

# CHEMISTRY PAPER 1

8.30 am – 11.00 am (2 hours 30 minutes)

This paper must be answered in English.

## GENERAL INSTRUCTIONS

- 1 There are **TWO** sections, A and B, in this Paper. You are advised to finish Section A in about 45 minutes.
  - 2 Section A consists of multiple-choice questions in this question book, while Section B contains conventional questions printed separately in Question-Answer Book **B**.
  - 3 Answers to Section A should be marked on the Multiple-choice Answer Sheet while answers to Section B should be written in the spaces provided in Question-Answer Book **B**. **The Answer Sheet for Section A and the Question-Answer Book for Section B will be collected separately at the end of the examination.**
  - 4 A Periodic Table is printed on page 16 of Question-Answer Book **B**. Atomic numbers and relative atomic masses of elements can be obtained from the Periodic Table.
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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.

Not to be taken away before the  
end of the examination session

This section consists of two parts. There are 24 questions in PART I and 12 questions in PART II.

Choose the best answer for each question.

Candidates may refer to the Periodic Table printed on page 20 of Question-Answer Book

### PART I

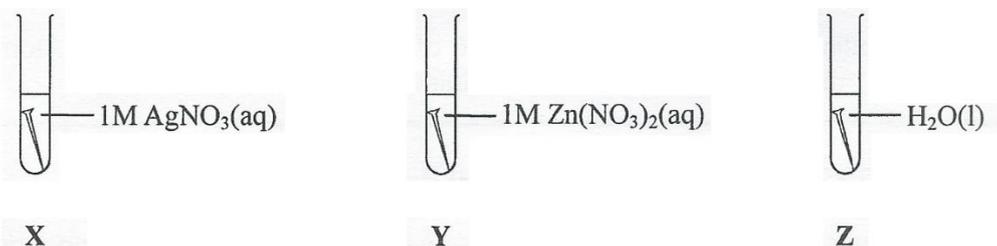
1. Which of the following atoms has the smallest number of neutrons ?

- A.  $^{63}\text{Cu}$
- B.  $^{59}\text{Co}$
- C.  $^{58}\text{Ni}$
- D.  $^{57}\text{Fe}$

2. Which of the following compounds has a giant ionic structure?

- A.  $\text{N}_2\text{O}_4$
- B.  $\text{HNO}_3$
- C.  $\text{NCl}_3$
- D.  $\text{NH}_4\text{NO}_3$

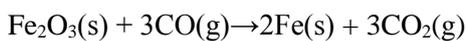
3. The diagram below shows three iron nails of the same size and shape each immersed in a liquid.



Which of the following arrangements represents the ascending order of rate of corrosion of the iron nails?

- A.  $Z < Y < X$
- B.  $Y < Z < X$
- C.  $Z < X < Y$
- D.  $X < Z < Y$

4. Refer to the following chemical equation:



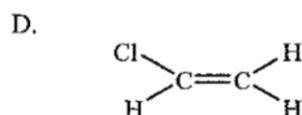
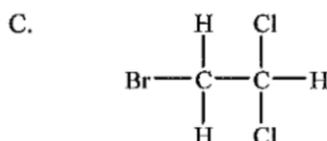
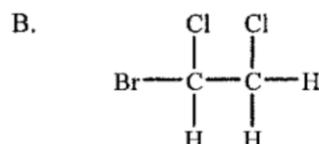
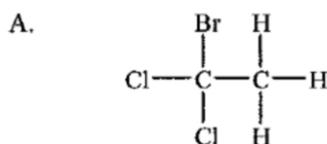
$N$  moles of  $\text{Fe}_2\text{O}_3$  are allowed to react with  $2N$  moles of  $\text{CO}$  under suitable conditions until the reaction stops. How many moles of  $\text{Fe}$  are formed?

- A.  $N$
- B.  $2N$
- C.  $\frac{2}{3}N$
- D.  $\frac{4}{3}N$

5. Hydrated salt  $X \cdot nH_2O$  contains 51.16% of water by mass. Given that the molar mass of X is 120.3 g, what is n ?

