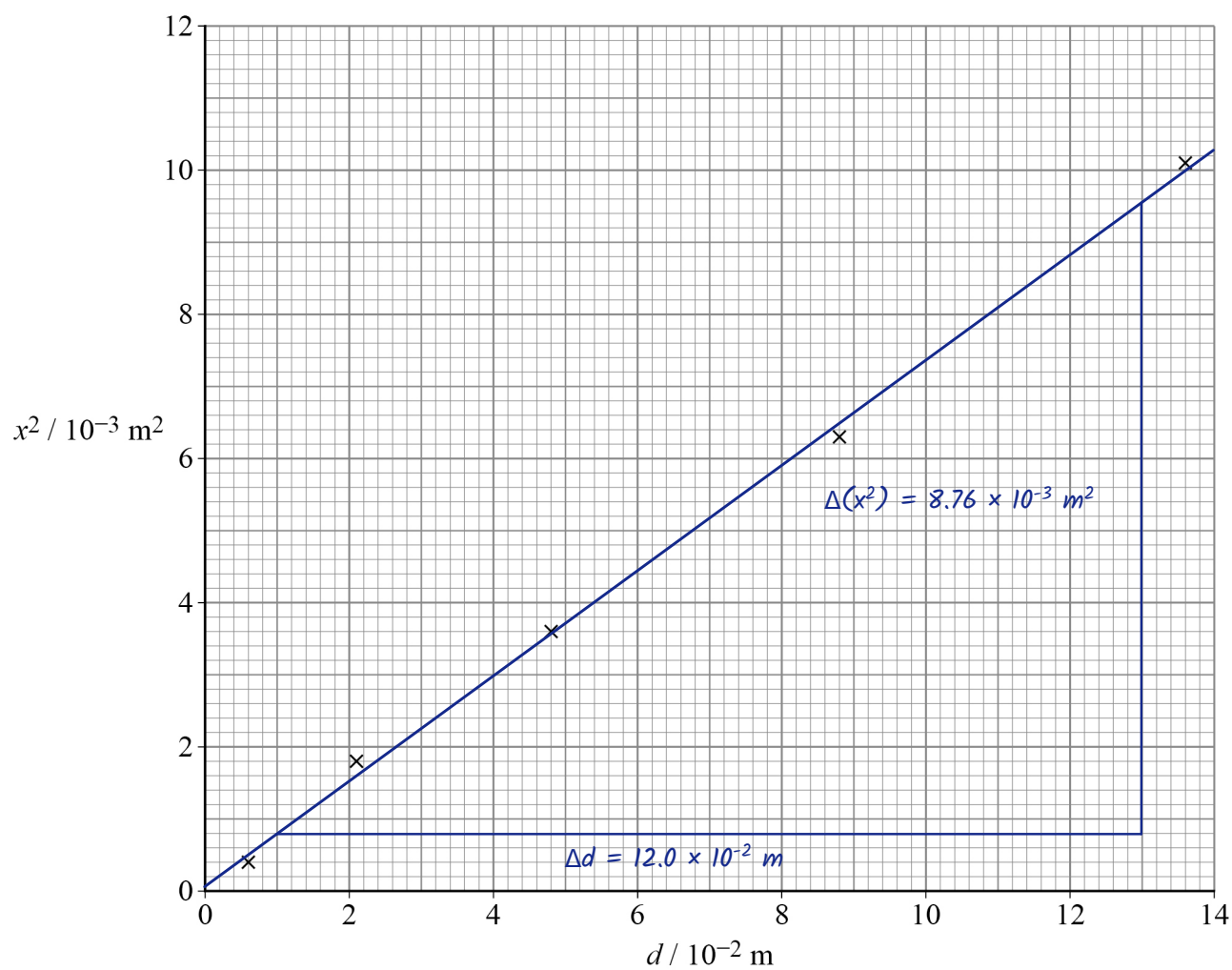
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The student determines mean values of d for a range of values of x .

Figure 17 shows the student's plot of x^2 against d .

Figure 17



1 0 . 2 Draw a best-fit line on **Figure 17**.

[1 mark]



The frictional force F between the surface and the block is related to the weight W of the block by the equation

$$F = \mu W$$

where μ is a constant.

