



PHYSICS

9792/01

Paper 1 Part A Multiple Choice

May/June 2011

1 hour 15 minutes

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)



READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.

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 separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any working should be done in this booklet

This document consists of **27** printed pages and **1** blank page.



Data

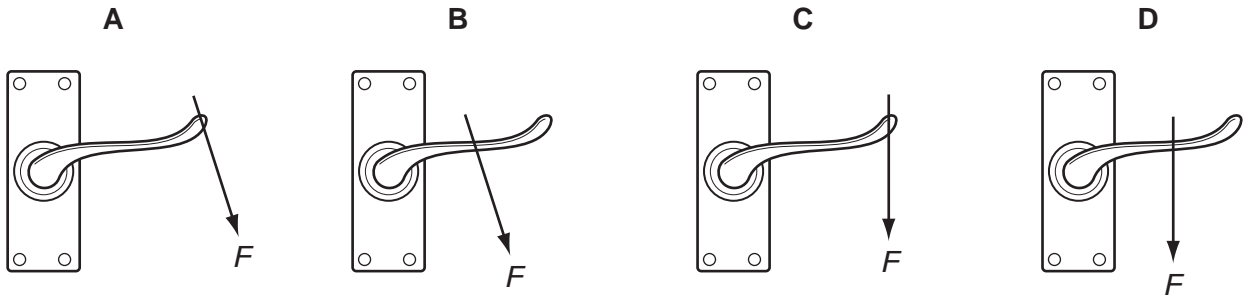
gravitational field strength close to Earth's surface	$g = 9.81 \text{ N kg}^{-1}$
elementary charge	$e = 1.60 \times 10^{-19} \text{ C}$
speed of light in vacuum	$c = 3.00 \times 10^8 \text{ m s}^{-1}$
Planck constant	$h = 6.63 \times 10^{-34} \text{ J s}$
permittivity of free space	$\epsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$
gravitational constant	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
electron mass	$m_e = 9.11 \times 10^{-31} \text{ kg}$
proton mass	$m_p = 1.67 \times 10^{-27} \text{ kg}$
unified atomic mass constant	$u = 1.66 \times 10^{-27} \text{ kg}$
molar gas constant	$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$
Avogadro constant	$N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$
Boltzmann constant	$k = 1.38 \times 10^{-23} \text{ J K}^{-1}$
Stefan-Boltzmann constant	$\sigma = 5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$

Formulae

uniformly accelerated motion	$s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$ $s = \left(\frac{u+v}{2}\right)t$	magnetic force	$F = BIl \sin \theta$ $F = BQv \sin \theta$
heating	$\Delta E = mc\Delta\theta$	electromagnetic induction	$E = \frac{-d(N\Phi)}{dt}$
change of state	$\Delta E = mL$	Hall effect	$V = Bvd$
refraction	$n = \frac{\sin\theta_1}{\sin\theta_2}$ $n = \frac{v_1}{v_2}$	time dilation	$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}}$
photon energy	$E = hf$	kinetic theory	$\frac{1}{2}m\langle c^2 \rangle = \frac{3}{2}kT$
de Broglie wavelength	$\lambda = \frac{h}{p}$	work done on/by a gas	$W = p\Delta V$
simple harmonic motion	$x = A \cos \omega t$ $v = -A\omega \sin \omega t$ $a = -A\omega^2 \cos \omega t$ $F = -m\omega^2 x$ $E = \frac{1}{2}mA^2\omega^2$	radioactive decay	$\frac{dN}{dt} = -\lambda N$ $N = N_0 e^{-\lambda t}$ $t_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$
energy stored in a capacitor	$W = \frac{1}{2}QV$	attenuation losses	$I = I_0 e^{-\mu x}$
electric force	$F = \frac{Q_1 Q_2}{4\pi\epsilon_0 r^2}$	mass-energy equivalence	$\Delta E = c^2 \Delta m$
electrostatic potential energy	$W = \frac{Q_1 Q_2}{4\pi\epsilon_0 r}$	hydrogen energy levels	$E_n = \frac{-13.6 \text{ eV}}{n^2}$
gravitational force	$F = \frac{-Gm_1 m_2}{r^2}$	Heisenberg uncertainty principle	$\Delta p \Delta x \geq \frac{h}{2\pi}$ $\Delta E \Delta t \geq \frac{h}{2\pi}$
gravitational potential energy	$E = \frac{-Gm_1 m_2}{r}$	Wien's law	$\lambda_{\text{max}} \propto \frac{1}{T}$
		Stefan's law	$L = 4\pi\sigma r^2 T^4$
		electromagnetic radiation from a moving source	$\frac{\Delta\lambda}{\lambda} \approx \frac{\Delta f}{f} \approx \frac{v}{c}$

