



Cambridge International AS & A Level

PHYSICS

9702/01

Paper 1 Multiple Choice

For examination from 2022

SPECIMEN PAPER

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 **18** pages. Blank pages are indicated.

Data

acceleration of free fall	$g = 9.81 \text{ ms}^{-2}$
speed of light in free space	$c = 3.00 \times 10^8 \text{ ms}^{-1}$
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	$m_p = 1.67 \times 10^{-27} \text{ kg}$
rest mass of electron	$m_e = 9.11 \times 10^{-31} \text{ kg}$
Avogadro constant	$N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$
molar gas constant	$R = 8.31 \text{ JK}^{-1} \text{ mol}^{-1}$
Boltzmann constant	$k = 1.38 \times 10^{-23} \text{ JK}^{-1}$
gravitational constant	$G = 6.67 \times 10^{-11} \text{ Nm}^2 \text{ kg}^{-2}$
permittivity of free space	$\epsilon_0 = 8.85 \times 10^{-12} \text{ Fm}^{-1}$ $(\frac{1}{4\pi\epsilon_0} = 8.99 \times 10^9 \text{ mF}^{-1})$
Planck constant	$h = 6.63 \times 10^{-34} \text{ Js}$
Stefan–Boltzmann constant	$\sigma = 5.67 \times 10^{-8} \text{ Wm}^{-2} \text{ K}^{-4}$

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	$f_o = \frac{f_s v}{v \pm v_s}$
electric current	$I = Anvq$
resistors in series	$R = R_1 + R_2 + \dots$
resistors in parallel	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$

- 1 A student creates a table to show reasonable estimates of some physical quantities.

Which row is **not** a reasonable estimate?

	quantity	value
A	electric current in a fan heater	12A
B	mass of an adult person	70 kg
C	maximum speed of an Olympic sprint runner	10 m s ⁻¹
D	water pressure at the bottom of a garden pond	10 ⁶ Pa

- 2 Which expression has the same SI base units as pressure?

A $\frac{\text{force}}{\text{length} \times \text{speed}}$

B $\frac{\text{force}}{\text{length} \times \text{time}}$

C $\frac{\text{mass}}{\text{length} \times (\text{time})^2}$

D $\frac{\text{mass} \times (\text{time})^2}{\text{length}}$

- 3 The speed v of a liquid leaving a tube depends on the change in pressure ΔP and the density ρ of the liquid. The speed is given by the equation

$$v = k \left(\frac{\Delta P}{\rho} \right)^n$$

where k is a constant that has no units.

What is the value of n ?

A $\frac{1}{2}$

B 1

C $\frac{3}{2}$

D 2

- 4 Which row correctly describes the quantities momentum, power and temperature?

	momentum	power	temperature
A	scalar	scalar	vector
B	scalar	vector	vector
C	vector	scalar	scalar
D	vector	vector	scalar

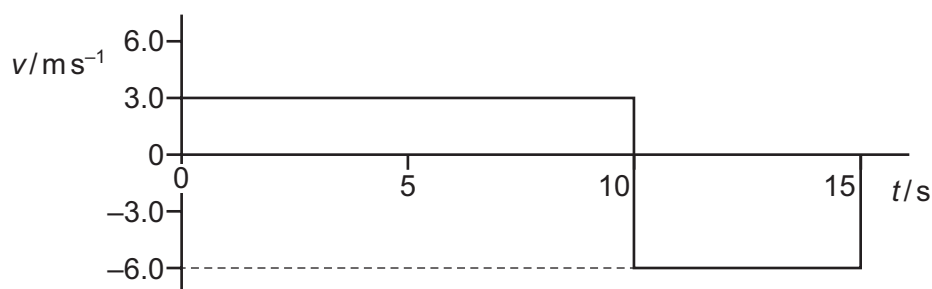
- 5 A girl throws a ball vertically upwards. It takes a time of 3.20 s to return to her hand.

Assume air resistance is negligible.

What is the initial speed with which the ball is thrown?

- A** 3.07 ms^{-1} **B** 7.85 ms^{-1} **C** 15.7 ms^{-1} **D** 31.4 ms^{-1}
- 6 A radio-controlled toy car travels along a straight line for a time of 15 s.

