Cambridge IGCSE

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

PHYSICS **0625/43**

Paper 4 Theory (Extended) **May/June 2019**

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.

1.

Fig. 1.1 shows a distance-time graph for a cyclist travelling between points P and V on a straight road.

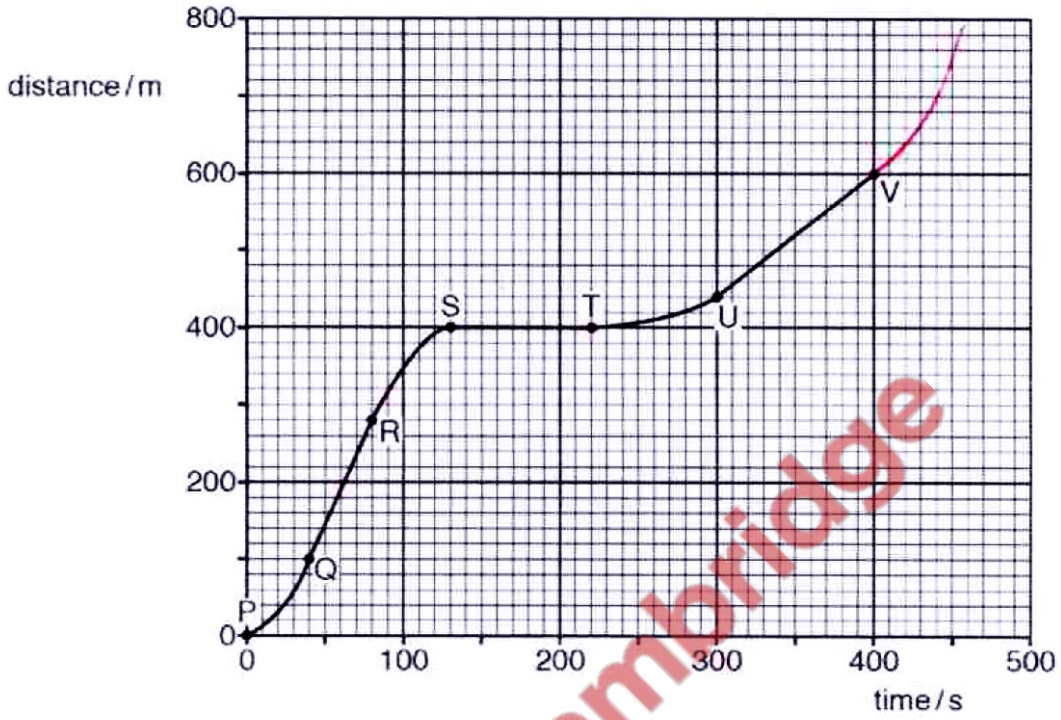


Fig. 1.1

(a) Describe the motion between:

Q and R ..... Constant Speed. .....

R and S ..... Slowing down .....

S and T. ..... Stationary. .....

[3]

(b) Calculate the speed between U and V.

- Find gradient
(300, 440), (400, 600)

$G = \frac{\Delta y}{\Delta x} = \frac{600-440}{400-300}$

$G = \frac{160}{100}$

$= 1.6 m/s$

speed = ... 1.6 m/s ..... [2]

(c) After point V, the straight road continues down a steep hill. The cyclist travels down the steep hill. He does not apply the brakes and all resistive forces can be ignored.

On Fig. 1.1, sketch a possible motion for the cyclist after V. [1]

[Total: 6]

2.

Fig. 2.1 is the top view of a small ship of mass 1.2×10^6 kg. The ship is moving slowly sideways at 0.040 m/s as it comes in to dock.

