Physics Model Paper 1 2025

Time Allowed: 1 hour 45 minutes
Total Marks: 65

You must bring a soft pencil (preferably type B or HB), a clean eraser, and a dark blue or black pen.

Before attempting the paper, write your name, candidate number, centre name, and centre number clearly in the designated spaces.

Instructions for Candidates

- **Section A** contains multiple choice questions. You are required to attempt all questions by selecting the most appropriate option and marking it on the separate MCQ answer sheet using a soft pencil.
- **Section B** comprises both theoretical questions and practical questions. All questions in this section are compulsory. Answers must be written in the space provided on the question paper using a dark blue or black pen.You may use an HB pencil for any diagrams or graphs.
- You may use a scientific calculator.
- You should show all your working and use appropriate units.
- Do not use an erasable pen or correction fluid.
- Avoid writing over any barcodes printed on the paper.

Information for Candidates

- This paper consists of a total of **65 marks**.
- **Section A** includes **30 multiple choice questions**, each carrying **1 mark**. There is no negative marking for incorrect answers.
- **Section B** carries a total of **35 marks**, divided as follows:
  Theoretical Questions: 25 marks
  Practical Questions: 10 marks
- The number of marks for each question or part question is shown in brackets [ ].
- A formula sheet will be provided with this paper.

Please read all questions carefully and follow the instructions exactly to ensure your responses are properly evaluated.

Section A: Multiple Choice Questions (30 questions)

1 The table shows some measurable quantities.

Which row gives the correct order of magnitude of the measurable quantity in the stated unit?

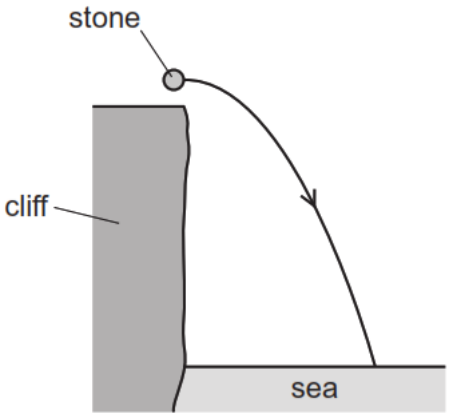
	measurable quantity	order of magnitude	unit
A	mass of a coin	10^{-4}	kg
B	thickness of a sheet of paper	10^{-2}	m
C	weight of an apple	10^{0}	N
D	temperature of a person's body	10^{1}	K

2 A byte (b) comprises 8 bits.

How many bits are there in 1 terabyte (1Tb)?

A 1×10^{9} **B** 8×10^{9} **C** 1×10^{12} **D** 8×10^{12}

3 A stone is thrown horizontally from the top of a cliff and falls into the sea below. Air resistance is negligible. The path of the stone is shown.



In which direction does the resultant force on the stone act during its fall?

A horizontally to the right

B parallel to its velocity

C perpendicular to its velocity

D vertically downwards

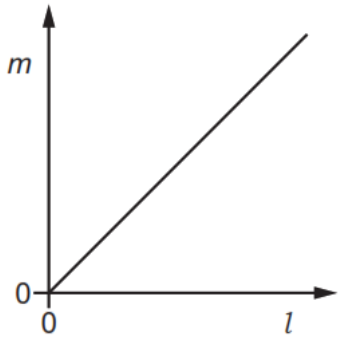
4 A car moves with uniform acceleration along a straight road. Oil leaks from the car at the rate of one drop every two seconds. The diagram shows the distances between three successive oil drops on the road.

What is the acceleration of the car?

A 0.75 m s^{-2} **B** 1.5 m s^{-2} **C** 3.0 m s^{-2} **D** 6.0 m s^{-2}

5 A balance is used to measure the mass *m* of a number of cylindrical metal rods of length ***l***. All the metal rods have the same radius *r*.

The graph shows the variation with ***l*** of *m*.

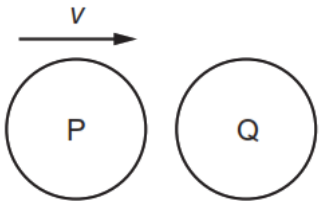


The gradient of the graph is *G*.

Which expression gives the density of the metal?

A $\frac{G}{2\pi r}$ **B** $G2\pi r$ **C** $\frac{G}{\pi r^2}$ **D** $G\pi r^2$

6 The diagram shows a particle P, travelling at speed *v*, about to collide with a stationary particle Q of the same mass. The collision is perfectly elastic.



Which statement describes the motion of P and of Q immediately after the collision?

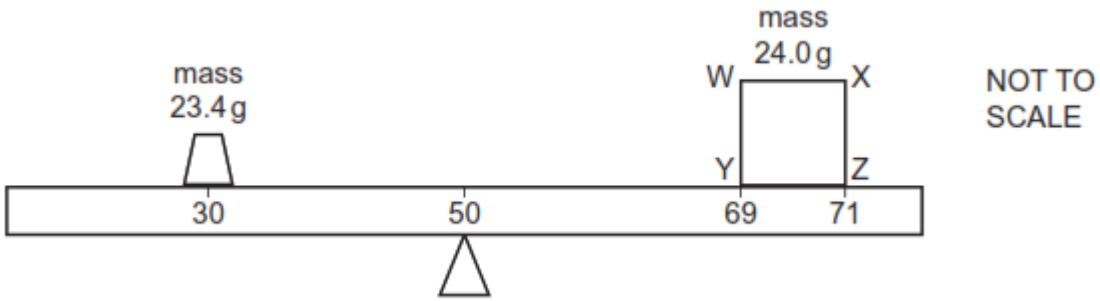
A P and Q both travel in the same direction with speed $\frac{1}{2}v$.

B P comes to rest and Q acquires speed *v*.

