

**PRACTICE PAPER**  
**INTEGRATED SCIENCE PAPER 1**  
**Question-Answer Book**

(2 hours)

This paper must be answered in English

**INSTRUCTIONS**

- (1) After the announcement of the start of the examination, you should first write your Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided on Pages 1, 3, 5, 7 and 9.
- (2) Answer **ALL** questions. 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.
- (3) Graph paper and 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, and fasten them with string **INSIDE** this book.
- (4) Unless otherwise specified, numerical answers should be either exact or corrected to 3 significant figures.
- (5) The last page of this Question-Answer Book contains a list of formulae and relationships which you may find useful.
- (6) No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.

Please stick the barcode labels here.

Candidate Number

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Answer **ALL** questions. Write your answers in the spaces provided.

1. (a) A unique property of water is that its density when in the solid state (ice) is lower than when in the liquid state (water).

(i) State the main type of attraction between water molecules. (1 mark)

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(ii) With reference to the structures of ice and water, explain why the density of ice is lower than that of water. (2 marks)

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(iii) Explain the importance of the above property of water to organisms living in lakes at freezing temperatures. (2 marks)

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(b) Water shortages used to be a serious problem in Hong Kong. The problem was solved when Hong Kong began to receive a sufficient supply of Dongjiang water from Guangdong.

(i) What was the main source of Hong Kong's fresh water before 1970? Why did the water supply become insufficient in the 1970s? (2 marks)

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(ii) The Lok On Pai Desalination Plant was completed in 1975. It was intended to increase the supply of fresh water. In the plant, distillation was used to convert seawater into fresh water.

(1) Using the following data, estimate the energy required to change 1 m<sup>3</sup> of water at 20°C to steam (at 100°C). (2 marks)

Mass of 1 m <sup>3</sup> of water	1000 kg
Initial temperature of water	20°C
Final temperature of steam	100°C
Specific heat capacity of water	4200 J kg <sup>-1</sup> °C <sup>-1</sup>
Specific latent heat of vaporisation of water	2.26 × 10 <sup>6</sup> J kg <sup>-1</sup>

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(2) With reference to the properties of water, explain why desalinating seawater by distillation is costly. (2 marks)

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(iii) The quality of Dongjiang water showed signs of deterioration in the 1990s.

(1) Give a source of pollution of the Dongjiang River. (1 mark)

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(2) Suggest a method of ensuring the high quality of Dongjiang water supplied to Hong Kong. (1 mark)

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Total: 13 marks

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2. Mr. Chan was driving along a horizontal, straight road. He suddenly saw a box on the road and applied the brakes. The speed–time graph of the car is shown in Figure 1. The moment he saw the box is taken as time  $t = 0$ .

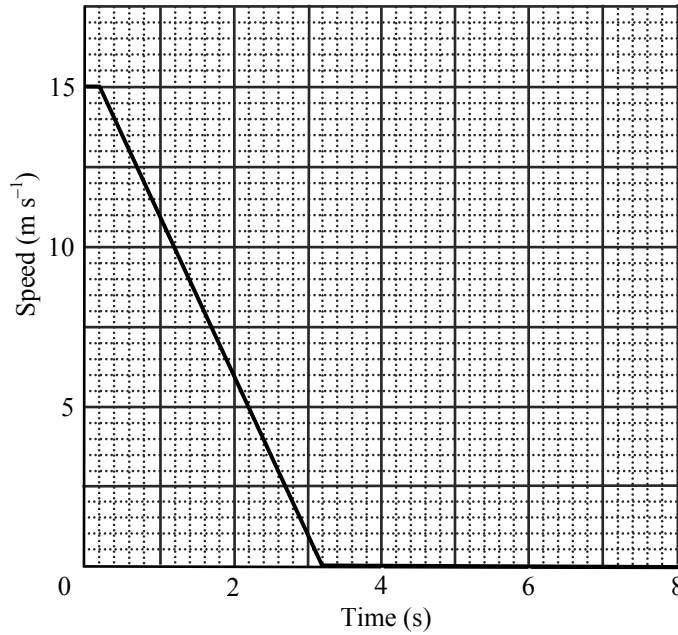


Figure 1

- (a) The speed limit for this road is  $70 \text{ km h}^{-1}$ . Was Mr. Chan speeding at  $t = 0$ ? Support your answer with a calculation. (1 mark)

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- (b) Describe how the different parts of Mr. Chan's nervous system enabled him to see the box and initiate the response of applying the brakes. (4 marks)

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- (c) Given that the box was 30 m away from the car at  $t = 0$ , determine whether the car hit the box. (3 marks)

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- (d) (i) If Mr. Chan had consumed some alcoholic drinks, which part of his central nervous system would have been affected? (1 mark)

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- (ii) If Mr. Chan was drunk, his reaction time would have been longer. In addition, he would have applied a smaller force to the brake. In Figure 1, sketch the speed–time graph of the car. (Assume the speed of the car at  $t = 0$  is the same as that in (a).) (2 marks)

Total: 11 marks

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3. (a) The following shows part of the periodic table used nowadays:

Period	Group		Group					0
	I	II	III	IV	V	VI	VII	0
1			H					He
2	Li	Be	B	C	N	O	F	Ne
3	Na	Mg	Al	Si	P	S	Cl	Ar
4	K	Ca						

- (i) Aluminum forms an oxide,  $Al_2O_3$ . Using the information in the periodic table, draw the electron diagram of  $Al_2O_3$  (showing electrons in the outermost shells only). Explain your answer. (3 marks)

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- (ii) Gallium (symbol: Ga) was discovered by the French chemist P.E. Lecoq de Boisbaudran in 1875. Before its discovery, Dmitri Mendeleev had predicted the position of gallium in the periodic table based on the observed patterns and trends in the properties of elements. The following shows a simplified version of a part of the periodic table Dmitri Mendeleev published. The predicted position of gallium is indicated by ‘?’.

Period	Group			
	I	II	III	IV
3	Na = 23	Mg = 24	Al = 27.4	Si = 28
4	K = 39	Ca = 40		Ti = 48
5	Cu = 63	Zn = 65.2	?	Ge = 70

Note: The figures in the table are the relative atomic masses.

- (1) Based on the information in the above table, suggest a reasonable value for the relative atomic mass of gallium. (1 mark)

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- (2) Lecoq de Boisbaudran obtained gallium from the electrolysis of molten gallium hydroxide. Write the ionic half equation to show the chemical change at the negative electrode during the electrolysis. (1 mark)

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- (3) The relative atomic mass of zinc is 65.2. Explain why this is **not** a whole number. (2 marks)

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- (b) Carbon dioxide ( $\text{CO}_2$ ) is a linear molecule. Its structure can be represented by the following ball-and-stick model:



Key:  oxygen atom  
 carbon atom

- (i) Explain why carbon dioxide molecules are non-polar. (1 mark)

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- (ii) State the attraction between carbon dioxide molecules. (1 mark)

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- (iii) Silicon and carbon belong to the same group in the periodic table. Knowing that silicon forms an oxide,  $\text{SiO}_2$ , a student proposed that  $\text{SiO}_2$  has a molecular structure similar to that of  $\text{CO}_2$ . However, after he had found from the data book that  $\text{SiO}_2$  has a melting point of  $1610^\circ\text{C}$ , he realised that his proposal was wrong. Suggest why this information caused him to realise that his proposal was wrong. (2 marks)

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4. It was a warm day and Rosy was walking quickly up a hill. She was breathing heavily and her heart beating fast. She felt hot and her face had turned red. She wiped off the sweat and drank some water.