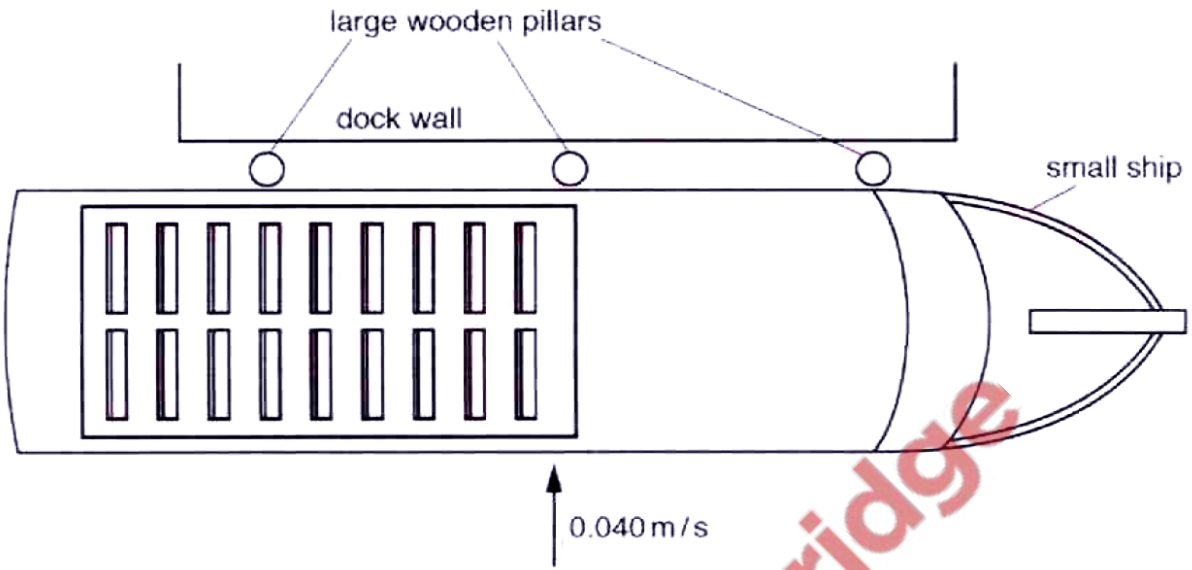


Fig. 2.1

The ship hits the wooden pillars which move towards the dock wall.

(a) Calculate the kinetic energy of the ship before it hits the pillars.

$K.E = \frac{1}{2}mv^2$

$= \frac{1}{2} \times 1.2 \times 10^6 \times 0.04^2$

$= 960\ J.$

kinetic energy = 960 J. [2]

(b) The ship is in contact with the pillars for 0.30 s as it comes to rest.

Calculate the average force exerted on the side of the ship.

$f = \frac{mv - mu}{t}$

$= \frac{m(v-u)}{t}$

$= \frac{1.2 \times 10^6 (0 - 0.04)}{0.3}$

$= 160{,}000\ N$

force = 160,000N [4]

(c) Assume that the kinetic energy calculated in **(a)** is used to do work moving the pillars.

Calculate the distance moved by the pillars.

Work done = K.E transfered.

$W = F \times d$

$d = \frac{W}{F} = \frac{960\ J}{160{,}000\ N} = 0.006\ m = 0.6\ cm.$

distance = 0.6 cm. [2]

(d) Dock walls sometimes have the pillars replaced with rubber car tyres.

Explain how this reduces the possibility of damage when a boat docks.

- With rubber car tyres, there is increased time of collision with the ship

- Since $f = \frac{mv - mu}{t}$, so a smaller force acts on the ship, so less or no damage at all. [1]

[Total: 9]

3.

Fig. 3.1 shows a small submarine submerged below the surface of the sea.