The variation with time t of the velocity v of the car is shown.



What is the average velocity of the toy car for the journey shown by the graph?

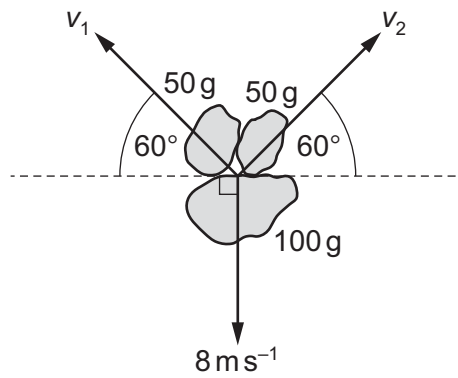
- A** -1.5 ms^{-1} **B** 0.0 ms^{-1} **C** 4.0 ms^{-1} **D** 4.5 ms^{-1}
- 7 The acceleration of free fall on Pluto is 0.66 ms^{-2} .

An object weighs 6.0 N on Earth.

What would this object weigh on Pluto?

- A** 0.40 N **B** 0.93 N **C** 4.0 N **D** 39 N

- 8 A stationary firework explodes into three pieces moving in the same plane. The masses and the velocities of the three pieces immediately after the explosion are shown.



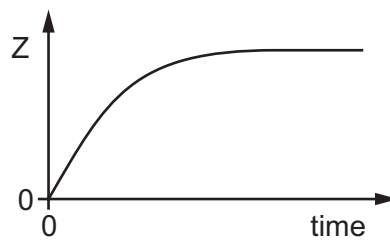
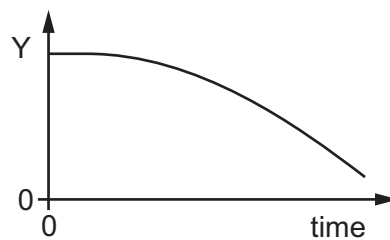
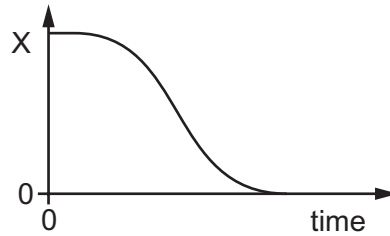
What are speeds v_1 and v_2 ?

	v_1/ms^{-1}	v_2/ms^{-1}
A	4.0	4.0
B	9.2	9.2
C	14	14
D	16	16

- 9 An object is dropped at time $t = 0$ from a high building. Air resistance is significant.

Three graphs are plotted against time:

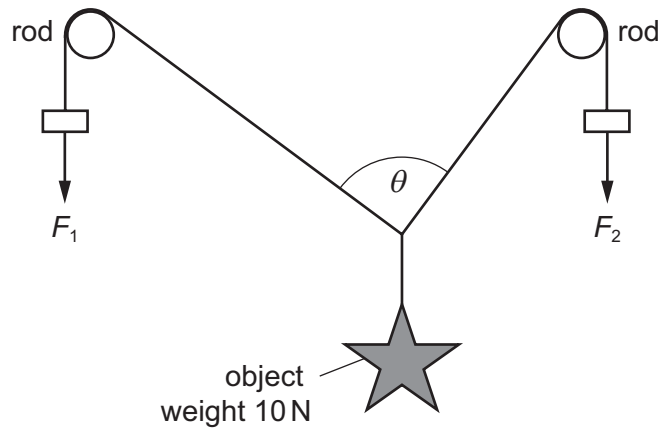
- the height of the object above the ground
- the speed of the object
- the magnitude of the resultant force on the object.



What are the quantities X, Y and Z?

	height of the object above the ground	speed of the object	magnitude of the resultant force on the object
A	X	Y	Z
B	X	Z	Y
C	Y	Z	X
D	Z	Y	X

- 10 An object hangs by means of two cords around two rods, as shown.



The object is held in equilibrium by the forces F_1 and F_2 . The object weighs 10 N. There is negligible friction between the rods and cords.

Which row of the table gives an angle θ of 90° ?

	F_1/N	F_2/N
A	4.0	6.0
B	6.0	4.0
C	6.0	8.0
D	8.0	6.0

- 11 Which force is caused by a difference in hydrostatic pressure?