The elastic potential energy E in the compressed spring is given by

$$E = \frac{1}{2} kx^2$$

where k is the spring constant of the spring.

1 0 . 3 Show that $x^2 = \frac{2\mu mgd}{k}$

where m is the mass of the block.

[1 mark]

elastic energy in spring = work done against friction

$$\frac{1}{2} kx^2 = F \times d = \mu Wd = \mu mgd$$

$$x^2 = 2\mu mgd / k$$

1 0 . 4 Determine μ using **Figure 17**.

$$k = 60 \text{ N m}^{-1}$$

$$m = 0.75 \text{ kg}$$

[3 marks]

$$\text{gradient} = \Delta(x^2) / \Delta d = 8.76 \times 10^{-3} / 12.0 \times 10^{-2} = 0.0730 \text{ m}$$

$$\text{gradient} = 2\mu mg / k$$

$$\mu = \text{gradient} \times k / 2mg = 0.0730 \times 60 / (2 \times 0.75 \times 9.81)$$

$$\mu = 4.38 / 14.7 = 0.30$$

$$\mu = \underline{\quad 0.30 \quad}$$

7

END OF SECTION B

Turn over ►



Section C

Each of the questions in this section is followed by four responses, **A**, **B**, **C** and **D**.

For each question select the best response.

Only **one** answer per question is allowed.

For each question, completely fill in the circle alongside the appropriate answer.

CORRECT METHOD



WRONG METHODS



If you want to change your answer you must cross out your original answer as shown. 

If you wish to return to an answer previously crossed out, ring the answer you now wish to select as shown. 

You may do your working in the blank space around each question but this will not be marked.
Do **not** use additional pages for this working.

1 1 An object of mass m falls from rest through a vertical distance s , reaching a velocity v .

The work done by air resistance during this fall is:

[1 mark]

A $m\left(gs - \frac{v^2}{2}\right)$ ☒

B $mgs + \frac{v^2}{2}$ ☐

C $m\left(\frac{v^2}{2} - gs\right)$ ☐

D $mgs - \frac{v^2}{2}$ ☐



1 2 A nucleus of ${}^{170}_{74}\text{W}$ decays by alpha emission to form nuclide **X**.

What is the specific charge of the nucleus of **X**?

[1 mark]

A $2.21 \times 10^7 \text{ C kg}^{-1}$ ☐

B $3.99 \times 10^7 \text{ C kg}^{-1}$ ☐

C $4.18 \times 10^7 \text{ C kg}^{-1}$ ☒

D $4.23 \times 10^7 \text{ C kg}^{-1}$ ☐

1 3 A rocket of mass m moves upwards with an acceleration a . It experiences a drag force D .

The thrust of the rocket is:

[1 mark]

A $m(a - g) - D$ ☐

B $m(a + g) - D$ ☐

C $m(a - g) + D$ ☐

D $m(a + g) + D$ ☒

Turn over for the next question

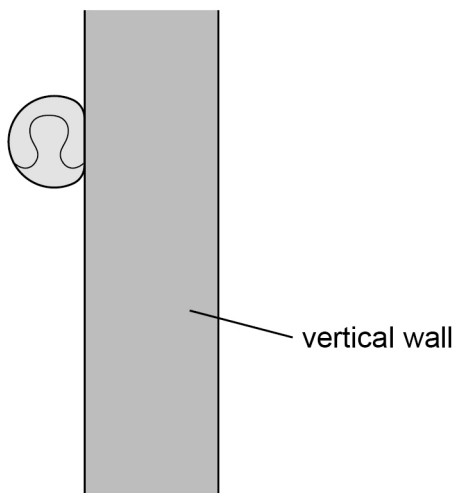
Turn over ►



1 4

A ball is travelling horizontally when it hits a vertical wall. The ball compresses when it hits the wall.

side view



What is the direction of the resultant force acting on the ball when the compression is at a maximum?