C P rebounds with speed $\frac{1}{2}v$ and Q acquires speed $\frac{1}{2}v$.

D P rebounds with speed *v* and Q remains stationary.

7 A cube WXZY has sides of length 2.0 cm and mass 24.0 g. The cube rests on a metre rule of negligible mass. The geometrical centre of the cube is vertically above the 70.0 cm mark on the scale of the rule.



The cube has a non-uniform density so that its centre of gravity is **not** at its geometrical centre. The centre of gravity of the cube is in the plane of the diagram.

The rule rests on a pivot at the 50.0 cm mark. A mass of 23.4 g is placed vertically above the 30.0 cm mark. The rule is horizontal and in equilibrium.

What can be determined about the position of the centre of gravity of the cube?

A It must be somewhere along a horizontal line that is 0.5 cm from line WX.

B It must be somewhere along a horizontal line that is 0.5 cm from line YZ.

C It must be somewhere along a vertical line that is 0.5 cm from line WY.

D It must be somewhere along a vertical line that is 0.5 cm from line XZ.

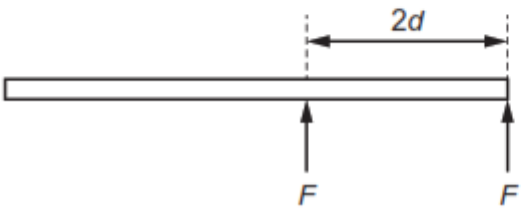
8 Two parallel forces, each of magnitude F, act on a rod of length 5d.

Which diagram shows the positions of the two forces that will produce the largest torque on the rod?

A

B

C



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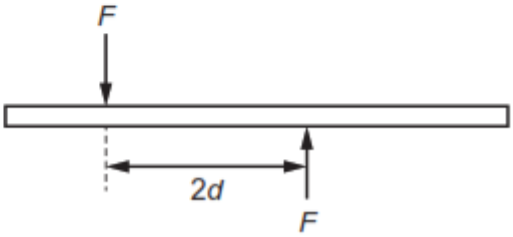


9 A student measures the current and the potential difference for a resistor in a circuit.

current = (50.00 ± 0.01) mA

potential difference = (500.0 ± 0.1) mV

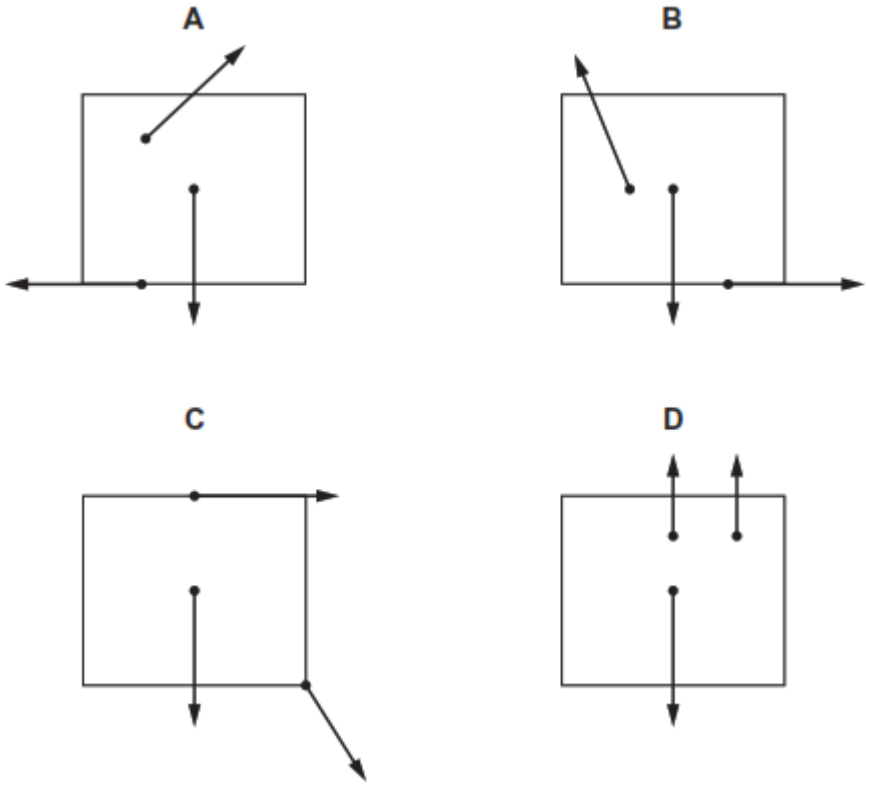
The measurements are used to calculate the resistance of the resistor.

What is the percentage uncertainty in the calculated resistance?

A 0.0002% **B** 0.0004% **C** 0.02% **D** 0.04%

10 Three coplanar forces act on a block.

Which diagram shows the directions of the forces such that the block could be in equilibrium?



11 What is a unit for density?

A $N\ m^{-3}$ **B** $g\ mm^{-1}$ **C** $kg\ cm^{-2}$ **D** $\mu g\ mm^{-3}$

12 An object is stretched until it reaches the elastic limit.

Which statement must describe the stress on the object when it is at the elastic limit?

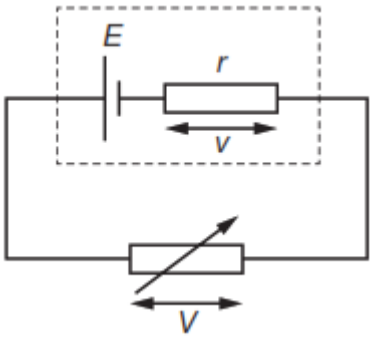
A It is the maximum stress for which the object obeys Hooke's law.

B It is the maximum stress that can be applied to the object before it has elastic deformation.

C It is the maximum stress that can be applied to the object before it has plastic deformation.

