Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/11**

Paper 1 Multiple Choice **May/June 2025**

1 hour 15 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.

This document has **16** pages.

[Turn over

Data

acceleration of free fall	$g = 9.81\,\text{m s}^{-2}$
speed of light in free space	$c = 3.00 \times 10^{8}\,\text{m s}^{-1}$
elementary charge	$e = 1.60 \times 10^{-19}\,\text{C}$
unified atomic mass unit	$1\,\text{u} = 1.66 \times 10^{-27}\,\text{kg}$
rest mass of proton	$m_\text{p} = 1.67 \times 10^{-27}\,\text{kg}$
rest mass of electron	$m_\text{e} = 9.11 \times 10^{-31}\,\text{kg}$
Avogadro constant	$N_\text{A} = 6.02 \times 10^{23}\,\text{mol}^{-1}$
molar gas constant	$R = 8.31\,\text{J K}^{-1}\,\text{mol}^{-1}$
Boltzmann constant	$k = 1.38 \times 10^{-23}\,\text{J K}^{-1}$
gravitational constant	$G = 6.67 \times 10^{-11}\,\text{N m}^2\,\text{kg}^{-2}$
permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}\,\text{F m}^{-1}$ $\left(\frac{1}{4\pi\varepsilon_0} = 8.99 \times 10^{9}\,\text{m F}^{-1}\right)$
Planck constant	$h = 6.63 \times 10^{-34}\,\text{J s}$
Stefan–Boltzmann constant	$\sigma = 5.67 \times 10^{-8}\,\text{W m}^{-2}\,\text{K}^{-4}$

Formulae

uniformly accelerated motion	$s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
hydrostatic pressure	$\Delta p = \rho g \Delta h$
upthrust	$F = \rho g V$
Doppler effect for sound waves	$f_\text{o} = \frac{f_\text{s} v}{v \pm v_\text{s}}$
electric current	$I = Anvq$
resistors in series	$R = R_1 + R_2 + \ldots$
resistors in parallel	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$

1 Which quantity is a vector?

A pressure

B temperature

C weight

D work

2 Four students, **A**, **B**, **C** and **D**, have completed an experiment to determine the acceleration of free fall, *g*. Each student repeated the experiment three times. The determined values of *g* are shown in the table.

Which set of results has a high precision and a low accuracy?

	acceleration of free fall / $m\,s^{-2}$		
	experiment 1	experiment 2	experiment 3
A	7.2	9.4	8.3
B	9.5	9.8	10.2
C	9.8	9.8	9.9
D	10.1	10.2	10.1

3 The diameter of a ball is measured as $(5.26 \pm 0.02)\,cm$.

What is the absolute uncertainty in the volume of the ball?

A $0.29\,cm^3$ **B** $0.87\,cm^3$ **C** $1.1\,cm^3$ **D** $7.0\,cm^3$

4 Two vectors, X and Y, are shown.

What are the directions of X + Y and X – Y?

	X + Y	X – Y
A	→	↓
B	→	↑
C	←	↓
D	←	↑

5 A ball is projected vertically downwards with an initial velocity of $20\,m\,s^{-1}$. Air resistance is negligible.

What is the displacement from its initial position of the ball after a time of 1.5 s?

A 11 m **B** 19 m **C** 37 m **D** 41 m

6 A surveyor's device emits a pulse of light. The light is reflected from a wall 150 m away.

What is the total time taken for the pulse to travel from the device to the wall and then back to the device?

A 0.05 ns **B** 0.10 ns **C** 0.50 μs **D** 1.0 μs

7 Which equation of uniformly accelerated motion can be derived using only the gradient of a velocity–time graph?

A $s = \frac{1}{2}(u + v)t$

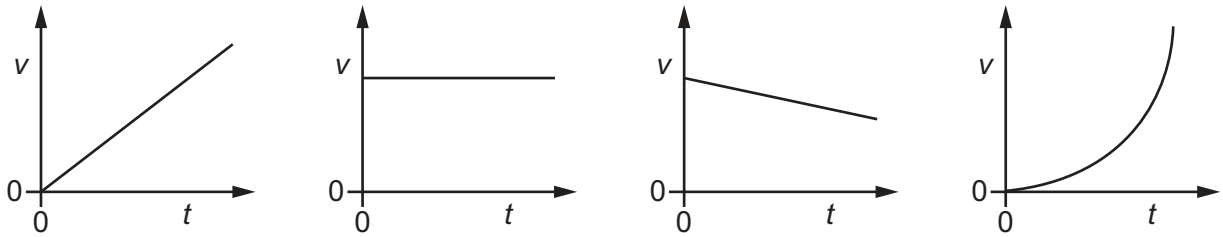
B $s = ut + \frac{1}{2}at^2$

C $v = u + at$

D $v^2 = u^2 + 2as$

8 An object is projected horizontally from a table at time $t = 0$. The object falls in a uniform gravitational field. Air resistance is negligible.

