Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/13**

Paper 1 Multiple Choice **October/November 2025**

1 hour 15 minutes

You must answer on the multiple choice answer sheet.

1700426015

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 **20** pages. Any blank pages are indicated.

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 The table shows some physical quantities.

Which row correctly identifies the quantities as scalars or vectors?

	acceleration	charge	kinetic energy	wavelength
A	scalar	vector	vector	scalar
B	vector	vector	scalar	scalar
C	scalar	scalar	scalar	vector
D	vector	scalar	scalar	scalar

2 Two quantities are measured.

$$L = 6.8 \pm 0.1\,\text{cm}$$

$$T = 2.42 \pm 0.08\,\text{s}$$

L and T are related to X by the equation shown.

$$X = \frac{4\pi^2 L}{T^2}$$

What is the calculated value and uncertainty of X?

A $45.8 \pm 0.2\,\text{cm s}^{-2}$

B $45.8 \pm 0.3\,\text{cm s}^{-2}$

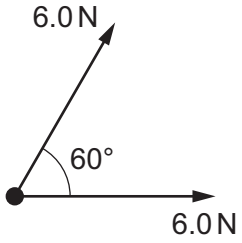
C $46 \pm 2\,\text{cm s}^{-2}$

D $46 \pm 4\,\text{cm s}^{-2}$

3 What are the SI base units of the watt?

A J s^{-1} **B** $\text{kg m}^2\text{ s}^{-3}$ **C** $\text{kg m}^2\text{ s}^{-1}$ **D** N m s^{-1}

4 The diagram shows two forces of 6.0 N acting on an object. The angle between the lines of action of the two forces is 60°.



What is the magnitude of the resultant force?

A 6.0 N **B** 7.9 N **C** 10 N **D** 12 N

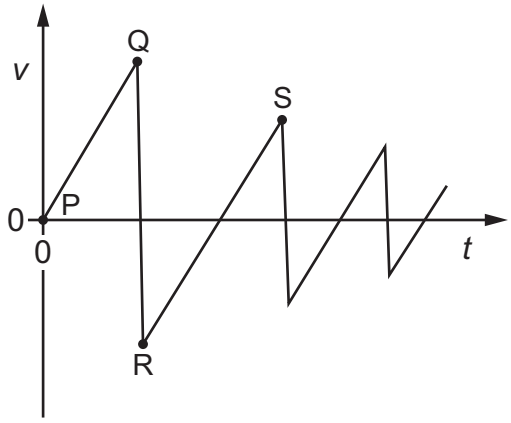
5 A goods train passes through a station at a constant speed of $10\,m\,s^{-1}$ at time $t = 0$. An express train is at rest at the station. The express train leaves the station with a uniform acceleration of $0.5\,m\,s^{-2}$ just as the goods train goes past. Both trains move in the same direction on straight, parallel tracks.

At which time t does the express train overtake the goods train?

A 6 s **B** 10 s **C** 20 s **D** 40 s

6 A ball is held above the ground and released. It falls to the ground and bounces several times.

The graph shows the variation with time t of the velocity v of the ball.



Four points on the graph are labelled P, Q, R and S.

Which statement is **not** correct?

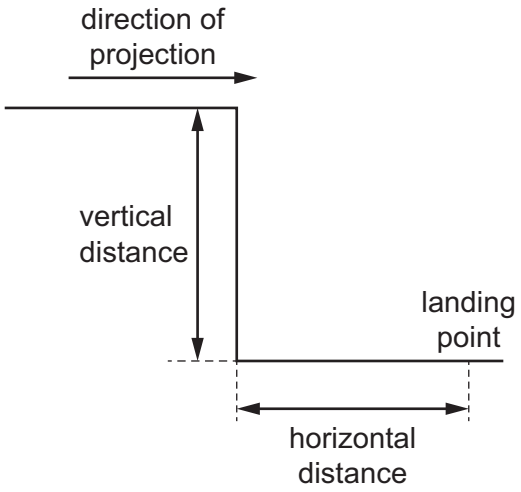
A The area under line PQ represents the initial height of the ball.

B The collisions of the ball with the ground are inelastic.

C The gradient of the line RS represents the acceleration due to free fall.

D The maximum upwards velocity of the ball is reached at point P.

7 An object is projected horizontally. The object falls a vertical distance y and travels a horizontal distance x before landing on the ground.