(Relative atomic masses: H = 1.0, O = 16.0)

- A. 2  
B. 5  
C. 7  
D. 10
6.  $50.0 \text{ cm}^3$  of 0.6 M  $FeSO_4(aq)$  is mixed with  $150.0 \text{ cm}^3$  of 0.2 M  $Fe_2(SO_4)_3(aq)$ . What is the concentration of  $SO_4^{2-}(aq)$  ions in the resulting mixture?
- A. 0.3 M  
B. 0.4 M  
C. 0.6 M  
D. 0.8 M
7. Which of the following pairs of aqueous solutions, upon mixing, would have the lowest electrical conductivity?
- A.  $20.0 \text{ cm}^3$  of 0.1 M  $HNO_3$  and  $20.0 \text{ cm}^3$  of 0.1 M  $KOH$   
B.  $20.0 \text{ cm}^3$  of 0.1 M  $H_2SO_4$  and  $20.0 \text{ cm}^3$  of 0.1 M  $Ba(OH)_2$   
C.  $20.0 \text{ cm}^3$  of 0.1 M  $CH_3COOH$  and  $20.0 \text{ cm}^3$  of 0.1 M  $NH_3$   
D.  $20.0 \text{ cm}^3$  of 0.1 M  $HCl$  and  $20.0 \text{ cm}^3$  of 0.1 M  $C_6H_{12}O_6$  (glucose)
8. Which of the following compounds would be formed when bromoethene reacts with chlorine in a suitable organic solvent?



9. The enthalpy changes of three reactions under certain conditions are shown below:

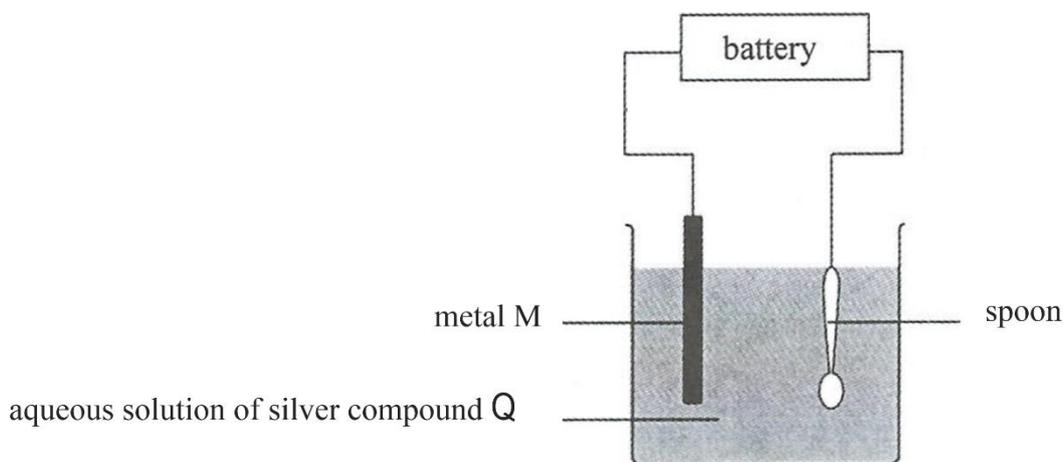
| Reaction  | Enthalpy change             |
|---|-----------------------------|
| $B_2H_6(g) + 3 O_2(g) \rightarrow B_2O_3(s) + 3H_2O(l)$ | $-2170 \text{ kJ mol}^{-1}$ |
| $B(s) + 3/4 O_2(g) \rightarrow 1/2 B_2O_3(s)$           | $-635 \text{ kJ mol}^{-1}$  |
| $H_2(g) + 1/2 O_2(g) \rightarrow H_2O(l)$               | $-286 \text{ kJ mol}^{-1}$  |

Which of the following is the enthalpy change of formation of  $B_2H_6(g)$  under the same conditions?