Graphs P, Q, R and S are velocity–time graphs.



Which graphs represent the horizontal and vertical components of the velocity of the object?

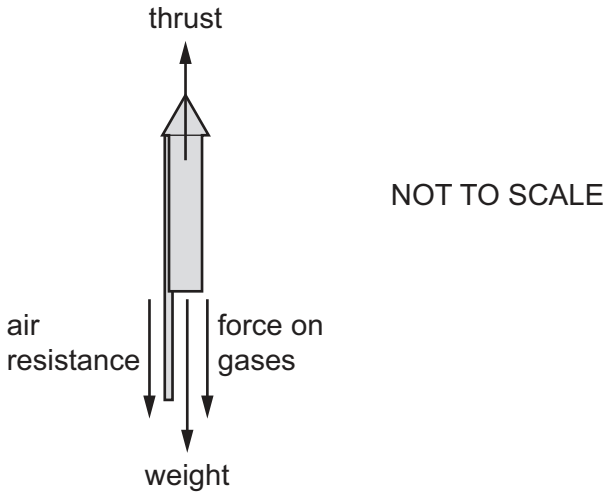
	horizontal	vertical
A	Q	P
B	Q	S
C	R	P
D	R	S

9 What is always conserved in elastic collisions?

	total kinetic energy	total velocity
A	yes	yes
B	yes	no
C	no	yes
D	no	no

10 A firework travels vertically upwards in air. Gases are pushed vertically downwards from the firework.

Several forces that act on the firework and gases are shown.



Which forces are a Newton's third law pair?

A air resistance and force on gases

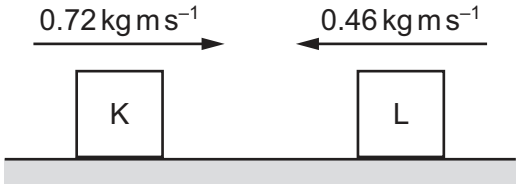
B air resistance and thrust

C force on gases and thrust

D thrust and weight

11 Two blocks K and L slide towards each other along a horizontal frictionless surface.

The diagram shows the momentum of the two blocks just before they collide.



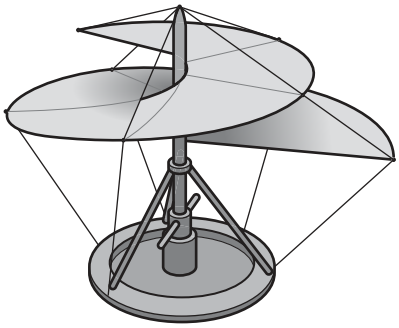
During the collision, the blocks are in contact with each other for a time of 0.084 s.

After the collision, the blocks separate and block L moves back along its original path with a momentum of 0.12 kg m s^{-1}.

What is the magnitude of the average force exerted on block L by block K during the collision?

A 3.1 N **B** 4.0 N **C** 6.9 N **D** 7.1 N

12 Leonardo da Vinci proposed a flying machine that would work like a screw to lift the pilot into the air. The 'screw' is rotated by the pilot.



The machine and the pilot together have a total mass of 120 kg.

Which useful output power must the pilot provide to move vertically upwards at a constant speed of $2.5\,m\,s^{-1}$?

