B

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION

PHYSICS PAPER 1 (Sample Paper)

Section B : Question-Answer Book B

This paper must be answered in English

INSTRUCTIONS

(1) Write your Candidate Number in the space provided on Page 1.

(2) Stick barcode labels in the spaces provided on Pages 1, 3, 5, 7 and 9.

(3) This section carries 84 marks. Answer **ALL** questions.

(4) Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.

(5) Supplementary answer sheets will be provided on request. Write your Candidate Number, mark the question number box and stick a barcode label on each sheet. Tie them loosely but securely with a string INSIDE this Question-Answer Book.

(6) The diagrams in this section are **NOT** necessarily drawn to scale.

Please stick the barcode label here.

Candidate Number							

	Marker's Use Only	**Examiner's Use Only**
	Marker No.	Examiner No.
Question No.	Marks	Marks
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2		
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7		
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Total		

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Answer **ALL** questions. Parts marked with "*" involve knowledge of the extension component. Write your answers in the spaces provided.

1.

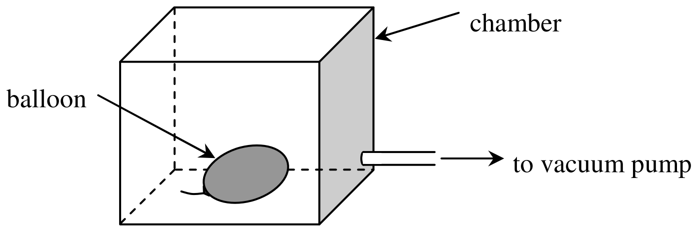

Figure 1.1

A balloon containing 0.01 m^3 of gas at a pressure of 100 kPa is placed inside a chamber. Air is slowly pumped out from the chamber while the temperature remains unchanged.

*(a) Explain, in terms of molecular motion, how the gas inside the balloon exerts a pressure on its inner surface. (2 marks)

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*(b) Find the final pressure inside the balloon when its volume is doubled. (2 marks)

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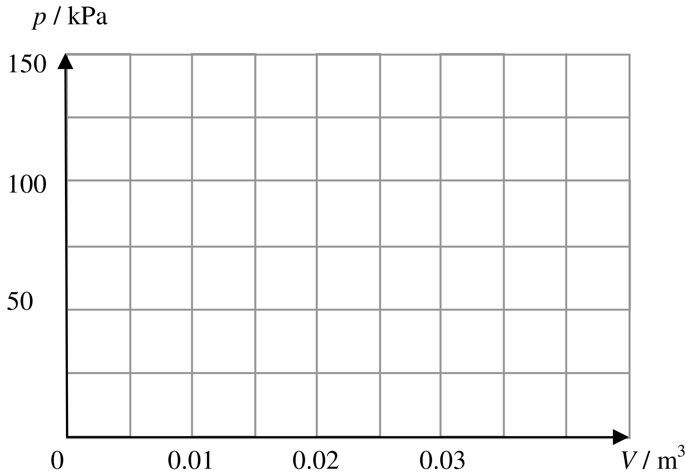
*(c) Sketch a graph to show the relationship between the pressure p inside the balloon and the volume V of the balloon. (2 marks)



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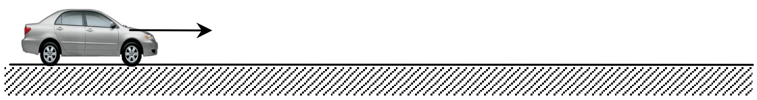

Figure 2.1

In a road test, John drives his car along a straight horizontal road (see Figure 2.1). The car takes 9.3 s to accelerate from rest to 100 km h^{-1}. The total mass of John and his car is 1400 kg.
(Note: 100 km h^{-1} = 27.8 m s^{-1})

(a) Find the total kinetic energy of John and his car when travelling at 100 km h^{-1}. Hence estimate the average output power of the car during this acceleration. (3 marks)

(b) A similar road test is conducted on an inclined road. The car now takes more than 9.3 s to accelerate from rest to 100 km h^{-1} along the road (see Figure 2.2). Assume the output power of the car remains unchanged. Explain why it takes a longer time for the car to accelerate up an inclined road than along a horizontal road. (2 marks)

