

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

INTERNATIONAL AS PHYSICS

Unit 1 Mechanics, materials and atoms

Monday 27 April 2026

08:00 UK Time

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 page 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	
5	
6	
7	
8	
9	
10	
11	
12	
13–26	
TOTAL	



Section AAnswer **all** questions in this section.**0 1 . 1**

State what is meant by the elastic limit.

[1 mark]

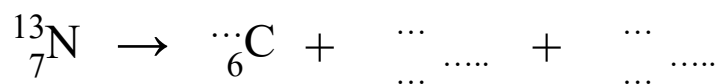
0 1 . 2

State what is meant by the limit of proportionality.

[1 mark]

0 2Nitrogen-13 (${}^{13}_{7}\text{N}$) undergoes radioactive decay to form a nuclide of carbon (C).

Complete the decay equation for nitrogen-13.

[2 marks]

2

2


0	3
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A brass object is made by combining $33 \times 10^{-6} \text{ m}^3$ of copper with $17 \times 10^{-6} \text{ m}^3$ of zinc.

Calculate, in kg m^{-3} , the density of the brass object.
Assume that there is no change in volume when the two metals are combined.

density of copper = 8900 kg m^{-3}

density of zinc = 7100 kg m^{-3}

[3 marks]

density = _____ kg m^{-3}

3

Turn over for the next question

Turn over ►

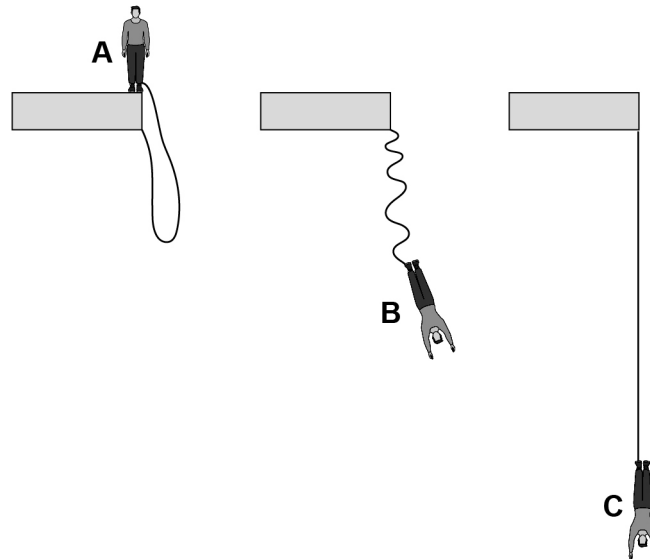


0 4

In a bungee jump, a person is attached to a platform by an elastic rope. The person steps off the platform and falls freely for a short distance before the elastic rope begins to stretch.

Figure 1 shows three instances **A**, **B** and **C** in this jump.

Figure 1



At **A**, the person has just stepped off the platform.

At **B**, the person is in freefall.

At **C**, the person is at the lowest point of the jump.

Describe the energy changes between **A** and **B** and the energy changes between **B** and **C**.

[3 marks]

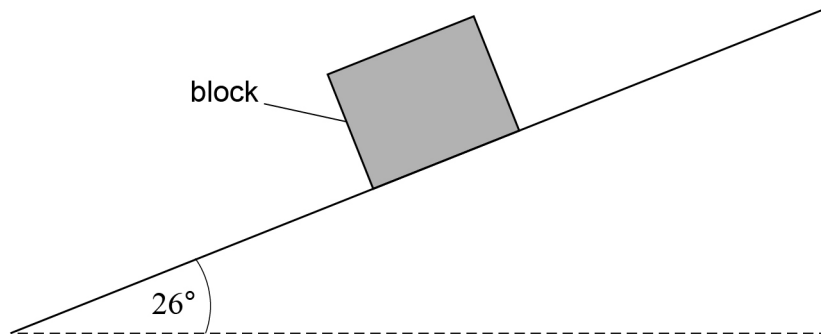
3



0	5
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Figure 2 shows a block of mass 5.0 kg on a slope.
The slope is at an angle of 26° to the horizontal.
The maximum value of friction that the slope can apply to the block is 25 N .