A friction **B** upthrust **C** viscous force **D** weight

- 12 A car of mass 1400 kg is travelling on a straight, horizontal road at a constant speed of 25 m s^{-1} . The useful output power from the car's engine is 30 kW.

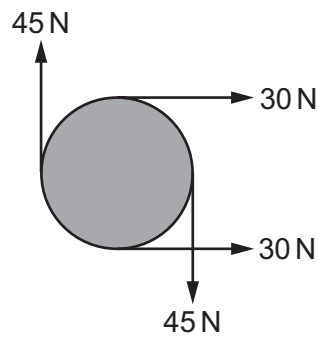
The car then travels up a slope at 2.0° to the horizontal, maintaining the same constant speed.



What is the useful output power of the car's engine when travelling up the slope?

A 12 kW **B** 31 kW **C** 42 kW **D** 65 kW

- 13 The diagram shows four forces applied to a circular object.

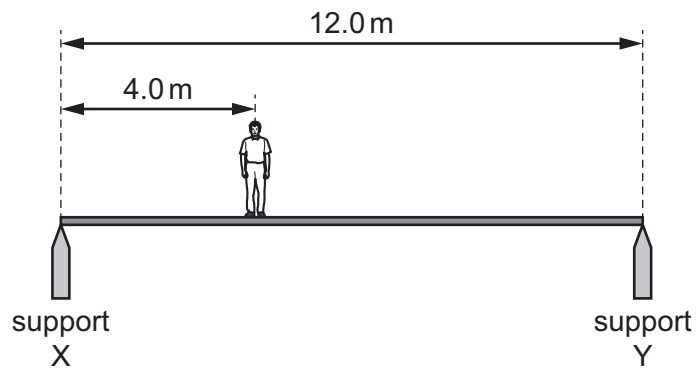


Which row describes the resultant force and resultant torque on the object?

	resultant force	resultant torque
A	non-zero	non-zero
B	non-zero	zero
C	zero	non-zero
D	zero	zero

- 14 A uniform horizontal footbridge is 12.0 m long and weighs 4000 N.

It rests on two supports X and Y, as shown.



A man of weight 600 N stands a distance of 4.0 m from support X.

What is the upward force on the footbridge from support X?

- A** 2200 N **B** 2300 N **C** 2400 N **D** 2600 N

- 15 A metal block has a mass of 750g. Magnesium makes up 60% of the mass and the remaining 40% is copper.

The density of magnesium is 1.7 g cm^{-3} .

The density of copper is 9.0 g cm^{-3} .

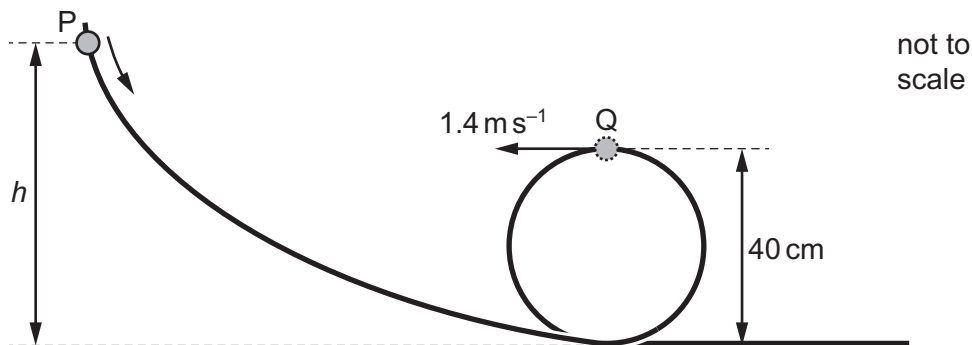
What is the density of the block?

- A 2.5 g cm^{-3} B 4.6 g cm^{-3} C 5.4 g cm^{-3} D 10.7 g cm^{-3}
- 16 A man climbs slowly at a steady speed to the top of a ladder.

What is the **main** energy transfer taking place for the man as he climbs?

- A chemical potential to gravitational potential
 B chemical potential to kinetic
 C kinetic to gravitational potential
 D thermal (heat) to kinetic

- 17 A bead is released from rest at point P and slides along a wire, as shown.