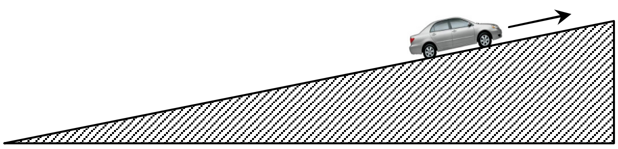

Figure 2.2

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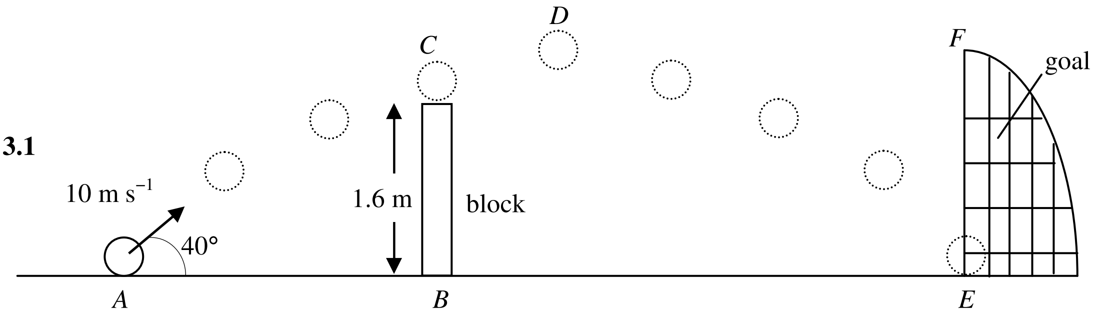
3. A ball is kicked and moves with an initial velocity of 10 m s^{-1} at an angle of 40° to the horizontal. The ball then just passes a block of height 1.6 m, reaching the highest point *D*, and finally hits the ground at *E* as shown in Figure 3.1. (Neglect air resistance and the size of the ball.)

Figure 3.1



(a) Draw an arrow to indicate the direction of acceleration of the ball at *C*. (1 mark)

*(b) For a projectile of initial velocity u that makes an angle θ with the horizontal, show that its horizontal range is given by $\dfrac{u^2 \sin 2\theta}{g}$. Hence, or otherwise, find another angle of projection such that the ball can still reach *E* with the same initial speed of 10 m s^{-1}.
(Given: $2\sin\theta\cos\theta = \sin 2\theta$) (4 marks)

(c) Calculate the speed of the ball at *C*. (2 marks)