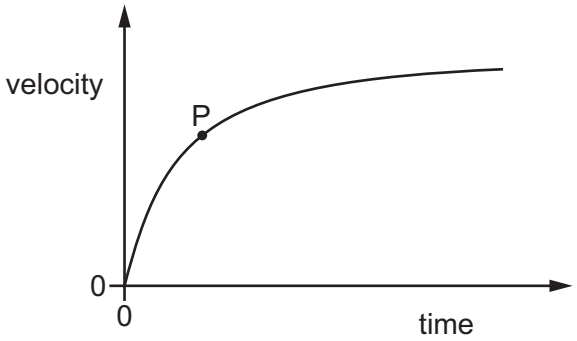
A second object is projected horizontally with the same initial velocity and falls a vertical distance $4y$ before landing on the ground.

Assume that air resistance is negligible.

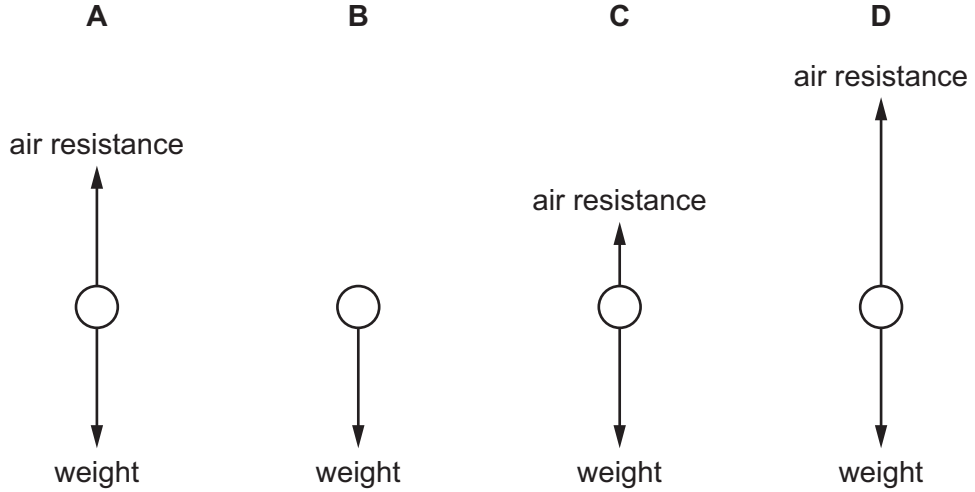
Which horizontal distance does the second object travel?

A x **B** $2x$ **C** $4x$ **D** $16x$

8 A sphere falls from rest through the air. The graph shows the variation with time of the sphere's velocity.



Which diagram shows the forces acting on the sphere when it is at the velocity corresponding to point P on the graph?



9 In which situation is total linear momentum **always** conserved?

A in all collisions between two objects

B in collisions between two objects moving at equal and opposite velocity

C in collisions between two objects that form an isolated system

D in collisions between two objects with the same mass

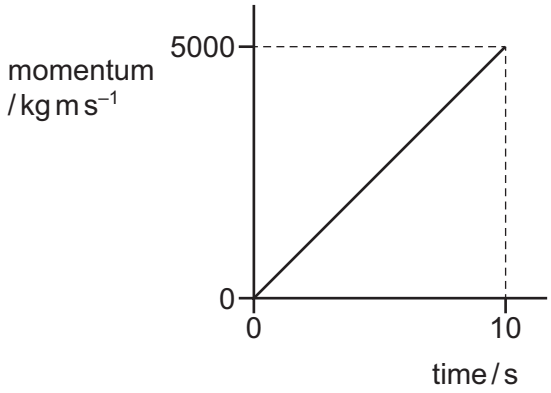
10 An object of mass m moving with velocity $9.0\,m\,s^{-1}$ has a head-on elastic collision with a stationary object of mass $2m$.

After the collision, both objects are moving. No external forces act on the system.

What is the velocity of the object of mass $2m$ after the collision?

A $-6.0\,m\,s^{-1}$ **B** $-3.0\,m\,s^{-1}$ **C** $4.5\,m\,s^{-1}$ **D** $6.0\,m\,s^{-1}$

11 The graph shows how the momentum of a motorcycle changes with time.



What is the resultant force on the motorcycle?

A 500 N **B** 5000 N **C** 25 000 N **D** 50 000 N

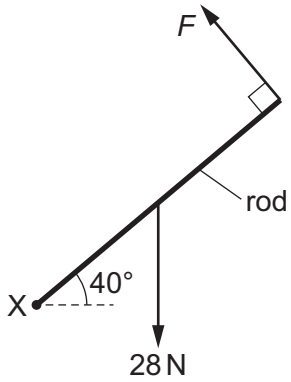
12 A rocket has a weight of W and an initial acceleration of a as the rocket leaves the ground vertically. The acceleration of free fall is g.

