Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | CANDIDATE NUMBER

0939772161

PHYSICS **0625/42**

Paper 4 Theory (Extended) **May/June 2018**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
Take the weight of 1.0 kg to be 10 N (acceleration of free fall = $10\,m/s^2$).

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **17** printed pages and **3** blank pages.

DC (CE/SW) 150768/5

CAMBRIDGE International Examinations

1 **(a)** Fig. 1.1 shows the axes of a distance-time graph for an object moving in a straight line.

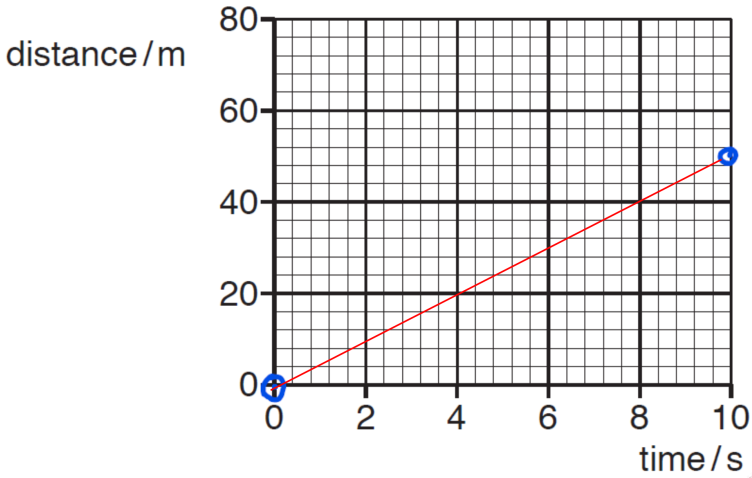


Fig. 1.1

(i) **1.** On Fig. 1.1, draw between time = 0 and time = 10 s, the graph for an object moving with a constant speed of 5.0 m / s. Start your graph at distance = 0 m.

2. State the property of the graph that represents speed.

The gradient represents the speed .... [2]

(ii) Between time = 10 s and time = 20 s the object accelerates. The speed at time = 20 s is 9.0 m / s.

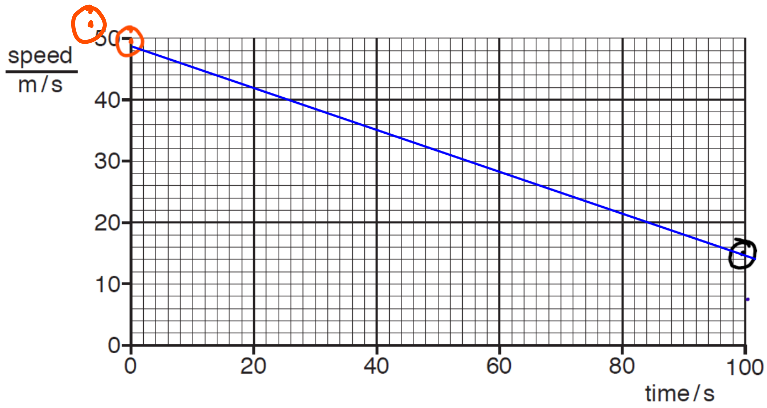
Calculate the average acceleration between time = 10 s and time = 20 s.

$a = \frac{(9-5)}{10} = \frac{4}{10} = 0.4\, m/s^2$

Note:
At 10s → speed = 5 m/s
At 20s → speed = 9 m/s
$Acc = \frac{\text{change in velocity}}{\text{Time}}$

acceleration = ... 0.4 m/s² .... [2]

(b) Fig. 1.2 shows the axes of a speed-time graph for a different object.



Acc = ch. vel / Time

0.35 = (50 - x) / 100

x = 50 - 35 = 15

∴ Final velo = 15 m/s

Fig. 1.2

(i) The object has an initial speed of 50 m / s and decelerates uniformly at 0.35 m / s^2 for 100 s.

On Fig. 1.2, draw the graph to represent the motion of the object. [2]

(ii) Calculate the distance travelled by the object from time = 0 to time = 100 s.

