

ST. PAUL'S COLLEGE
F.5 Mid-year Examination Sample Paper
CHEMISTRY

Name _____

Form 5 _____ Class No. _____

Time allowed : **2 hours**

Instructions

1. Answer **ALL** questions.
2. There are **TWO** sections in this paper, Section A and Section B.
3. Section A consists of 30 multiple-choice questions.
4. Section B consists of 3 conventional questions.
5. An asterisk (*) has been put next to the questions where one mark will be awarded for effective communication.

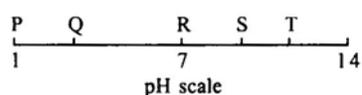
Section	Question No.	Marks
A	–	
B	1	
	2	
	3	
	Total	

Section A

1. Answer all questions by filling in the multiple choice answer sheet.
2. Mark your answers in pencil.

1. Which of the following about dilute sulphuric acid is correct?
 - A. It reacts with copper when heated.
 - B. It reacts with copper(II) oxide to form a blue solution.
 - C. It reacts with sodium carbonate to form salt and water only.
 - D. 1 mole of sulphuric acid reacts with excess magnesium to form 2 moles of hydrogen gas.
2. What is the pH value of 0.0500 M ethanoic acid?
 - A. < 0.70
 - B. 0.70
 - C. 1.30
 - D. > 1.30
3. In a solution of sodium carbonate and sodium chloride, the concentration of sodium ions is 1.30 M and the concentration of carbonate ions is 0.40 M. What is the concentration of chloride ions?
 - A. 0.30 M
 - B. 0.50 M
 - C. 0.70 M
 - D. 1.00 M
4. What is the mass of hydrated sodium carbonate ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$) required to prepare 250.0 cm^3 of 0.0800 M sodium carbonate solution?
(Relative atomic masses: H = 1.0, C = 12.0, O = 16.0, Na = 23.0)
 - A. 2.12 g
 - B. 5.26 g
 - C. 5.72 g
 - D. 22.9 g

5. The pH scale below shows the position of five aqueous solutions P, Q, R, S and T, of equal molarities.



What could the aqueous solutions be?

	Ethanoic acid	Sulphuric acid	Ammonia	Sodium chloride	Sodium hydroxide
A.	P	Q	R	S	T
B.	Q	P	S	R	T
C.	Q	P	T	S	R
D.	S	T	Q	R	P

6. Which method could be used to prepare a pure sample of barium sulphate from dilute sulphuric acid?
 - A. Add barium chloride solution, filter, wash and dry the residue.
 - B. Add an excess of barium carbonate, filter, crystallise the filtrate.
 - C. Add an excess of barium hydroxide, filter, crystallise the filtrate.
 - D. Add an excess of barium carbonate, filter, wash and dry the residue.

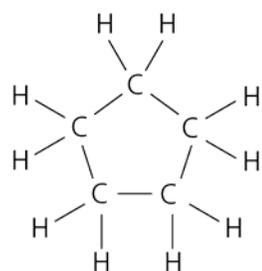
7. Which of the following compounds can be used as antacid?
- (1) Limewater
 - (2) Calcium oxide
 - (3) Potassium hydroxide
 - (4) Aluminium hydroxide
- A. (1) and (2) only
 - B. (1) and (4) only
 - C. (2) and (3) only
 - D. (3) and (4) only
8. Five students each dissolved an indigestion tablet in 100 cm³ of water. Then they titrated 25.0 cm³ of their solutions with dilute hydrochloric acid, using the same indicator. The results are shown in the table below.

Student	1	2	3	4	5
Volume of hydrochloric acid used / cm ³	20.40	20.50	20.45	20.60	22.00