The wire loops around and forms a vertical circle of diameter 40 cm. At point Q, the bead has a speed of 1.4 ms^{-1} .

Air resistance and friction on the wire are negligible.

What is the height h from which the bead is released?

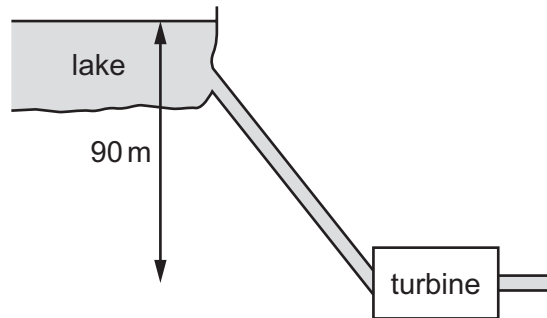
- A 0.30 m B 0.40 m C 0.50 m D 0.60 m

- 18 A mass is raised vertically. In time t , the increase in its gravitational potential energy is E_p and the increase in its kinetic energy is E_k .

What is the average power input to the mass?

- A $(E_p - E_k)t$ B $(E_p + E_k)t$ C $\frac{E_p - E_k}{t}$ D $\frac{E_p + E_k}{t}$

- 19 Water flows from a lake into a turbine that is a vertical distance of 90 m below the lake, as shown.



The mass flow rate of the water is 2400 kg min^{-1} . The turbine has an efficiency of 75%.

What is the output power of the turbine?

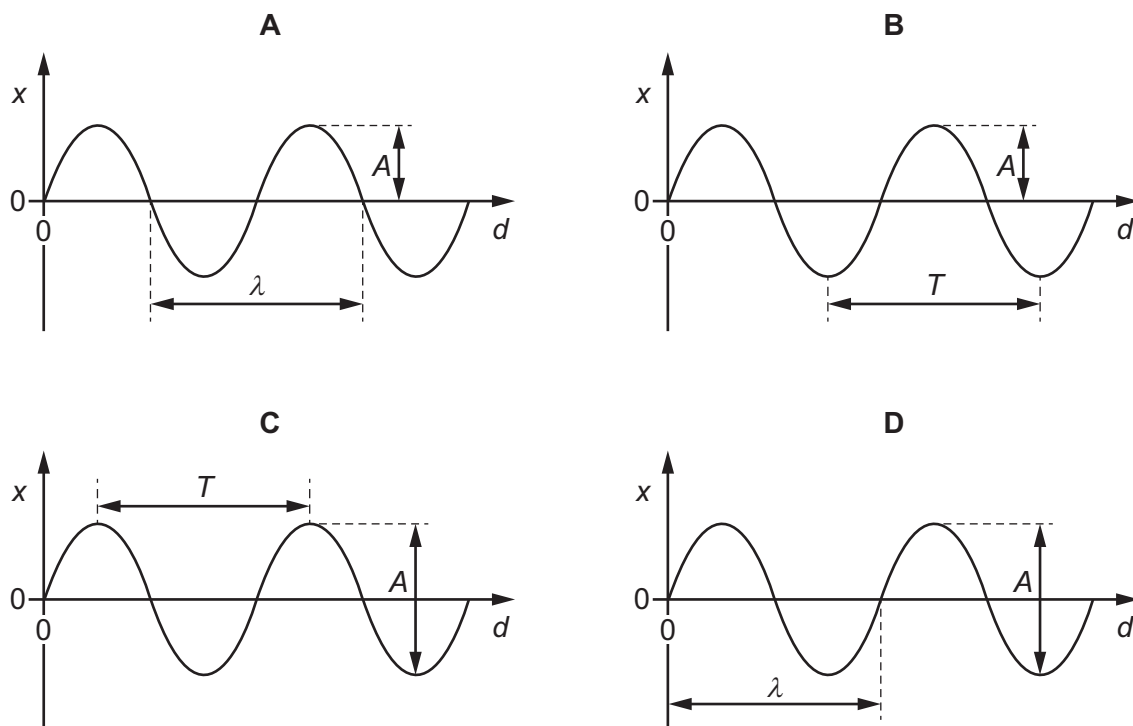
- A 26 kW B 35 kW C 1.6 MW D 2.1 MW
- 20 A wire of diameter d and length l hangs vertically from a fixed point. The wire is extended by hanging a mass M on its end. The Young modulus of the wire is E . The acceleration of free fall is g .