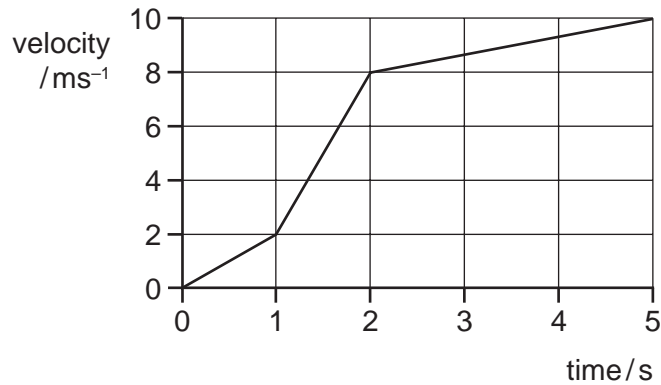
1 The diagrams show a force of magnitude F being applied to the same door handle.

Which diagram shows the greatest moment?



2 An athlete runs along a track.

A student draws a graph to represent how the velocity of the athlete varies with time for the first five seconds of his run.



What is the maximum acceleration and total distance run during these five seconds?

	maximum acceleration /m s ⁻²	distance run /m
A	2	33
B	2	50
C	6	33
D	6	50

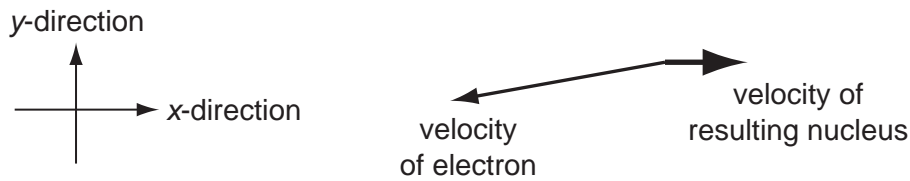
Space for working

- 3 The Yangtze River Dam in China, like all dams, must be wider at its base due to the increased water pressure.

The depth of the water is 74 m. The density of water is 0.998 g cm^{-3} .

What is the pressure exerted on the base of the dam by the water?

- A 0.72 kPa B 7.5 kPa C 74 kPa D 720 kPa
- 4 A stationary nucleus undergoes beta-decay. The diagram shows the velocities of the resulting nucleus and the emitted electron.



How does **this diagram** support the idea that a third, unseen particle is also emitted?

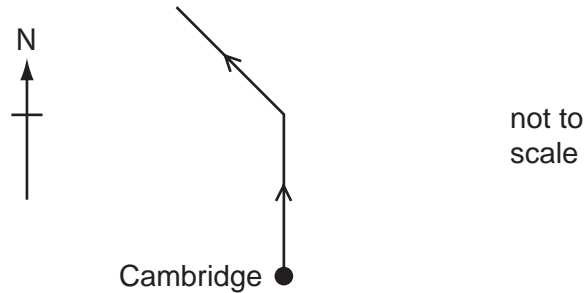
- A If there were only two particles involved, their velocities should be equal and opposite.
- B It is clear that linear momentum is not conserved in the x-direction.
- C Something must carry away the extra energy.
- D The original nucleus had no y-component of linear momentum.

Space for working

- 5 The air-traffic control centre at Cambridge looks after all aircraft within a 250 mile radius of Cambridge.

A small aircraft, flying due north at 200 miles per hour, passes over Cambridge at 12:00pm. It carries enough fuel for another 350 miles of flying.

At 12:30pm, air traffic control instructs the pilot to turn through 45° onto a north-westerly bearing. The aircraft continues at 200 miles per hour until 1:30pm.



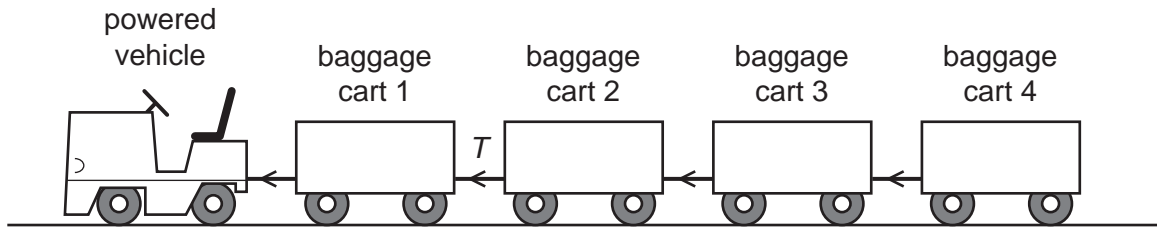
At 1:30pm the aircraft is still 80 miles from its destination.