Distance travelled = Area under the graph

= $\frac{1}{2}$ (50 + 15) × 100

= 3250 ⇒ Approx 3300 m

distance = ...3300 m........ [3]

[Total: 9]

2 Fig. 2.1 shows a hollow metal cylinder containing air, floating in the sea.

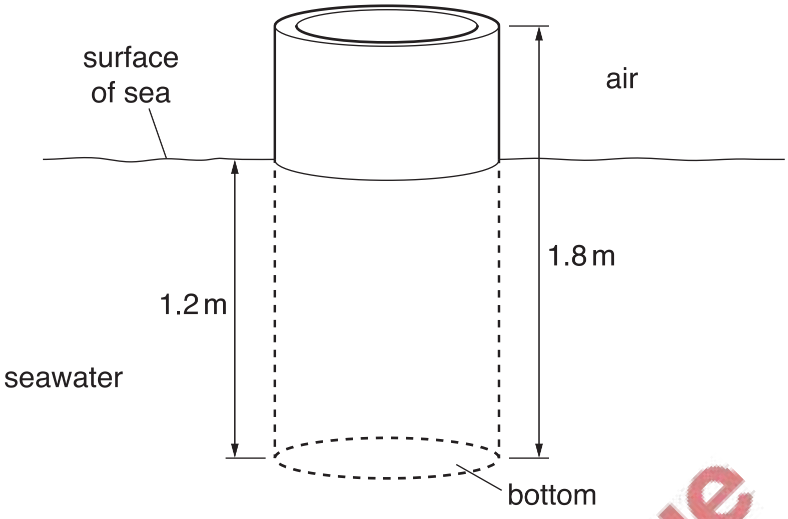


Fig. 2.1

(a) The density of the metal used to make the cylinder is greater than the density of seawater.

Explain why the cylinder floats.

This is because the combined density of cylinder and the air in it is less than that of the seawater [1]

(b) The cylinder has a length of 1.8 m. It floats with 1.2 m submerged in the sea. The bottom of the cylinder has an area of cross-section of 0.80 m^2.

The density of seawater is 1020 kg/m^3. Calculate the force exerted on the bottom of the cylinder due to the depth of the seawater.

Force = Pressure × Area --→ (1)
Pressure = hρg
= 1·2 × 1020 × 10 = 12240 → Approx 12000 Pa
Force = 12240 × 0·80 = 9800N

force = 9800N [4]

(c) Deduce the weight of the cylinder. Explain your answer.

weight = 9800N

explanation The upward force = downward force OR Net force is zero.

[2]

[Total: 7]

3 Fig. 3.1 shows an aircraft on the deck of an aircraft carrier.

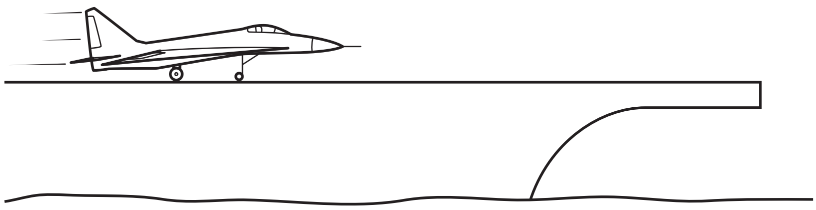


Fig. 3.1

The aircraft accelerates from rest along the deck. At take-off, the aircraft has a speed of 75 m/s. The mass of the aircraft is 9500 kg.

(a) Calculate the kinetic energy of the aircraft at take-off.

$K.E = \frac{1}{2}mv^2 = 2.7 \times 10^7$ J

$= \frac{1}{2} \times 9500 \times 75^2$

kinetic energy = 2.7×10^7 J ....[3]

(b) On an aircraft carrier, a catapult provides an accelerating force on the aircraft. The catapult provides a constant force for a distance of 150 m along the deck.

Calculate the resultant force on the aircraft as it accelerates. Assume that all of the kinetic energy at take-off is from the work done on the aircraft by the catapult.

∴ Work = Force × displacement

K.E = Force × displacement

∴ Force = $\frac{2.7 \times 10^7}{150} = 1.8 \times 10^5$ N

force = 1.8×10^5 N ....[2]

[Total: 5]

4 **(a)** Fig. 4.1 represents an atom.