Which equation is used to determine the extension x of the wire?

- A $x = \frac{Ml}{\pi d E}$ B $x = \frac{Mgl}{\pi d^2 E}$ C $x = \frac{4Mgl}{\pi d E}$ D $x = \frac{4Mgl}{\pi d^2 E}$

- 21 A wave has period T , wavelength λ and amplitude A . The wave is shown on a graph of displacement x against distance d .

Which graph is correctly labelled?



- 22 A vehicle emits sound of a constant frequency. A stationary observer hears the sound.

The vehicle moves directly towards the observer at constant speed. The observer hears sound of frequency f_o .

The vehicle then accelerates, still moving towards the observer, travels at a higher steady speed for a time and then decelerates until it stops.

What is the variation in the frequency of the sound that is heard by the observer?

- A The observed frequency will fall, then remain steady then return to the frequency f_o .
 B The observed frequency will fall, then remain steady then rise to a higher frequency than f_o .
 C The observed frequency will rise, then remain steady then fall to a lower frequency than f_o .
 D The observed frequency will rise, then remain steady then return to the frequency f_o .
- 23 A car travelling in a straight line at a speed of 30 ms^{-1} passes near a stationary observer while sounding its horn. The frequency of sound emitted by the horn is 400 Hz.

The speed of sound in air is 336 ms^{-1} .

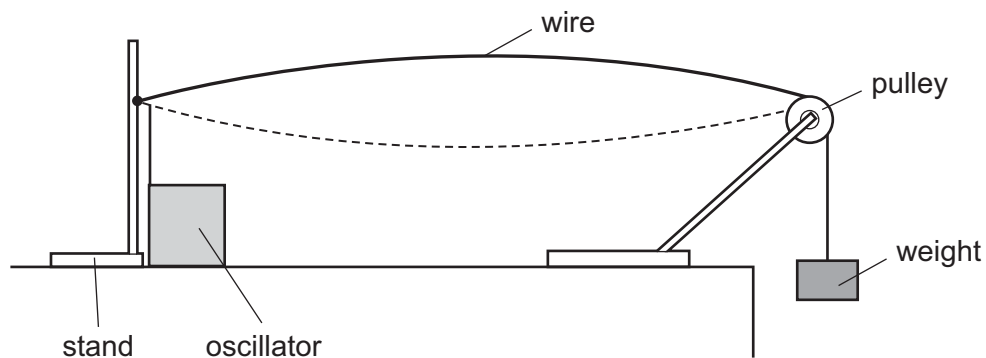
What is the change in the frequency of the sound heard by the observer as the car passes?

- A 39 Hz B 66 Hz C 72 Hz D 78 Hz

24 Which list shows electromagnetic waves in order of increasing frequency?

- A radio waves → gamma-rays → ultraviolet → infrared
- B radio waves → infrared → ultraviolet → gamma-rays
- C ultraviolet → gamma-rays → radio waves → infrared
- D ultraviolet → infrared → radio waves → gamma-rays

25 The diagram shows a steel wire fixed at one end. The other end is attached to a weight hanging over a pulley.



An oscillator is attached to the wire near the fixed end. A stationary wave with one loop is produced. The frequency of the oscillator is f .

Which frequency of the oscillator produces a stationary wave with two loops?

- A $\frac{f}{4}$
- B $\frac{f}{2}$
- C $2f$
- D $4f$

26 Which statement gives a condition that enables diffraction to occur?

- A A source of waves moves towards a stationary observer.
- B A wave is partially blocked by an obstacle.
- C Two coherent waves are superposed.
- D Two waves are travelling through the same part of a medium in opposite directions.

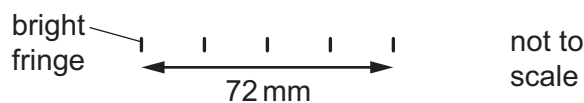
27 A parallel beam of light of wavelength 600 nm is incident normally on a diffraction grating. The grating has 300 lines per millimetre.

What is the total number of intensity maxima from the grating?