(a) Explain how heavier breathing and a faster heartbeat helped Rosy's body cope with the vigorous activity. (3 marks)

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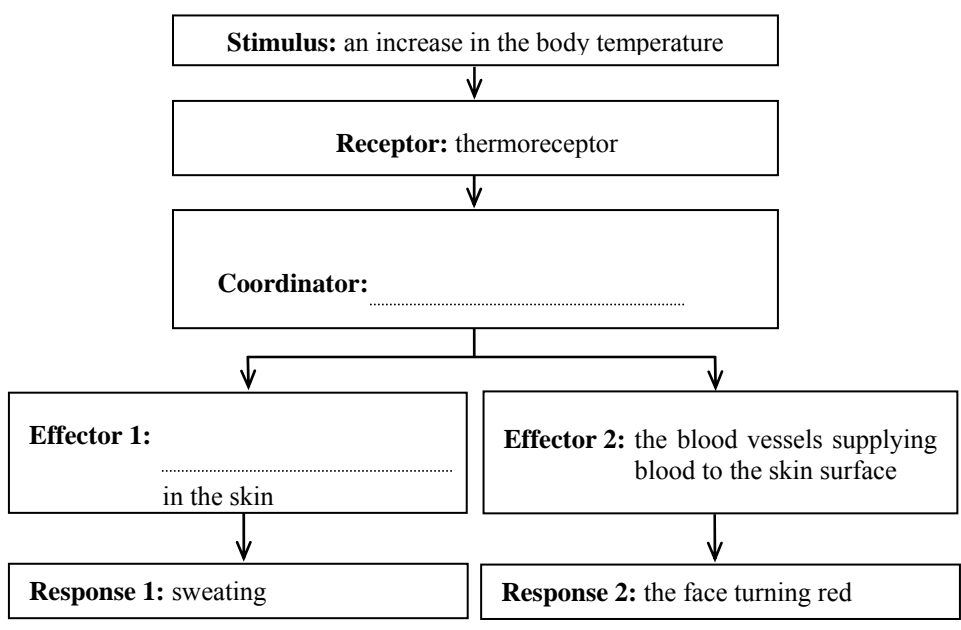
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(b) (i) Fill in each blank in the flow chart below with suitable word(s) to show how Rosy's body responded to the increase in body temperature. (2 marks)



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- (ii) Describe how **Effector 2** caused **Response 2**. State the significance of the response. (3 marks)

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- (c) Give **one** reason why it was important for Rosy to drink water after the vigorous activity. (1 mark)

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Total: 9 marks

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5. (a) Lily and Kiki are identical twins.

(i) How are identical twins formed? (1 mark)

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(ii) They are identical twins, yet Lily and Kiki have different fingerprints. Explain why. (2 marks)

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(b) Thalassaemia is a genetic disease. A couple has given birth to a baby with thalassaemia. They are shocked since neither of them has the disease.

(i) If  $T$  represents the dominant allele for the normal condition and  $t$  represents the recessive allele for the disease, what are the genotypes of the couple? (1 mark)

Husband: \_\_\_\_\_ Wife: \_\_\_\_\_

(ii) Draw a punette square to work out the chance of this couple having another affected child in the next birth. Based on the predicted chance, state your view on whether this couple should give birth to another child. (2 marks)

Punette square:

Your view:

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Total: 6 marks

Answers written in the margins will not be marked.

6. (a) In 1819, Oersted accidentally discovered that a current-carrying wire could deflect a nearby compass needle. One of his early ideas about the magnetic effect (i.e. magnetic field in present scientific terms) produced by a current-carrying wire was as follows:

Idea: The magnetic effect ( $\rightarrow$ ) is parallel to the current-carrying wire ( $\text{---}$ ) (Figure 1).

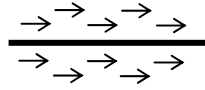
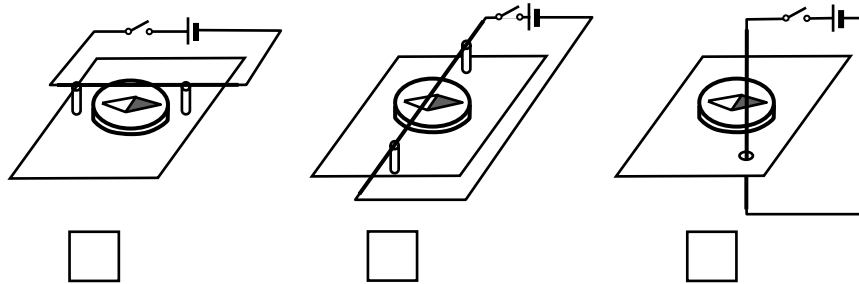


Figure 1

- (i) Which of the following set-ups would you use to test Oersted's idea? Put a '✓' in the appropriate box and predict the result of the test if Oersted's idea was correct. (2 marks)



The predicted result if Oersted's idea was correct: \_\_\_\_\_

- (ii) After some experiments, Oersted found that the above idea was wrong. He discovered later that for a straight current-carrying wire,
- I. the direction of the circular magnetic field produced is determined by the direction of the current.
  - II. the magnetic field strength decreases with the distance from the wire.

Figure 2 shows a circular magnetic field line produced by the current-carrying wire  $AB$ .

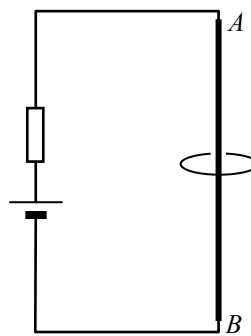


Figure 2

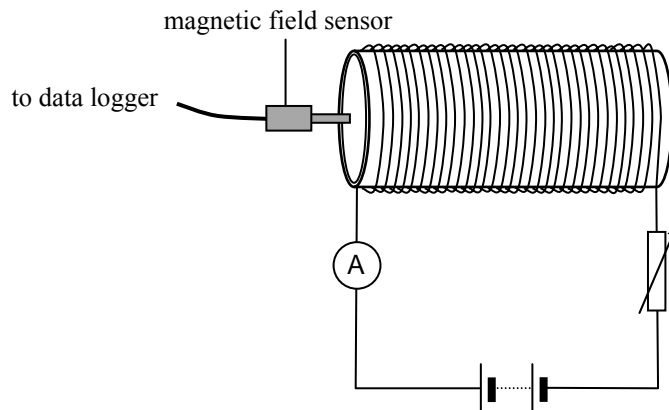
- (1) Draw an arrowhead on the magnetic field line in Figure 2 to show its direction. (1 mark)
- (2) In Figure 2, sketch **three** additional magnetic field lines produced by the current-carrying wire  $AB$  to show the relationship between the magnetic field strength and the distance from the current-carrying wire. (1 mark)

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- (b) Based on Oersted's discovery, Ampere invented the solenoid. A student used the set-up shown in Figure 3 to investigate the relationship between the magnitude of the magnetic field ( $B$ ) of a solenoid and its number of turns per metre ( $n$ ).



**Figure 3**

The student measured the values of  $B$  for solenoids of different  $n$  with a constant current. The results are shown in the following table:

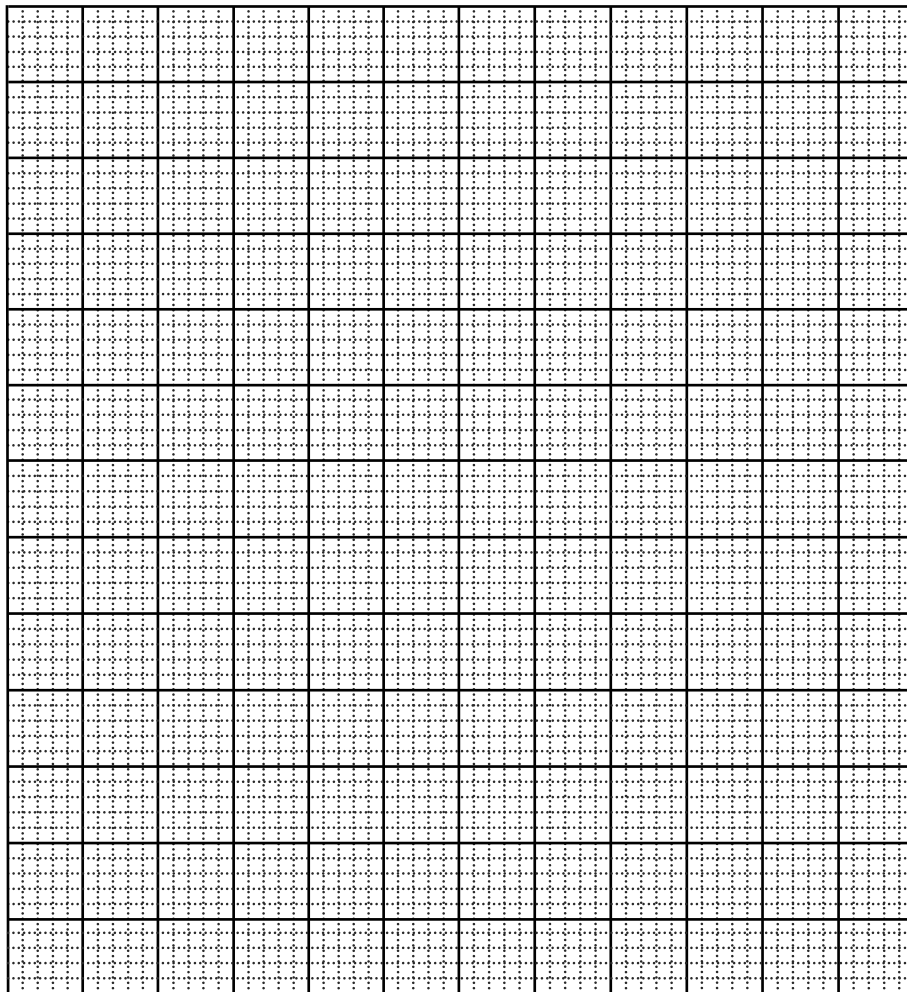
Number of turns	50	100	150	200
Length of solenoid (m)	0.1	0.1	0.1	0.1
Number of turns per metre $n$ ( $\text{m}^{-1}$ )				
Magnitude of the magnetic field $B$ ( $\times 10^{-6}$ T)	310	600	980	1260

Note: The unit of  $B$  is tesla, which is abbreviated as T.