D It is the maximum stress the object can withstand before it breaks.

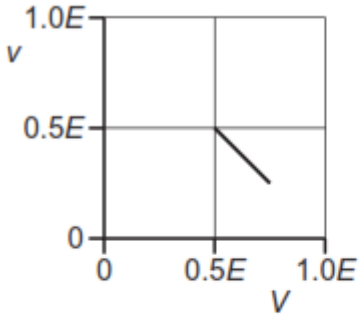
13 A cell of electromotive force (e.m.f.) *E* and internal resistance *r* is connected to a variable resistor, as shown.



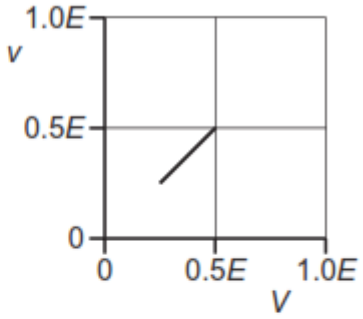
The resistance of the variable resistor is gradually increased from *r* to 3*r*.

Which graph shows the variation of the potential difference (p.d.) *v* across the internal resistance with the p.d. *V* across the variable resistor?

A



B



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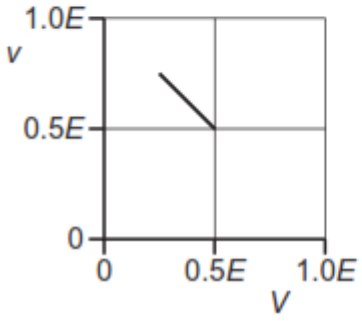

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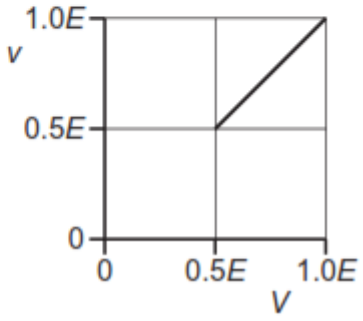
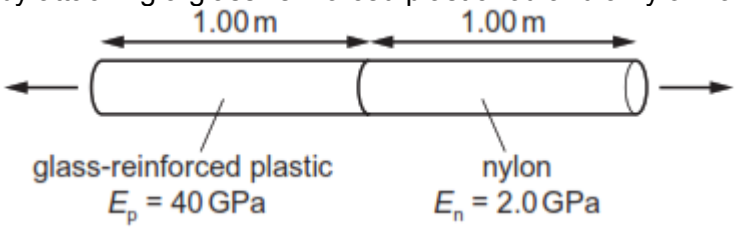


14 A composite rod is made by attaching a glass-reinforced plastic rod and a nylon rod end to end, as shown.



The rods have the same cross-sectional area and each rod is 1.00 m in length. The Young modulus *E*p of the plastic is 40 GPa and the Young modulus *E*n of the nylon is 2.0 GPa.

The composite rod will break when its total extension reaches 3.0 mm.
What is the greatest tensile stress that can be applied to the composite rod before it breaks?

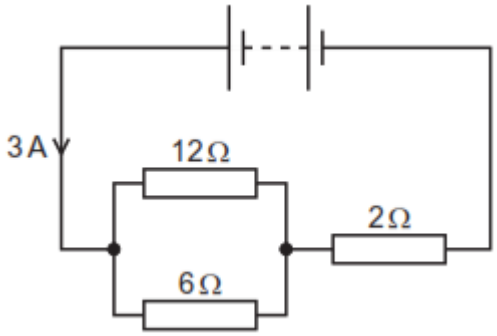
A 2.9×10^6 Pa **B** 5.7×10^6 Pa **C** 2.9×10^9 Pa **D** 5.7×10^9 Pa

15 Electrons move in a vacuum from one metal plate to another metal plate. As a result of this, there is an electric current of 48 μA between the two plates.

How many electrons are emitted by the first plate in a time of 5.0 minutes?

A 1.4×10^4 **B** 1.5×10^{15} **C** 1.8×10^{16} **D** 9.0×10^{16}

16 A battery is connected to three resistors of resistances 12 Ω, 6 Ω and 2 Ω, as shown.



The current from the battery is 3 A.

What is the value of the ratio $\frac{power\ dissipated\ in\ the\ resistor\ of\ the\ resistance\ 6\Omega}{power\ dissipated\ in\ the\ resistor\ of\ the\ resistance\ 2\ \Omega}$?

A $\frac{1}{3}$ **B** $\frac{4}{3}$ **C** $\frac{2}{1}$ **D** $\frac{3}{1}$

17 A wire is stretched by applying increasing values of force *F*. For each value of force applied, the extension *x* is recorded. A force–extension graph is plotted from the data obtained.

Which statement about the area under the graph **must** be correct?

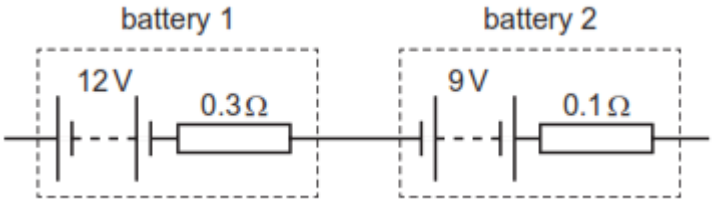
A It can be calculated as $\frac{1}{2}Fx$.

B It is the elastic potential energy stored in the stretched sample.

C It is the work done in stretching the sample.

D It would be the same for any wire of the same material.