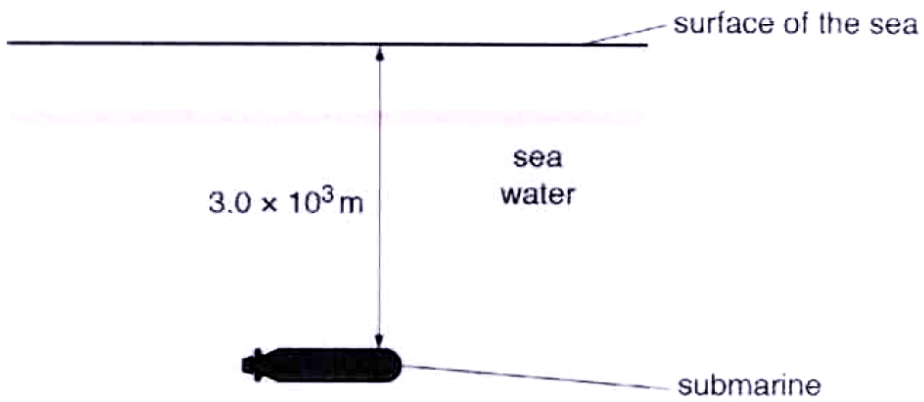


Fig. 3.1

(a) The density of sea water is 1030 kg/m^3.

Calculate the pressure due to the sea water on the top of the submarine when it is 3.0×10^3 m below the surface.

$P = \rho g h$.

$= 1030 \times 10 \times 3.0 \times 10^3$

$= 3.1 \times 10^7$ Pa

pressure = 3.1×10^7 Pa [2]

(b) The submarine emits a pulse of sound to detect other objects in the sea. The speed of sound in sea water is 1500 m/s. An echo is received with a time delay of 0.50 s after the original sound is emitted.

(i) Calculate the distance between the submarine and the other object.

$d = s \times t$

$= 1500 \times \frac{0.5}{2}$

$= 375$

$\simeq 380$ m

distance = ... 375 m. ..... [3]

(ii) Another pulse of sound is emitted through the air when the submarine is on the surface.

An echo is received from a second object that is in the air. This echo is received 0.50 s after the pulse of sound is emitted.

Compare the distance of the second object from the submarine with the distance calculated in **(b)(i)**. Tick **one** box. Give a reason for your answer.

distance is smaller ✓

distance is the same

distance is larger

Speed of sound in air = 340 m/s

$d = 340 \times \frac{0.5}{2}$

$= 85$ m

Reason ..... Speed of sound in air is slower than speed in liquid. ..... [1]

[Total: 6]

4.

(a) Water molecules escape to the atmosphere from water boiling in a pan. Water molecules evaporate from the surface of a bowl of cool water and also escape to the atmosphere.

State **two** ways in which boiling is different from evaporation.

1. In boiling, bubbles form throughout the liquid, but no bubbles in evaporation

2. Boiling only occur at one temperature, but evaporation occurs at all temperatures.

[2]

(b) Fig. 4.1 shows a heater in a metal block.

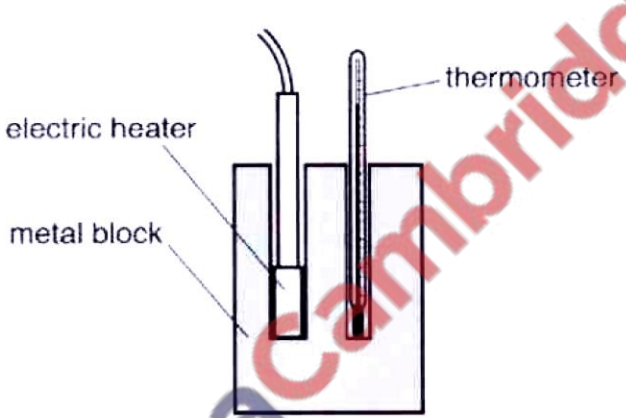


Fig. 4.1

The power of the heater is 370 W and it is switched on for 4.0 minutes. The metal block has a specific heat capacity of 420 J/(kg °C) and a mass of 5.0 kg.

Calculate the increase of temperature of the block. Assume all the thermal energy from the heater is transferred to the block.

$P = \frac{E}{t}$

$E = P \times t$

$= 370 \times (4 \times 60)$

$= 88,800$ J.

$E = mc\Delta T$

$\Delta T = \frac{E}{mc}$

$= \frac{88,800}{5 \times 420}$

$= 42.29$ °C

temperature increase = 42 °C. [4]

[Total: 6]

5.

Fig. 5.1 shows a cross-section of the inside of a vacuum flask containing a cold liquid. The walls of the vacuum flask are made of glass.