A 48 W **B** 300 W **C** 470 W **D** 2900 W

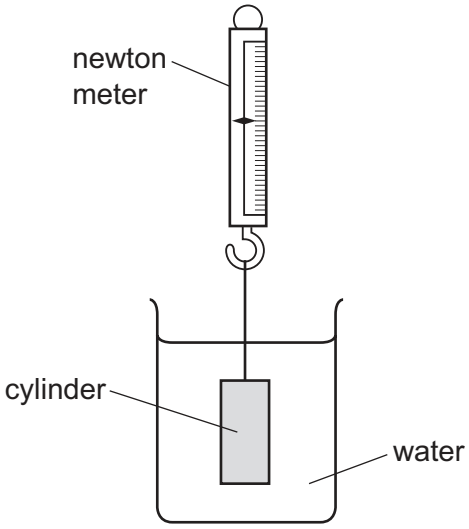
13 Which row describes a pair of forces that forms a couple?

	direction of the forces	magnitude of the forces
A	opposite	different
B	opposite	equal
C	same	different
D	same	equal

14 A uniform cylinder of weight 25.0 N is suspended from a newton meter.

The cylinder is fully submerged in water, as shown.

The reading on the newton meter is 10.0 N.

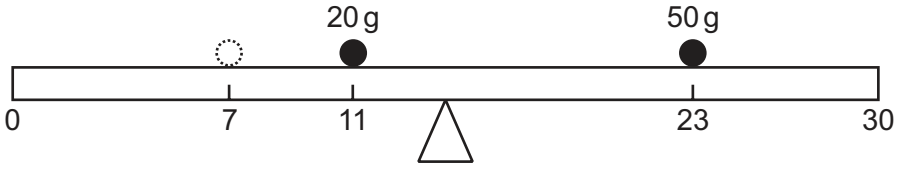


The water is replaced by a liquid with a density 10% greater than the density of water. The cylinder remains fully submerged.

What is the new reading on the newton meter?

A 8.5 N **B** 9.0 N **C** 11.0 N **D** 11.5 N

15 A student balances a 30 cm ruler on a fulcrum set at the 15 cm mark. She then places a 50 g mass on the 23 cm mark and a 20 g mass on the 11 cm mark, as shown.



Which mass should she place on the 7 cm mark to restore the balance?

A 30 g **B** 40 g **C** 47 g **D** 133 g

16 A submarine is at a depth of 130 m below the surface of the sea.

The pressure on the submarine due to the sea water is p.

The submarine sinks to a depth of 260 m below the surface.

Assume that the density of sea water is constant.

What is the **difference** between the pressures on the submarine due to the sea water at the two depths?

A 0 **B** 0.5p **C** p **D** 2p

17 An object is falling in a uniform gravitational field.

Which two quantities are sufficient to calculate the change in gravitational potential energy?

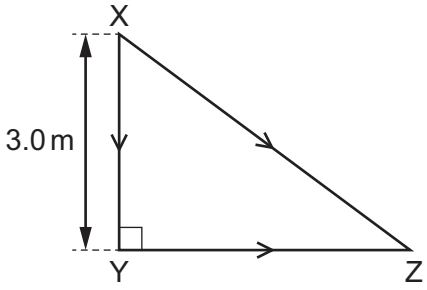
A mass and acceleration of free fall

B mass and change in vertical displacement

C weight and acceleration of free fall

D weight and change in vertical displacement

18 The points X, Y and Z are on a rough, horizontal surface.



A box P is pushed across the surface from X to Y and then from Y to Z.

The distance from X to Y is 3.0 m. The work done against the frictional force in moving the box from X to Y is 150 J.

The work done against the frictional force in moving the box from Y to Z is 200 J.

An identical box Q is pushed in a straight line from X to Z.

The magnitude of the frictional force between the boxes and the surface is constant.

How much extra work is done against the frictional force in moving P than Q?

A 100 J **B** 250 J **C** 350 J **D** 600 J

19 The momentum of a car of mass m increases from p_1 to p_2.

What is the increase in the kinetic energy of the car?

A $\frac{(p_2^2 - p_1^2)}{2m}$ **B** $\frac{(p_2 - p_1)^2}{2m}$ **C** $\frac{p_2 - p_1}{2m}$ **D** $\frac{p_1 - p_2}{2m}$

20 A parachutist is falling at constant (terminal) velocity.

Which statement is **not** correct?

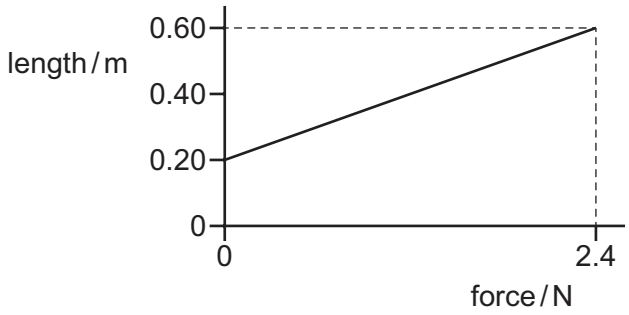
A Gravitational potential energy is converted into kinetic energy of the air.