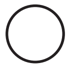
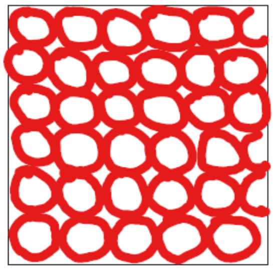


Fig. 4.1

Representing atoms by circles approximately the same size as in Fig. 4.1, sketch

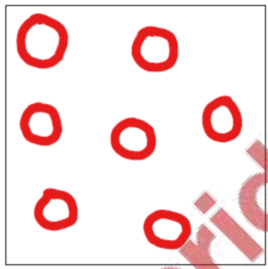
(i) on Fig. 4.2, the arrangement of atoms in a crystalline solid, [1]

(ii) on Fig. 4.3, the arrangement of atoms in a gas. [1]



solid

Fig. 4.2



gas

Fig. 4.3

(b) **(i)** Describe the motion of the atoms in a solid.

Atoms vibrate (oscillate) [1]

(ii) A sculptor makes a statue from a block of crystalline rock using a cutting tool. Explain why he must apply a large force to the tool to remove a small piece of rock.

Attractive forces exist between molecules of rock and large energy is needed to seperate these molecules and hence large force is needed. [2]

(c) A helium-filled balloon in the room of a house suddenly bursts.

State and explain, in terms of atoms, what happens to the helium from the balloon after the balloon has burst.

Helium spreads (diffuses) and collides with the air molecules and travel randomly at high speeds. [2]

[Total: 7]

5 A student wants to investigate good and bad absorbers of thermal radiation. She has the apparatus shown in Fig. 5.1, a supply of cold water and a metre rule.

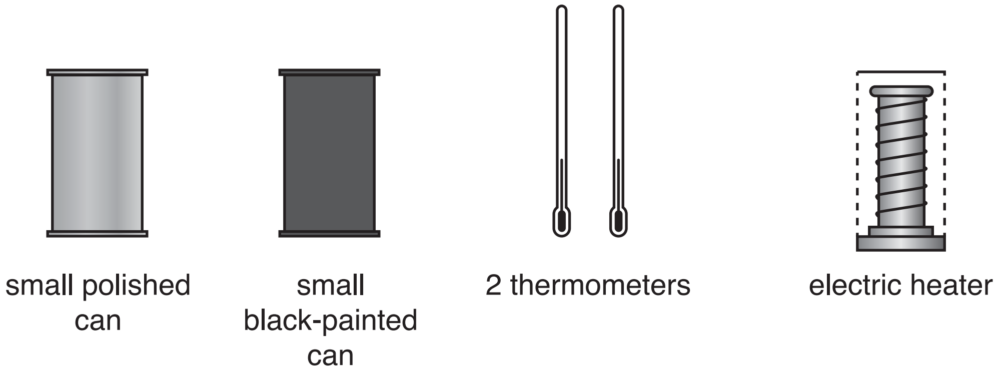
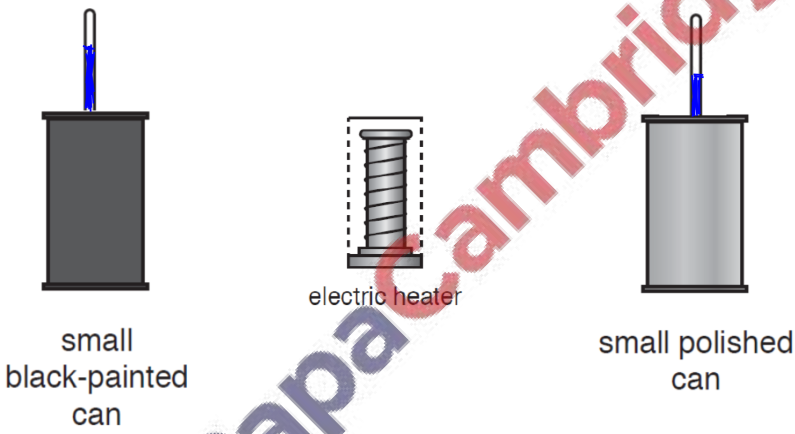


Fig. 5.1

Explain how the student could use the apparatus she has available to carry out her investigation. Describe the results she would expect to obtain. Draw a diagram of the set-up.