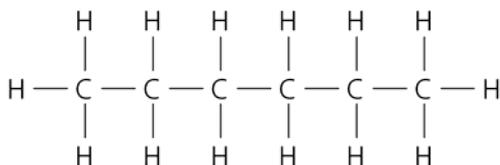
- Which of the following could explain the result obtained by student 5?
- A. The pipette was washed with the tablet solution.
 - B. The burette was washed with hydrochloric acid.
 - C. The conical flask was washed with the tablet solution.
 - D. The student measured to the top of the meniscus in the pipette.
9. 25.0 cm³ of 0.500 M sodium hydroxide solution is used to completely neutralise 15.0 cm³ of a solution of a dibasic acid. The concentration of the acid is
- A. 0.208 M.
 - B. 0.417 M.
 - C. 0.833 M.
 - D. 1.67 M.
10. Which of the following apparatus is NOT required in the preparation of a standard solution of ethanedioic acid from its crystals?
- A. pipette
 - B. weighing bottle
 - C. volumetric flask
 - D. electronic balance
11. Which of the following statements about coal are correct?
- (1) It originates from plants which died and were buried underground millions of years ago.
 - (2) It is the most abundant fossil fuels on the Earth.
 - (3) It is a non-renewable energy source.
- A. (1) and (2) only
 - B. (1) and (3) only
 - C. (2) and (3) only
 - D. (1), (2) and (3)

12. Which of the following are aliphatic hydrocarbons?

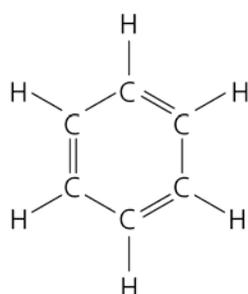
(1)



(2)



(3)



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

13. Which of the following is NOT obtained from the fractional distillation of petroleum?

- A. Liquefied petroleum gas
B. Natural gas
C. Kerosene
D. Lubricating oil

14. Electrostatic precipitators are installed in chimneys of power stations to reduce the emission of

- A. carbon monoxide.
B. sulphur dioxide.
C. nitrogen dioxide.
D. carbon soot.

15. Which of the following gases are responsible for global warming?

- (1) Chlorofluorocarbons
(2) Nitrogen oxides
(3) Carbon monoxide
A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

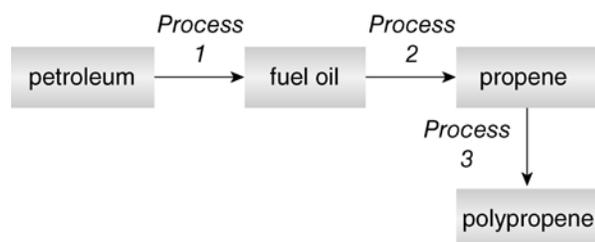
16. Which of the following statements concerning the members of a homologous series is INCORRECT?

- A. The members can be represented by the same general formula.
B. The relative molecular mass of each successive member differs by 14.
C. The members have the same chemical properties.
D. The members show a gradual change in physical properties.

17. Which of the following homologous series does $\text{CH}_3\text{CH}_2\text{OH}$ belong to?

- A. Alkanes
- B. Alkanols
- C. Alkenes
- D. Alkanoic acids

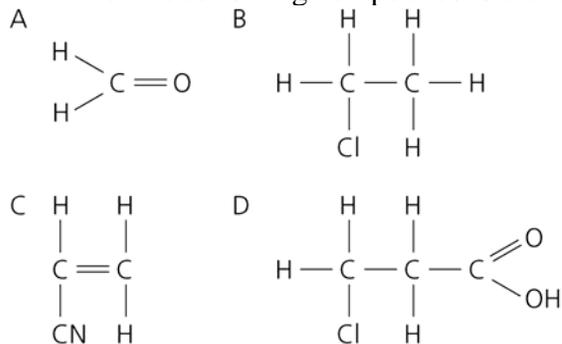
18. The following flow diagram shows how polypropene can be made from petroleum.



Which of the following combinations is CORRECT?

- | | <u>Process 1</u> | <u>Process 2</u> | <u>Process 3</u> |
|----|-------------------------|------------------|------------------|
| A. | Fractional distillation | Cracking | Condensation |
| B. | Fractional distillation | Cracking | Polymerization |
| C. | Cracking | Dehydration | Condensation |
| D. | Cracking | Dehydration | Polymerization |

19. Which of the following compounds is the most likely to undergo addition polymerization?



20. Which of the following pairs of species are trigonal planar?

- A. PBr_3 , PCl_3
- B. NH_3 , BF_3
- C. BF_3 , COCl_2
- D. NH_3 , COCl_2

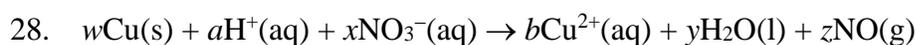
21. In which of the following sets does the bond angle around the central atom in the second species larger than that in the first?