Figure 2



Deduce whether the block will slide down the slope.

[2 marks]

2

Turn over for the next question

Turn over ►



0 6

A photon of sufficient energy can be converted into an electron and a positron.

0 6 . 1

Calculate, in J, the minimum energy of a photon that can be converted into an electron and a positron.

rest energy of an electron = 0.511 MeV

[2 marks]

photon energy = _____ J

0 6 . 2

The electron and the positron attract each other with forces that are equal in magnitude.

Explain how Newton's laws can be applied to these forces.
Assume that all other forces acting on the particles are negligible.

[2 marks]

0 6 . 3

The positron meets a different electron. They annihilate to produce two photons.

Explain why a single photon cannot be produced.

[2 marks]

6



Turn over for the next question

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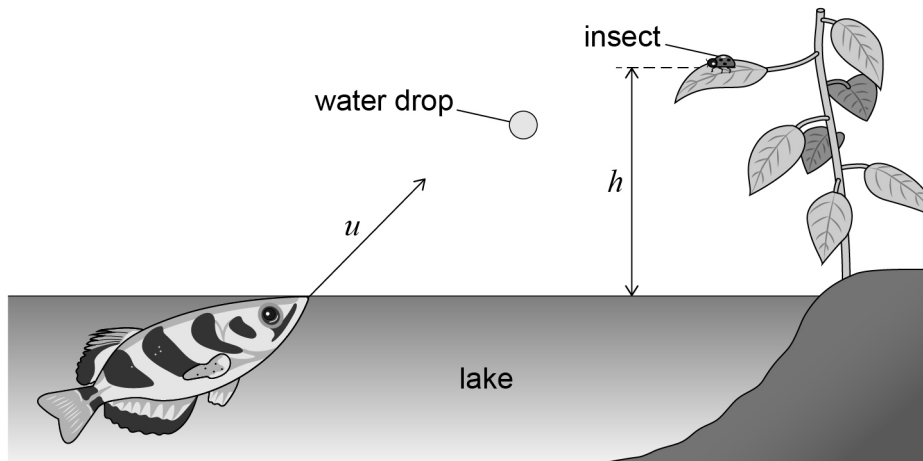
0 7

An archer fish hunts insects using water drops that it shoots from its mouth. The water drop collides with the insect and knocks it off the leaf and into the lake below.

Figure 3 shows an archer fish in the lake and a stationary insect on a leaf. The insect is a height h above the surface of the lake.

A water drop leaves the fish's mouth at the surface of the lake with velocity u .

Figure 3



The water drop is moving horizontally when it hits the insect.

The vertical component of u is 3.8 m s^{-1} .

Assume that air resistance is negligible.

0 7 . 1

Calculate h .

[2 marks]

$h =$ _____ m



The water drop collides inelastically with the insect.

0 7 . 2 Explain what is meant by an inelastic collision.

[1 mark]

Immediately after the collision, the insect and the water drop move together.
The insect and the water drop have a horizontal speed of 2.2 m s^{-1} .
The mass of the insect is 0.160 g .

0 7 . 3 The initial velocity u of the water drop in **Figure 3** is 4.5 m s^{-1}

Determine, in g, the mass of the water drop.

[4 marks]

mass = _____ g

0 7 . 4 The collision between the water drop and the insect takes 50 ms .

Calculate the average force acting on the insect.

[2 marks]

average force = _____ N



0 8

A radioactive tracer is used to check the health of a patient.

The tracer used is technetium-99m ($^{99}_{43}\text{Tc}$). Technetium-99m emits gamma radiation.

0 8 . 1

Calculate the specific charge of a nucleus of technetium-99m.

[2 marks]

specific charge = _____ C kg^{-1}

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

0 8 . 2

A syringe is filled with a solution containing technetium-99m that has an initial activity of 1320 MBq.

The technetium-99m must have a minimum activity of 330 MBq when it is injected into the patient.

Calculate the maximum time after the syringe is filled that the technetium-99m can be injected into the patient.

[1 mark]

maximum time = _____ hours



After the technetium-99m is injected, the patient is scanned.