What is the location of the aircraft and which action is required?

	location of aircraft	action required
A	outside Cambridge's air-traffic control space	carry on to destination
B	outside Cambridge's air-traffic control space	make an emergency landing before getting to destination
C	within Cambridge's air-traffic control space	carry on to destination
D	within Cambridge's air-traffic control space	make an emergency landing before getting to destination

Space for working

- 6 A transport system, used to move luggage from the airport terminal to the aircraft, consists of a powered vehicle connected to four baggage carts by a series of connecting bars.



The mass of the powered vehicle is 200 kg and each of the baggage carts has a mass of 400 kg.

The system starts with an acceleration of 2.0 m s^{-2} .

What is the tension T in the connecting bar between baggage carts 1 and 2? (Ignore any friction forces on the carts.)

- A 800 N B 1200 N C 2400 N D 3600 N

Space for working

- 7 The flat vertical wall of a building has area 60 m^2 . It is hit perpendicularly by air moving at 8.0 ms^{-1} .

Assume that all of the momentum of the air is lost on hitting the wall.

What is the force exerted on the wall? (density of air = 1.3 kg m^{-3})

- A** 0.62 kN **B** 3.0 kN **C** 5.0 kN **D** 49 kN

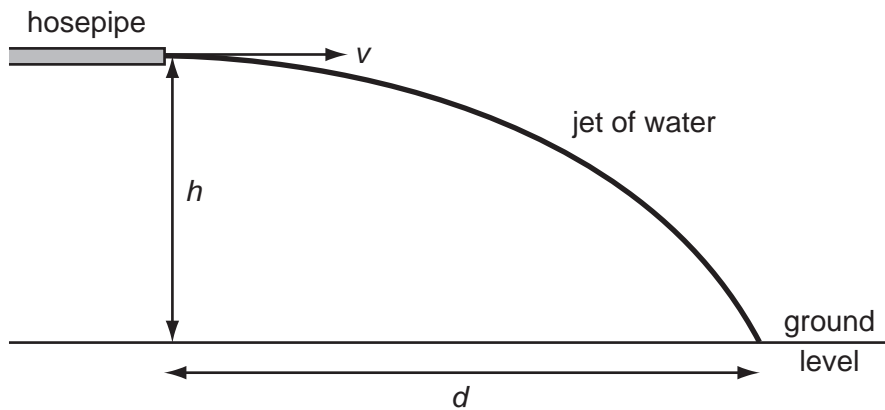
- 8 Object X has a mass of 10 kg and object Y has a mass of 60 kg. The gravitational field strength on the Moon is 1.6 N kg^{-1} .

Which statement about objects X and Y is correct?

- A** The inertia of X on the Earth is greater than its inertia on the Moon.
B The weights of X and Y do not change when they are taken from the Earth to the Moon.
C X experiences the same gravitational field strength as Y on the Moon.
D X has about the same weight on the Moon as Y has on the Earth.

Space for working

- 9 A hosepipe is fixed as shown.



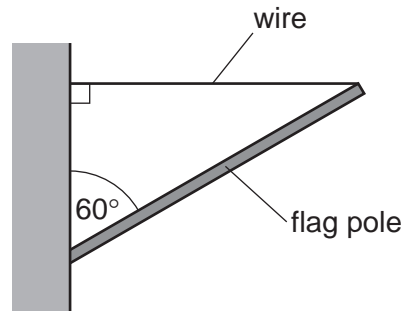
The jet of water emerges with a horizontal velocity v . The hosepipe is fixed at a height h above the ground. The water jet hits the floor at a horizontal distance d from the nozzle tip. The gravitational field strength is g .

What is the expression for distance d ? (Ignore air resistance.)

- A** $d = \frac{vg}{2h}$
 B $d = \frac{2vh}{g}$
 C $d = v\sqrt{\frac{g}{2h}}$
 D $d = v\sqrt{\frac{2h}{g}}$

Space for working

- 10** A flag pole of length 3.0 m and mass 75 kg is attached to a building. The angle between the pole and the building is 60° . The end of the pole is supported by a wire attached to the building at a right angle.



What is the tension in the wire?

- A** 65 N **B** 210 N **C** 640 N **D** 1300 N
- 11** A heavy weight is hung from a steel cable. The cable is then replaced by a similar steel cable with half the diameter.

What will be the tensile stress and strain in the new cable compared with the original one?