- A.  $+42 \text{ kJ mol}^{-1}$   
B.  $+614 \text{ kJ mol}^{-1}$   
C.  $+677 \text{ kJ mol}^{-1}$   
D.  $+1249 \text{ kJ mol}^{-1}$

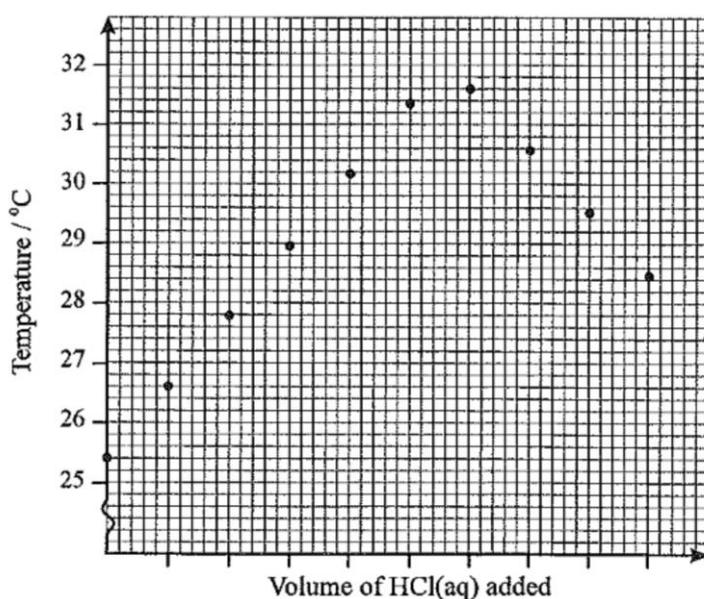
10. One mole of methane is allowed to react with two moles of chlorine in the presence of light. Which of the following best describes the organic product(s) that would be formed?
- one mole of  $\text{CCl}_4$
  - one mole of  $\text{CH}_2\text{Cl}_2$
  - a mixture containing only  $\text{CCl}_4$  and  $\text{CH}_2\text{Cl}_2$
  - a mixture containing  $\text{CH}_3\text{Cl}$ ,  $\text{CH}_2\text{Cl}_2$ ,  $\text{CHCl}_3$  and  $\text{CCl}_4$

11. The diagram below shows a set-up in which silver is being plated on a spoon:



Which of the following statements concerning the above set-up is correct?

- M must be silver.
  - Q can be silver chloride.
  - The spoon is connected to the negative pole of the battery.
  - Electrons flow from metal M to the spoon through the solution.
12. In an experiment, standard  $\text{HCl}(\text{aq})$  was added from a burette to a known volume of  $\text{NaOH}(\text{aq})$  placed in an expanded polystyrene cup. The graph below shows the temperatures of the mixture in the cup during the process:

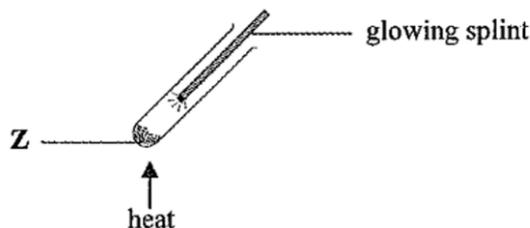


What is the greatest temperature rise of the mixture in the cup as estimated from the graph above?

- 2.0 °C
- 4.6 °C
- 6.2 °C
- 6.6 °C

13. Which of the following gases, after dissolved in 1 dm<sup>3</sup> of water, would give a solution with the highest pH?
- 0.002 mol of NO<sub>2</sub>
  - 0.002 mol of SO<sub>2</sub>
  - 0.002 mol of NH<sub>3</sub>
  - 0.002 mol of HCl

14. As shown in the diagram below, the glowing splint relights when solid Z is heated.



Which of the following chemicals may Z be?

- HgO
  - Al<sub>2</sub>O<sub>3</sub>
  - CaCO<sub>3</sub>
  - MgCO<sub>3</sub>
15. Which of the following hazard warning labels should be displayed on both the reagent bottle storing concentrated sulphuric acid and the reagent bottle storing concentrated hydrochloric acid?

(1)



(2)



(3)



- (1) only
  - (2) only
  - (1) and (3) only
  - (2) and (3) only
16. Which of the following statements concerning a zinc-carbon cell is / are correct?

- The zinc case would become thinner when being used.
- Its voltage remains unchanged when being used.
- It can be recharged after use

- (1) only
- (2) only
- (1) and (3) only
- (2) and (3) only

17. What are the advantages of using natural gas over using coal as a fuel in power stations?

- In comparing with coal, natural gas burns more completely.
- In comparing with coal, natural gas has less Sulphur-containing substances.
- Natural gas is a renewable energy source, but coal is not.