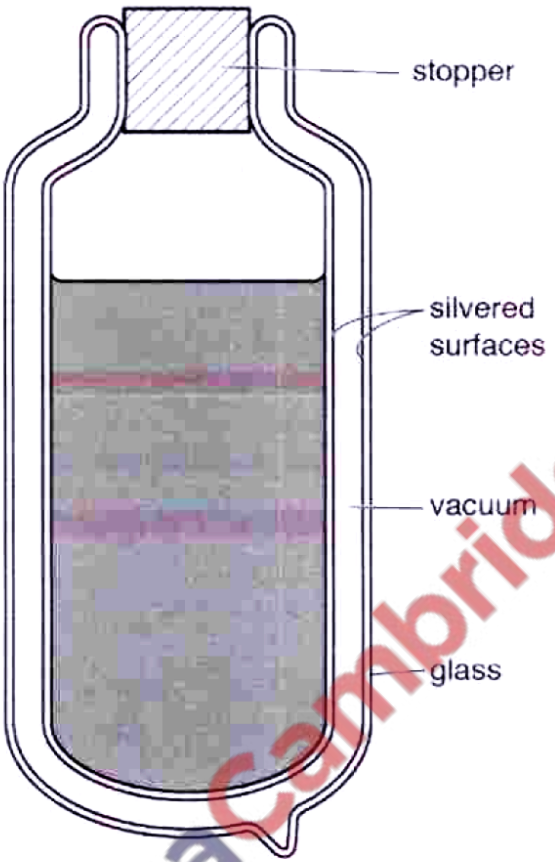


Fig. 5.1

(a) The vacuum flask is being used to keep a liquid cool on a hot day.

Explain how the labelled features of the vacuum flask keep the liquid cool by reducing thermal energy transfer. Include the names of the processes involved.

- The vacuum between the Silvered surfaces prevents heat transfer through conduction and convection
- The stopper reduces thermal energy through convection into the flask.
- The Silvered surfaces are poor absorbers of radiant heat.
- Glass is a poor conductor so reduces heat conduction

[5]

(b) Suggest a suitable material for the stopper.

plastic

[1]

[Total: 6]

6.

(a) Fig. 6.1 shows wavefronts of a wave approaching a narrow gap and passing through the gap. The wavelength is λ.

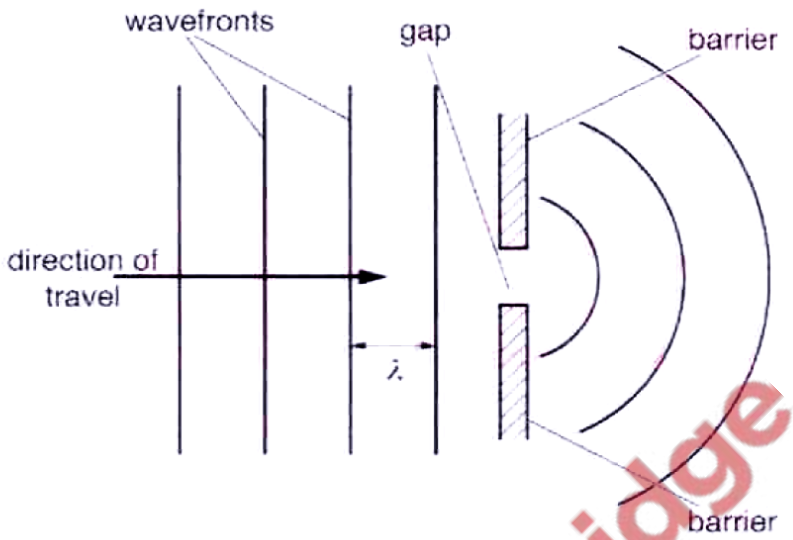


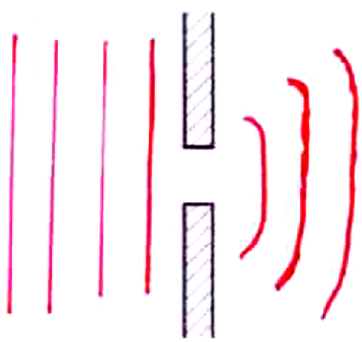
Fig. 6.1

(i) State the name of the process that occurs as the wave passes through the gap.

diffraction ..... [1]

(ii) A wave with a wavelength $\frac{\lambda}{2}$ approaches the same gap.