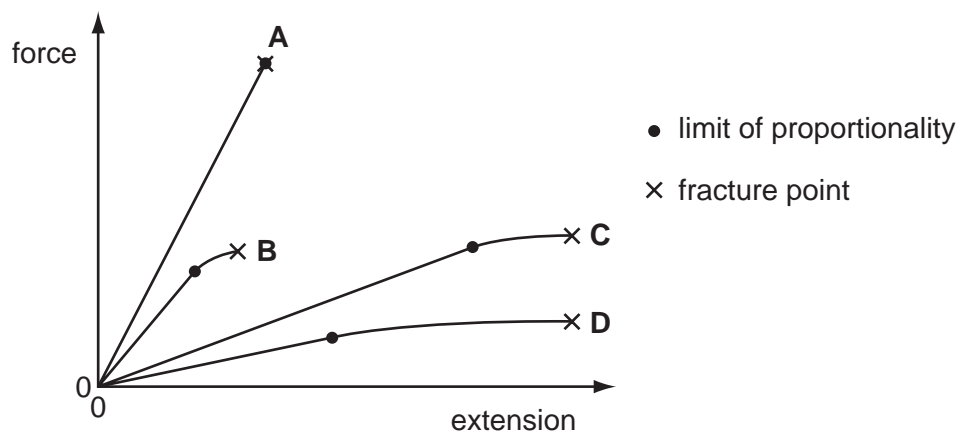
	stress	strain
A	$\times 2$	$\times 2$
B	$\times 2$	same
C	$\times 4$	$\times 4$
D	$\times 4$	same

Space for working

12 Four materials, **A**, **B**, **C** and **D**, are elastic only up to the limit of proportionality.

A graph of force against extension for each of the four materials is shown.

Which material undergoes the most plastic deformation before breaking?



13 In the Rhinns of Islay lighthouse in Scotland, there are 131 steps to the light at the top. The average height of each step is 23 cm. It takes the lighthouse keeper exactly two minutes to run up all the steps.

The mass of the keeper is 74 kg.

What is the keeper's average power?

- A** 18.6 W **B** 182 W **C** 1.86 kW **D** 18.2 kW

Space for working

- 14** The Kingda Ka, the tallest and fastest rollercoaster in the world, was opened in 2005 in New Jersey, USA.

A car carrying passengers starts from rest at a height of 139.5 m. It then descends to a height of 12.5 m.

What is the velocity of the car at the lowest point? (Ignore energy losses due to friction).

- A** 16 ms^{-1} **B** 35 ms^{-1} **C** 50 ms^{-1} **D** 52 ms^{-1}

- 15** A motor of power 10 W is used to lift a load of 20 N.

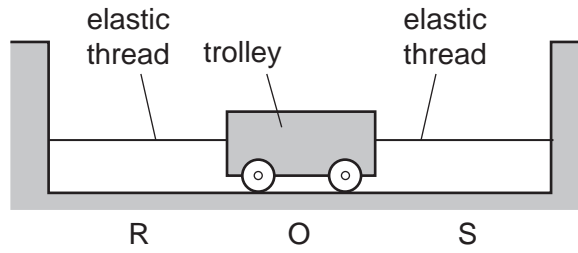
The efficiency of the motor is 25 %.

How long does it take to lift the load through a vertical distance of 0.50 m?

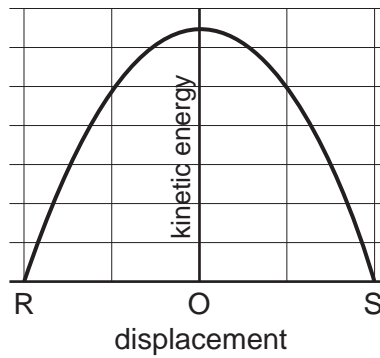
- A** 0.040 s **B** 0.25 s **C** 4.0 s **D** 39 s

Space for working

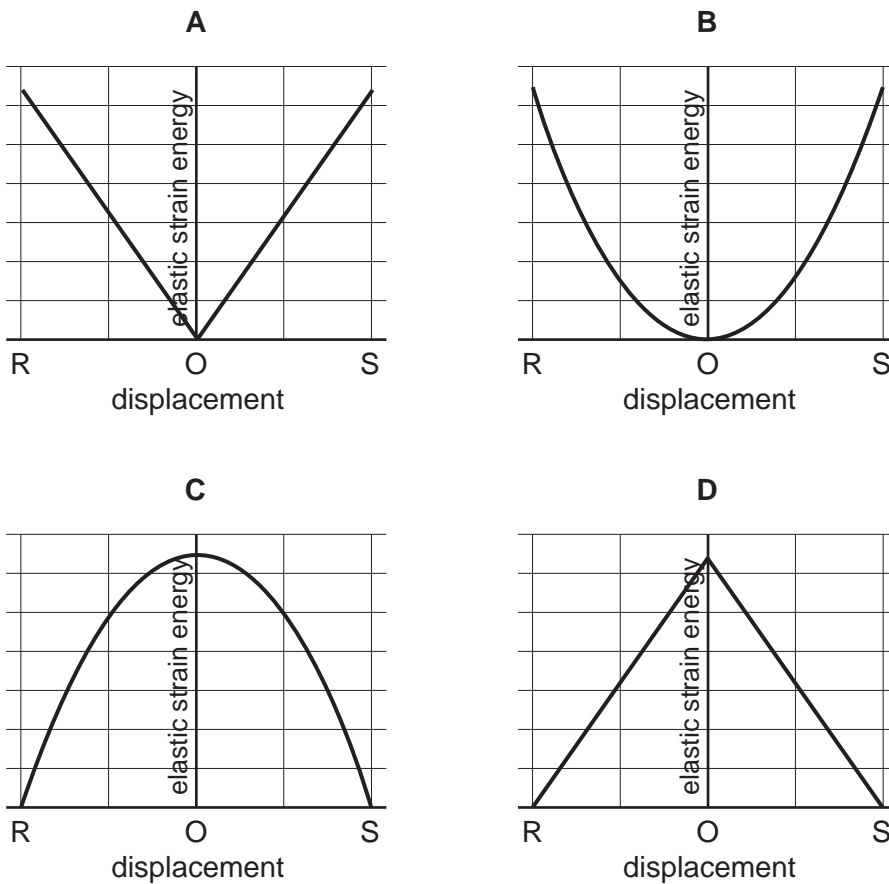
- 16 A trolley is attached to two similar stretched elastic threads. It is pulled to the left, to position R, and released from rest.