Which expression gives the initial upward force exerted on the rocket due to the engine?

A $\frac{Wa}{g} + W$ **B** $\frac{Wa}{g}$ **C** $\frac{Wa}{g} - W$ **D** $Wa + W$

13 A uniform rod of weight 28 N is supported at one end by force F.

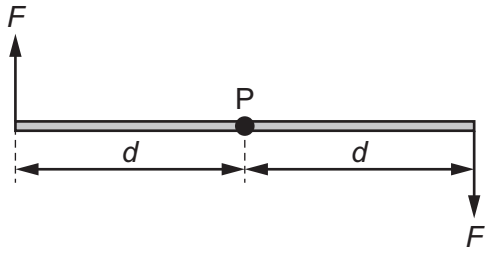
The rod is in equilibrium and attached to a frictionless hinge at end X.



What is the magnitude of F?

A 9.0 N **B** 11 N **C** 18 N **D** 21 N

14 Two forces, each of magnitude F, act in opposite directions on a rod.



Each force acts on the rod at a distance d from the pivot P.

What is the torque of this couple about P?

A 0 **B** $F \times d$ **C** $2F \times d$ **D** $2F \times 2d$

15 A man of weight 600 N stands with both feet flat on the ground.

What is a reasonable estimate of the pressure exerted on the ground by the weight of the man?

A 1×10^0 Pa **B** 1×10^2 Pa **C** 1×10^4 Pa **D** 1×10^6 Pa

16 The formula for the upthrust on a block of wood partially submerged in water is shown.

$$F = \rho g V$$

What do the symbols ρ and V represent?

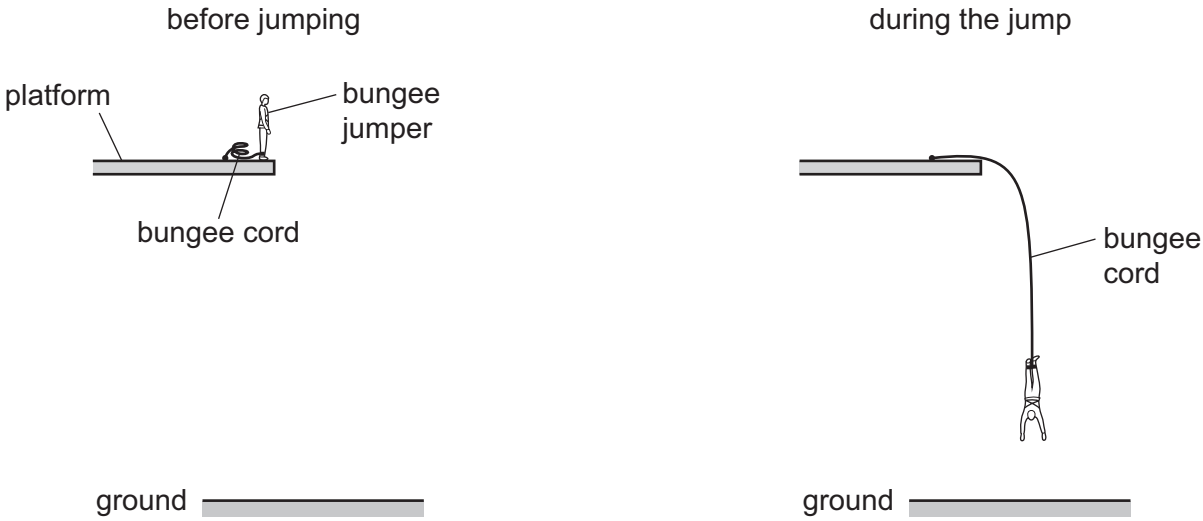
	ρ	V
A	density of water	volume of whole block
B	density of water	volume of block below surface of water
C	density of wood	volume of whole block
D	density of wood	volume of block below surface of water

17 An object with a mass of 100 g falls a vertical distance of 10 m.

What is the change in the gravitational potential energy of the object?

A 1 J **B** 10 J **C** 100 J **D** 10 000 J

18 A bungee jumper jumps from a platform and is decelerated by an elastic bungee cord, as shown.



NOT TO SCALE

When the jumper makes the jump, his initial gravitational potential energy relative to the ground is converted into his kinetic energy and into elastic potential energy in the cord.