- A 1
- B 3
- C 11
- D 13

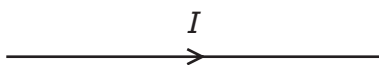
- 28 A pattern of interference fringes is produced using a red laser, a double slit and a screen. The screen is 3.5 m from the double slit. The light from the laser has a wavelength of 640 nm.

The pattern of fringes is shown.



What is the separation of the slits?

- A 1.2×10^{-4} m B 1.6×10^{-4} m C 3.1×10^{-5} m D 3.3×10^{-9} m
- 29 The diagram shows the symbol for a wire carrying a current I .



What does this current represent?

- A the charge flowing past a point in the wire per unit time
 B the number of electrons flowing past a point in the wire per unit time
 C the number of positive nuclei flowing past a point in the wire per unit time
 D the number of protons flowing past a point in the wire per unit time
- 30 An electric current I is given by the formula $I = Anvq$.

What do each of the symbols represent for an electric current in a metal wire?

	A	n	v	q
A	area of cross-section	number of free electrons	voltage	charge of each nucleus
B	area of cross-section	number of free electrons per unit volume	average drift speed of free electrons	charge of each electron
C	current	number of free electrons	average drift speed of free electrons	charge of each nucleus
D	current	number of free electrons per unit volume	voltage	charge of each electron

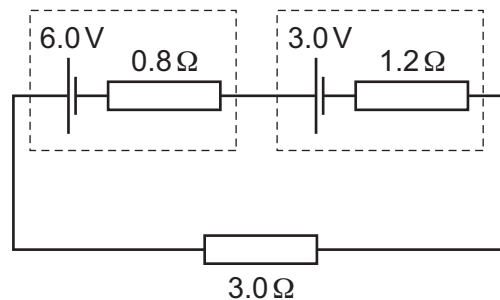
- 31 Which values of current and resistance will produce a rate of energy transfer of 16 J s^{-1} ?

	current/A	resistance/ Ω
A	1	4
B	2	2
C	2	8
D	4	1

- 32 A coil contains N turns of insulated copper wire wound on to a cylinder of diameter D . The copper wire has diameter d . The resistivity of copper is ρ . Diameter D is much greater than diameter d .

What is the total resistance between the two ends of the coil of copper wire?

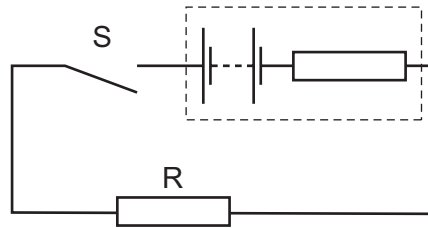
- A** $\frac{4N\rho D}{d^2}$ **B** $\frac{4N\rho d}{D^2}$ **C** $\frac{8N\rho D}{d^2}$ **D** $\frac{8N\rho d}{D^2}$
- 33 Two cells are connected to a load resistor of resistance 3.0Ω . The electromotive force (e.m.f.) and the internal resistance of each of the cells are shown.



What is the current in the load resistor?

- A** 0.60A **B** 1.2A **C** 1.8A **D** 3.0A

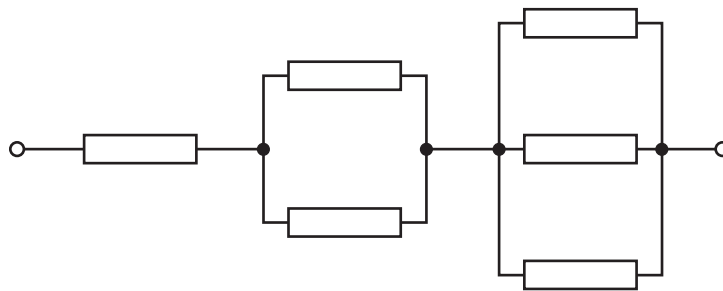
34 The diagram shows a simple circuit.



Which statement is correct?

- A When switch S is closed, the e.m.f. of the battery falls because work is done against the internal resistance of the battery.
- B When switch S is closed, the e.m.f. of the battery falls because work is done against the resistance of R.
- C When switch S is closed, the potential difference across the battery falls because work is done against the internal resistance of the battery.
- D When switch S is closed, the potential difference across the battery falls because work is done against the resistance of R.