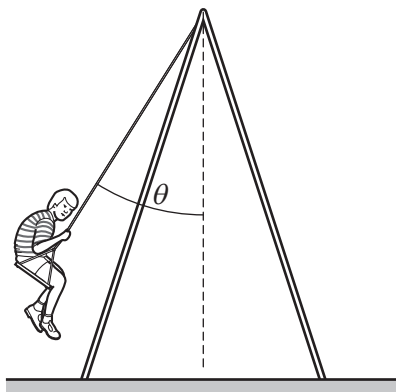
The graph shows how the kinetic energy of the trolley varies with displacement as it moves from R to S.



How does the elastic strain energy in the system vary with the displacement of the trolley?



- 17 A child of mass 50 kg is on a swing which is suspended by 4.0 m ropes from a rigid support. The horizontal speed of the swing as it passes through the lowest point is 3.0 m s^{-1} .



What is the angle θ that the ropes make with the vertical when the swing is at its highest point?

- A 28° B 40° C 42° D 62°
- 18 An 80 kg man and his 40 kg son take an elevator to the top floor of a building which is 64 m above ground level.

Which row describes the change in gravitational potential for both of them in going from ground level to the top floor?

	change in gravitational potential for 80 kg man / J kg^{-1}	change in gravitational potential for 40 kg son / J kg^{-1}
A	decrease of 6.3×10^2	decrease of 6.3×10^2
B	decrease of 5.0×10^4	decrease of 2.5×10^4
C	increase of 6.3×10^2	increase of 6.3×10^2
D	increase of 5.0×10^4	increase of 2.5×10^4

Space for working

- 19 A rectangular tank, with vertical sides, contains water to a depth of 30 cm. On a cold day, the water is initially 0°C . The top 3.0 cm of it freezes into ice at 0°C .

Assume that half of the latent heat given out by the ice goes to heating the remainder of the water.

What is now the temperature of the water below the ice?

(The specific latent heat of fusion of water is 330 kJ kg^{-1} and the specific heat capacity of water is $4.2\text{ kJ kg}^{-1}\text{ K}^{-1}$.)

- A 3.9°C B 4.4°C C 7.9°C D 8.7°C

- 20 A woman touches the body of a car that has become charged during its journey.

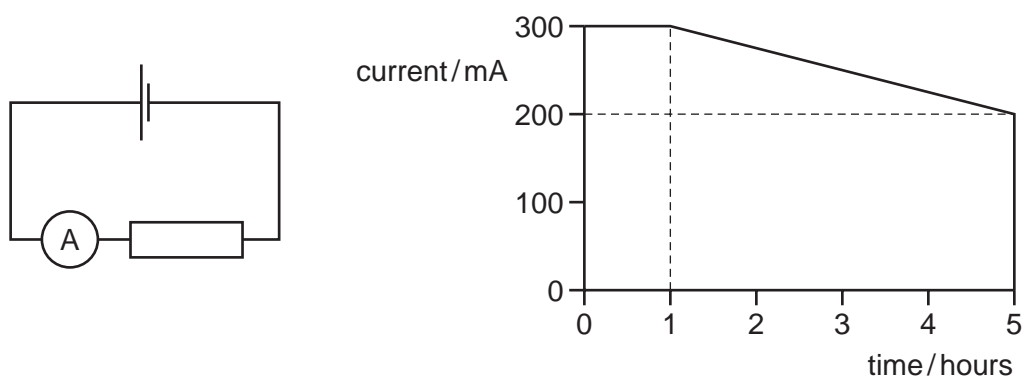
A current of 10 mA passes through her for 20 ms.