At which part of the jump are all three types of energy non-zero?

A on the platform before the jump

B on the way down before the cord has started to extend

C on the way down as he decelerates

D at the bottom of the jump when he is stationary

19 A sailboat is pushed by the wind at a constant velocity *v* across a lake.

The force of the wind and the velocity of the sailboat are in the same direction.

Which additional information is required to determine the work done per unit time by the wind acting on the sailboat?

A the force exerted by the wind

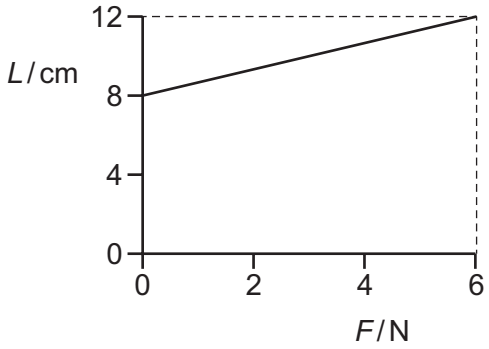
B the distance travelled by the sailboat per unit time

C the total energy input to the sailboat by the wind

D the weight of the sailboat

20 A spring is fixed at one end. The length L of the spring is increased by applying a tensile force F to the other end.

The graph shows the variation of L with F.



What is the elastic potential energy of the spring when F is 6.0 N?

A 0.12 J **B** 0.24 J **C** 0.36 J **D** 0.60 J

21 A wire has an unstretched length of 2.00 m.

A stress of 1.6×10^5 Pa is applied to the wire, and the new length of the wire is 2.10 m.

The wire obeys Hooke's law.

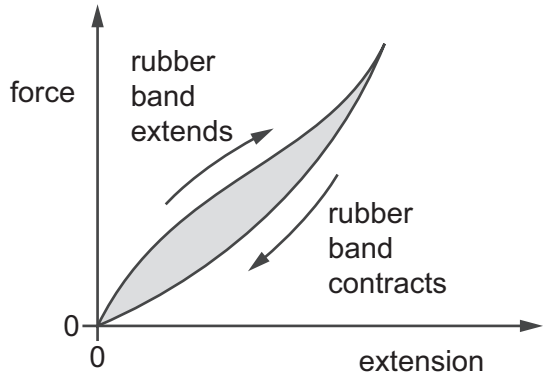
What is the Young modulus of the wire?

A 8.0×10^3 Pa **B** 7.8×10^4 Pa **C** 1.5×10^5 Pa **D** 3.2×10^6 Pa

22 What are the SI base units of stress?

A kg m s^{-2} **B** $\text{kg m}^{-1}\text{ s}^{-2}$ **C** $\text{kg m}^{-2}\text{ s}^{-2}$ **D** $\text{kg m}^{-3}\text{ s}^{-2}$

23 The diagram shows a force–extension graph for a rubber band as the band is extended and then the stretching force is decreased to zero.



What can be deduced from the graph?

A The rubber band does **not** return to its original length when the force is decreased to zero.

B The rubber band obeys Hooke's law for the extensions shown.

C The rubber band remains elastic for the extensions shown.

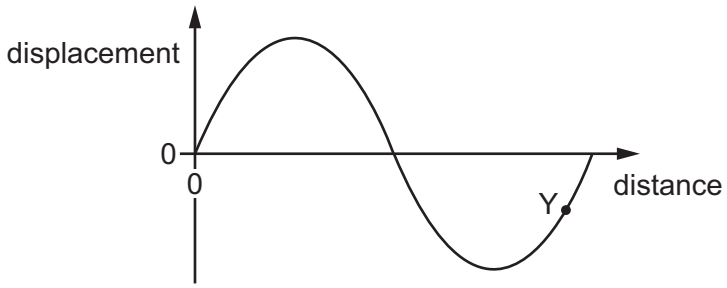
D The shaded area represents the work done in extending the rubber band.

24 Which row is correct for sound waves?

	can travel in a vacuum	can be polarised	can diffract through a gap
A	no	no	yes
B	yes	no	no
C	no	yes	no
D	no	yes	yes

25 A source emits a progressive sound wave in the horizontal direction. The wave travels away from the source in a direction towards the right.

The graph shows the variation of the displacement of the particles from their equilibrium positions with distance from the source at a particular instant in time. Displacements to the right of the equilibrium positions are shown as positive.



Position Y represents the displacement of a particle in the sound wave at a particular distance from the source at this instant.

Which statement about the motion of this particle is correct?

A The particle is moving away from the source.