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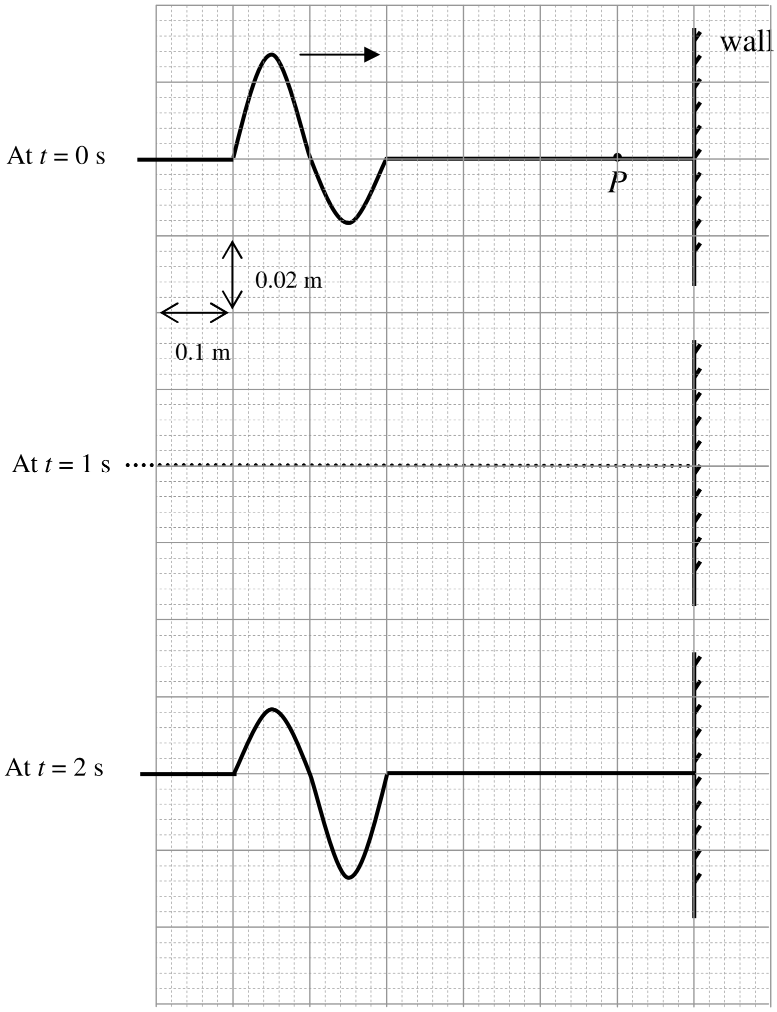
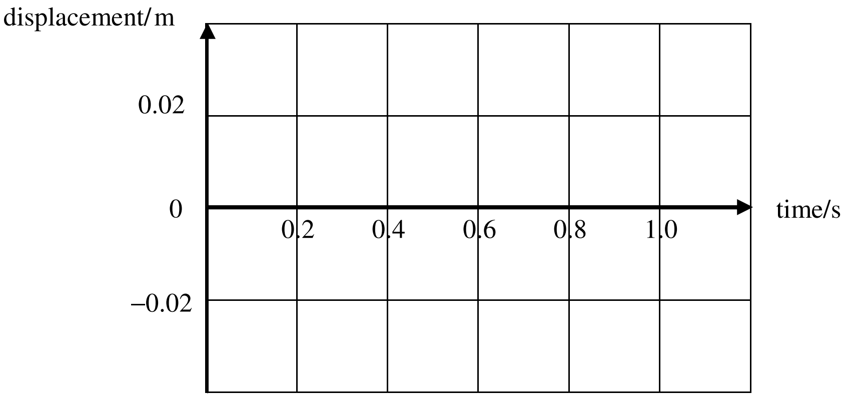
4. One end of a piece of string is fixed to a wall. A wave pulse travels along the string at a speed of $0.5\ \mathrm{m\ s^{-1}}$ towards the fixed end. Figure 4.1 shows the string at time $t = 0$ s and $t = 2$ s.

Figure 4.1



(a) On Figure 4.1, draw the shape of the wave pulse at t = 1 s. (1 mark)

(b) Sketch a graph of the displacement of point P on the string at a distance of 0.1 m from the wall during the period $t = 0$ s to $t = 1$ s. (2 marks)



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5.

Figure 5.1

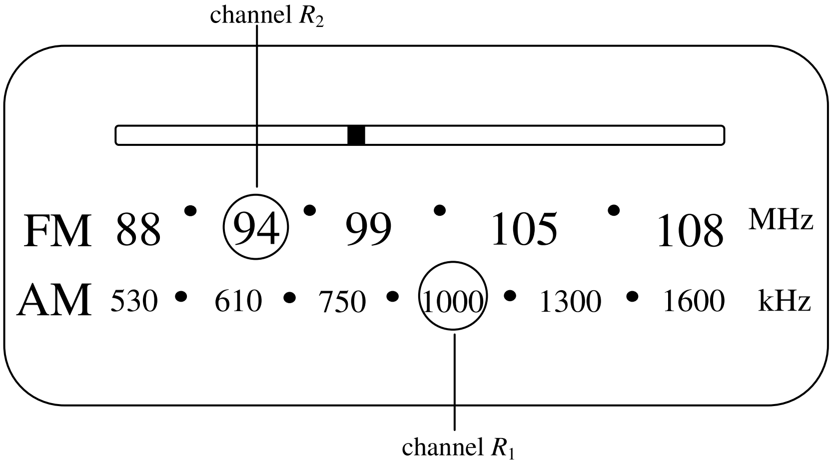

Figure 5.1 shows the display panel of a radio and the broadcasting frequencies of two radio channels R_1 and R_2. Given : speed of electromagnetic waves = 3.00×10^8 m s^{-1}

(a) Find the wavelength of the radio waves used by channel R_1. (1 mark)

(b) Anita's house is surrounded by hills and at her house, the reception of one of the two radio channels is better. For which radio channel is the reception better ? Explain your answer. (2 marks)