Your answer should include:

- how gamma radiation is emitted by the technetium-99m
- why gamma radiation is the most suitable type of radiation for this scan
- why a half-life of 6.0 hours means that technetium-99m is suitable for this scan.

[6 marks]

[illegible]

C

Turn over ►



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ANSWER IN THE SPACES PROVIDED**

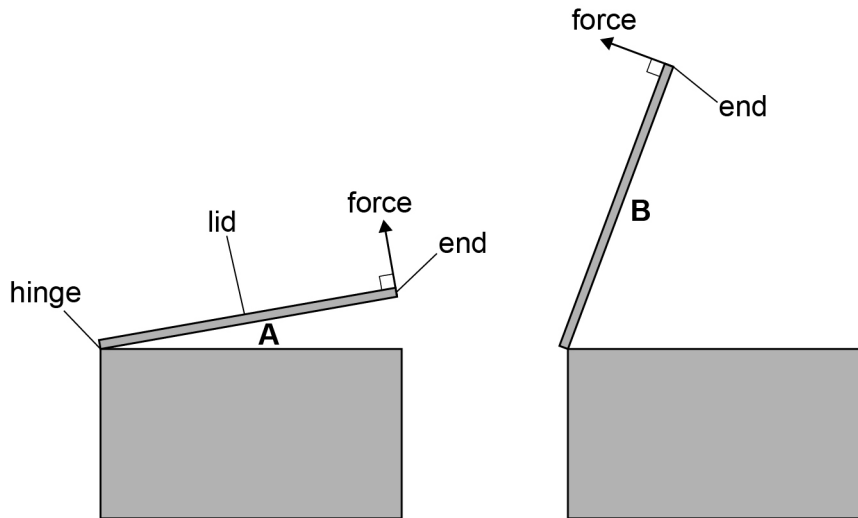


0 9

Figure 4 shows a box with a uniform hinged lid. The hinge is frictionless.

The lid is held stationary at position **A** by a force that is applied to the end of the lid. The lid is then moved to position **B** and held stationary. The force is always perpendicular to the lid.

Figure 4



0 9 . 1

Compare the magnitude of the force applied on the lid at **A** and at **B**.

[2 marks]

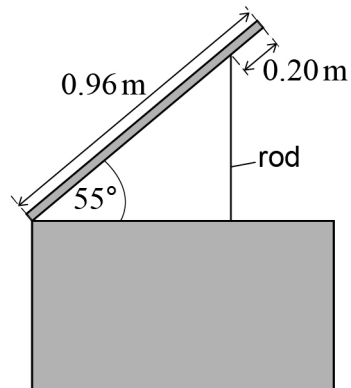
Question 9 continues on the next page

Turn over ►



Figure 5 shows the lid held open at an angle of 55° by a vertical support rod of negligible mass. The rod is fixed at a distance of 0.20 m from the end of the lid. The lid has a length of 0.96 m and a mass of 2.5 kg.

Figure 5



0 9 . 2 Determine the force exerted by the rod on the lid.

[3 marks]

force = _____ N

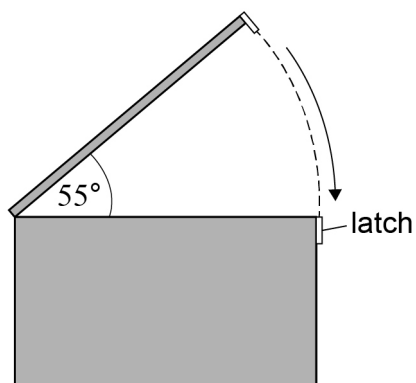


0 9 . 3

A latch is added to the lid and box. A latch is a device that holds the lid closed when it is engaged. The latch will engage if the lid has more than 11 J of kinetic energy when it reaches the latch.

The rod is removed and the lid drops from its open position as shown in **Figure 6**.

Figure 6



Determine whether the latch will engage when the lid is dropped from the position shown in **Figure 6**.