B Gravitational potential energy is converted into kinetic energy of the parachutist.

C Gravitational potential energy is converted into thermal energy of the air.

D Gravitational potential energy is converted into thermal energy of the parachutist.

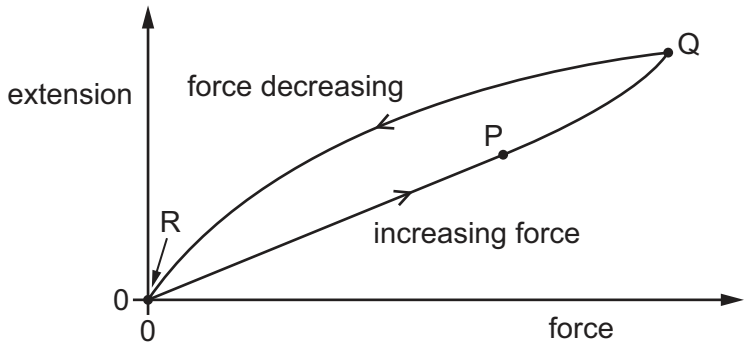
21 A student investigates a spring. The variation of the length of the spring with the force applied to the spring is shown.



What is the spring constant of the spring?

A $0.17\,N\,m^{-1}$ **B** $0.25\,N\,m^{-1}$ **C** $4.0\,N\,m^{-1}$ **D** $6.0\,N\,m^{-1}$

22 The graph shows the variation with force of the extension of a wire.



The force is gradually increased to a maximum at Q and then gradually decreased to zero at R.

Which statement is correct?

A Along the line PQ, the wire obeys Hooke's law.

B Along the line RP, the spring constant is equal to $\frac{\text{extension}}{\text{force}}$.

C The wire has elastic deformation at point Q.

D The work done in stretching the wire to P is equal to (force × extension) at point P.

23 A uniform metal wire of length L and diameter d has spring constant k.

What is the Young modulus of the metal?

A $\frac{\pi d^2}{4kL}$ **B** $\frac{\pi d^2}{kL}$ **C** $\frac{kL}{\pi d^2}$ **D** $\frac{4kL}{\pi d^2}$

24 An aircraft produces a sound at a frequency of 30.0 Hz.

The speed of sound in air is 330 m s^{-1}.

The aircraft is directly in front of the stationary observer and travels in a straight line towards or away from the observer.

The observer hears the sound from the aircraft at a frequency of 20.0 Hz.

What is the speed and direction of the aircraft?

	speed / m s^{-1}	direction
A	110	away from observer
B	110	towards observer
C	165	away from observer
D	165	towards observer

25 Which statement about longitudinal and transverse wave motion for a progressive wave is correct?

A All transverse and longitudinal waves require a medium for propagation.

B All transverse waves travel at the same speed, but longitudinal waves can travel at different speeds.

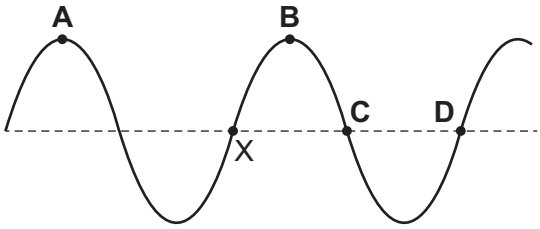
C In both transverse waves and longitudinal waves, a particle with zero displacement has a maximum speed.

D In a longitudinal wave there is a net movement of particles in the direction of travel of the wave, but there is no net movement of particles in a transverse wave.

26 The diagram shows a progressive transverse wave on a stretched string at one instant in time.

One point on the string is labelled X.

Which point on the string is 270° out of phase with X?



27 Which wavelength of electromagnetic radiation in free space could be green light?

A 4.9×10^{-9} m **B** 6.6×10^{-9} m **C** 5.5×10^{-7} m **D** 8.6×10^{-7} m

28 Which group contains only waves that can be polarised?

A infrared waves, radio waves, sound waves

B visible light waves, microwaves, radio waves

C visible light waves, radio waves, sound waves

D microwaves, visible light waves, sound waves

29 One wave has an amplitude of $2A$. A second wave has an amplitude of $\frac{A}{2}$. The waves are otherwise identical.