On Fig. 6.2, draw three wavefronts for this wave as it approaches the gap and three more wavefronts as the wave continues beyond it. [3]



- wave half the wavelength in fig 6.1
- much less spreading since $\lambda <$ gap.

Fig. 6.2

(b) Table 6.1 shows 5 different types of electromagnetic wave.

In the blank column in Table 6.1, write the numbers 1 to 5 to show the order of wavelength. Write 1 for the wave with the shortest wavelength and 5 for the wave with the longest wavelength. [2]

Table 6.1

type of electromagnetic wave	order of wavelength
gamma rays	1
light	4
microwaves	5
ultraviolet	3
X-rays	2

(c) **(i)** State the speed of radio waves in air.

3.0×10^8 m/s ..... [1]

(ii) A radio station transmits radio waves with a frequency of 96 MHz.
Calculate the wavelength of these radio waves.

$c = f \times \lambda$

$\lambda = \frac{c}{f}$

$= \frac{3.0 \times 10^8}{96 \times 10^6}$

$= 3.1$ m

wavelength = 3.1 m. ..... [3]

[Total: 10]

7.

Fig. 7.1 shows light approaching a boundary between two materials at speed v. The speed of the light after crossing the boundary is $1.3v$.

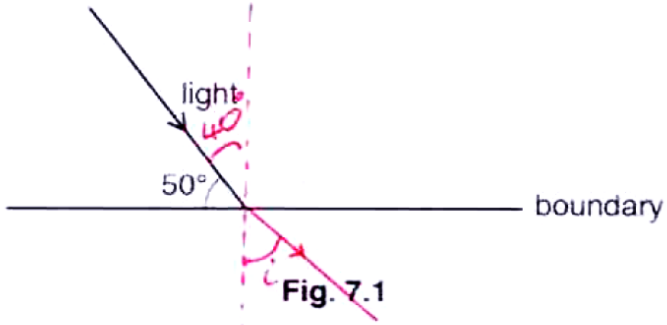


Fig. 7.1

(a) Determine the angle of incidence.

angle of incidence = ... 40° ..... [1]

(b) Calculate the angle of refraction.

$n = \frac{\text{speed in vacuum}}{\text{speed in material}}$

$n = \frac{1.3v}{v} = 1.3$

- This is faster after crossing boundary
- So use reversibility of light to find n

$n = 1.3$

$n = \frac{\sin i}{\sin r}$

$n = \frac{\sin i}{\sin 40°}$

$\sin i = 1.3 \sin 40°$

$i = \sin(1.3 \sin 40°)$

$= 56.68°$

angle of refraction = ... 57° ..... [3]

[Total: 4]

8.

Fig. 8.1 shows a 240 V mains supply connected to an air-conditioning unit and a freezer. A fuse X is placed in the circuit as shown.

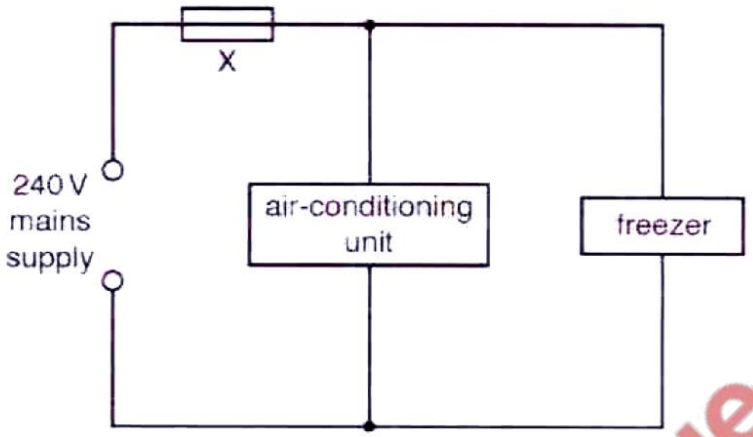


Fig. 8.1

The freezer has an operating power of 700 W.