[3 marks]



1 0

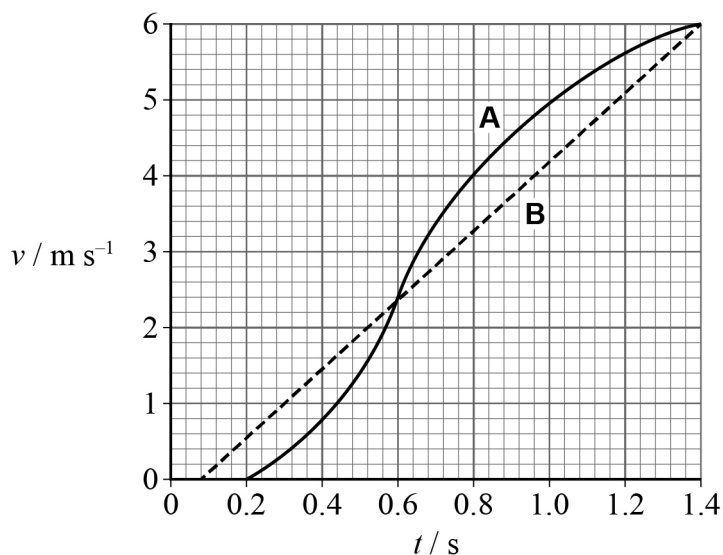
Two runners **A** and **B** are in a race.

At time $t = 0$ a starting pistol is fired to begin the race.

A and **B** move in a straight line away from the starting position.

Figure 7 shows the variation of velocity v with time t for **A** and **B** for the first 1.4 s of the race.

Figure 7



1 0 . 1

Suggest why, for both lines on **Figure 7**, $v = 0$ at $t = 0.050$ s.

[1 mark]

1 0 . 2

Determine, using **Figure 7**, the maximum acceleration of **A**.

[2 marks]

maximum acceleration = _____ m s^{-2}



1	0	.	3
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Deduce, for $t = 1.4$ s:

- which runner has travelled the greater distance
- the distance between the runners.

[3 marks]

runner = _____

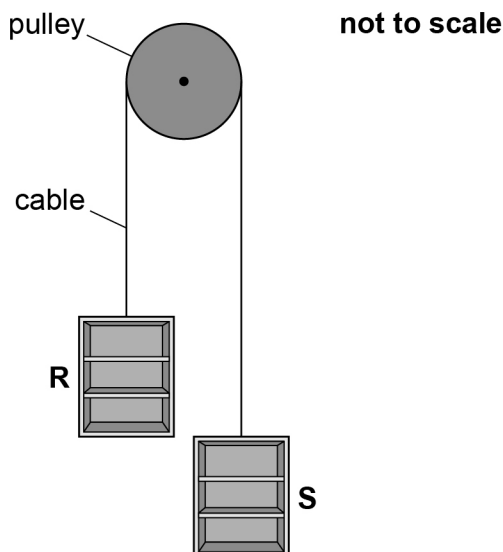
distance between runners = _____ m

6

END OF SECTION A**Turn over ►**

Section BAnswer **all** questions in this section.**1 1**

Figure 8 shows a pulley system that is used to move food between different levels of a hotel. The system uses two containers **R** and **S** connected by a cable that runs over a frictionless pulley. One container moves up while the other container moves down.

Figure 8

The mass of **R** is 55 kg and the mass of **S** is 35 kg. The mass and the extension of the cable are both negligible.

When the containers are not in use, they are held in place by a brake. When the brake is released, the containers initially accelerate due to gravity alone.

1 1**1**

Annotate **Figure 8** with labelled arrows to show the forces acting on **S**.

[1 mark]

1 1 . 2

Determine the tension in the cable when the system is in motion.

[3 marks]

tension = _____ N

1 1 . 3

R and **S** are now loaded and the strain on the cable is now 7.5×10^{-4} .

The maximum tension allowed in the cable is 7.5 kN.

The cable has a diameter of 5.2 mm.

The Young modulus of the material of the cable is 5.0×10^{11} Pa.

Deduce whether the cable is suitable for this load.