- A. SiH_4 , NH_3
- B. NH_3 , H_2S
- C. CS_2 , SiF_4
- D. SO_2 , CS_2

22. Which of the following lists of compounds is in order of *increasing* boiling point?

- A. $\text{H}_2\text{O} < \text{CH}_3\text{CH}_2\text{OH} < \text{CH}_3\text{CH}_2\text{-O-CH}_2\text{CH}_3$
- B. $\text{H}_2\text{O} < \text{CH}_3\text{CH}_2\text{-O-CH}_2\text{CH}_3 < \text{CH}_3\text{CH}_2\text{OH}$
- C. $\text{CH}_3\text{CH}_2\text{-O-CH}_2\text{CH}_3 < \text{H}_2\text{O} < \text{CH}_3\text{CH}_2\text{OH}$
- D. $\text{CH}_3\text{CH}_2\text{-O-CH}_2\text{CH}_3 < \text{CH}_3\text{CH}_2\text{OH} < \text{H}_2\text{O}$

23. The oxidation number of copper in $[\text{Cu}(\text{NH}_3)_4]^{2+}$ is
- +4.
 - +2.
 - 0.
 - +6.
24. Each of the following equations represents a redox reaction except
- $2\text{Fe} + 3\text{Cl}_2 \rightarrow 2\text{FeCl}_3$
 - $2\text{Li} + 2\text{H}_2\text{O} \rightarrow 2\text{LiOH} + \text{H}_2$
 - $\text{Pb}(\text{NO}_3)_2 + \text{H}_2\text{SO}_4 \rightarrow \text{PbSO}_4 + 2\text{HNO}_3$
 - $3\text{NaOH} + 4\text{P} + 3\text{H}_2\text{O} \rightarrow \text{PH}_3 + 3\text{NaH}_2\text{PO}_2$
25. In which of the following reactions does hydrogen peroxide act as a reducing agent?
- $\text{PbO}_2(\text{s}) + \text{H}_2\text{O}_2(\text{aq}) \rightarrow \text{PbO}(\text{s}) + \text{H}_2\text{O}(\text{l}) + \text{O}_2(\text{g})$
 - $\text{H}_2\text{S}(\text{aq}) + \text{H}_2\text{O}_2(\text{aq}) \rightarrow \text{S}(\text{s}) + 2\text{H}_2\text{O}(\text{l})$
 - $\text{H}_2\text{SO}_3(\text{aq}) + \text{H}_2\text{O}_2(\text{aq}) \rightarrow \text{H}_2\text{SO}_4(\text{aq}) + \text{H}_2\text{O}(\text{l})$
 - $\text{PbS}(\text{s}) + 4\text{H}_2\text{O}_2(\text{aq}) \rightarrow \text{PbSO}_4(\text{s}) + 4\text{H}_2\text{O}(\text{l})$
26. In the reaction $\text{I}_2(\text{aq}) + 2\text{S}_2\text{O}_3^{2-}(\text{aq}) \rightarrow 2\text{I}^-(\text{aq}) + \text{S}_4\text{O}_6^{2-}(\text{aq})$,
- $\text{I}_2(\text{aq})$ is reduced to $\text{I}^-(\text{aq})$.
 - $\text{I}_2(\text{aq})$ is a reducing agent.
 - $\text{S}_2\text{O}_3^{2-}(\text{aq})$ is an oxidizing agent.
 - the oxidation number of oxygen is changed.
- (1) only
 - (3) only
 - (1) and (2) only
 - (3) and (4) only
27. From the following equations:
- $$\text{Cl}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) + \text{SO}_2(\text{g}) \rightarrow 2\text{HCl}(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq})$$
- $$\text{Cl}_2(\text{g}) + \text{H}_2\text{S}(\text{g}) \rightarrow 2\text{HCl}(\text{g}) + \text{S}(\text{s})$$
- $$\text{SO}_2(\text{g}) + 2\text{H}_2\text{S}(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + 3\text{S}(\text{s})$$
- We can deduce that of the three gases, Cl_2 , SO_2 , and H_2S , the strongest oxidizing and reducing agents are respectively
- Cl_2 and SO_2 .
 - Cl_2 and H_2S .
 - SO_2 and Cl_2 .
 - H_2S and Cl_2 .