B The particle is moving towards the source.

C The particle is moving upwards.

D The particle is moving downwards.

26 Two polarising filters are placed next to each other so that their planes are parallel.

The first polarising filter has its transmission axis at an angle of 50° to the vertical.

The second polarising filter has its transmission axis at an angle of 20° to the vertical. The angle between the transmission axes of the two polarising filters is 30°.

A beam of vertically polarised light of intensity $8.0\,W\,m^{-2}$ is incident normally on the first polarising filter.

What is the intensity of the light that is transmitted from the second polarising filter?

A zero **B** $2.5\,W\,m^{-2}$ **C** $2.9\,W\,m^{-2}$ **D** $6.0\,W\,m^{-2}$

27 A dolphin is swimming at a speed of $16.0\,m\,s^{-1}$ directly towards a stationary underwater microphone.

The dolphin emits a sound of frequency 122 kHz. The speed of sound in water is $1480\,m\,s^{-1}$.

What is the frequency of sound detected by the microphone?

A 1300 Hz **B** 1330 Hz **C** 121 kHz **D** 123 kHz

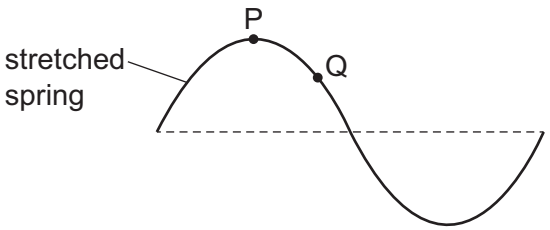
28 A student carries out a double-slit experiment using a laser emitting red light of wavelength of 680 nm. The light is incident normally on a double slit.

The diagram shows part of the pattern of bright fringes visible on a screen at a distance of 2.4 m from the slits. The distance across five bright fringes is measured as 34 mm.

What is the slit separation?

A 8.5×10^{-3} m **B** 2.4×10^{-4} m **C** 1.9×10^{-4} m **D** 4.8×10^{-5} m

29 The diagram shows a stationary wave on a stretched spring at an instant in time.



Two particles on the spring, P and Q, are shown.

Which statement about the vibrations of P and Q is correct?

A They have different frequencies.

B They have the same amplitudes.

C They have different periods.

D They are always in phase.

30 Green laser light passes through a diffraction grating and forms an interference pattern.

The diffraction grating contains 400 lines per mm.

The wavelength of the laser light is 550 nm.

What is the highest order diffraction maximum produced by the grating?

A 4 **B** 5 **C** 8 **D** 9

31 There is a potential difference V across a resistor of resistance R. The current in the resistor is I.

Which equation gives the power P dissipated by the resistor?

A $P = V^2 I$ **B** $P = \frac{V^2}{I}$ **C** $P = V^2 R$ **D** $P = \frac{V^2}{R}$