- (i) Calculate the 'Number of turns per metre  $n$ ' and complete the above table. (1 mark)

(ii) Plot a graph of  $B$  against  $n$ .

(3 marks)



(iii) What can be concluded from the graph plotted in (ii)?

(1 mark)

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(iv) State and explain **one** precaution to improve the accuracy of the measurements.

(2 marks)

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Total: 11 marks

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7. Read the passage below and answer the questions that follow:

**Boosting crop yield in farming**

Farmers use different methods to ensure a good crop yield. These include:

- proper irrigation
- use of fertilisers
- use of insecticides
- growing crops in greenhouses
- practising selective breeding

In recent years, some farmers have begun working with scientists in genetic engineering programmes to obtain crops with desirable characteristics.

(a) With reference to **one** method used by farmers, explain how the method helps ensure a good yield. (1 mark)

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(b) It is commonly observed that an insecticide becomes less effective when it has been used repeatedly for some years. Explain why. (3 marks)

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- (c) After harvesting, some farmers cover the soil with remains of crops and dried animal manure, leave these in place for some time before the next planting. How does this practice help maintain crop yield? (3 marks)

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- (d) Using genetic engineering, a gene from one species can be introduced into another species. Explain why the transferred gene is able to produce its gene product in the new host. (3 marks)

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Total: 10 marks

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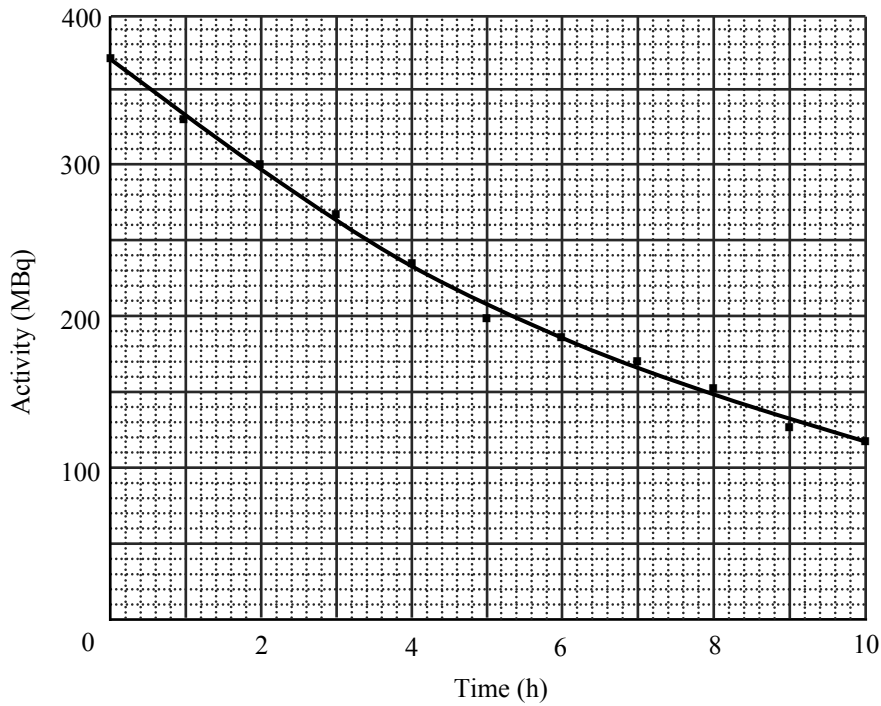
Answers written in the margins will not be marked.

8. Technetium-99m ( $^{99}_{43}\text{Tc}$ ) is a radioisotope widely used as a medical tracer for taking images of the kidney. It emits  $\gamma$  radiation when it decays.

(a) Write an equation for the decay of technetium-99m.

(1 mark)

(b) The figure below shows the decay curve of a sample of technetium-99m.



(i) Why do the data points **not** fall exactly on the decay curve?

(1 mark)

(ii) Estimate the half-life of technetium-99m from the decay curve.

(1 mark)

(iii) The initial activity of technetium-99m injected into a patient is 370 MBq. Find the activity of the technetium-99m in the patient 24 hours later. (2 marks)

Answers written in the margins will not be marked.

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Answers written in the margins will not be marked.



(c) The characteristics of two radioisotopes,  $X$  and  $Y$ , are shown in Table 1.

Radioisotope	Radiation emitted	Half-life
$X$	$\gamma$	40.3 days
$Y$	$\alpha$	5.8 hours

**Table 1**

Explain why **neither**  $X$  **nor**  $Y$  is suitable for replacing technetium-99m as medical tracers. (2 marks)

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(d) Two radiologists  $P$  and  $Q$  are discussing how frequently images of the kidneys of a patient with mild kidney problems should be taken in one year.

$P$ : The condition of the patient should be monitored closely. We should take an image of the patient's kidneys once every month.

$Q$ : It is sufficient for diagnostic purposes to take an image of the patient's kidneys once every 6 months.

Technetium-99m with an initial activity of 370 MBq is injected into the patient in order to take images of the kidneys. In each injection, the radiation dose is about 0.0015 Sv.

With reference to the effects of radiation dose on the human body as shown in Table 2, comment on the two radiologists' different approaches to using technetium-99m. (4 marks)

Annual dose	< 0.08 Sv	0.08 – 2.00 Sv	2 – 8 Sv
Effects on human body	No health effects observed	Some increase in cancer rates, mutation induction	Various symptoms observed

**Table 2**

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Total: 11 marks

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**List of formulae and relationships**

C1	$E = mc \Delta T$	energy transfer during heating and cooling
	$E = l \Delta m$	energy transfer during change of state
C3	For uniformly accelerated linear motion:	
	$v = u + at$	
	$s = ut + \frac{1}{2}at^2$	
	$v^2 = u^2 + 2as$	
	$F = ma$	force
C5	$R = R_1 + R_2$	resistors in series
	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$	resistors in parallel
	$E = I^2Rt$	electrical energy
	$P = IV = I^2R$	power in a circuit
C7	$E = hf$	energy of a photon
	$E = mc^2$	mass-energy relationship

**PRACTICE PAPER**  
**INTEGRATED SCIENCE PAPER 2**

(1 hour 30 minutes)

This paper must be answered in English

**GENERAL INSTRUCTIONS**

1. There are **TWO** sections in the paper, Section A and Section B.
2. You are advised to spend about 35 minutes on Section A (multiple-choice questions) and about 55 minutes on Section B.
3. Unless otherwise specified, numerical answers should be either exact or corrected to 3 significant figures.
4. The last page of this Question Book contains a list of formulae and relationships which you may find useful.

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**INSTRUCTIONS FOR SECTION A (MULTIPLE-CHOICE QUESTIONS)**

1. Read carefully the instructions on the Answer Sheet. After the announcement of the start of the examination, you should first stick a barcode label and insert the information required in the spaces provided. No extra time will be given for sticking on the barcode label after the 'Time is up' announcement.
2. When told to open this book, you should check that all the questions are there. Look for the words '**END OF SECTION A**' after the last question.
3. All questions carry equal marks.
4. **ANSWER ALL QUESTIONS.** You are advised to use an HB pencil to mark all the answers on the Answer Sheet, so that wrong marks can be completely erased with a clean rubber. You must mark the answers clearly; otherwise you will lose marks if the answers cannot be captured.
5. You should mark only **ONE** answer for each question. If you mark more than one answer, you will receive **NO MARKS** for that question.
6. No marks will be deducted for wrong answers.