The values of w , x , y and z should be

- A. 3, 4, 4, 2.
- B. 3, 6, 2, 2.
- C. 3, 4, 2, 1.
- D. 3, 2, 4, 2.

Directions: Each question below (Question Nos. 29 to 30) consists of two separate statements. Decide whether each of the two statements is true or false; if both are true, then decide whether or not the second statement is a *correct* explanation of the first statement. Then select one option from A to D according to the following table:

A.	Both statements are true and the 2nd statement is a correct explanation of the 1st statement.
B.	Both statements are true but the 2nd statement is NOT a correct explanation of the 1st statement.
C.	The 1st statement is false but the 2nd statement is true.
D.	Both statements are false.

	1st statement	2nd statement
29.	Methyl orange is a suitable indicator for weak acid-strong alkali titration.	Methyl orange is yellow in acidic medium and red in alkaline medium.
30.	A conical flask must be dried completely before it is filled with the solution to be titrated.	Any water present in the conical flask will dilute the solution it is to contain.

– END OF SECTION A –

Section B

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

1. (a) Suggest a chemical test to distinguish between copper(II) nitrate solution and iron(III) nitrate solution. In your answers, you should include
- (1) appropriate reagents and conditions (if necessary);
 - (2) observations for both compounds; and
 - (3) all chemical equation(s) for the reactions involved.

(5 marks)

- (b) Instructions for preparing hydrated crystals of magnesium sulphate are given below.

Add one spatula measure of magnesium carbonate to 50 cm³ of dilute sulphuric acid. Add further amounts (1) until no more will dissolve. Then (2) filter the mixture. Evaporate the filtrate to (3) about half its volume. Allow the (4) filtrate to cool. Filter to obtain the crystals. Wash the crystals with (5) small amount of cold distilled water. Dry them on filter paper. (6) Do not heat the crystals.

Explain the purpose of the six underlined instructions.

- (1) _____

- (2) _____

- (3) _____

- (4) _____

- (5) _____

- (6) _____

(6 marks)

- (c) A chemist carried out an experiment to determine the percentage by mass of nitrogen in a sample of nitrogenous fertilizer, which contained ammonium ions as the only source of nitrogen. The experiment consisted of three stages.

Stage 1 4.65 g of the sample were dissolved in distilled water and then made up to 250.0 cm³.

Stage 2 25.0 cm³ of this solution were heated with 25.0 cm³ of 0.250 mol dm⁻³ sodium hydroxide solution until no more ammonia gas was evolved.

Stage 3 The resulting solution was titrated against 0.200 mol dm⁻³ hydrochloric acid. 16.20 cm³ of the acid were required to reach the end point.

- **(i)* Briefly describe how the 250.0 cm³ solution was made up in *Stage 1*. (5 marks)

(ii) Write an *ionic* equation for the reaction that occurred in *Stage 2*. (1 mark)

(iii) (1) Based on the titration result in *Stage 3*, calculate the number of moles of sodium hydroxide left in 25.0 cm³ of the resulting solution.

(2) Calculate the number of moles of sodium hydroxide reacted with the ammonium ions in 25.0 cm³ of the solution in *Stage 2*.

- (3) Calculate the percentage by mass of nitrogen in the fertilizer.
(Relative atomic mass: N = 14.0)

(8 marks)

2. (a) The table below shows the melting points and boiling points of the first four members of the alkane series.

Alkane	Melting point (°C)	Boiling point (°C)
Methane	-182	-162
Ethane	-183	-89
Propane	-190	-42
Butane	-138	-0.5

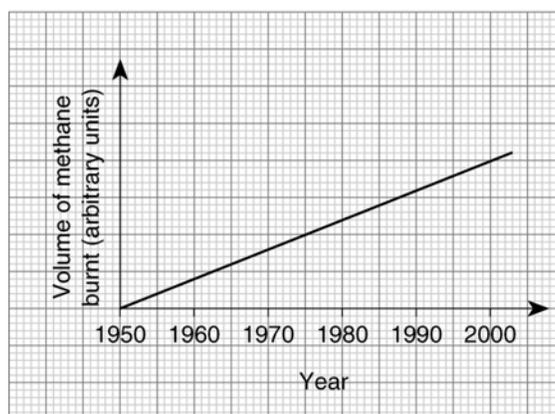
- (i) Which of the above alkanes exist(s) as a gas at $-100\text{ }^{\circ}\text{C}$?