18 Two batteries are connected together, as shown.



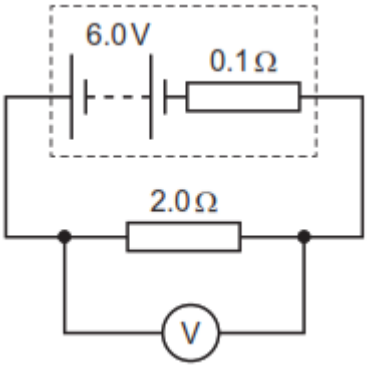
Battery 1 has electromotive force (e.m.f.) 12 V and internal resistance 0.3 Ω.

Battery 2 has e.m.f. 9 V and internal resistance 0.1 Ω.

What are the e.m.f. and the internal resistance of a single battery that has the same effect as the combination?

	e.m.f. / V	internal resistance / Ω
A	3	0.2
B	3	0.4
C	21	0.2
D	21	0.4

19 The diagram shows a circuit.



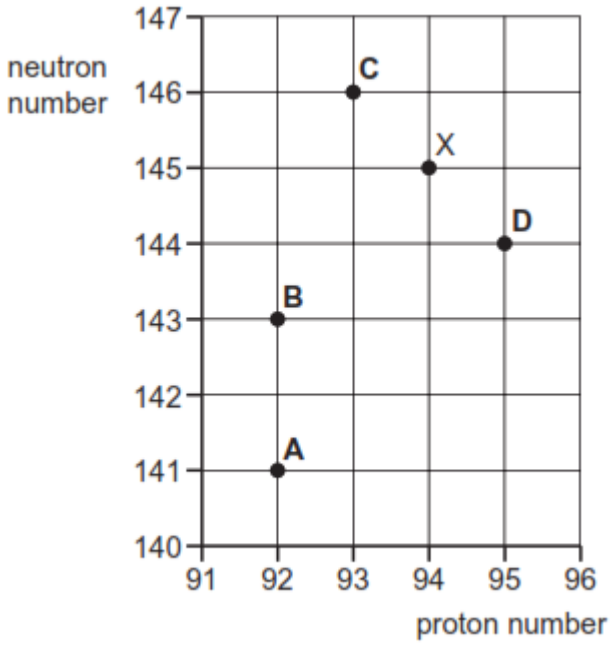
What is the reading on the voltmeter?

A 0.3 V **B** 5.7 V **C** 6.0 V **D** 6.3 V

20 The figure shows part of a chart of nuclides where neutron number is plotted against proton number.

An unstable nuclide X decays by emitting an α-particle.

Which nuclide is formed by the decay of nuclide X?

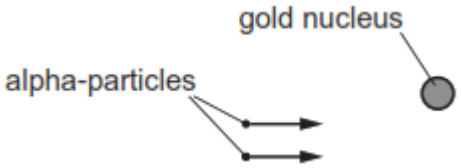


21 The nuclei of common isotopes of hydrogen, helium, lithium and beryllium are shown.

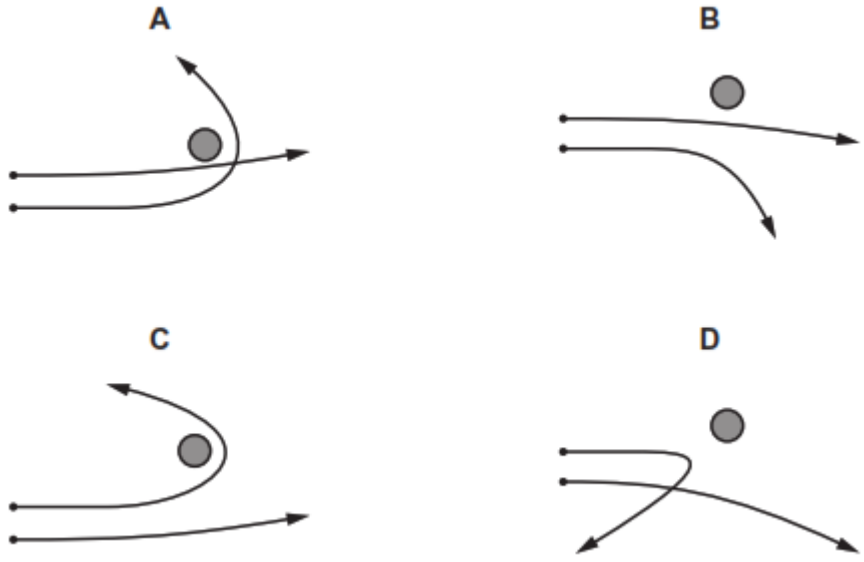
Which nucleus contains equal numbers of up and down quarks?

A $1\,1\,H$ **B** $2\,4\,He$ **C** $7\,3\,Li$ **D** $9\,4\,Be$

22 Two alpha-particles with the same kinetic energy are moving towards, and are then deflected by, a gold nucleus.



Which diagram could show the paths of the two alpha-particles?



23 The equation represents the decay of a nucleus X to a nucleus Y.

$$^{A}_{Z}X \rightarrow {}^{A}_{Z-1}Y + p + q$$

What are particles p and q?

	p	q
A	β^- particle	neutron
B	β^- particle	proton
C	β^+ particle	antineutrino
D	β^+ particle	neutrino

24 Which row gives the correct type and quark composition for the named particle?

	particle	type	quark composition
A	neutron	hadron	u u d
B	neutron	lepton	u d d
C	proton	hadron	u u d
D	proton	lepton	u d d

key

u = up quark

d = down quark

25 A man of mass 75.2 kg uses a set of weighing scales to measure his mass three times. He obtains the following readings.

	mass / kg
reading 1	80.2
reading 2	80.1
reading 3	80.2

Which statement describes the precision and accuracy of the weighing scales?