How much charge flows through her?

- A $2 \times 10^{-4}\text{ C}$ B 0.5 C C 2 C D 200 C

Space for working

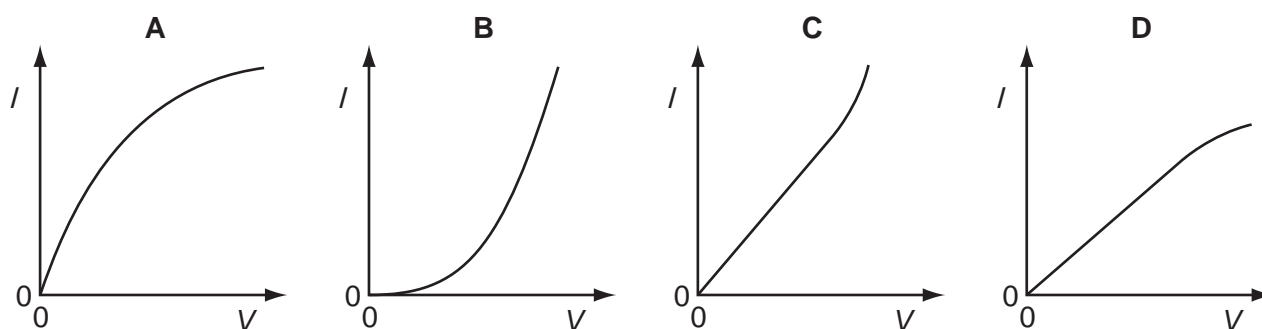
- 21 A cell is connected to a resistor and the current is measured. The graph shows how the current varies with time.



How much charge passes through the cell during this time?

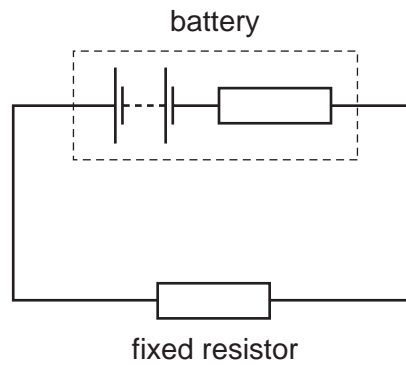
- A 1.50 kC B 4.68 kC C 5.40 kC D 5400 kC
- 22 The graphs show how the current varies with the voltage for four electrical components, A, B, C and D.

For which component is the resistance initially constant before increasing?



Space for working

23 A battery is connected to a fixed resistor.



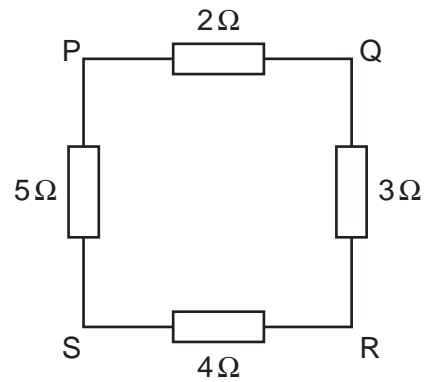
The battery is replaced by one of the same e.m.f. but with a larger internal resistance.

What happens to the terminal potential difference across the battery and the current through the fixed resistor?

	terminal potential difference across the battery	current through the fixed resistor
A	decreases	decreases
B	decreases	stays the same
C	stays the same	decreases
D	stays the same	stays the same

Space for working

- 24 The diagram shows four resistors connected in a square. An ohmmeter measures the resistance between different points.



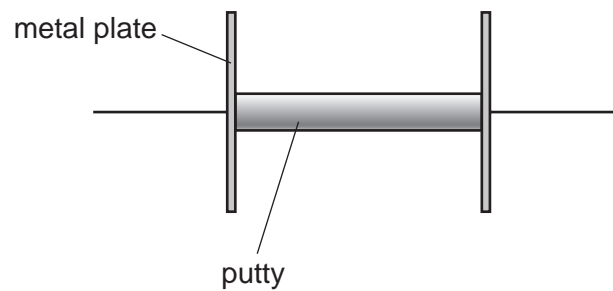
Between which points will the ohmmeter reading be the **smallest**?

- A** P and Q **B** Q and R **C** R and S **D** S and P

Space for working

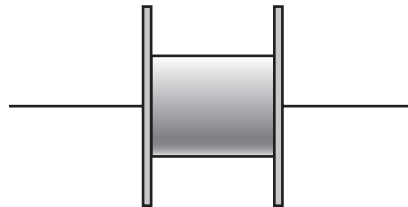
- 25 Conducting putty is a soft material which can easily be made into different shapes. It conducts electricity.

50g of conducting putty is placed between two metal plates as shown.