Keep both cans at equal distances from the heater. Ensure that both have the same water level Position thermometers in the cans Observe the mercury level in both the thermometers at the same time. It will be observed that the mercury level will be higher in the black painted can as compared to the other can. [4]

[Total: 4]

6 **(a)** Circle **two** of the following that apply to an ultrasound wave travelling in air.

frequency 3.5 Hz   frequency 350 Hz   frequency 35 000 Hz   longitudinal

transverse   speed 1.5 m/s   speed 1.5 × 10^3 m/s   speed 1.5 × 10^6 m/s

[2]

(b) Calculate the wavelength in a vacuum of X-rays of frequency 1.3 × 10^{17} Hz.

$v = f\lambda$

$\lambda = \frac{v}{f} = \frac{3 \times 10^8}{1.3 \times 10^{17}} = 2.3 \times 10^{-9}$ m

wavelength = 2.3 × 10^{-9} m [3]

(c) A dentist takes an X-ray photograph of a patient's teeth. Explain why it is safe for the patient to be close to the source of X-rays, but the dentist must stand away from the source.

X-rays are ionising (damaging) to the humans. A patient is rarely exposed to these rays and he recieves a total low dose.

[2]

(d) State, with a reason, why microwave ovens are designed only to work with the door closed.

Microwaves are harmful (dangerous) to humans. Thus if door is kept open, they would pass through the door. [2]

[Total: 9]

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7 (a) Fig. 7.1 shows a ray of light in water that is incident on a submerged, transparent plastic block.

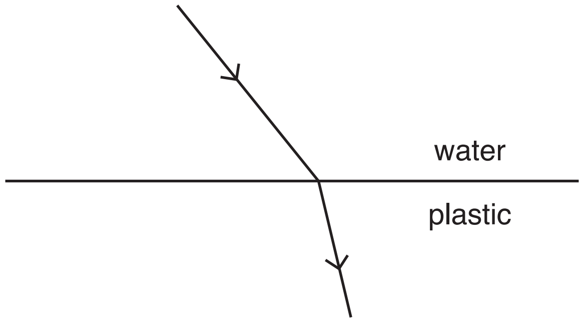

Fig. 7.1

State what happens to the speed of light as it enters the plastic block. Explain your answer.

Its speed decreases. This is because the rays bend towards the normal

.... [2]

(b) Fig. 7.2 shows the two principal focuses F_1 and F_2 of a thin converging lens.