35 Six resistors, each of resistance R , are connected as shown.



The combined resistance is $66\text{ k}\Omega$.

What is the value of R ?

- A $11\text{ k}\Omega$
- B $18\text{ k}\Omega$
- C $22\text{ k}\Omega$
- D $36\text{ k}\Omega$

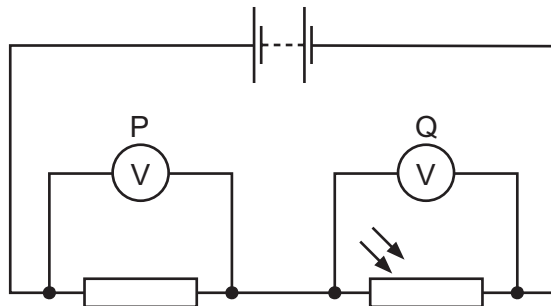
36 A cell has a constant electromotive force and a constant internal resistance.

A thermistor is connected between the terminals of the cell.

The temperature of the thermistor is increased.

Which statement about the change of the cell's terminal potential difference (p.d.) is correct?

- A The terminal p.d. is decreased because more work is done moving unit charge through the internal resistance of the cell.
 - B The terminal p.d. is decreased because the current in the thermistor is decreased.
 - C The terminal p.d. is increased because more work is done moving unit charge through the thermistor.
 - D The terminal p.d. is increased because the current in the thermistor is increased.
- 37 A battery with negligible internal resistance is connected in series with a resistor and a light-dependent resistor (LDR) as shown.



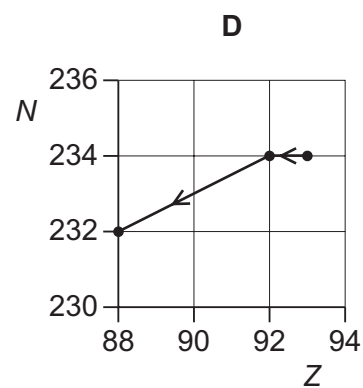
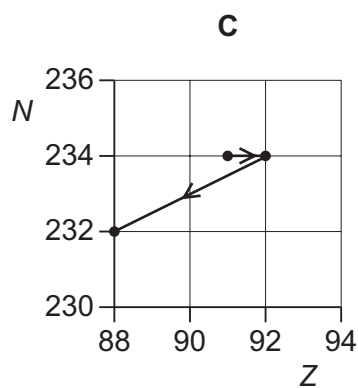
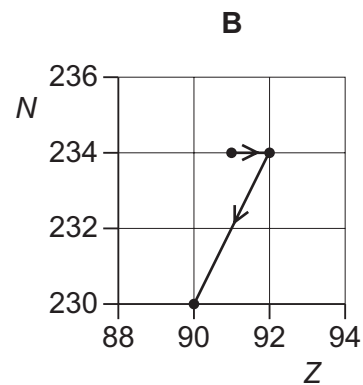
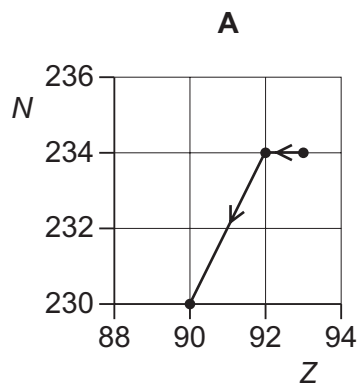
The light intensity on the LDR is decreased.

How do the readings of the voltmeters change?

	reading on voltmeter P	reading on voltmeter Q
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

38 A radioactive nucleus is formed by β^- decay. This nucleus then decays by α -emission.

Which graph of nucleon number N plotted against proton number Z shows the β^- decay followed by the α -emission?



39 What are the structures of the proton and of the neutron in terms of quarks?

	proton		neutron	
	up quark	down quark	up quark	down quark
A	1	1	2	2
B	1	2	2	1
C	2	1	1	2
D	2	2	1	1

40 What is the charge of a top antiquark?

A $-\frac{2}{3}$

B $-\frac{1}{3}$

C $+\frac{1}{3}$

D $+\frac{2}{3}$

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