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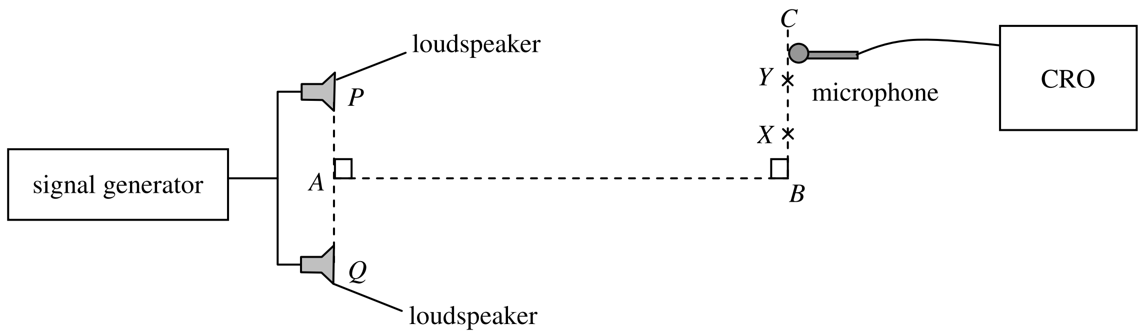

Figure 6.1

Figure 6.1 shows two identical loudspeakers P and Q are connected to a signal generator. Position A is the mid-point of PQ. A microphone connected to a CRO is moved along BC. The amplitude of the CRO trace increases as the loudness of the sound detected increases. Figure 6.2 shows how the amplitude of the CRO trace varies with the position of the microphone.

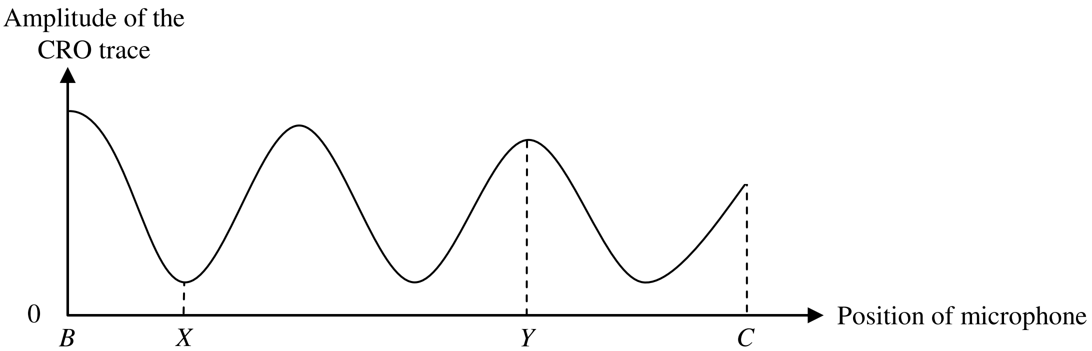

Figure 6.2

(a) (i) Explain why the loudness of the sound varies along BC. (2 marks)

(ii) State **ONE** reason why the amplitude of the CRO trace is **NOT** zero at position X. (1 mark)

(b) If PY = 5.10 m and QY = 5.78 m, find the wavelength of the sound. (2 marks)

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7. Amy uses the motor of a toy fan as a simple generator. She connects a bulb to the two terminals of the motor. This is shown in Figure 7.1.

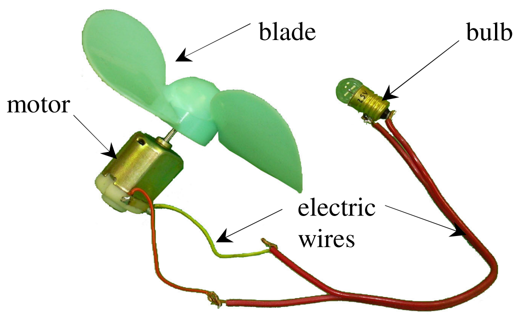

Figure 7.1

The bulb lights up when the blades are turned rapidly. Explain why and state the energy conversion taking place in this process. (4 marks)

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8. Figure 8.1 shows an earth leakage circuit breaker (漏電斷路器) installed in a domestic circuit. The live and the neutral wires pass through the centre of a soft iron ring of mean radius 1 cm. A 100-turn coil *C* with cross-section area 0.8 cm^2 is wound on the ring.