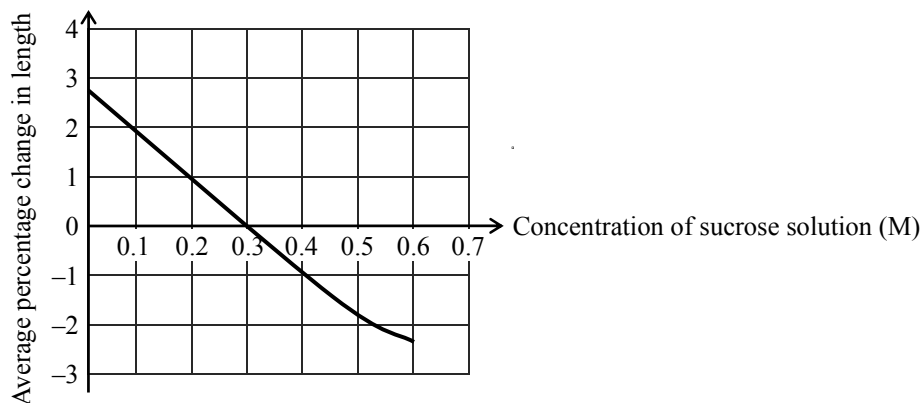
**INSTRUCTIONS FOR SECTION B**

1. Answer any **TWO** questions.
2. Write your answers in the Answer Book provided. Start each question (not part of a question) on a new page.

## SECTION A

There are **32** questions in this section. Choose the best answer for each question.

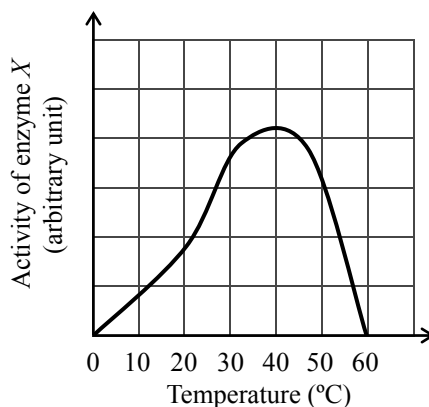
1. In an experiment for determining the water potential of potato tissue, equal numbers of potato cylinders were immersed in sucrose solutions of different concentrations for 40 minutes. The percentage change in length was then determined for each potato cylinder and the results are shown in the graph below:



Find from the graph the water potential of the potato tissue (in terms of concentration of sucrose solution).

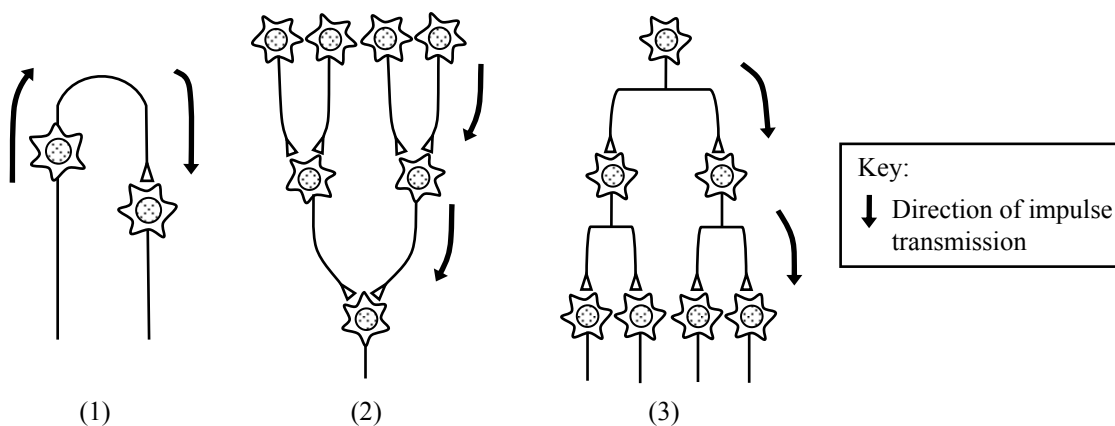
- A. 0.2 M  
 B. 0.3 M  
 C. 0.4 M  
 D. 0.5 M
2. A student tested lemon juice and rain water with pH paper. The result showed that the pH value of lemon juice was 2 and that of rain water was 6. What can he conclude?
- A. Rain water is more acidic than lemon juice.  
 B. The carbon dioxide in air dissolves slightly in water.  
 C. The number of hydrogen ions in lemon juice is greater than that in rain water.  
 D. The concentration of hydrogen ions in lemon juice is higher than that in rain water.
3. Which of the following statements explain(s) the formation of hydrogen bonds between water molecules?
- (1) A water molecule contains atoms of different elements.  
 (2) The oxygen atom in the water molecule has two lone pairs of electrons.  
 (3) The oxygen atom, bonded to the hydrogen atoms in the water molecule, is highly electronegative.
- A. (1) only  
 B. (2) only  
 C. (1) and (3) only  
 D. (2) and (3) only

4. Enzyme *X* catalyses a certain biochemical reaction in the human body. The activity of enzyme *X* at different temperatures is shown in the following graph:



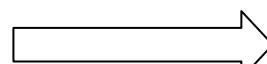
Which of the following can be concluded from the above graph?

- A. Enzyme *X* is denatured at 0°C.
  - B. The activity of enzyme *X* increases with temperature.
  - C. The activity of enzyme *X* is higher when we have a slight fever.
  - D. The activity of enzyme *X* is lower when we feel cold.
5. Diagrams (1), (2) and (3) show three types of synaptic connection between neurones.



Which of the following combinations correctly shows the types of synaptic connection involved in the nervous pathways below?

	<b>Impulses sent from cerebrum to effectors to pick a ball</b>	<b>Impulses sent from sense organs to cerebrum</b>	<b>Knee jerk reflex</b>
A.	(1)	(2)	(3)
B.	(2)	(3)	(1)
C.	(3)	(2)	(1)
D.	(3)	(1)	(2)



6. In a 100 metre sprint, a girl completed the first 35 m in 6.3 s. What was her average acceleration during this period?

- A.  $0.88 \text{ m s}^{-2}$
- B.  $1.76 \text{ m s}^{-2}$
- C.  $5.56 \text{ m s}^{-2}$
- D.  $11.1 \text{ m s}^{-2}$

**Directions:** Questions 7 and 8 refer to the following table, which shows the time for a sprinter to complete a 100 metre sprint recorded by five timekeepers:

Timekeeper	Time recorded (s)
<i>P</i>	13.6
<i>Q</i>	14.1
<i>R</i>	13.8
<i>S</i>	13.9
<i>T</i>	11.9

7. Whose time record is an outlier?

- A. *Q*
- B. *R*
- C. *S*
- D. *T*

8. Which of the following statements is/are correct?

- (1) The difference in time records is due to the difference in the timekeepers' reaction time.
- (2) The finishing time is the average of the five time records.
- (3) The use of a computerised timing system would eliminate errors caused by reaction time.

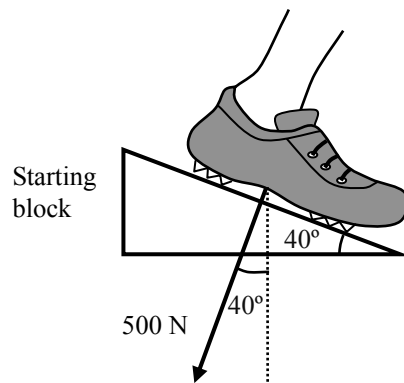
- A. (1) only
- B. (2) only
- C. (1) and (3) only
- D. (2) and (3) only

9. A dart of mass 0.02 kg hits a dart board at a speed of  $6.0 \text{ m s}^{-1}$ . It comes to a complete stop in 0.01 s. What is the impact force on the dart board?

- A. 3 N
- B. 6 N
- C. 12 N
- D. 36 N

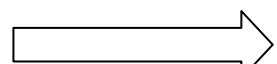


10. A sprinter of mass 60 kg exerts a force of 500 N onto a starting block inclined at an angle of  $40^\circ$  to the horizontal.