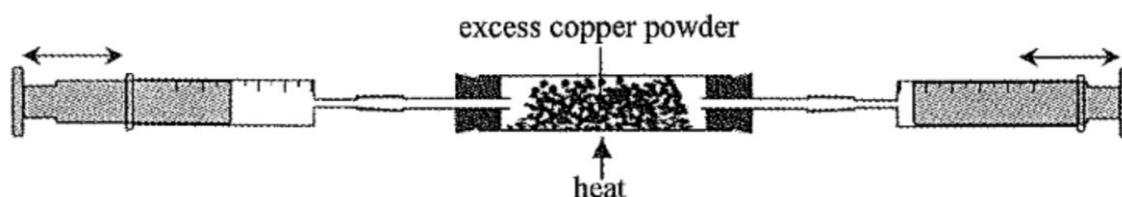
- (1) and (2) only
- (1) and (3) only
- (2) and (3) only
- (1), (2) and (3)

18. In an experiment, a small piece of potassium is added to a trough of water containing phenolphthalein. Which of the following statements concerning the experiment are correct?

- (1) An exothermic reaction occurs
- (2) A colourless solution is formed.
- (3) The metal burns with a lilac flame.

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

19. The set-up of an experiment is shown below. At room temperature, the system initially contains  $40\text{ cm}^3$  of  $\text{N}_2(\text{g})$ ,  $23\text{ cm}^3$  of  $\text{O}_2(\text{g})$  and  $10\text{ cm}^3$  of  $\text{He}(\text{g})$ .

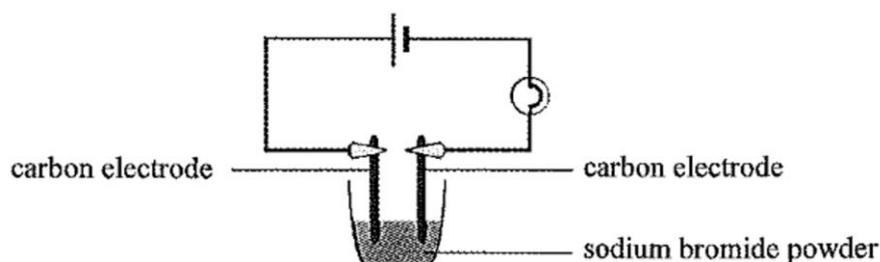


The plungers of the gas syringes are moved to and fro until there is no further change in the system. The system is then allowed to cool to room temperature. Which of the following statements concerning the experiment are correct?

- (1) Some copper powder would change to a black substance.
- (2) The total volume of the gases in the system would decrease by  $25\text{ cm}^3$ .
- (3) The same change in total volume of the gases would be observed if excess copper powder is replaced with excess iron powder.

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

20. The diagram below shows the set-up of an experiment:



Which of the following methods may light up the light bulb?

- (1) heating the sodium bromide powder until molten
- (2) adding deionised water to the sodium bromide powder
- (3) replacing the sodium bromide powder with bromine liquid

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

21. Which of the following processes would show a blue colour?

- (1) adding litmus to NaOH(aq)
- (2) mixing CuSO<sub>4</sub>(s) and NH<sub>3</sub>(aq)
- (3) K<sub>3</sub>Fe(CN)<sub>6</sub>(aq) and FeCl<sub>2</sub>(aq)

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

22. Which of the following molecules have non-octet structures?

- (1) NO<sub>2</sub>
- (2) PBr<sub>3</sub>
- (3) BCl<sub>3</sub>

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

23. When a negatively charged rod is placed near a jet of liquid running out from a burette, the jet of liquid deflects towards the rod. Which of the following may the liquid be?

- (1) water
- (2) hexane
- (3) trichloromethane

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

**Directions:** Each question below (Questions 35 and 36) 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**

24. All acidic gases can react with CaO(s) to form salt and water only.

All acidic gases contain hydrogen as one of their constituent atoms.