(a) Calculate the current in the freezer.

$P = VI$

$I = \frac{P}{V} = \frac{700}{240} = 2.9\ A$

current = 2.9 A [2]

(b) The maximum operating current of the air-conditioning unit is 7.5 A.

Fuses of current rating 1 A, 3 A, 5 A, 10 A, 13 A and 30 A are available.

Suggest a suitable rating for fuse X. Give **two** reasons for your answer.

fuse rating 13 A

Reason 1 If the rating is two high it wouldnt break until current was too high which would be dangerous to damage the air-conditioner

Reason 2 If too low, it would blow when the appliance is working properly, which is not good. [3]

(c) A fuse is made out of a short length of wire.

Explain why fuses of a higher rating are made of thicker wire.

- Resistance of thicker wire is lower.
- So the fuse will blow at a higher current because heating Power ($P = I^2R$)
- So it will require high current for the fuse to melt.

[3]

(d) Electrical energy can be obtained from renewable and non-renewable sources of energy.

(i) State **two** renewable sources of energy.

Source 1 Wind

Source 2 tidal

hydroelectric, Solar, waves geothermal.

[2]

(ii) State **one** social, economic or environmental disadvantage of one of your answers to **(d)(i)**.

- Energy from the wind is not always available
- Building wind turbines is expensive
- Wind turbines affect the scenery of area.

[1]

[Total: 11]

9.

(a) Fig. 9.1 shows an electrical component.

Fig. 9.1

State the name of the component shown in Fig. 9.1. Light dependent resistor [1]
LDR

(b) In the space below, write down the truth table for a NOR gate.

↑ It equivalent to OR gate with NOT gate at the output

Input		output
A	B	Q
0	0	1
0	1	0
1	0	0
1	1	0

[2]

(c) Fig. 9.2 shows the connections between two logic gates.

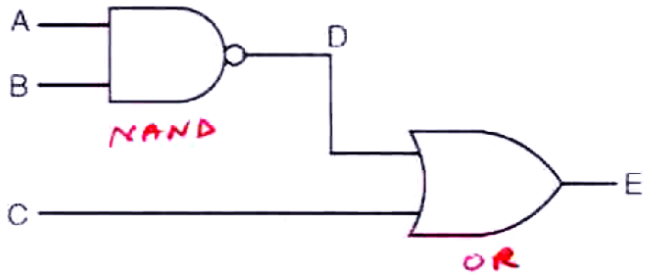


Fig. 9.2

Complete the truth table shown in Table 9.1 for this combination of logic gates.

Table 9.1

inputs			intermediate point	output
A	B	C	D	E
0	1	1	1	1
1	0	1	1	1
1	1	0	0	0
1	1	1	0	1

[3]

(d) Referring to a simple electron model, state what distinguishes electrical conductors from electrical insulators.

– Conductors have free electrons which move freely and pass electricity through.
– Insulators do not have free electrons which can move.

[1]

[Total: 7]

10.

Fig. 10.1 shows a simple alternating current generator.