A not precise to ± 0.1 kg and accurate to ± 0.1 kg

B not precise to ± 0.1 kg and not accurate to ± 0.1 kg

C precise to ± 0.1 kg and accurate to ± 0.1 kg

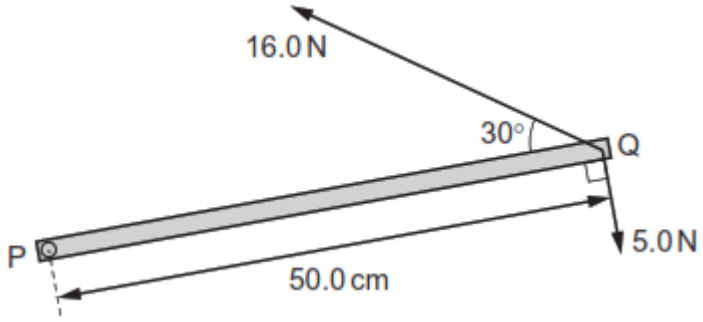
D precise to ± 0.1 kg and not accurate to ± 0.1 kg

26 A car of mass 750 kg has a horizontal driving force of 2.0 kN acting on it. It has a forward horizontal acceleration of 2.0 m s^{-2}.

What is the resistive force acting horizontally?

A 0.50 kN **B** 1.5 kN **C** 2.0 kN **D** 3.5 kN

27 A horizontal metal bar PQ of length 50.0 cm is hinged at end P. The diagram shows the metal bar viewed from above.

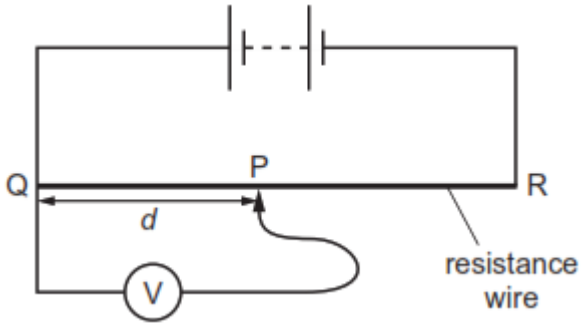


Two forces of 16.0 N and 5.0 N are in the horizontal plane and act on end Q, as shown.

What is the resultant moment about P due to the two forces?

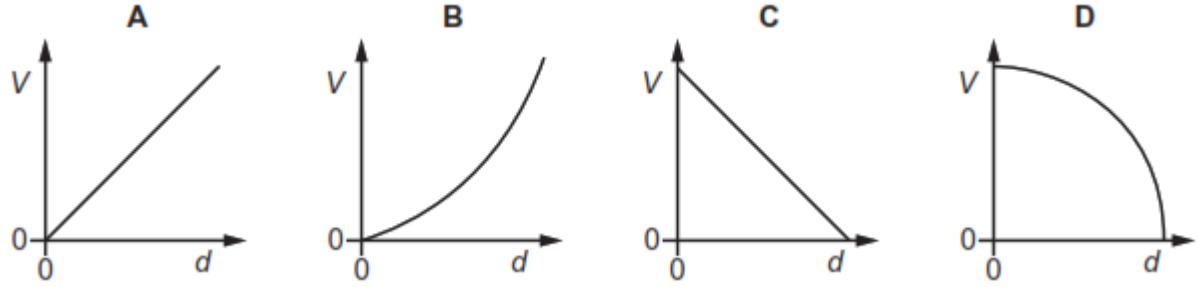
A 1.5 N m **B** 4.4 N m **C** 6.5 N m **D** 9.4 N m

28 A battery is connected to a potentiometer. The potentiometer consists of a uniform resistance wire and a sliding contact P.



The potential difference (p.d.) *V* between the sliding contact P and end Q of the wire is measured using a voltmeter. The sliding contact P is moved from end Q to end R of the wire. Sliding contact P is distance *d* from Q.

Which graph shows the variation with distance *d* of the p.d. *V*?



29 Each of Kirchhoff's two laws presumes that some quantity is conserved.

Which row states Kirchhoff's **first** law and names the quantity that is conserved?

	statement	quantity
A	the algebraic sum of currents into a junction is zero	charge
B	the algebraic sum of currents into a junction is zero	energy
C	the e.m.f. in a loop is equal to the algebraic sum of the product of current and resistance round the loop	charge
D	the e.m.f. in a loop is equal to the algebraic sum of the product of current and resistance round the loop	energy

30 A nucleus X is radioactive and decays into a nucleus Y.

X and Y are isotopes of the same element.

Which combination of particles could have been emitted during the decay process?

A 1 α-particle and 1 β^- particle

B 1 α-particle and 2 β^-particles

C 2 α-particles and 1 β^-particle

D 2 α-particles and 2 β^-particles

Section B (35 marks)
Theoretical Questions (25 marks)

1 (a) Complete Table 1.1 by stating whether each of the quantities is a vector or a scalar.

Table 1.1

quantity	vector or scalar
acceleration	
electrical resistance	
momentum	

[2]

(b) State the conditions for an object to be in equilibrium.

.....

.....

.....

..... [2]

(c) A floating solid cylinder is attached by a wire to the sea bed, as shown in Fig. 1.1.