- (ii) State and explain the trend of the boiling points of alkanes.

- (iii) State ONE other physical property of alkanes which shows the same trend as boiling point.

(5 marks)

- (iv) Scientists know that during the last 100 years, average world temperatures have risen by about $1\text{ }^{\circ}\text{C}$. The graph shows the volume of methane burnt annually over the last 50 years.



Some scientists have linked the rise in the Earth's temperature with the volume of methane burnt as a fuel. Other scientists do not agree with this.

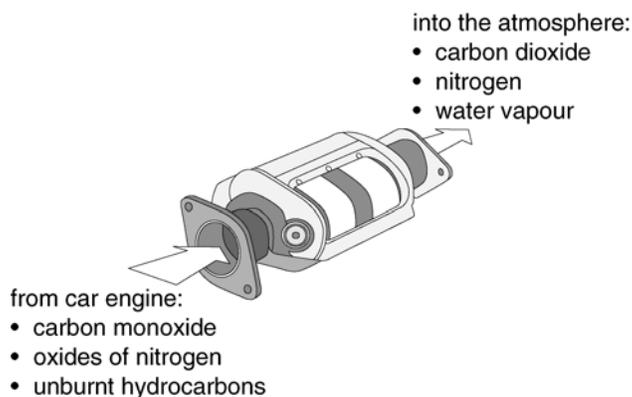
- (1) Write a chemical equation for the complete combustion of methane.

- (2) Use the graph to explain why scientists have linked the burning of methane with the rise in the Earth's temperature.

- (3) Suggest why other scientists do not agree that the burning of methane has caused the Earth's temperature to rise.

(3 marks)

- (b) The following picture shows a catalytic converter installed in a motor car.



- (i) Explain why the exhaust gas contains carbon monoxide.

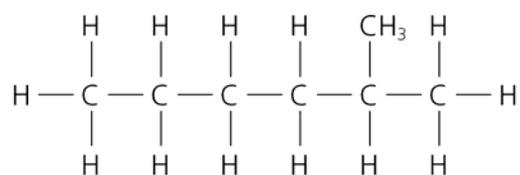
(ii) State ONE health hazard associated with carbon monoxide.

(iii) Explain why the exhaust gas contains oxides of nitrogen.

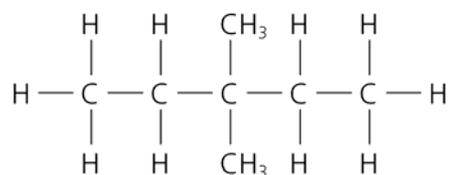
(iv) Name the type of pollution which is formed when oxides of nitrogen and unburnt hydrocarbons in the atmosphere are exposed to bright sunlight.

(4 marks)

(c) The following compounds have the same molecular formula, C_7H_{16} .



X



Y

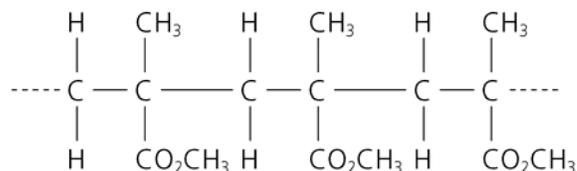
(i) Give the systematic names of X and Y.

(ii) Undecane ($C_{11}H_{24}$) can be cracked into ethene and a straight-chain alkane X such that the mole ratio of ethene to straight-chain alkane X is 2 to 1. Write a chemical equation for this reaction.

(iii) A student performed an experiment to crack undecane and collect the gaseous products with a boiling tube. He added a few drops of bromine (dissolved in an organic solvent) into the boiling tube containing the gaseous products. The orange colour of the bromine solution disappeared immediately. Explain the observation briefly.

(5 marks)

(d) Perspex can be used as a substitute for glass. Its structure is shown below:



(i) Write a chemical equation for the formation of Perspex from its monomers.

(ii) Perspex can be used instead of glass to make camera lenses.

(1) Why can Perspex be used as a substitute for glass?