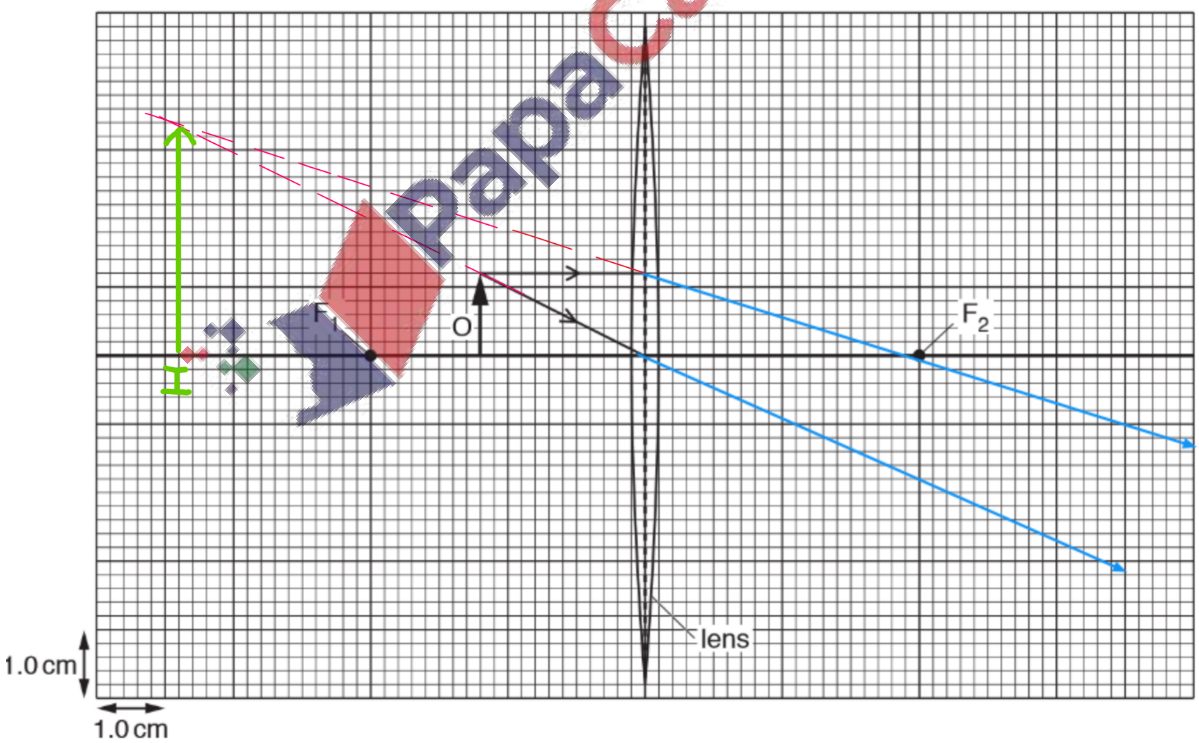

Fig. 7.2 also shows an object O of height 1.2 cm placed close to the lens. Two rays from the tip of the object O are incident on the lens.

(i) On Fig. 7.2, continue the paths of these two rays for a further distance of at least 5 cm. [2]

(ii) Using your answer to **(b)(i)**, find and mark on Fig. 7.2 the image I of object O and label this image. [2]

(iii) Determine the height of image I.

height = 3·2 cm [1]

(iv) State and explain whether I is a real image or a virtual image.

It is a virtual image as it cannot be projected on the screen. [1]

[Total: 8]

8 Fig. 8.1 shows a circuit that contains a battery of electromotive force (e.m.f.) 6.0 V, an ammeter, a 20 Ω resistor and component X.

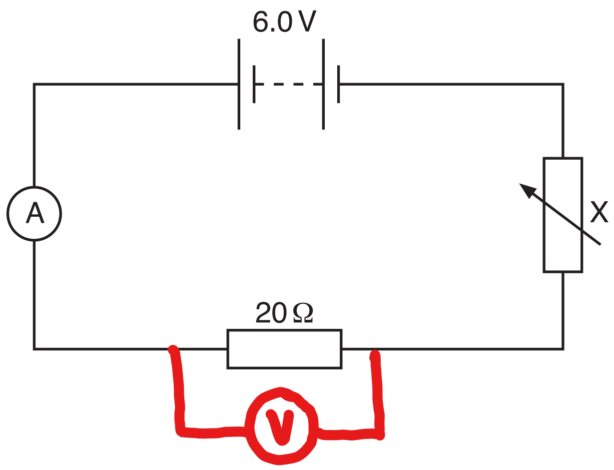

Fig. 8.1

(a) **(i)** State the name of component X.

Variable resistor .... [1]

(ii) The potential difference (p.d.) across the 20 Ω resistor is measured with a voltmeter.

On Fig. 8.1, draw the symbol for this voltmeter connected to the circuit. [1]

(b) The p.d. across the 20 Ω resistor is varied from zero to 6.0 V. For each value of p.d. a corresponding current is measured.

Pd/V	R(20Ω)	I = V÷R/A
0	20	0
1	20	0·05
2	20	0 1
3	20	0·15
4	20	0·2
5	20	0·25
6	20	0·3

On Fig. 8.2, draw a line to indicate how the current measured by the ammeter depends on the p.d. across the 20 Ω resistor.