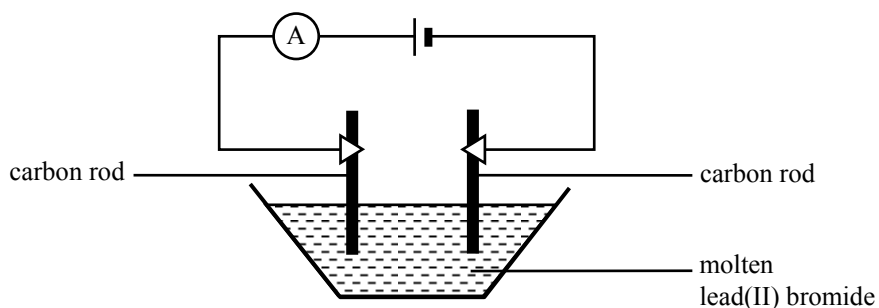


His forward acceleration is determined by:

- A.  $60 \times 500 \times \cos 40^\circ$   
 B.  $60 \times 500 \times \sin 40^\circ$   
 C.  $\frac{500 \times \cos 40^\circ}{60}$   
 D.  $\frac{500 \times \sin 40^\circ}{60}$
11. Tommy is running in a marathon. Which of the following is the main energy source for him in the middle of the race?
- A. ATP stored in the muscles  
 B. ATP/PC system  
 C. lactic acid system  
 D. aerobic system
12. Which of the following statements about atoms is correct?
- A. Atoms of different elements are distinguished by their mass numbers.  
 B. Atoms of an element cannot be transformed into atoms of another element.  
 C. Compounds are formed from atoms of different elements.  
 D. All atoms of an element are identical.
13. Which of the following substances have covalent bonds?
- (1) water  
 (2) hydrogen gas  
 (3) sodium chloride
- A. (1) and (2) only  
 B. (1) and (3) only  
 C. (2) and (3) only  
 D. (1), (2) and (3)

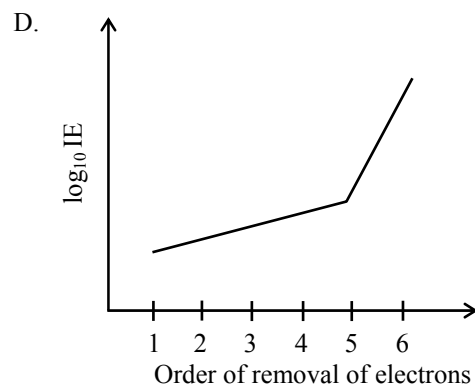
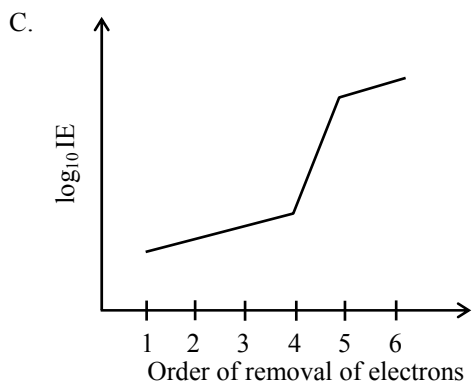
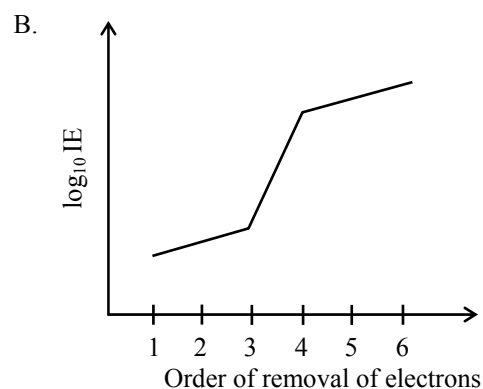
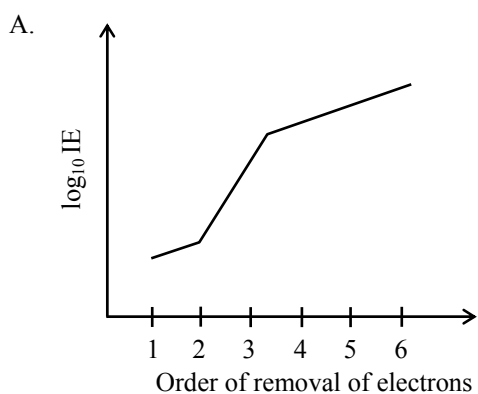


14. When electricity is applied to molten lead(II) bromide, a gas appears at the positive electrode and is formed at the negative electrode.



Which of the following statements can be inferred from this experiment?

- A. Molten lead(II) bromide contains mobile ions.
  - B. Lead(II) ions and bromide ions in lead(II) bromide are attracted to each other by ionic bonds.
  - C. Lead forms ions with two units of positive charges and bromine forms ions with one unit of negative charge.
  - D. Lead(II) ions are attracted to the positive electrode and bromide ions are attracted to the negative electrode.
15. Which of the following graphs correctly shows the variation of the first six ionisation energies ( $\log_{10} \text{IE}$ ) of a Group V element?

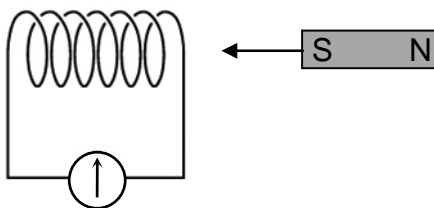


16. Elements  $A$  and  $B$  form an ionic compound with the chemical formula  $A_2B$ . Which of the following are the electron arrangements for atoms  $A$  and  $B$ ?

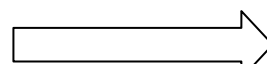
	Atom A	Atom B
(1)	2, 8, 1	2, 6
(2)	2, 8, 2	2, 8, 6
(3)	2, 8, 8, 1	2, 8, 7

- A. (1) only  
 B. (2) only  
 C. (1) and (3) only  
 D. (2) and (3) only
17. Which of the following trends in the properties of Group VII elements is correct?
- A. The melting point decreases down the group.  
 B. The atomic size decreases down the group.  
 C. The reactivity decreases down the group.  
 D. The density decreases down the group.

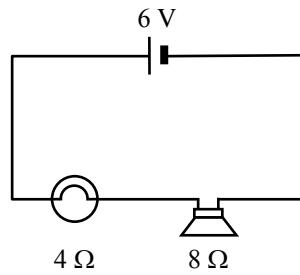
18. The following figure shows a magnet moving towards a coil, which is connected to a centre-zero galvanometer. The pointer of the galvanometer deflects to the right.



- Which of the following would cause the pointer to deflect to the left?
- (1) moving the magnet away from the coil  
 (2) using a stronger magnet  
 (3) reducing the speed of the magnet
- A. (1) only  
 B. (2) only  
 C. (1) and (3) only  
 D. (2) and (3) only
19. Which of the following is an application of electromagnetic induction?
- A. generator  
 B. fuel cell  
 C. motor  
 D. electromagnet



20. The circuit of a toy consists of a battery, a light bulb and a speaker. The resistances of the light bulb and the speaker are  $4\ \Omega$  and  $8\ \Omega$  respectively.



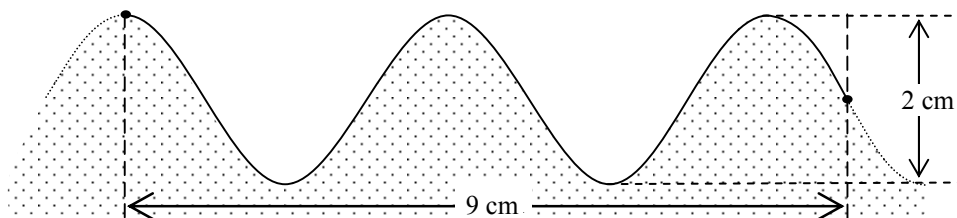
What is the power output of the speaker?

- A. 0.5 W
  - B. 2.0 W
  - C. 3.0 W
  - D. 4.5 W
21. Some specifications of Susan's monitor are shown below:

Voltage	AC 120 / 230 V
Power (operational)	45 W
Power (standby)	2 W

Susan uses the monitor 6 hours every day. Instead of switching off the monitor, she leaves it in standby mode after use. What is the extra cost of electricity in 365 days due to not switching the monitor off?  
(Given: Each unit of electricity (kWh) costs \$0.8.)

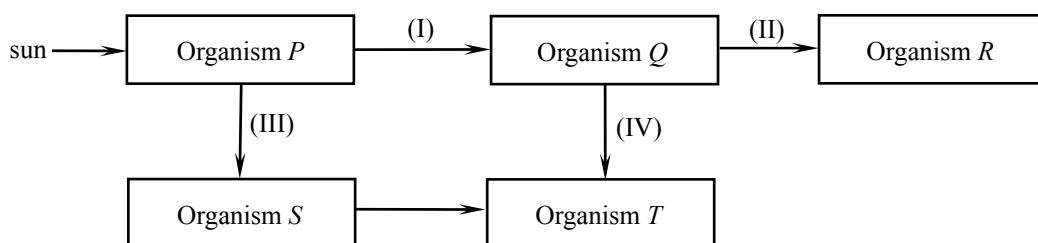
- A. \$ 3.5
  - B. \$ 10.5
  - C. \$ 75.3
  - D. \$ 226.0
22. The following figure shows a water wave travelling to the right at a speed of  $24\ \text{cm s}^{-1}$ .