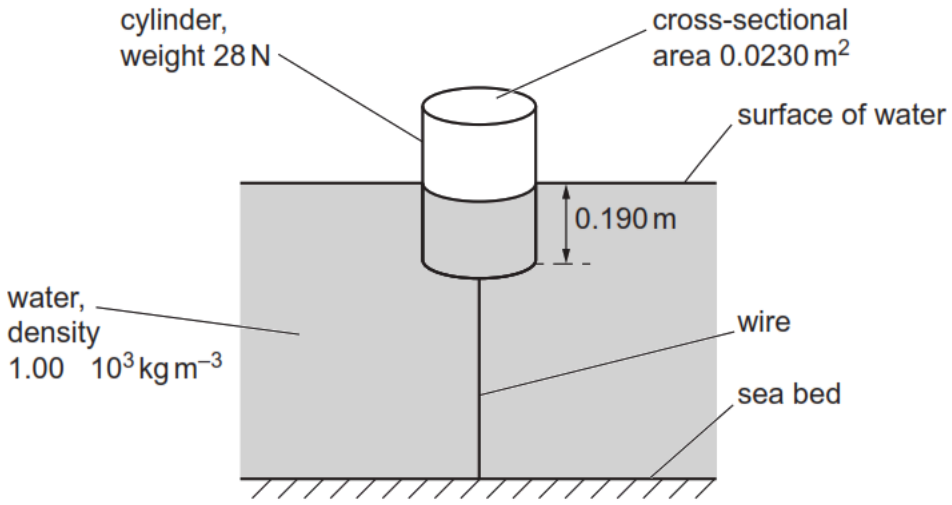


Fig. 1.1 (not to scale)

The density of the water is 1.00×10^3 kg m^{-3}. The base of the cylinder is at a depth of 0.190 m below the surface of the water. The cylinder has a weight of 28 N and a cross-sectional area of 0.0230 m^2. The wire and the central axis of the cylinder are both vertical. The cylinder is in equilibrium.

(i) Calculate, to three significant figures, the upthrust acting on the cylinder due to the water.

upthrust = ... N [2]

(ii) Show that the tension *T* in the wire is 15 N.

[1]

(iii) The wire has a cross-sectional area of 3.2 mm^2.

Calculate the stress in the wire.

stress = ... Pa [2]

2 (a) Define the *ohm*.

.....

..... [1]

(b) A wire is made of metal of resistivity ρ. The length *L* of the wire is gradually increased. Assume that the volume *V* of the wire remains constant as its length is increased.

Show that the resistance *R* of the extending wire is proportional to L^2.

[2]

(c) A battery of electromotive force (e.m.f.) *E* and internal resistance *r* is connected to a variable resistor of resistance *R*, as shown in Fig. 2.1.

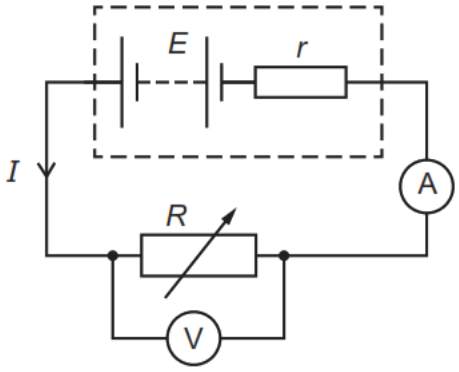


Fig. 2.1

An ammeter measures the current *I* in the circuit. A voltmeter measures the potential difference *V* across the variable resistor.

The resistance R is now varied to change the values of I and V.
The variation with I of V is shown in Fig. 2.2.

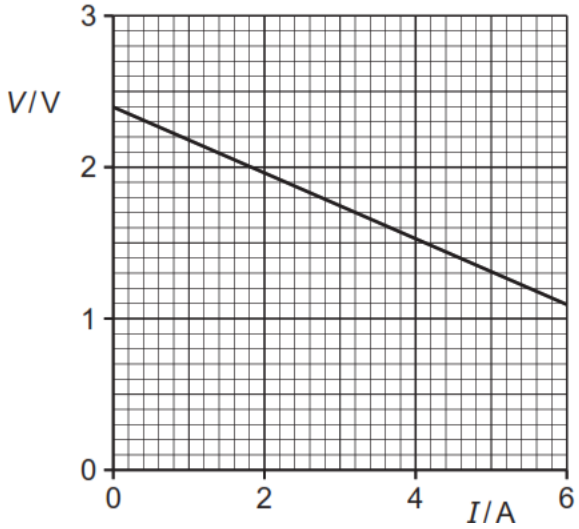


Fig. 2.2

(i) Use Fig. 2.2 to state the e.m.f. E of the battery.

E = ... V [1]

(ii) Use Fig. 2.2 to determine the power dissipated in the variable resistor when there is a current of 5.0 A.

power = ... W [3]

3 (a) A proton in a nucleus decays to form a neutron and a β^+ particle.

(i) State the name of another lepton that is produced in the decay.

..... [1]

(ii) State the name of the interaction (force) that gives rise to this decay.

..... [1]

(iii) State which of the three particles (proton, neutron or β^+ particle) has the largest ratio of +charge to mass.

..... [1]

(iv) Use the quark model to show that the charge on the proton is $+e$, where e is the elementary charge.

[2]

(v) The quark composition of the proton is changed during the decay.

Describe the change to the quark composition.

.....

..... [1]

(b) A nucleus X ($^{12}_{6}$X) and a nucleus Y ($^{16}_{8}$Y) are accelerated by the same uniform electric field.

(i) Determine the ratio

$$\frac{electric\ force\ acting\ on\ nucleus\ X}{electric\ force\ acting\ on\ nucleus\ Y}$$

ratio = ... [1]

(ii) Determine the ratio

$$\frac{acceleration\ of\ nucleus\ X\ due\ to\ the\ field}{acceleration\ of\ nucleus\ Y\ due\ to\ the\ field}$$

ratio = ... [1]

(iii) Nucleus X is at rest in the uniform electric field at time $t = 0$.

The field causes nucleus X to accelerate so that it moves through the field.

On Fig. 3.1, sketch the variation with time t of the acceleration a of nucleus X due to the field.

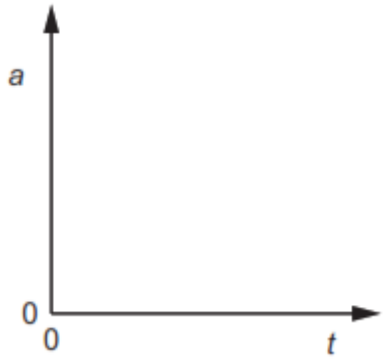


Fig. 3.1

[1]

Practical Component (10 marks)

1 A student has two identical springs. He suspends them from a thin metal bar that is held in a horizontal position between two stands.