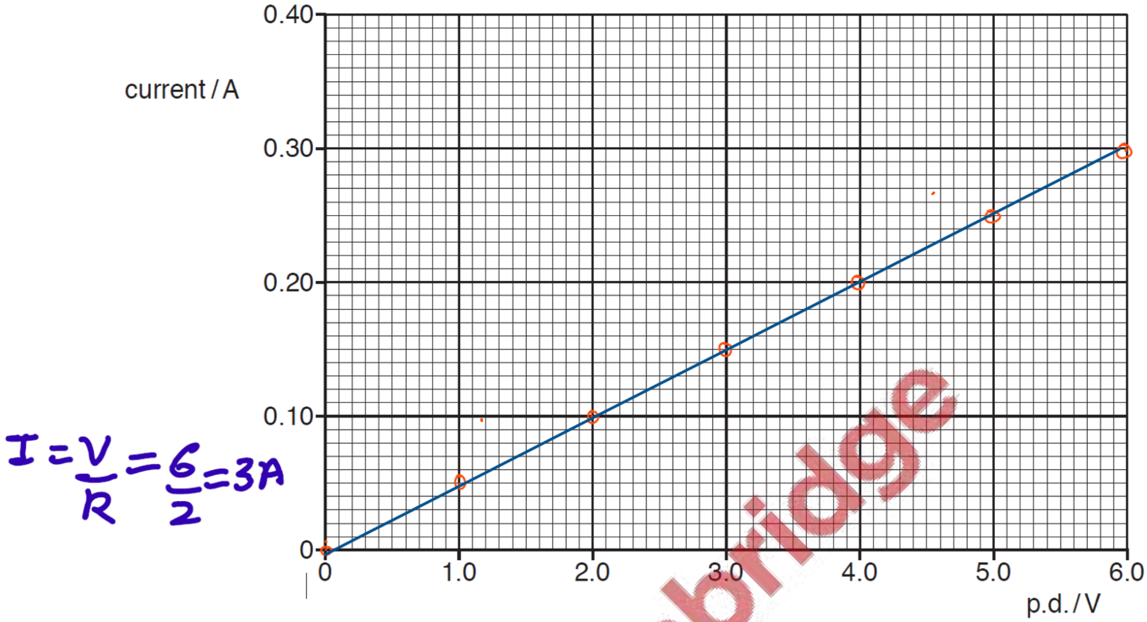

Fig. 8.2

[3]

(c) A second resistor is connected into the circuit in parallel with the 20 Ω resistor.

(i) State how the combined resistance of the two resistors in parallel compares with the resistance of each of the resistors on its own.

Combined resistance smaller than the resistance of the smaller resistor. [1]

(ii) The p.d. across the two parallel resistors is changed and the current in the battery for each value of the p.d. is measured. A second line could be drawn on Fig. 8.2 to indicate how the current measured by the ammeter depends on the p.d. across the two resistors in parallel.

State how the second line differs from the original line. You are **not** expected to draw this second line.

Steeper gradient

[1]

[Total: 7]

9 **(a)** Fig. 9.1 shows a coil ABCD with two turns. The coil is in a magnetic field.

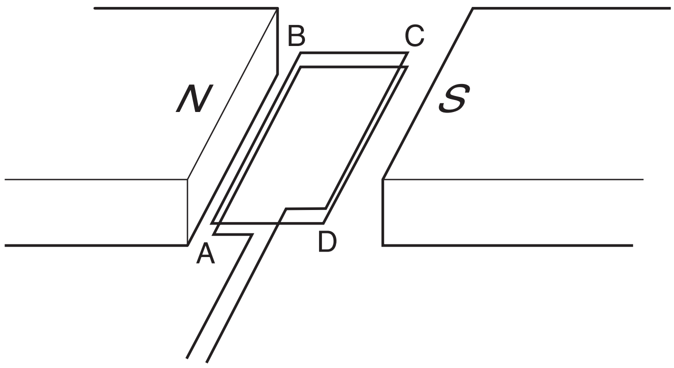

Fig. 9.1

When there is a current in the coil, the coil experiences a turning effect.

(i) Explain why there is a turning effect.

Forces on AB and CD are in opposite directions. .... [1]

(ii) The value of the current is 3A. Place **one** tick in each column of the table to indicate how the turning effect changes with the change described.

turning effect	number of turns on coil increased to six	current increased to 9A	strength of magnetic field decreased by a factor of 2
decreased by factor of 4			
decreased by factor of 3			
decreased by factor of 2			
no change			
increased by factor of 2			
increased by factor of 3	✓	✓	✓
increased by factor of 4			

[3]

(b) Fig. 9.2 shows a magnet held just below a vertical coil connected to a galvanometer.