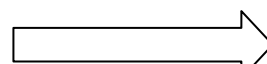
What is the wavelength of this water wave?

- A. 1 cm
- B. 2 cm
- C. 4 cm
- D. 4.5 cm

**Directions:** Questions 23 and 24 refer to the following diagram, which shows the energy flow among groups of organisms in a food web in an ecosystem:



23. Which organism(s) is/are the primary consumer(s) in this food web?
- $P$  only
  - $Q$  and  $R$  only
  - $Q$  and  $S$  only
  - $R$  and  $T$  only
24. If organism  $P$ 's population stores 100 000 units of energy in their biomass, which of the following descriptions of the energy transfer is/are correct?
- The energy transferred via (I) is more than that via (II).
  - The energy transferred via (II) and (IV) is the same.
  - The sum of the energy transferred via (I) and (III) is 100 000 units.
- (1) only
  - (2) only
  - (1) and (3) only
  - (2) and (3) only
25. Which of the following shows that visible light is a kind of wave?
- It can be spread into different colour bands through a prism.
  - Its intensity decreases with distance from the light source.
  - It travels through a vacuum.
  - It shows interference.
26. Which of the following are the uses of ultraviolet light?
- detecting watermarks in banknotes
  - sterilising drinking water
  - killing cancer cells
- (1) and (2) only
  - (1) and (3) only
  - (2) and (3) only
  - (1), (2) and (3)



27. Which of the following processes will give out energy?

- (1)  $\alpha$  decay of americium
- (2) synthesis of ATP from ADP
- (3) decay of organic matter by decomposers

- A. (1) and (2) only
- B. (1) and (3) only
- C. (2) and (3) only
- D. (1), (2) and (3)

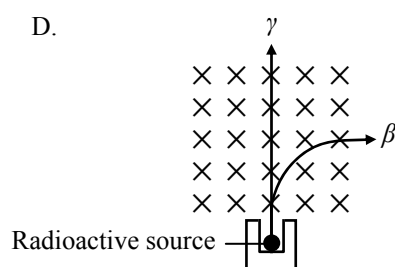
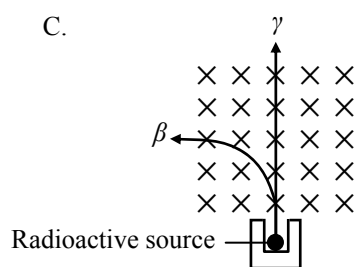
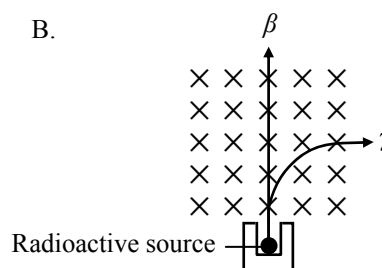
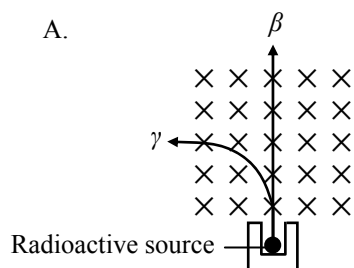
28. A microwave oven operates at a power of 650 W with microwaves of frequency  $2.45 \times 10^9$  Hz. What is the number of photons emitted by the microwave oven per second?

(Given: Planck constant =  $6.63 \times 10^{-34}$  J s)

- A.  $9.47 \times 10^{20}$
- B.  $4.00 \times 10^{26}$
- C.  $5.69 \times 10^{39}$
- D.  $2.40 \times 10^{45}$

29. A radioactive source emits both  $\beta$  and  $\gamma$  radiation. Which of the following diagrams shows the correct paths of a  $\beta$  particle and  $\gamma$  radiation when they enter a uniform magnetic field?

(Note: The magnetic field is pointing into the paper, denoted by  $\times$  in the diagrams.)



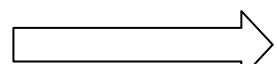
30. Which of the following is the complementary DNA sequence for 5'-GCTAATCGAACAAG-
- A. 3'-ATCGGCTAGGTGGA-5'
  - B. 3'-CGATTAGCTTGTTTC-5'
  - C. 3'-CGAUUAGCUUGUUC-5'
  - D. 5'-CGATTAGCTTGTTTC-3'
31. If an mRNA sequence has 1200 nucleotides from the start codon to the stop codon inclusive, how many amino acids does the polypeptide translated from this mRNA sequence have?
- A. 398
  - B. 399
  - C. 400
  - D. 1200
32. *X*, *Y* and *Z* are individuals who claim to be the biological children of Mr. Lee. The following table shows some results of a paternity test conducted on these people:

Subject	Locus <i>P</i>	Locus <i>Q</i>	Locus <i>R</i>
Mr. Lee	12, 16	33	9, 11
<i>X</i>	12,16	33	11
<i>Y</i>	16	33	9
<i>Z</i>	12	33	12

Based on the above table, who are likely to be the biological children of Mr. Lee?

- A. *X* and *Y* only
- B. *X* and *Z* only
- C. *Y* and *Z* only
- D. *X*, *Y* and *Z*

**END OF SECTION A**

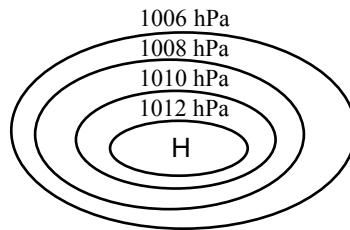


## SECTION B

Answer any **TWO** questions. Write your answers in the answer book provided.

## 1. Energy, Weather and Air Quality

- (a) Figure 1.1 shows a high pressure region in the northern hemisphere.



**Figure 1.1**

- (i) Explain the development of a high pressure region with reference to the surface temperature of the region. (3 marks)
- (ii) State the cause of the Coriolis effect. (1 mark)
- (iii) Copy Figure 1.1 into the answer book. Draw arrows to show the direction of air flow. (1 mark)
- (b) Figure 1.2 shows a map. Siberia is a large area of continental land mass north of China.



**Figure 1.2**

- (i) Siberia's land is covered with a highly reflective icy surface during most days in winter.
- (1) Hence, explain, in terms of surface-atmosphere radiation exchange, why the average temperature of Siberia during the daytime in winter is persistently very low ( $-20^{\circ}\text{C}$ ). (3 marks)
- (2) Explain why the air in Siberia is drier in winter than in summer. (1 mark)
- (ii) With reference to the locations of Siberia and Hong Kong as shown on the map, state and explain the prevailing wind pattern during winter in Hong Kong. (3 marks)



- (c) A sandstorm occurs when strong wind blows loose sand and dust from a desert. The air-borne particles in a sandstorm are mainly respirable suspended particulates (RSP). These particulates can be transported over long distances causing the air quality of affected areas to become poor.
- (i) State **one** effect of RSP on human health. (1 mark)
- (ii) On the weather chart in Figure 1.3, the mass of fine particles that battered Taiwan on 21 March 2010 is shown. Figure 1.4 shows the RSP concentrations measured during the period of 21 to 23 March 2010 from the general air quality monitoring station at Tap Mun, a rural island in Hong Kong's waters.