32 What is a possible charge on a particle?

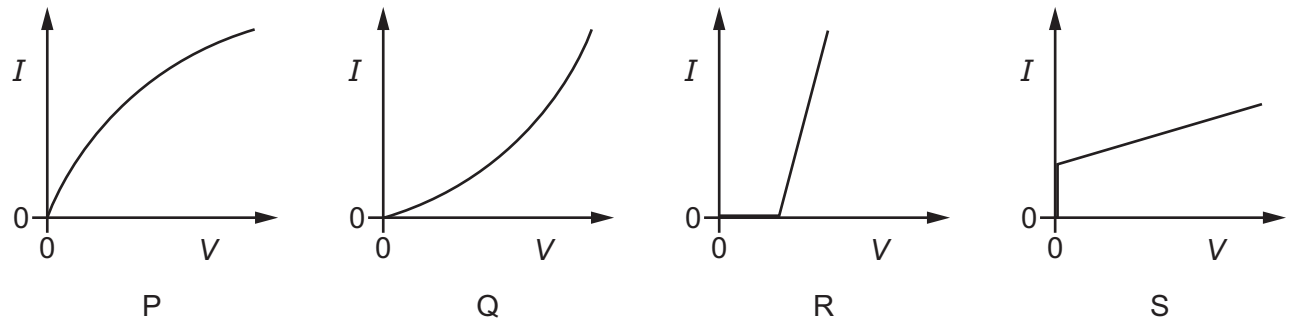
A 6.40×10^{-20} C

B 4.00×10^{-19} C

C 1.12×10^{-18} C

D 9.11×10^{-18} C

33 The graphs show possible current–voltage (I–V) characteristics for a filament lamp and for a semiconductor diode.



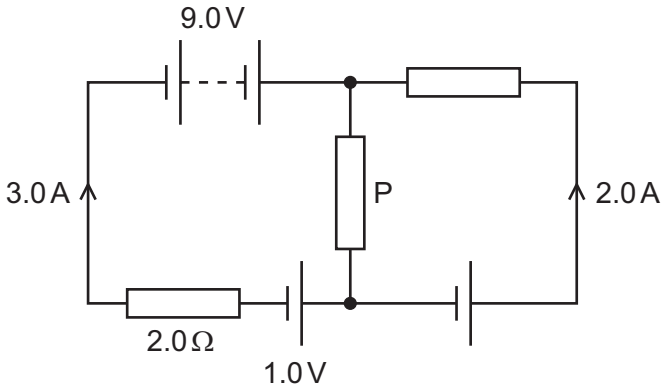
Which row identifies the I–V graphs for the lamp and for the diode?

	filament lamp	semiconductor diode
A	P	R
B	P	S
C	Q	R
D	Q	S

34 The diagram shows a circuit containing a battery and cells with negligible internal resistance.

Some values of current, electromotive force (e.m.f.) and resistance are shown.

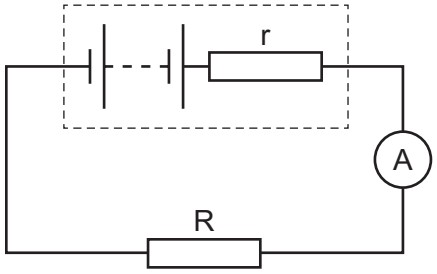
One resistor is labelled P.



What is the resistance of resistor P?

A 0.40 Ω **B** 0.80 Ω **C** 2.0 Ω **D** 2.8 Ω

35 The diagram shows a circuit with a battery connected to a resistor R. The battery has an internal resistance represented by resistor r.

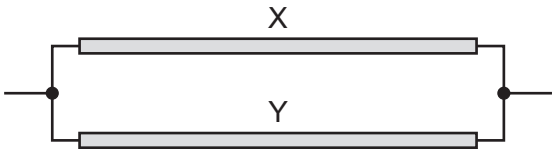


A second resistor, identical to R, is connected in parallel with R.

Which row describes the changes to the potential difference (p.d.) across r and the current shown on the ammeter when the second resistor is connected?

	p.d. across r	current shown on ammeter
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

36 Two identical wires X and Y, each of length L and radius r, are connected in parallel as shown.



The total resistance of this combination is R_1.

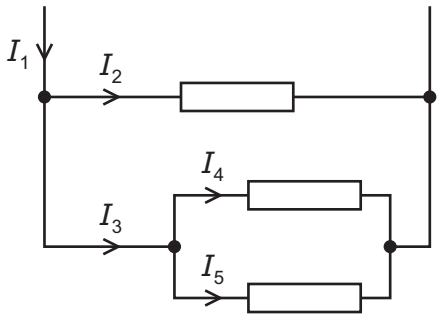
Wire X is replaced with a wire of the same material with length L and radius $2r$.

The total resistance of the new combination is R_2.

What is the ratio $\frac{R_1}{R_2}$?

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

37 The diagram shows the currents in part of an electric circuit.



The resistors are identical.

Which equation is **not** correct?

A $I_1 = I_2 + I_4 + I_5$

B $I_2 = I_1 - I_3$

C $I_2 = I_3 + I_4 + I_5$

D $I_4 = I_3 - I_5$

38 The diagram shows a sequence of radioactive decays involving three α-particles and a β^- particle.

$$^{237}_{93}\text{Np} \xrightarrow{\alpha} \text{Q} \xrightarrow{\beta^-} \text{R} \xrightarrow{\alpha} \text{S} \xrightarrow{\alpha} \text{T}$$

What is nuclide T?

A $^{225}_{88}\text{Ra}$ **B** $^{231}_{88}\text{Ra}$ **C** $^{225}_{90}\text{Th}$ **D** $^{229}_{90}\text{Th}$

39 The number of electrons in a neutral atom of an isotope of plutonium, $^{239}_{94}Pu$, is changed to produce a charged atom (ion) W.

W has an overall charge of $+1.6 \times 10^{-19}$ C.

How many protons, neutrons and electrons are in W?

	protons	neutrons	electrons
A	94	145	93
B	94	145	95
C	238	94	239
D	239	94	238

40 Which particle is a lepton?

A meson

B positron

C proton

D quark

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