[1 mark]

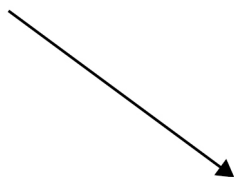
A



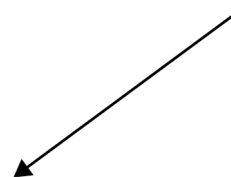
B



C



D



A



B



C



D

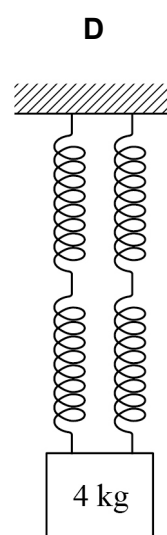
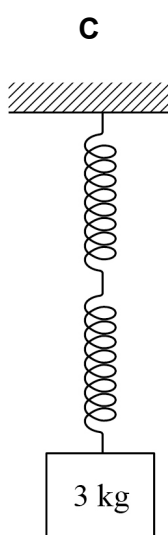
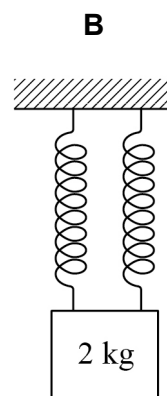
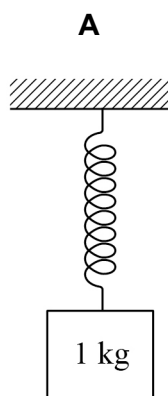


1 5

Arrangements of springs are used to suspend different masses.
All the springs are identical.

Which arrangement of springs has the greatest extension?

[1 mark]



A ☐

B ☐

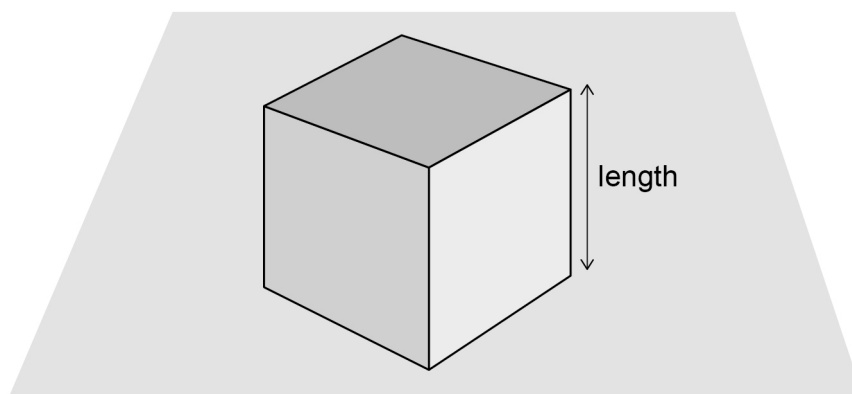
C ☒

D ☐

Turn over ►



1 6 A cube is resting on a surface.



A student makes the following measurements:

$$\text{weight} = 0.50 \pm 0.01 \text{ N}$$

$$\text{length} = 0.025 \pm 0.001 \text{ m}$$

The student calculates the pressure applied to the bottom of the block to be 800 N m^{-2} .

What is the percentage uncertainty in the calculated value of pressure?

[1 mark]

- A** 2% ☐
- B** 4% ☐
- C** 6% ☐
- D** 10% ☒



1 7

A spacecraft of constant mass is initially at rest.
A constant resultant force F acts on the spacecraft.
The change in momentum of the spacecraft is Δp .
The change in kinetic energy of the spacecraft is ΔE_k .

Which row shows the relationship between Δp and F and between ΔE_k and F ?

[1 mark]

A	$\Delta p \propto F$	$\Delta E_k \propto F$	☐
B	$\Delta p \propto F$	$\Delta E_k \propto F^2$	☒
C	$\Delta p \propto F^2$	$\Delta E_k \propto F$	☐
D	$\Delta p \propto F^2$	$\Delta E_k \propto F^2$	☐

1 8

Nuclide **X** is radioactive.

Which decay series produces an isotope of nuclide **X**?

[1 mark]

- A** α, β^+, β^+ ☐
- B** α, β^-, β^- ☒
- C** $\alpha, \alpha, \beta^+, \beta^+$ ☐
- D** $\alpha, \alpha, \beta^-, \beta^-$ ☐

Turn over for the next question

Turn over ►



1 9

A car is being driven at a speed of 13.8 m s^{-1} .

The driver takes a time of 0.72 s to react to a hazard and apply the brakes.

The brakes cause a deceleration of 6.9 m s^{-2} which brings the car to rest.