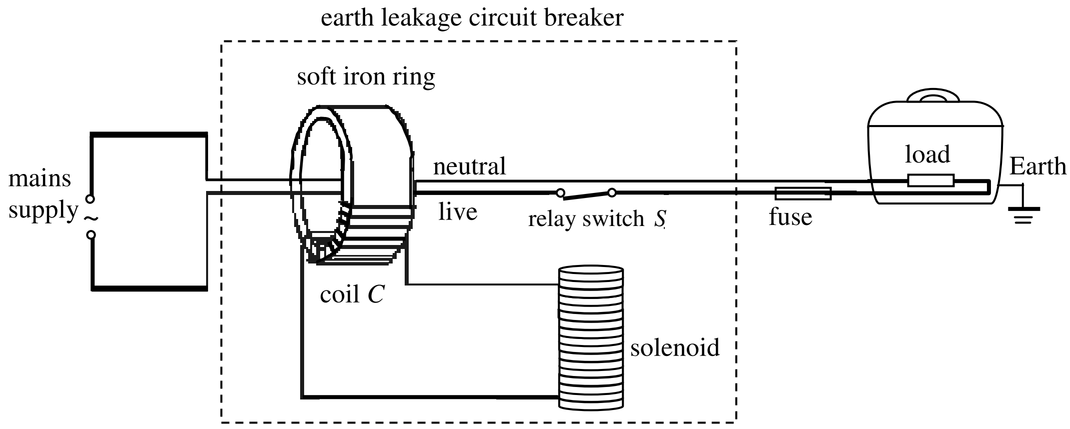

Figure 8.1

In case of an earth leakage in the domestic circuit such that the current in the neutral wire and the live wire differ by 0.5 A or more, the relay switch *S* opens and disconnects the mains supply. To reconnect the supply, *S* has to be reset manually.

(a) Explain why *S* opens when there is a leakage current of 0.5 A from the load to the Earth. (3 marks)

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(b) Calculate the magnetic field B through coil C when there is a leakage current of 0.5 A from the load to the Earth. The magnetic field B due to a current-carrying conductor is 1500 times larger in soft iron. (2 marks)

(c) Electrical appliances are usually equipped with fuses. When a short circuit occurs between the live and neutral wires, the fuse blows but the earth leakage circuit breaker does not operate. Explain these observations. (2 marks)

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9.

Figure 9.1

Figure 9.1 shows a microwave oven. Mary wants to estimate the useful output power of the oven. She is provided with the apparatus and material shown in Figure 9.2.

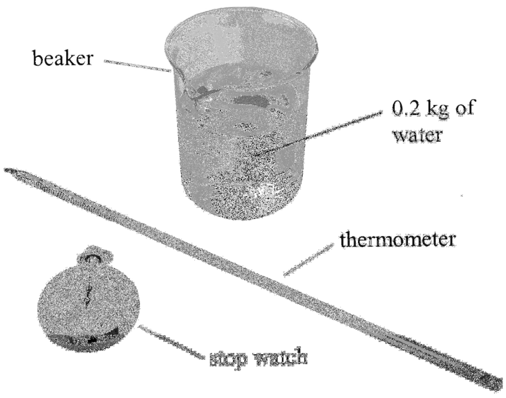

Figure 9.2

(a) Describe how Mary should conduct the experiment. Specify all measurements Mary has to take. State **EITHER** one precaution taken **OR** one assumption made when conducting this experiment. Write down an equation for calculating the useful output power. (5 marks)

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(b) The value obtained by Mary is found to be smaller than the rated power of the oven. Suggest one possible reason to account for this difference. (1 mark)

(c) Explain whether increasing the mass of water used in the experiment would improve the accuracy of the experiment. (1 mark)

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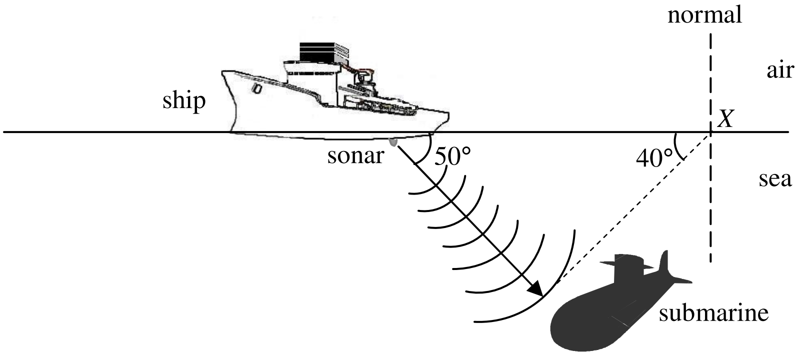