**PART II**

25.  $\text{H}_2\text{O}_2(\text{aq})$  decomposes into  $\text{H}_2\text{O}(\text{l})$  and  $\text{O}_2(\text{g})$  in the presence of  $\text{MnO}_2(\text{s})$ . Two experiments are performed to study this decomposition under the same conditions, except that  $50 \text{ cm}^3$  of  $2\text{M H}_2\text{O}_2(\text{aq})$  is used in Experiment(1), while  $100 \text{ cm}^3$  of  $1\text{M H}_2\text{O}_2(\text{aq})$  is used in Experiment (2). Which of the following combinations is correct?

|    | <b>Rate of formation of <math>\text{O}_2(\text{g})</math> at the start</b> | <b>Total volume of <math>\text{O}_2(\text{g})</math> formed</b> |
|----|--|---|
| A. | Experiment (1) > Experiment (2)  | Experiment (1) = Experiment (2)                                 |
| B. | Experiment (1) > Experiment (2)  | Experiment (1) > Experiment (2)                                 |
| C. | Experiment (1) = Experiment (2)  | Experiment (1) = Experiment (2)                                 |
| D. | Experiment (1) = Experiment (2)  | Experiment (1) > Experiment (2)                                 |

26. Consider the information below:

| <b>Reaction</b>  | <b>Equilibrium constant at <math>25^\circ\text{C}</math></b> |
|--|--|
| $\text{A}(\text{aq}) + \text{B}(\text{aq}) \rightleftharpoons \text{C}(\text{aq}) + \text{D}(\text{aq})$                       | $K_1$  |
| $\text{C}(\text{aq}) + \text{D}(\text{aq}) \rightleftharpoons \text{E}(\text{aq}) + \text{F}(\text{aq}) + \text{G}(\text{aq})$ | $K_2$  |
| $\text{E}(\text{aq}) + \text{F}(\text{aq}) + \text{G}(\text{aq}) \rightleftharpoons \text{A}(\text{aq}) + \text{B}(\text{aq})$ | $K_3$  |

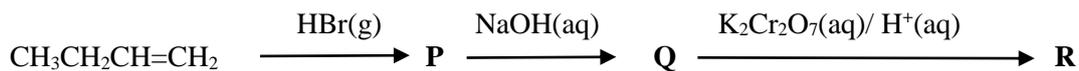
Which of the following combinations is correct?

|    | <u>Relationship of <math>K_1</math>, <math>K_2</math> and <math>K_3</math></u> | <u>Unit of <math>K_3</math></u> |
|----|--|---------------------------------|
| A. | $K_3 = \frac{1}{K_1 \times K_2}$   | $\text{mol dm}^{-3}$            |
| B. | $K_3 = \frac{1}{K_1 \times K_2}$   | $\text{mol}^{-1} \text{ dm}^3$  |
| C. | $K_3 = K_1 \times K_2$   | $\text{mol dm}^{-3}$            |
| D. | $K_3 = K_1 \times K_2$   | $\text{mol}^{-1} \text{ dm}^3$  |

27. Which of the following combinations concerning  $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}(\text{C}_2\text{H}_5)_2$  is correct?

|    | <b>Number of geometrical isomers</b> | <b>Number of enantiomers</b> |
|----|--------------------------------------|------------------------------|
| A. | 2                                    | 4                            |
| B. | 2                                    | 2                            |
| C. | 0                                    | 2                            |
| D. | 2                                    | 0                            |

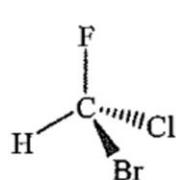
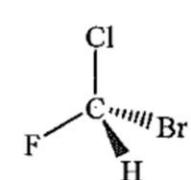
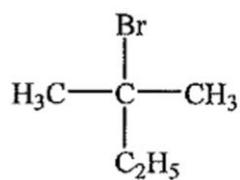
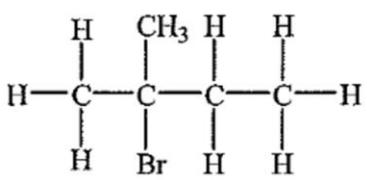
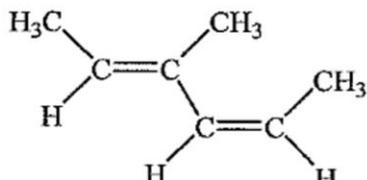
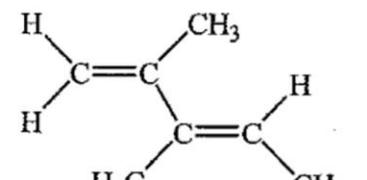
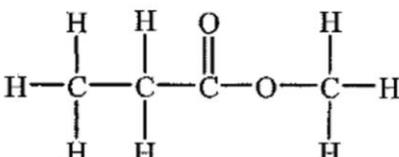
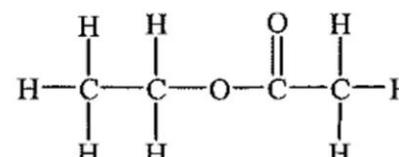
28. Consider the following organic reactions where P, Q and R are the major organic products formed.