The two waves travel in opposite directions and overlap.

What is the ratio $\frac{\text{maximum amplitude of combined wave}}{\text{minimum amplitude of combined wave}}$?

A $\frac{3}{2}$ **B** $\frac{5}{3}$ **C** $\frac{5}{2}$ **D** 4

30 Light of wavelength 680 nm is incident normally on a diffraction grating with 450 lines mm^{-1}.

What is the angle of diffraction of the second-order maximum in the diffraction pattern that is produced?

A 1.8° **B** 3.5° **C** 18° **D** 38°

31 A hollow tube is closed at one end and open at the other.

A stationary sound wave of the lowest possible frequency, 820 Hz, is produced in the tube.

The speed of sound in air is 330 $m\,s^{-1}$.

What is the length of the tube?

A 10 cm **B** 20 cm **C** 40 cm **D** 160 cm

32 Which expression gives the definition of resistance?

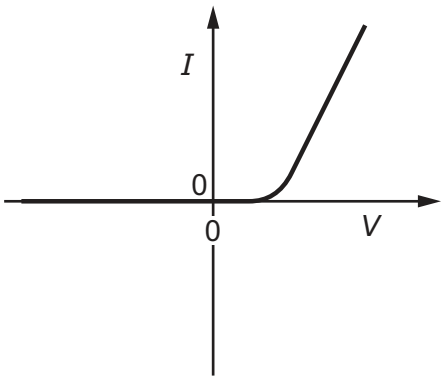
A current divided by potential difference

B current multiplied by potential difference

C potential difference divided by current

D resistivity multiplied by length

33 The graph shows the I–V characteristic of an electrical component.



What is the component?

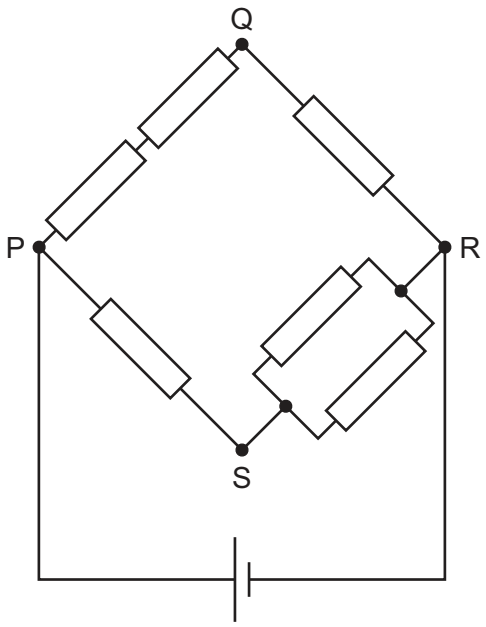
A a filament lamp

B a metallic conductor at constant temperature

C a resistor

D a semiconductor diode

34 The diagram shows six identical resistors connected in a circuit.

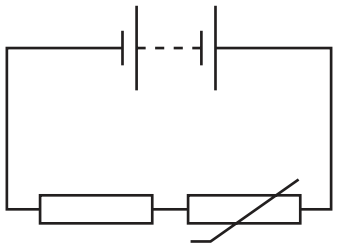


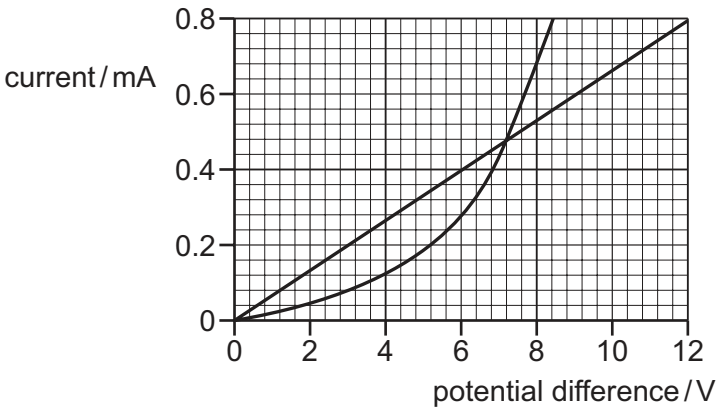
In which branch of the circuit is the most power dissipated?

A PQ **B** QR **C** RS **D** SP

35 The diagram shows a circuit containing a thermistor, a fixed resistor and a battery.

The graph shows the $I-V$ characteristics of both components.