With the putty arranged like this, it has a resistance of $8\ \Omega$.

The plates are now squeezed together so that the distance between them is halved.



What is the resistance of the putty now?

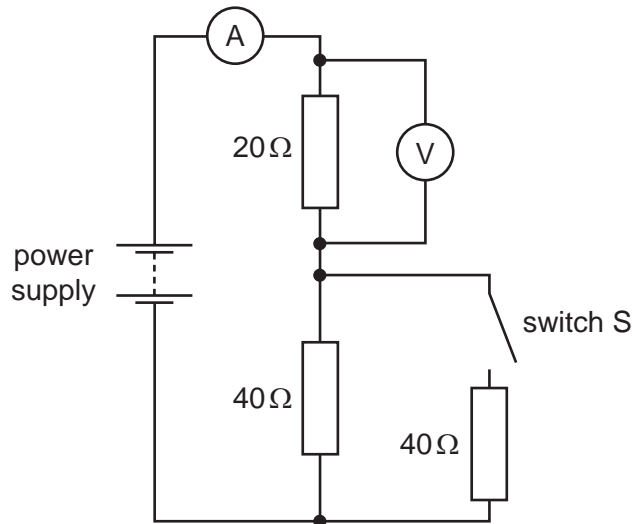
- A $2\ \Omega$ B $4\ \Omega$ C $8\ \Omega$ D $16\ \Omega$

Space for working

26 Which statement about dry cells is **not** correct?

- A A 6 V cell transfers 6 J of energy to every coulomb of charge passing through it.
- B Conventional current flows through a cell from its negative terminal to its positive terminal.
- C Inside a cell, chemical energy is used to do work on electric charges.
- D When a cell becomes 'discharged' it has used up its store of electric charge.

27 A circuit is connected as shown.



What will happen to the readings on the voltmeter and ammeter when switch S is closed?

	voltmeter reading	ammeter reading
A	decrease	decrease
B	decrease	increase
C	increase	increase
D	no change	increase

Space for working

- 28 Three identical resistors are connected in series across a cell. The same three resistors are then connected in parallel across the same cell. Assume that the cell has zero internal resistance and does not run down during the experiment.

What is the value of the ratio $\frac{\text{power from cell (resistors in parallel)}}{\text{power from cell (resistors in series)}}$?

- A $\frac{1}{3}$ B $\frac{1}{9}$ C $\frac{3}{1}$ D $\frac{9}{1}$

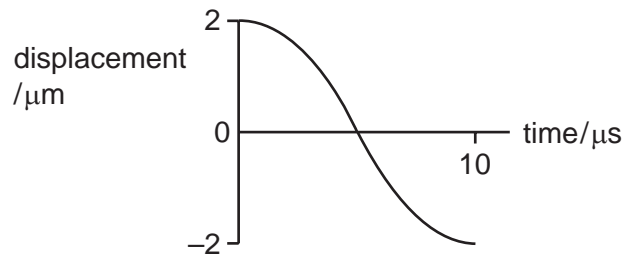
- 29 A student writes a list of statements about sound waves and radio waves.

Which statement is correct?

- A Radio waves are pressure waves.
B Radio waves can be plane polarised.
C Sound waves cannot be refracted.
D Sound waves travel faster in air than in solids.

Space for working

- 30 The graph shows the variation in the displacement of a particle in a progressive wave with respect to time.



Which row gives the correct values of the frequency and amplitude of the vibration of the particle?

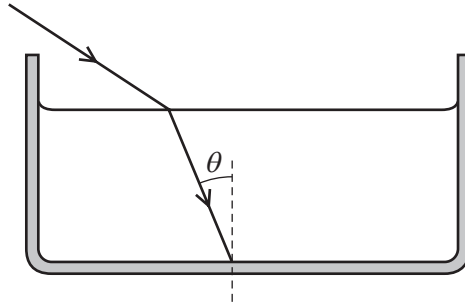
	frequency / kHz	amplitude / μm
A	25	2.0
B	25	4.0
C	50	2.0
D	50	4.0

- 31 The number of wavelengths of visible light in one metre is of the order of

A 10^4 . **B** 10^6 . **C** 10^8 . **D** 10^{10} .

Space for working

- 32 A light ray enters the water in a tank. The ray strikes the glass bottom of the tank at an angle of incidence θ .



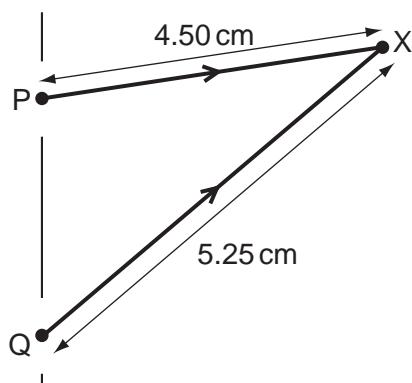
What is the maximum value of θ at which the ray will emerge from the other side of the glass into the air below?