Figure 10.1

Figure 10.1 shows a ship equipped with sonar. The sonar emits ultrasonic waves of frequency 25 kHz into the sea. The waves propagate at an angle of 50° to the surface of the sea and are reflected from a submarine back to the ship after 0.15 s.

Given : speed of sound in air = 340 m s^{-1}
speed of sound in sea water = 1500 m s^{-1}

(a) Calculate the vertical distance of the submarine beneath the sea surface. (2 marks)

(b) Some of the reflected waves propagate along the dotted line and emerge into the air at *X*. Calculate the angle of refraction in air. (2 marks)

(c) Is it possible for ultrasonic waves, at certain angles of incidence, to undergo total internal reflection when they go from sea water to the air ? Explain. (2 marks)

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11. (a) A spacecraft with an astronaut on board is launched on a rocket. The rocket with the spacecraft has an initial mass of 4.80×10^{5} kg at take-off. The rocket engine expels hot exhaust gas at a constant speed of 2600 m s^{-1} downwards relative to the rocket. Assume that 1.15×10^{3} kg of gas is expelled in the first 0.5 s. (Neglect air resistance.)

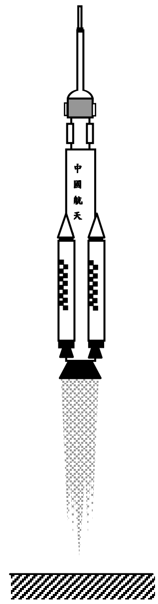

Figure 11.1

(i) Calculate the average thrust (the upward force) acting on the rocket due to the exhaust gas during the first 0.5 s. (2 marks)

(ii) On Figure 11.1, draw and label an arrow for each force acting on the rocket. Assuming that the change in mass of the rocket during the first 0.5 s is negligible, estimate the acceleration of the rocket. (3 marks)

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(b) The spacecraft of mass 7.80×10^3 kg now enters a circular orbit of radius r around the Earth.

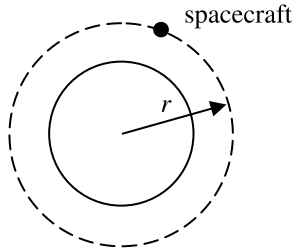

Figure 11.2

*(i) Show that the speed of the spacecraft in the orbit is given by $\sqrt{\frac{g}{r}} R_E$ where R_E is the radius of the Earth. (2 marks)

*(ii) How long does it take for the spacecraft to orbit the Earth 14 times ? (3 marks)
Given : radius of the orbit $r = 6.71 \times 10^6$ m
radius of the Earth $R_E = 6.37 \times 10^6$ m

(c) Give **ONE** reason why an aircraft is unable to fly in space like a rocket. (1 mark)

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12.