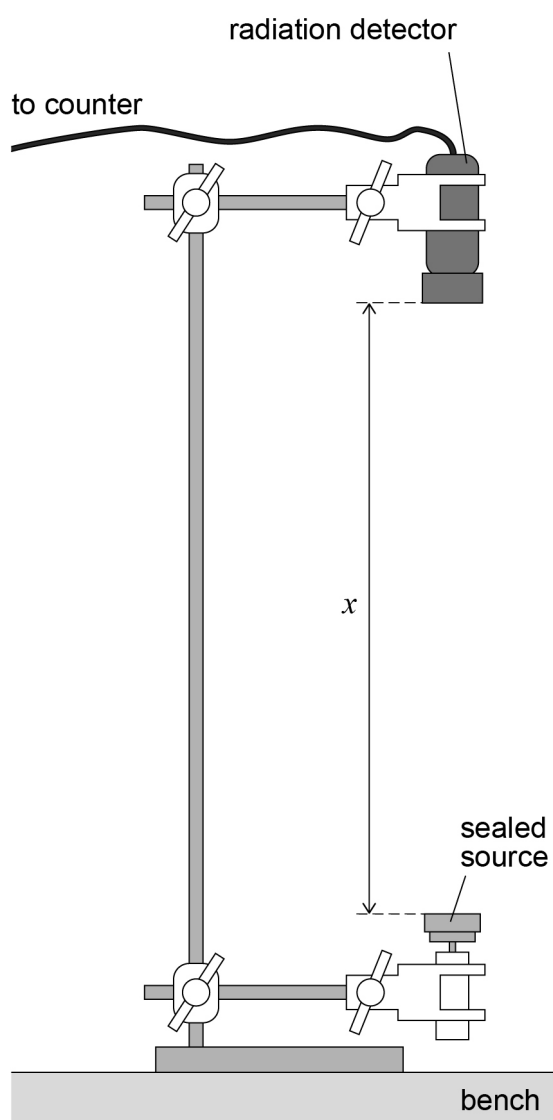
[4 marks]

8


1 2

Figure 9 shows an arrangement used to investigate the inverse-square law for gamma radiation using a radiation detector and a sealed source.

Figure 9



Before the sealed source is placed in this arrangement, the background count C_b is determined.

1 2 . 1

Suggest **one** source of background radiation.

[1 mark]



The sealed source is placed below the radiation detector. The distance x between the top of the sealed source and the bottom of the detector is measured.

The count rate is recorded for one minute and a corrected count rate C is determined. This is repeated for a range of values of x .

1 2 . 2

Explain **one** safety measure that should be taken when changing x .

[2 marks]

Question 12 continues on the next page

Turn over ►



A student suggests that $x = \frac{K}{\sqrt{C}}$ where K is a constant.

Table 1 shows the data obtained and four values of $\frac{1}{\sqrt{C}}$.