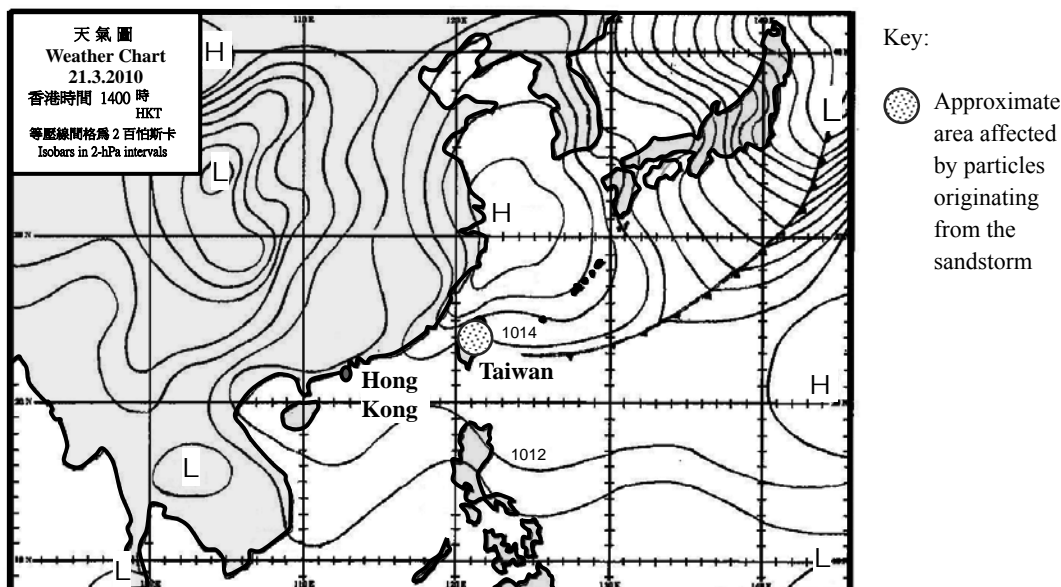


Figure 1.3

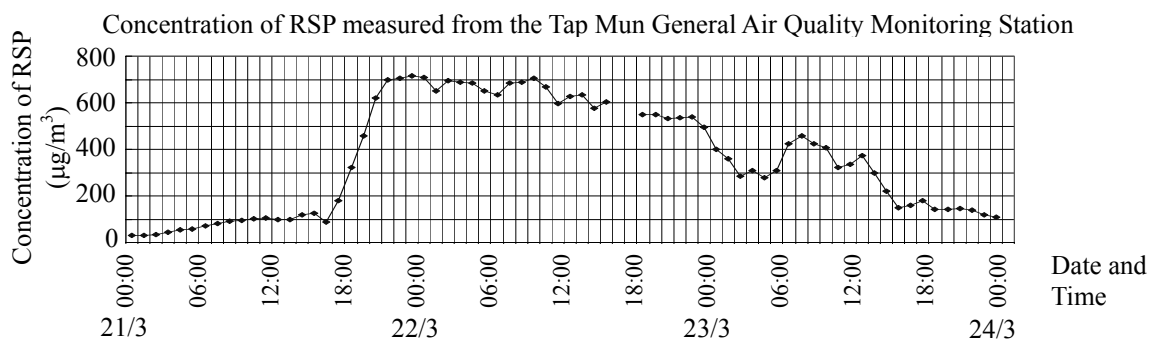
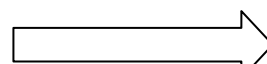


Figure 1.4

- (1) As shown in Figure 1.4, there was a rise in RSP concentration from 16:30 to 21:30 on 21 March in Hong Kong. With reference to Figure 1.3, identify the weather system that caused the rise in RSP concentration in Hong Kong. Explain how this weather system caused the rise. (3 marks)
- (2) The concentration of RSP remained at a high level in Hong Kong on 22 March. The visibility on that day was low. Account for the low visibility on that day with respect to the RSP concentration. (2 marks)
- (3) The Hong Kong Observatory forecast that there would be rainfall in the few days following 22 March. Explain the effect of the rainfall on the air quality. (2 marks)



## 2. Keeping Ourselves Healthy

- (a) Dengue fever is a mosquito-borne viral disease.
- (i) In the past, some investigators conducted a test to study whether the mosquito was the vector of dengue fever. They allowed some mosquitoes to bite patients with dengue fever. After 7 days, these mosquitoes were taken to dengue-free areas and were allowed to bite volunteers there.
- (1) Why was it necessary for the latter part of the study to be conducted in dengue-free areas? (1 mark)
  - (2) Describe a non-specific defence response of the body when the dengue virus was transmitted to the volunteer. (2 marks)
  - (3) There are different subtypes of dengue virus. Explain why a person who has recovered from dengue fever caused by a particular subtype of the dengue virus will develop immunity to that subtype. (3 marks)
- (ii) Figure 2.1 shows the average annual number of dengue fever cases reported to the World Health Organisation (WHO) and the average annual number of countries reporting dengue fever from 1955 to 2007. Figure 2.2 shows the global average air temperature over the same period.

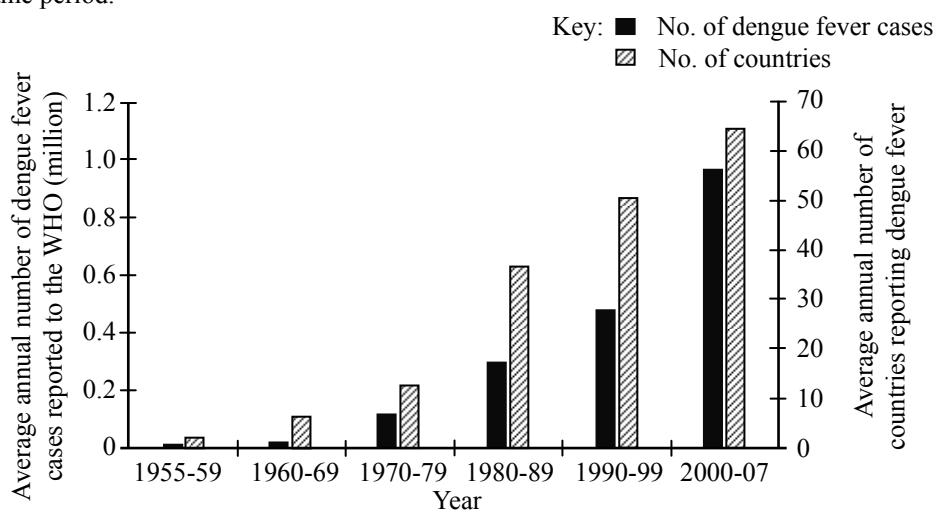


Figure 2.1

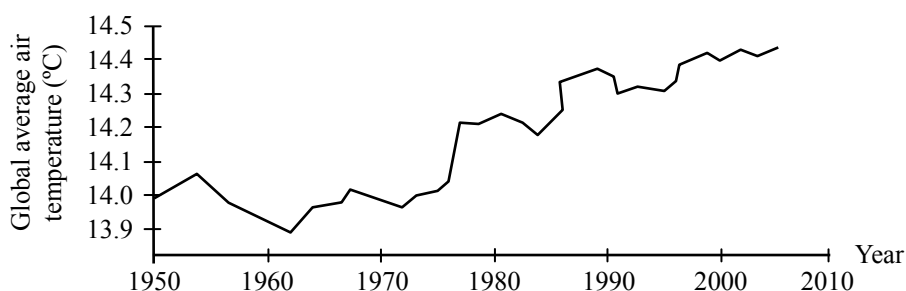


Figure 2.2

- (1) What relationship between the incidence of dengue fever and global average air temperature can be observed from the trends shown in Figures 2.1 and 2.2? (1 mark)
- (2) With reference to the trends shown in the above figures, predict and explain how global warming may affect the spread of dengue fever. (3 marks)

- (iii) An understanding of the life cycle of the mosquito (Figure 2.3) helps in the control of dengue fever.

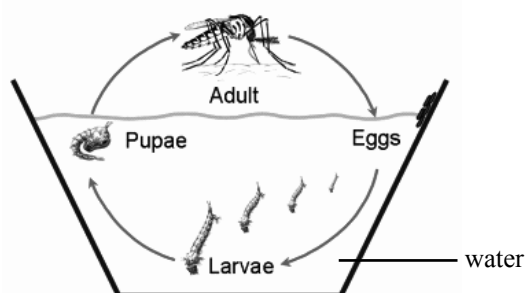


Figure 2.3

Spraying insecticide is an undesirable way of controlling dengue fever. With reference to the life cycle of the mosquito, explain a practical way to control the spread of dengue fever in areas with a high mosquito population. (2 marks)

- (b) Liver cancer is one of the leading causes of cancer death in Hong Kong. Epidemiological studies help to reveal its distribution in the population and its risk factors.

- (i) Figure 2.4 shows the crude incidence rate (number of new cases per 100000 population) of liver cancer in males and females in Hong Kong from 2001 to 2007.