(a) He hangs a load from one of the springs, as shown in Fig. 1.1. This spring extends by a distance ***h***.

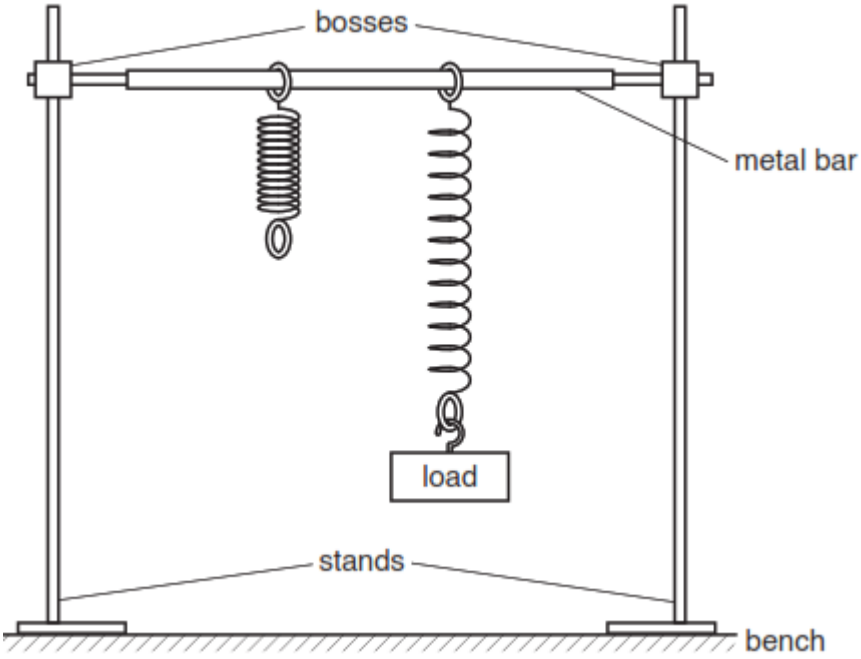


Fig. 1.1 (not to scale)

(i) On Fig. 1.1, show clearly the distance ***h***. [1]

(ii) Describe a practical method that the student can use to ensure that he measures the distance ***h*** accurately.

.....

.....

.....

.....[1]

(b) The student removes the load and then inserts a small wooden rod of negligible mass into the rings at the end of each of the two springs. He suspends the load from the middle of the rod, as shown in Fig. 1.2. He checks that the wooden rod is horizontal and then measures the extension ***h*** of one of the springs.

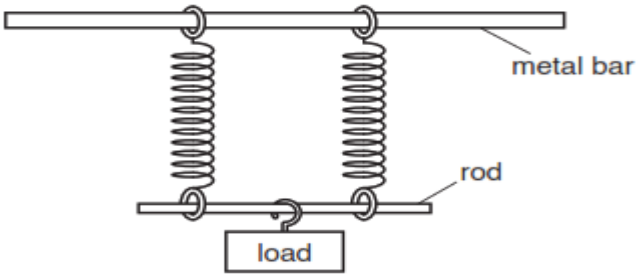


Fig. 1.2(not to scale)

(i) Explain why it is important for the wooden rod to be horizontal.

.....

.....

.....[1]

(ii) Suggest how the student checks that the wooden rod is horizontal.

.....

.....

.....

.....[1]

(iii) The experiment is repeated using more identical springs until there are eight springs hanging side by side. The extension ***h*** is measured each time a spring is added. The results are shown in the table of Fig. 1.3.

total number of springs *N*	*h*/cm
1	19.8
2	9.9
3	6.5
4	4.9
5	4.0
6	3.6
7	2.8
8	2.5

Fig. 1.3

On Fig. 1.4, plot a graph of ***h*** / cm on the ***y***-axis against ***N*** on the ***x***-axis.

Start your axes from (0,0). Draw a smooth curve of best fit. [4]