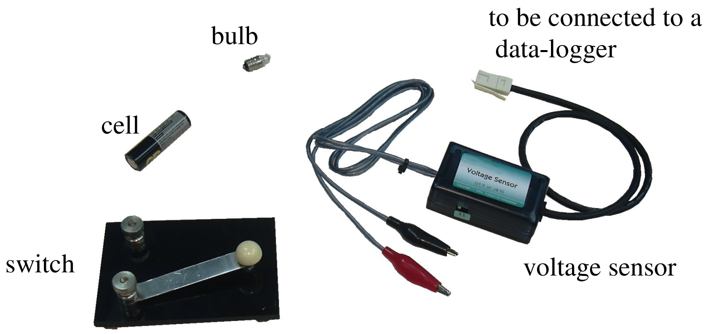


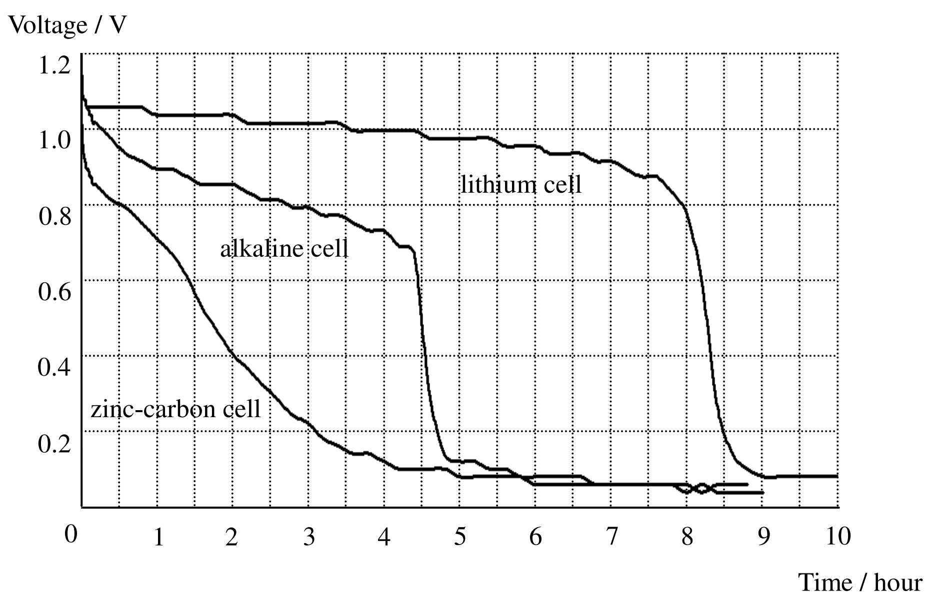
Figure 12.1

Iris uses the apparatus shown in Figure 12.1 to study the lifetime of AA-size cells when used to power a bulb. She connects a cell and a switch to the bulb and uses a voltage sensor to measure the voltage across the bulb.

(a) Draw a circuit diagram to illustrate how the apparatus is connected. Use the symbol (V) to denote the voltage sensor and the data-logger. (2 marks)

(b) Iris conducts the experiment with a zinc-carbon cell, an alkaline cell and a lithium cell separately. Figure 12.2 shows the variation of the voltage across the bulb with time for the cells. The bulb lights up as long as the voltage across it is above 0.6 V.

Figure 12.2



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(b) (i) A salesman claims that the lifetime of a lithium cell for lighting up the bulb is five times that of an alkaline cell. Determine whether the claim is correct or not. (2 marks)

(ii) Table 12.3 shows the prices of the three types of cell.

Type of cells	Price per cell
zinc-carbon	\$ 1.5
alkaline	\$ 3.8
lithium	\$25.0

Table 12.3

Which type of cells is the best buy, in terms of the cost per hour for lighting up the bulb ? Show your calculations. (3 marks)

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13. Josephine conducts an investigation on transformers. Primary and secondary coils are wound on two soft-iron C-cores to form a transformer. She sets up a circuit as shown in Figure 13.1.

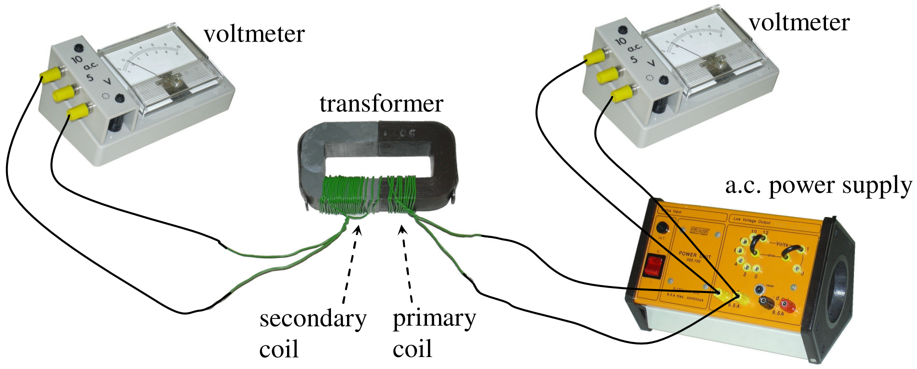

Figure 13.1

*(a) Josephine varies the input voltage V_1 to the transformer and records the corresponding output voltage V_2. The results are shown in Table 13.2. Figure 13.3 shows the graph of V_2 against V_1. Draw a conclusion for this investigation.