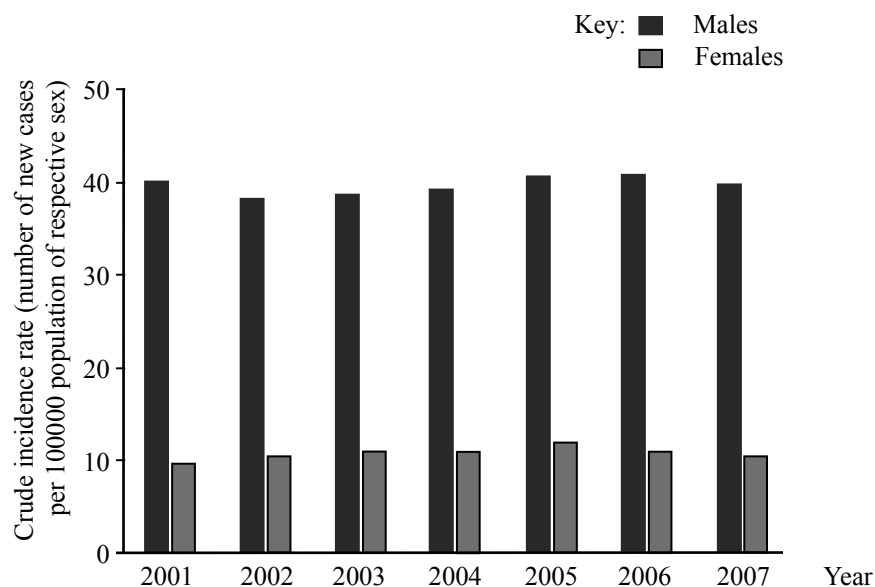
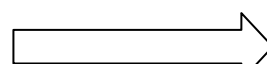


Figure 2.4

Which sex is more prone to liver cancer? Support your answer with evidence from Figure 2.4. (1 mark)

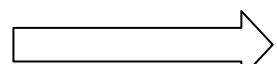


- (ii) In a study to identify the risk factors for liver cancer, 107 liver cancer patients, 107 sex- and age-matched people without liver cancer (i.e. the control group) were interviewed. The table below shows the data of some factors investigated, including smoking, infection by hepatitis B virus (HBV) and fruit consumption:

Group	No. of liver cancer patients	No. in the control group	Probability of liver cancer	Relative risk
Smokers	80	21	0.792	3.31
Non-smokers	27	86	0.239	
People infected with HBV	88	17	0.838	x
People not infected with HBV	19	90	0.174	
People consuming fruit frequently	89	93	0.489	y
People consuming little or no fruit	18	14	0.563	

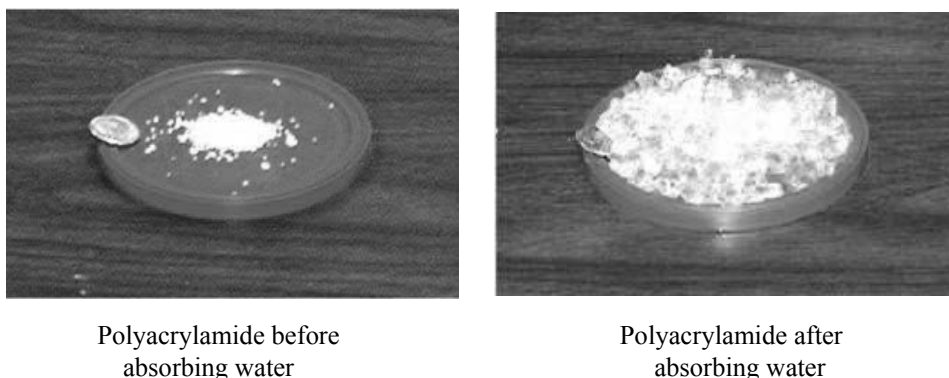
- (1) Calculate the relative risk of getting liver cancer for those infected with HBV ( $x$ ) and the relative risk of getting liver cancer for those who frequently consume fruit ( $y$ ).  
(2 marks)
  - (2) In this study, smoking was concluded to be a risk factor for liver cancer. Hence, determine whether infection by HBV and consumption of fruit are risk factors.  
(1 mark)
  - (3) Why is it that smoking can be shown from the results of this study to be only a 'risk factor' but not a 'cause' of liver cancer?  
(2 marks)
- (iii) Liver transplantation is a possible treatment for liver cancer. Patients adopting this treatment will be kept in an isolation ward and given medicines that suppress the immune system before and after surgery. Explain why these practices are essential. (2 marks)

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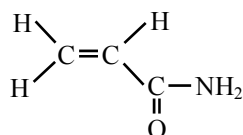


### 3. Chemistry for World Needs

- (a) Polyacrylamide is a water absorbing synthetic polymer. It can absorb water up to a hundred times its own volume. Figure 3.1 shows a sample of polyacrylamide before and after absorbing water. Figure 3.2 shows the structure of the monomer of polyacrylamide.

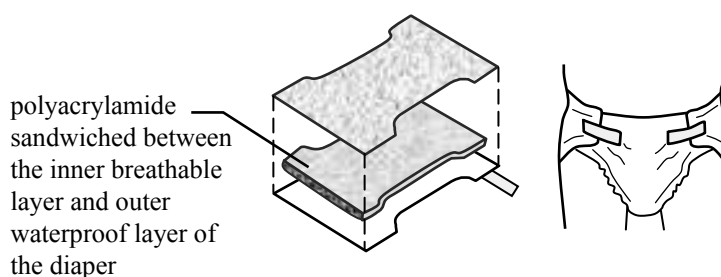


**Figure 3.1**



**Figure 3.2**

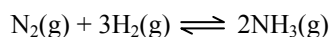
- (i) State the type of polymerisation involved in the formation of polyacrylamide. Hence, draw the structure of polyacrylamide. (2 marks)
- (ii) Suggest why polyacrylamide has a high affinity for water. (2 marks)
- (iii) Cellulose was used as the water absorbing material in disposable baby diapers. However, polyacrylamide's very high affinity for water makes it the most commonly used material in baby diapers now (Figure 3.3).



**Figure 3.3**

- (1) In addition to water absorbency and cost, state **one** factor that should be considered when choosing a water absorbing material for making baby diapers. (1 mark)
- (2) Diapers using cellulose as the water absorbing material are more environmentally friendly than those using polyacrylamide. Give **two** reasons. (2 marks)
- (3) In some places, farmers mix polyacrylamide into soil. Suggest **two** advantages of this practice for agriculture. (2 marks)

- (b) In the early twentieth century, Fritz Haber invented the Haber process, which is based on the following reaction:



- (i) The Haber process is usually operated at a high pressure (about 200 atm), a high temperature (about 450°C) and in the presence of an iron catalyst. The yield of ammonia from nitrogen at these conditions is about 15%.
- (1) What does the sign ' $\rightleftharpoons$ ' in the equation stand for? Hence, explain why the yield of the reaction is never 100%. (2 marks)
  - (2) It is more costly to operate the process at a pressure of 200 atm than under atmospheric pressure. Explain, in terms of gaseous volume, why the Haber process is operated at a high pressure. (3 marks)
- (ii) Fritz Haber was awarded a Nobel Prize in 1918 for his invention of the Haber process. Up till now, the Haber process is still the only industrial means to fix atmospheric nitrogen into soluble nitrogen compounds. The product,  $\text{NH}_3$ , is used in making fertilisers.
- (1) Explain, in terms of chemical bonding, why it is difficult to convert molecules of nitrogen into other compounds. (2 marks)
  - (2) Describe **one** natural process by which atmospheric nitrogen is fixed. (2 marks)
  - (3) Although the use of fertilisers can increase crop yield, excessive use of fertilisers can cause environmental problems. Describe the effects on aquatic life when nitrogen fertilisers are washed into a lake. (2 marks)

### END OF PAPER

Sources of materials used in this paper will be acknowledged in the *Hong Kong Diploma of Secondary Education Examination Practice Papers* published by the Hong Kong Examinations and Assessment Authority at a later stage.

**List of formulae and relationships**

- C1  $E = mc \Delta T$  energy transfer during heating and cooling  
 $E = l \Delta m$  energy transfer during change of state
- C3 For uniformly accelerated linear motion:  
 $v = u + at$   
 $s = ut + \frac{1}{2}at^2$   
 $v^2 = u^2 + 2as$   
 $F = ma$  force
- C5  $R = R_1 + R_2$  resistors in series  
 $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$  resistors in parallel  
 $E = I^2Rt$  electrical energy  
 $P = IV = I^2R$  power in a circuit
- C7  $E = hf$  energy of a photon  
 $E = mc^2$  mass-energy relationship



## 鳴謝 Acknowledgements

本專輯的試題曾引用下列刊物的資料：

Material from the following publications has been used in question papers in this volume:

Hong Kong Observatory	Image: weather map at 1400 hr on 21/3/2010
World Health Organisation	Image: graph <a href="http://www.searo.who.int/linkfiles/dengue_dhf_pcg_ch2.pdf">http://www.searo.who.int/linkfiles/dengue_dhf_pcg_ch2.pdf</a>
Department of Health	Image: graph <a href="http://www.chp.gov.hk/en/content/9/25/52.html">http://www.chp.gov.hk/en/content/9/25/52.html</a>

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