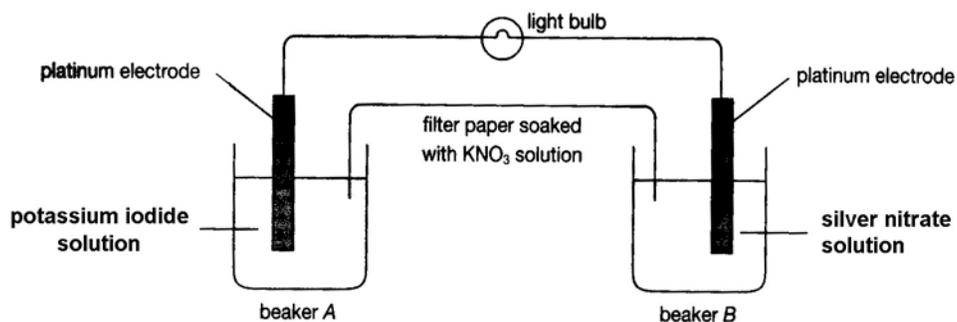
(2) State ONE advantage and ONE disadvantage of using Perspex instead of glass to make camera lenses.

(3) Determine the relative molecular mass of Perspex if the number of repeating units in each molecule of Perspex is 2500.
(Relative atomic masses: H = 1.0, C = 12.0, O = 16.0)

(iii) Suggest TWO reasons for recycling Perspex wastes.

(8 marks)

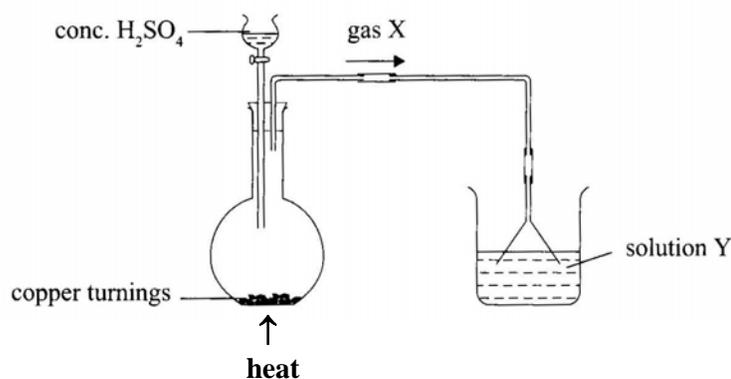
3. (a) A simple electrochemical cell is set up as follows. During the reaction, the light bulb lits and some brown coloration is seen around the electrode in beaker A.



- (i) Give the direction of the *current* flow.
-
- (ii) State any observable change in beaker B.
-
- (iii) Can sodium chloride solution be used to make the salt bridge? Briefly explain your answer.
-
-
- (iv) (1) Write an ionic half equation for the reaction taking place in beaker A.
-
- (2) Write an ionic half equation for the reaction taking place in beaker B.
-
- (v) Identify the anode in the cell above. Explain your answer.
-
-
- (vi) Which is the oxidizing agent in the above reaction? Explain your answer in terms of the change in oxidation number.
-
-
- (vii) Suggest what would be observed if potassium iodide solution and silver nitrate solution are mixed directly.
-
-

(11 marks)

- (b) A student uses the following set-up to prepare a solution Y by dissolving gas X in water.



- (i) Name gas X and solution Y.

- (ii) Explain why an inverted funnel is used instead of a delivery tube in dissolving gas X in the beaker.

- (iii) Write an equation for the reaction between copper turnings and concentrated sulphuric acid.

- (iv) (1) Describe what will be observed if excess solution Y is added to some potassium dichromate solution.

- (2) Write an ionic equation for the reaction in (1).

- (3) Explain the observation.

(9 marks)

- (c) Graphene is a crystalline form of carbon, alongside diamond, graphite, carbon nanotubes and fullerenes. In this material, carbon atoms are arranged in a regular hexagonal pattern. Graphene can be described as a one-atom thick layer of graphite.

- (i) Predict and explain the electrical conductivity of graphene.

(ii) What term can be used to describe the relationship of the different forms of carbon?

(iii) Based on the information in the paragraph,

(1) give ONE physical property (other than electrical conductivity) of graphene.

(2) suggest ONE application of graphene.

(5 marks)

– END OF SECTION B –

– END OF PAPER –