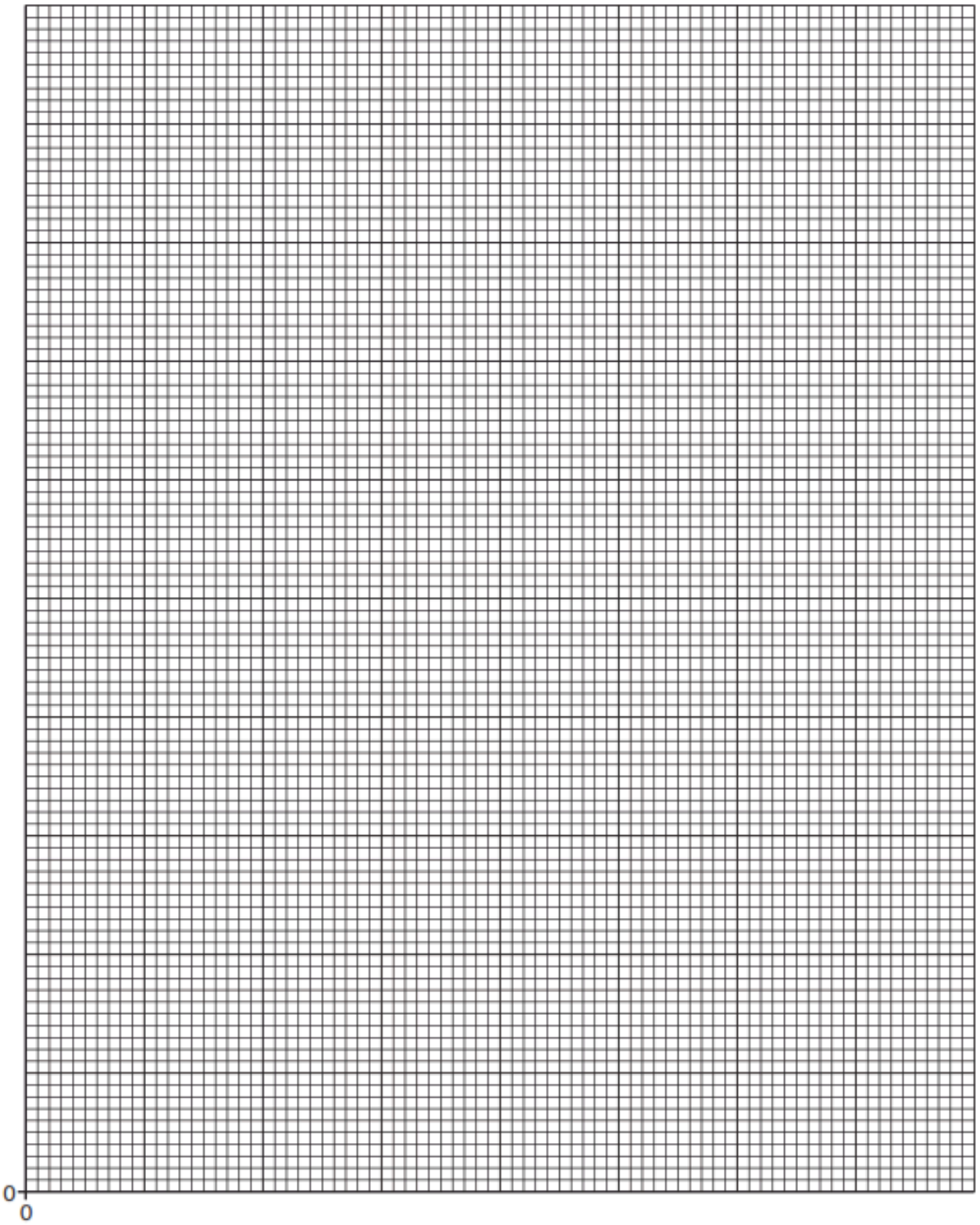


Fig. 1.4

(iv) Describe the relationship between ***N*** and ***h***.

.....

.....

.....[2]

Paper 1: Physics **Model Paper 2025** **(Time: 1 hour 45 minutes)**

Marking Scheme

INFORMATION:

- This paper has a total of 65 marks.
- In the objective section there are 30 questions, each carries one mark. There is no negative marking for incorrect responses.
- In the subjective section, 25 marks are for extended theory and 10 marks for practical components.

Section A: MCQ (30 marks)

Question Number	Answer Key
1	C
2	D
3	D
4	A
5	C
6	B
7	C
8	D
9	D
10	B
11	D
12	C
13	A
14	B
15	D

Question Number	Answer Key
16	B
17	C
18	B
19	B
20	B
21	B
22	D
23	D
24	C
25	D
26	A
27	A
28	A
29	A
30	B

Section B (35 marks)
Theory (25 marks)

1 (a)	acceleration: vector electrical resistance: scalar momentum: vector *1 mark for two correct, 2 marks for all three correct*	2
1 (b)	resultant force (in any direction) is zero	1
	resultant torque/moment (about any point) is zero	1
1 (c) (i)	upthrust = $\rho g(\Delta)h \times A$	1
	= $(1.00 \times 10^3 \times 9.81 \times 0.190) \times 0.0230$ = 42.9 N	1
1 (c) (ii)	(T =) 43 – 28 = 15 (N) **or** (T =) 42.9 – 28 = 14.9 or 15 (N)	1
1 (c) (iii)	$\sigma = F / A$ **or** T / A	1
	= $15 / (3.2 \times 10^{-6})$ = 4.7×10^6 Pa	1
2 (a)	volt / ampere	1
2 (b)	$R = \rho L / A$	1
	($A = V / L$) (so) $R = \rho L^2 / V$ (with ρ and V constant so $R \propto L^2$)	1
2 (c) (i)	E = 2.4 V	1
2 (c) (ii)	$P = VI$	1
	1.3 x 5.0	1
	6.5w	1
3 (a) (i)	(electron) neutrino	1
3 (a) (ii)	weak (nuclear force/interaction)	1
3 (a) (iii)	β^+ (particle)	1
3 (a) (iv)	(quark structure is) up up down **or** uud	1
	$(2 / 3)e + (2 / 3)e – (1 / 3)e = (+)e$	1
3 (a) (v)	up up down changes to up down down **or** uud → udd **or** up changes to down **or** u → d	1
3 (b) (i)	ratio = 6 / 8 =0.75	1
3 (b) (ii)	ratio = 0.75 x (16 / 12) = 1.0	1
3 (b) (iii)	horizontal straight line at a non-zero value of a	1

Practical Component (10 marks)

1 (a) (i)	*h* shown clearly on diagram from bottom of left hand spring to bottom of right hand spring or equivalent distance.	1
1 (a)(ii)	any one: lengths of spring before and after stretching **and** values subtracted use metre rule to measure from floor to one point on one spring and also to same point on second spring **and** subtract the values use of metre rule and set squares clearly explained ruler close to springs / person	1
1 (b)(i)	ensures the load is evenly shared / both springs stretch same amount / *h* is the same	1
1 (b)(ii)	use of spirit level / measuring distance from floor to rod at two points	1
1 (b) (iii)	axes labelled quantity and unit and axes correct way round	1
	scales linear and sensible	1
	points plotted accurately to nearest $\frac{1}{2}$ square	1
	best fit curve drawn	1
1 (b) (iv)	as *N* increases, *h* decreases / inverse relationship	1
	inversely proportional / *N* doubles as *h* halves / $N \times h$ is constant	1