Table 1

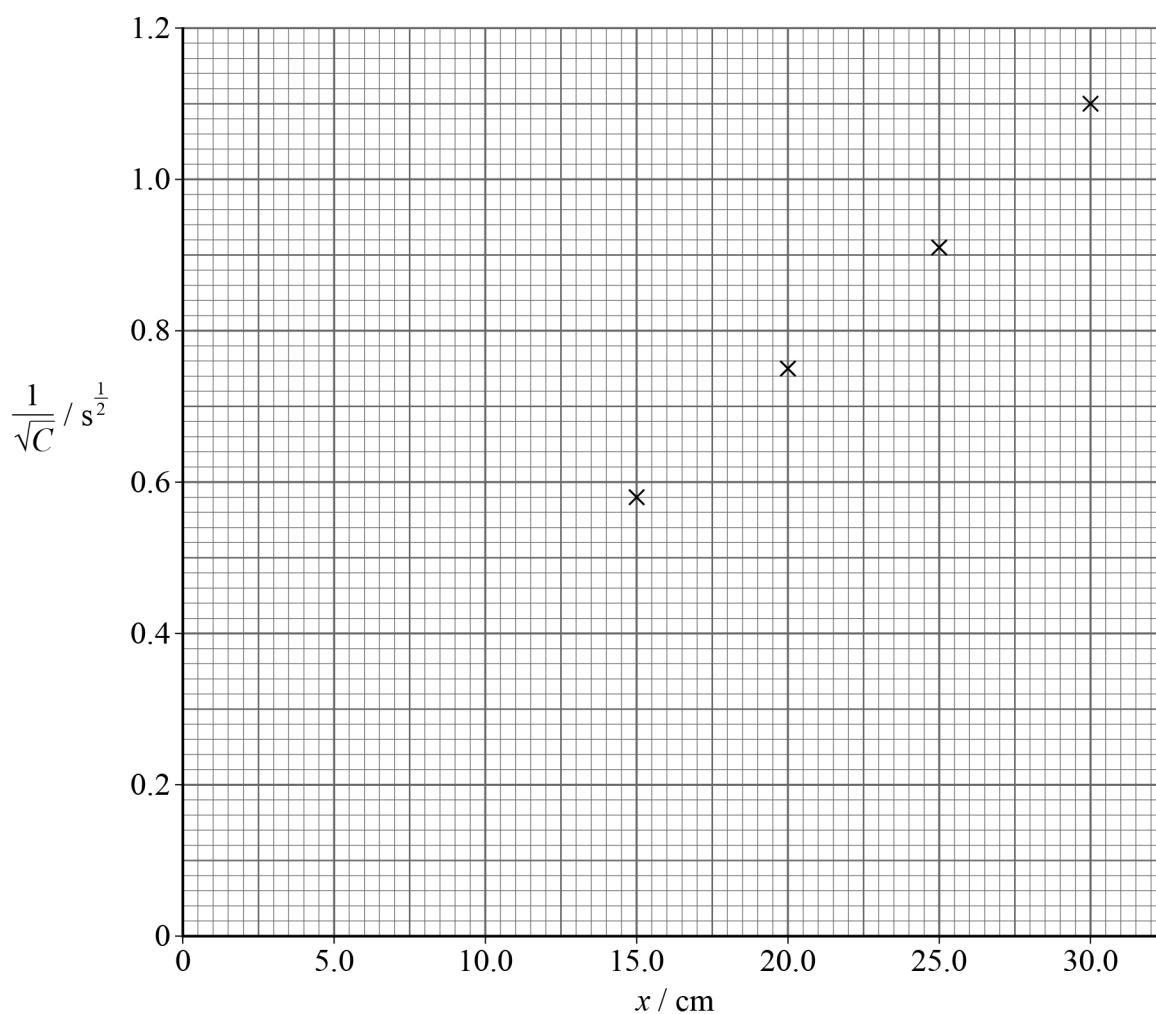
x / cm	C / s^{-1}	$\frac{1}{\sqrt{C}} / \text{s}^{\frac{1}{2}}$
5.0	20.66	
10.0	6.57	
15.0	2.97	0.580
20.0	1.78	0.750
25.0	1.21	0.909
30.0	0.86	1.1

1 2 . 3 Complete **Table 1**.

[1 mark]



1 2 . 4

Plot the **two** remaining points on **Figure 10** and draw a line of best fit.**[2 marks]****Figure 10**

1 2 . 5

Explain why **Figure 10** shows a systematic error.

In your answer you should refer to:

- a feature of the graph
- a possible source of this error.

[2 marks]

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 3** A projectile is fired with a velocity of 20 m s^{-1} at an angle of 60° to the horizontal.
Air resistance is negligible.

What is the height of the projectile when its horizontal displacement is 10 m?

[1 mark]

A 22.2 m 

B 17.4 m 

C 12.4 m 

D 7.4 m 



- 1 4** An athlete runs 100 m in approximately 10 s.

Which is the best estimate of the mean kinetic energy of the athlete while running?