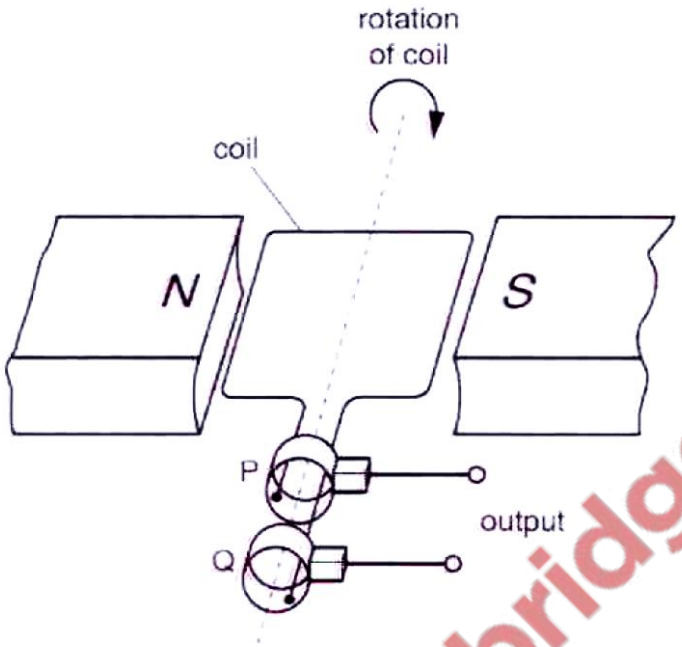


Fig. 10.1

(a) On Fig. 10.2, sketch a graph to show how the electromotive force (e.m.f.) induced varies with time for one revolution of the coil. Assume that the coil starts in the horizontal position, as shown in Fig. 10.1.

Label the points on the time axis where the coil has completed 1/4 revolution and 3/4 revolution. [3]

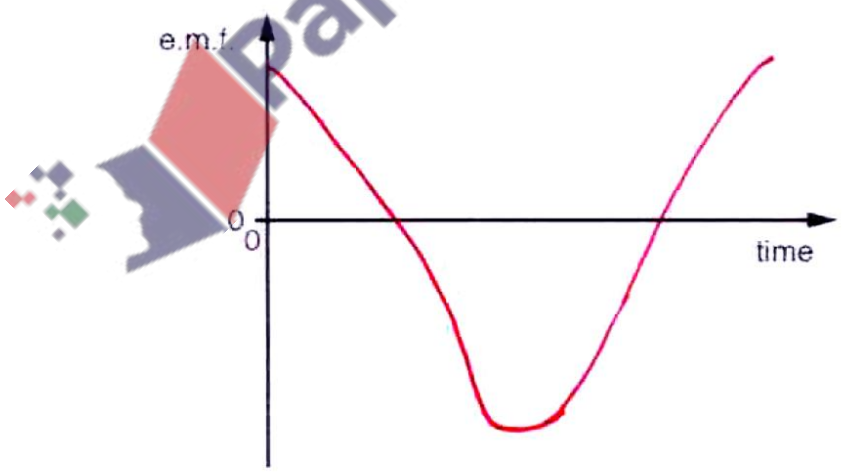


Fig. 10.2

(b) Explain why an e.m.f. is induced only when the coil is turning.

– coil cuts the magnetic field when turning and this induces emf. (voltage

[1]

(c) State the name of the components labelled P and Q and state their purpose.

Name: Slip rings.

Purpose: provide continous connection while the coil is rotating, for flow of current [2]

(d) State **two** possible changes that cause a larger e.m.f. to be induced.

1. Increase the strength of magnetic field
2. Increase the speed of rotation of the coil
3. Increase number of turns of coil.

[2]

[Total: 8]

11.

(a) Americium (Am) is a radioactive isotope. A nucleus of americium contains 95 protons and 146 neutrons. It decays by emitting an α-particle to form a nucleus of an isotope of neptunium (Np).

95 + 146 = 241

Write down the nuclide equation for the decay of americium to neptunium.

$$^{241}_{95}Am \longrightarrow {}^{237}_{93}Np + {}^{4}_{2}\alpha$$

[4]

(b) Ionisation smoke detectors contain americium and two small electrodes with a small voltage between them. The air between the electrodes is ionised by α-particles so that there is a small electric current between the electrodes.

(i) Suggest and explain the effect of smoke on the current between the electrodes in the smoke detector.

Suggestion: Current decreases when smoke enter the smoke detector.

Explanation: This is because the alpha particles are absorbed by smoke, so the don't ionise air to cause current flow in smoke detector. [1]

(ii) Suggest **two** reasons for using an α-particle emitter in a smoke detector.

Reason 1 α-particles are highly ionising, so will ionise the air inside the detector.

Reason 2 α-particle are safe to use since they have short range in air. [2]

[Total: 7]