V_1 / V	V_2 / V
1.5	2.5
3.0	5.1
4.5	7.6
6.0	10.0

Table 13.2

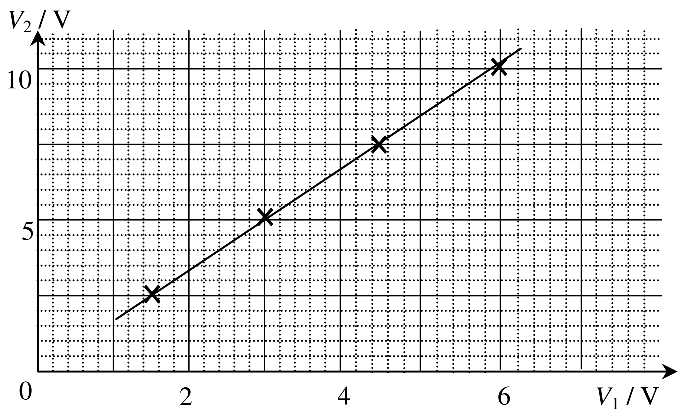

Figure 13.3

(1 mark)

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*(b) Deduce the value of V_2 that will be produced when V_1 equals 8.0 V. (1 mark)

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*(c) Josephine wants to study the relationship between the output voltage and the number of turns in the secondary coil of the transformer. Describe how she can conduct the experiment. (2 marks)

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*(d) Josephine adds a bulb to the circuit as shown in Figure 13.4. Suggest how Josephine can estimate the efficiency of the transformer. State the measurement(s) she must take. Additional apparatus may be used if necessary. (3 marks)

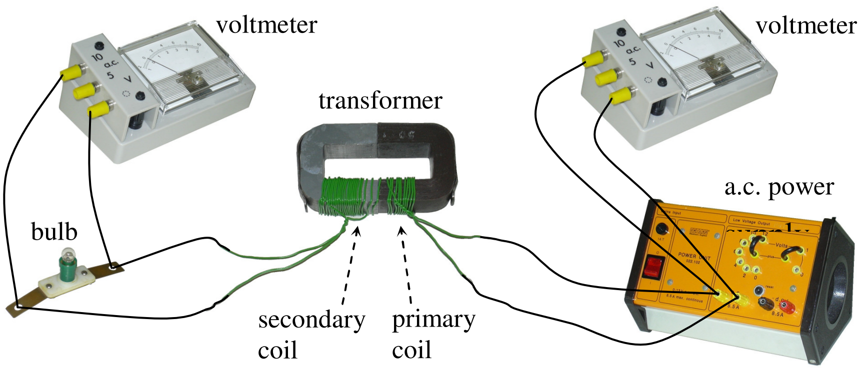

Figure 13.4

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14. In April 1986, a disastrous nuclear accident happened at the Chernobyl Nuclear Power Station. A large quantity of various radioactive substances was released and spread to neighbouring countries. The radiation levels recorded in these countries were much higher than the normal background count rate.

(a) State **ONE** source of background radiation. (1 mark)

(b) One of the radioactive isotopes released in the accident was caesium-137 (Cs-137). The following equation shows how Cs-137 is produced :

$$^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{137}_{55}\mathrm{Cs} + {}^{95}_{37}\mathrm{Rb} + x\,{}^{1}_{0}\mathrm{n}$$

Given : mass of one nuclide of
$^{235}_{92}\mathrm{U}$ = 235.0439 u
$^{137}_{55}\mathrm{Cs}$ = 136.9071 u
$^{95}_{37}\mathrm{Rb}$ = 94.9399 u
$^{1}_{0}\mathrm{n}$ = 1.0087 u

1 u is equivalent to 931 MeV

(i) What is the value of x ? (1 mark)

*(ii) Find the energy release in the fission of one U-235 nuclide in MeV. (2 marks)

*(iii) The half-life of Cs-137 is 30 years. A soil sample contaminated by Cs-137 has an activity of 1.2×10^6 Bq (disintegrations per second). A physicist comments that the contaminated sample will affect the environment for more than 350 years. Justify the physicist's claim with calculations. It is known that the activity of an uncontaminated soil sample is 200 Bq. (2 marks)

END OF PAPER

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