[1 mark]

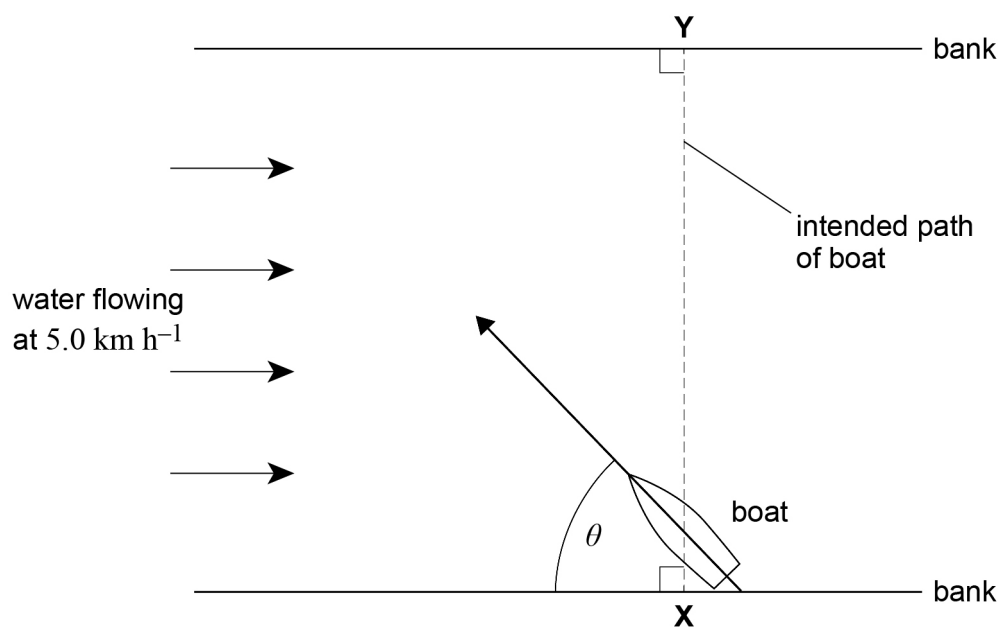
A 0.4 kJ ☐

B 4 kJ ☐

C 40 kJ ☐

D 4 MJ ☐

- 1 5** A boat must cross a river from point **X** to point **Y**.



The water in the river is flowing at 5.0 km h⁻¹.

The speed of the boat relative to the water is 9.0 km h⁻¹.

The boat is at an angle θ to the bank so that it travels in a straight line from **X** to **Y**.

What is θ ?

[1 mark]

A 29° ☐

B 34° ☐

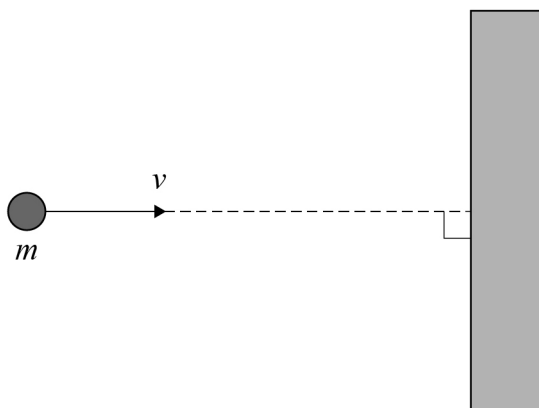
C 56° ☐

D 61° ☐



1 6

A ball of mass m travelling at a speed v collides elastically with a vertical wall.



Which row is correct?

[1 mark]

	Magnitude of change of momentum	Magnitude of change of kinetic energy	
A	$2mv$	0	☐
B	$2mv$	mv^2	☐
C	0	0	☐
D	0	mv^2	☐

1 7

Which is a unit of impulse?

[1 mark]

- A** N s^{-1} ☐
- B** kg m s^{-1} ☐
- C** kg m s^{-2} ☐
- D** s N^{-1} ☐



1 8

An object of mass 6.0 kg falls vertically through the air.
The magnitude of the air resistance is 25 N.

What is the acceleration of the object?

[1 mark]

A 5.6 m s^{-2} ☐

B 9.8 m s^{-2} ☐

C 14 m s^{-2} ☐

D 34 m s^{-2} ☐

1 9

Which statement about a couple is true?

[1 mark]

A It does not consist of forces on the same plane. ☐

B It can produce rotational motion. ☐

C It can produce translational motion. ☐

D It has a moment with units N m^{-1} . ☐

2 0

A system is used to lift a 12 kg mass vertically at a constant speed of 0.65 m s^{-1} .
The input power is 110 W.

What is the efficiency of the system?