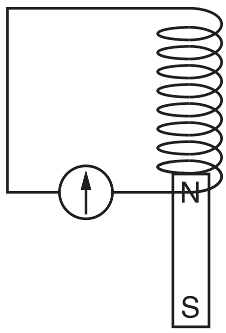

Fig. 9.2

The magnet is released.

(i) State any effect on the galvanometer.

The galvanometer needle deflects and returns to zero. ....[2]

(ii) State any effect on the magnetic field produced by the coil.

Produces a magnetic field that opposes motion of the magnet ....[2]

[Total: 8]

10 (a) An uncharged conducting metal plate rests on insulating supports. Fig. 10.1 shows the plate and a positively charged insulating plastic sheet placed on top of the metal plate.

*Rule: More -ve on top than +ve

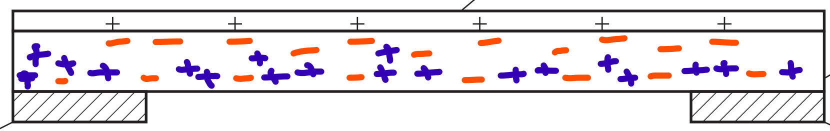

Fig. 10.1

(i) Describe any flow of charge that takes place when the plastic sheet is placed onto the metal plate.

The electrons move up. .... [1]

(ii) On Fig. 10.1, draw how charges are now arranged within the metal plate. [1]

(iii) State and explain if this arrangement of charge helps to keep the plastic sheet in place.

This arrangement of the charges helps to keep the plastic comb in place because unlike charges attract. .... [2]

(b) Fig. 10.2 shows two uncharged conducting spheres suspended on insulating threads.

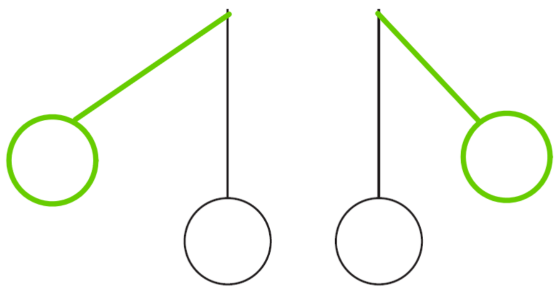

Fig. 10.2

1. The spheres are now both given positive charges. On Fig. 10.2, draw a possible position of each sphere and thread.

2. Explain the positions you have drawn.

Like charges repel. ....

....

[2]

[Total: 6]

11 **(a)** A radioactive nucleus of uranium-235 decays to a nucleus of thorium and emits an α-particle. Complete the equation.

$$^{235}_{92}U \longrightarrow ^{231}_{90}Th + ^{4}_{2}\alpha$$

[2]

(b) A nucleus of uranium-235 undergoes nuclear fission in a reactor.

(i) State what is meant by *nuclear fission*.

Nuclear fission means splitting of the nucleus into two lighter nuclei

[1]

(ii) Suggest why a nuclear reactor is surrounded by thick concrete walls.

Fission produces ionisation radiations harmful to humans. Thick concrete walls absorb the radiations and thus protect the workers.

[2]

(iii) State one environmental advantage and one environmental disadvantage of using a fission reactor to generate electrical energy in a power station.

advantage No SO_2 | CO_2 | green house gases | acid rain.

disadvantage Disposal of nuclear waste, leaks of radioactive material

[2]

(c) The thorium produced by the decay in **(a)** is also radioactive and has a half-life of 26 hours. At a certain time, a pure sample of this isotope initially contains 4.8×10^9 atoms.

Calculate the number of atoms of this sample that decay in the following 52 hours.

4.8×10^9 — 1st half life 26 hours

2.4×10^9 — 2nd half life 26 hours

1.2×10^9 → Atoms left after 52 hours

$\therefore 4.8 \times 10^9 - 1.2 \times 10^9 = 3.6 \times 10^9$ → decayed

number = 3.6×10^9 [3]

[Total: 10]