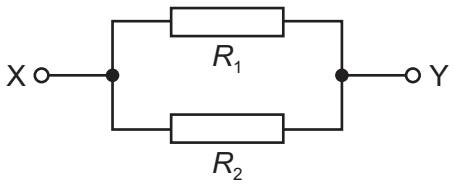


The battery has an e.m.f. of 12 V and negligible internal resistance.

What is the current in the fixed resistor?

A 0.36 mA **B** 0.40 mA **C** 0.48 mA **D** 0.80 mA

36 Two resistors of resistances R_1 and R_2 are connected in parallel.

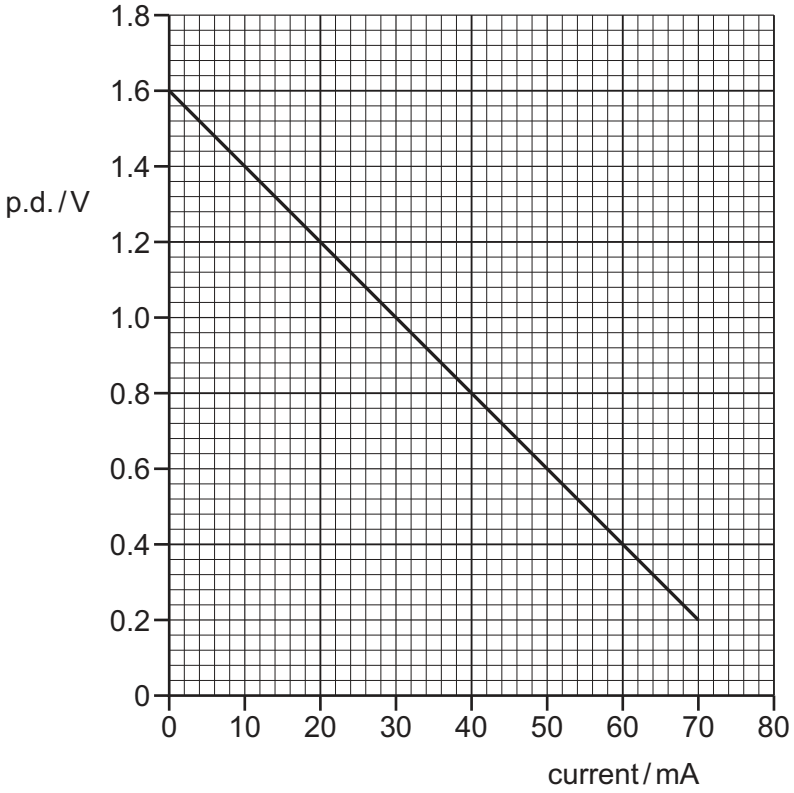


What is the combined resistance between X and Y?

A $R_1 + R_2$ **B** $\frac{R_1 R_2}{R_1 + R_2}$ **C** $\frac{R_1 + R_2}{R_1 R_2}$ **D** $\frac{R_1}{R_2}$

37 A cell is connected in series with an ammeter and a variable resistor. A voltmeter is used to measure the p.d. across the variable resistor. The resistance of the variable resistor is varied, and the p.d. and the current are recorded.

The graph shows the variation with current of the p.d. across the variable resistor.



What is the internal resistance of the cell?

A 0.050 Ω **B** 1.6 Ω **C** 20 Ω **D** 23 Ω

38 Which list contains only fundamental particles?

A antineutrinos, baryons, neutrons, electrons

B mesons, electrons, neutrinos, protons

C positrons, quarks, hadrons, protons

D quarks, positrons, neutrinos, leptons

39 Which statement explains why alpha-particles have discrete energies, but beta-particles have a continuous range of energies?

A Beta-particles have a much smaller mass than alpha-particles which means beta-particles can be emitted with a larger range of velocities.

B Only alpha-particles experience repulsion from the nucleus which is dependent on the number of protons in the nucleus.

C Only beta-particles are emitted with another lepton and some energy is transferred to the other lepton.

D Only the energy of alpha-particles is discrete because the composition of alpha-particles is always the same.

40 A hadron consists of antiquarks that are all identical.

What is a possible value, in terms of the elementary charge *e*, for the charge on the hadron?

A 0*e* **B** +1*e* **C** +2*e* **D** +3*e*