[1 mark]

A 7.1% ☐

B 70% ☐

C 71% ☐

D 77% ☐

Turn over ►

2 1

An object of 1.0 kg mass is accelerated from rest for 5.0 s by a force of 4.0 N. There is a constant resistive force of 3.0 N.

Which statement is **not** correct?

[1 mark]

- A** The final speed is 5.0 m s^{-1} . ☐
- B** The distance travelled in 5.0 s is 25 m. ☐
- C** The work done by the 4.0 N force is 50 J. ☐
- D** The kinetic energy after 5.0 s is 12.5 J. ☐



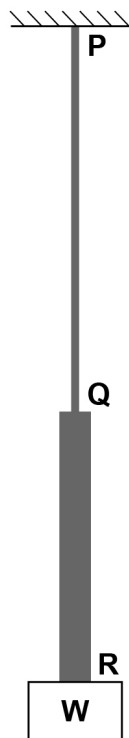
2 2

Two wires **PQ** and **QR** are joined at **Q** as shown.

The wires are made of the same material and have the same initial length.

QR has a larger diameter than **PQ**.

The combination **PR** is suspended vertically from a fixed point and a load **W** is attached at **R**.



Assume that Hooke's law is obeyed and that the weight of each wire is negligible.

Which two quantities have a constant value between **P** and **R**?

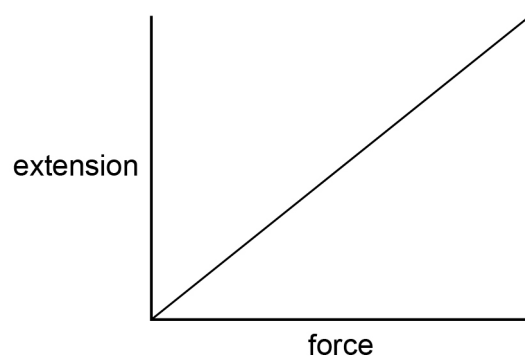
[1 mark]

- A** tension and tensile stress ☐
- B** $\frac{\text{tensile stress}}{\text{tensile strain}}$ and tensile strain ☐
- C** tensile strain and tensile stress ☐
- D** $\frac{\text{tensile stress}}{\text{tensile strain}}$ and tension ☐



2 3

The extension–force graph for a spring is shown below.



What is represented by the area under the graph?

[1 mark]

A work done in stretching the spring

☐

B $\frac{1}{\text{work done in stretching the spring}}$

☐

C spring constant of the spring

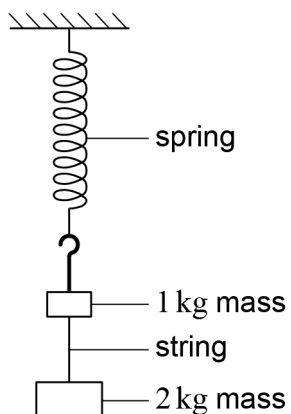
☐

D $\frac{1}{\text{spring constant of the spring}}$

☐


2 4

A 1 kg mass is suspended by a spring.
A 2 kg mass is suspended from the 1 kg mass by a string.
The system is initially at rest.



The string is then cut.

What is the initial acceleration of each mass immediately after the string is cut?

[1 mark]

	Acceleration of 1 kg mass	Acceleration of 2 kg mass	
A	g	g	☐
B	$2g$	g	☐
C	g	$2g$	☐
D	$2g$	$2g$	☐

Turn over for the next question

Turn over ►



- 2 5** A nuclide of uranium ($^{235}_{92}\text{U}$) decays by emitting three α particles and four β^- particles.

Which row shows the nucleon number and the proton number of the resulting nuclide?

[1 mark]

	Nucleon number	Proton number	
A	219	82	☐
B	219	90	☐
C	223	82	☐
D	223	90	☐

- 2 6** The following deductions can be made from Rutherford's scattering experiment:

1. the atom is mostly empty space
2. most of the mass of the atom is in the nucleus
3. the nucleus is positively charged.

Which of the deductions can be made from the motion of most of the alpha particles?

[1 mark]

- A** 1 only ☐
- B** 2 only ☐
- C** 1 and 2 only ☐
- D** 1, 2 and 3 ☐

END OF QUESTIONS



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