(speed of light in air = $3.00 \times 10^8 \text{ m s}^{-1}$, speed of light in water = $2.25 \times 10^8 \text{ m s}^{-1}$, speed of light in glass = $1.97 \times 10^8 \text{ m s}^{-1}$)

- A** 41.0° **B** 41.4° **C** 48.6° **D** 61.1°

Space for working

- 33 Two coherent microwaves of wavelength 1.5 cm are in phase at points P and Q in the diagram. They interfere with each other at point X.



What is the phase difference of the waves at point X?

- A** 0.75π **B** π **C** 1.5π **D** 2π
- 34 Which statement about standing waves is correct?
- A** A standing wave can be produced on a string fixed at two end points, when plucked at the middle.
- B** In a standing wave, nodes are separated by one wavelength.
- C** In a standing wave, points of zero amplitude are called antinodes.
- D** Standing waves can only be produced by the superposition of two sets of progressive transverse waves travelling in opposite directions.

Space for working

- 35 When Rutherford fired α -particles at thin gold foil the results of his experiment helped us to understand more about the structure of the atom.

Which conclusion was drawn from the results?

- A Neutrons and protons are significantly more massive than electrons.
- B The atom contains a small positively charged nucleus.
- C The atom contains the same number of electrons and protons.
- D The nucleus contains protons and neutrons.

- 36 ${}_{90}^{232}\text{Th}$ decays via a series of α , β^- and γ decays to the stable isotope ${}_{82}^{208}\text{Pb}$.

Which row describes what can be deduced about the numbers of each decay type?

	number of α decays	number of β^- decays	number of γ decays
A	6	4	cannot tell
B	6	cannot tell	4
C	cannot tell	6	6
D	cannot tell	cannot tell	cannot tell

Space for working

37 The activity of a radioactive source falls to $\frac{1}{16}$ of its original value in 32 minutes.

What is the half-life of the decay process?

- A 2 minutes B 4 minutes C 8 minutes D 16 minutes

38 White light falls on a photoelectric surface causing the release of photoelectrons, many of which are moving when released.

The threshold frequency for this surface is 5.3×10^{14} Hz (yellow light).

Which statement is correct?

- A If a red filter is interposed, the number of photoelectrons released per second will decrease to zero.
- B If a violet filter is interposed, the number of photoelectrons released per second will increase.
- C If the light is focussed onto a small patch, the electrons released will, on average, be moving more quickly.
- D It takes a little while for enough energy to accumulate on the surface before any photoelectrons are released.

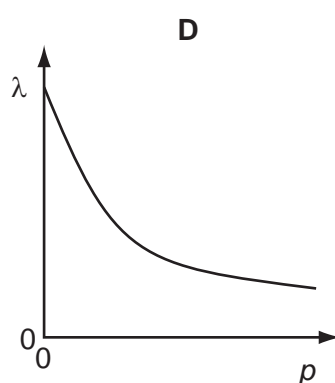
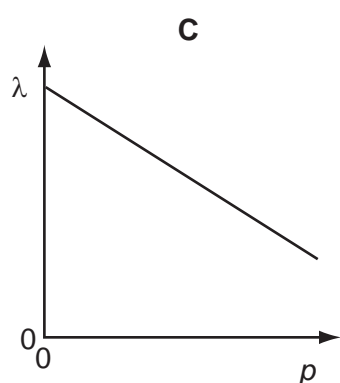
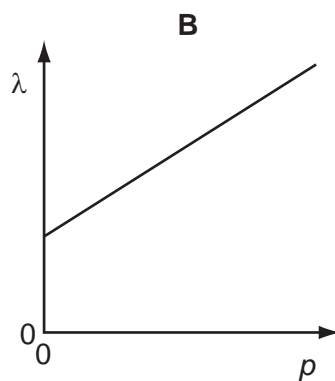
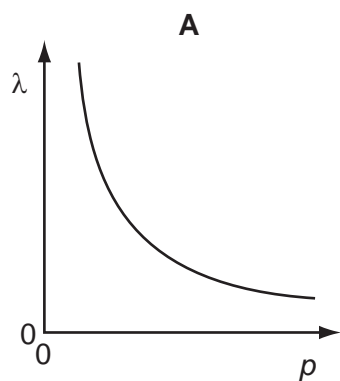
39 What is the energy of a photon of light of wavelength 3.1×10^{-7} m?

- A 4.0 eV
- B 6.4×10^{-19} eV
- C 1.0×10^{-37} eV
- D 2.1×10^{-40} eV

Space for working

40 An electron of momentum p has a corresponding de Broglie wavelength λ .

Which graph shows the relationship between λ and p ?



Space for working

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