What is the total distance travelled by the car from the point at which the driver sees the hazard?

[1 mark]

A 10 m ☐

B 14 m ☐

C 24 m ☒

D 38 m ☐

2 0

What is the unit of power in SI fundamental (base) units?

[1 mark]

A kg m s^{-1} ☐

B kg m s^{-2} ☐

C $\text{kg m}^2 \text{s}^{-2}$ ☐

D $\text{kg m}^2 \text{s}^{-3}$ ☒

2 1

A car of mass 1200 kg is travelling up a slope with an incline of 15° .

The car travels at a constant velocity of 20 m s^{-1} .

The motor provides a constant power output of 150 kW .

What is the magnitude of the resistive forces acting on the car?

[1 mark]

A 3000 N ☐

B 3900 N ☐

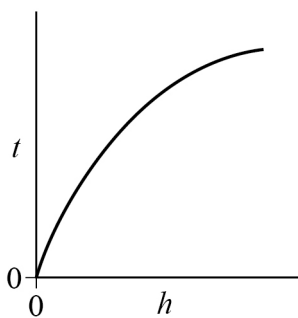
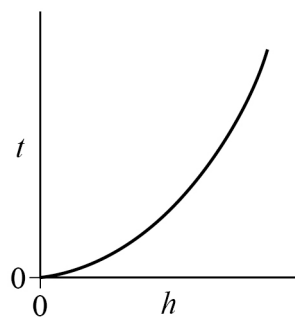
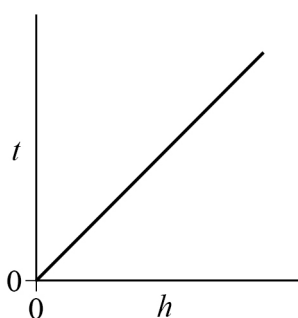
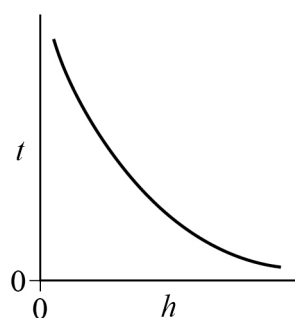
C 4500 N ☒

D $11\,000 \text{ N}$ ☐



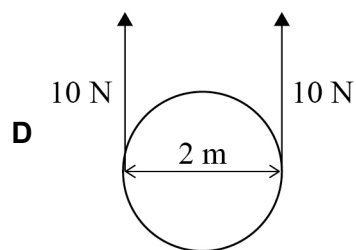
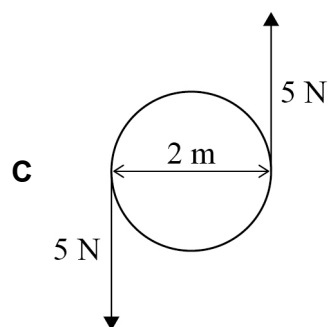
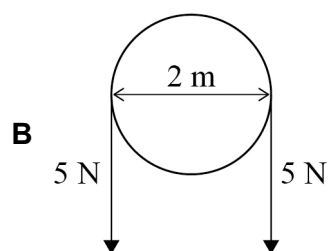
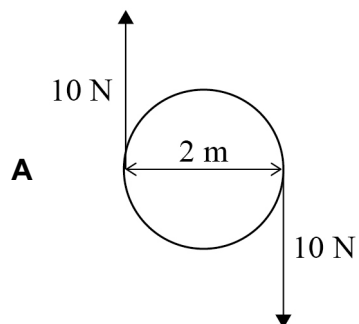
2 2

What was observed in the Rutherford scattering experiment?

[1 mark]**A** Few of the alpha particles passed through the gold foil undeflected.**B** Most alpha particles were deflected through a small angle.**C** Very few of the alpha particles were deflected through a large angle.**D** About half of the particles were deflected through angles between 0° and 90° .**2 3**An object is released from rest from height h above the ground.
The object takes a time t to reach the ground.Which graph shows the variation of t with h ?**[1 mark]****A****B****C****D****A****B****C****D****Turn over ►**

2 4

Which diagram shows a couple with a moment of 20 N m?

[1 mark]**END OF QUESTIONS**

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4 0



2 4 6 X P H 0 1