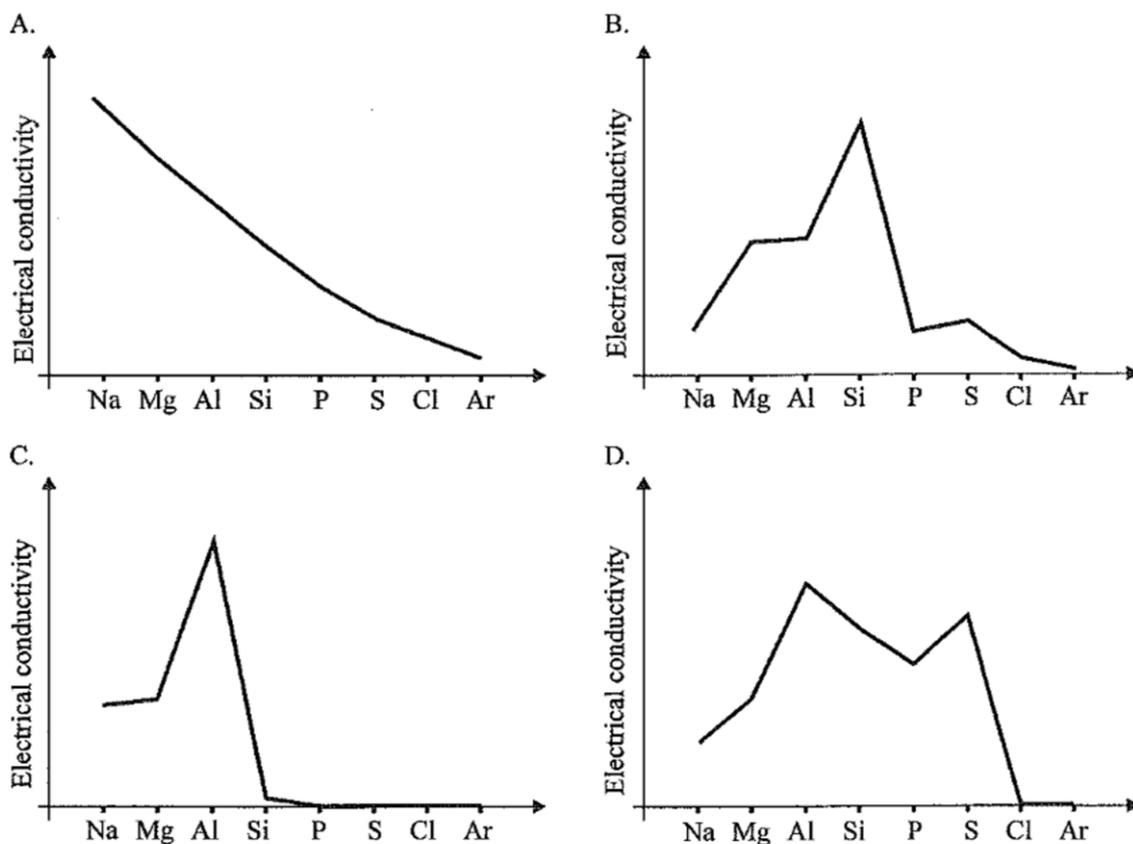
Which of the following combinations is correct?

|    | P   | Q   | R  |
|----|---|---|--|
| A. | $\text{CH}_3\text{CH}_2\text{CHBrCH}_3$                 | $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$ | $\text{CH}_3\text{CH}_2\text{COCH}_3$                            |
| B. | $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$ | $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ | $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$                    |
| C. | $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$ | $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$           | $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{OH}$ |
| D. | $\text{CH}_3\text{CH}_2\text{CHBrCH}_3$                 | $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$ | $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$                      |

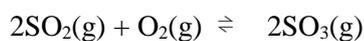
29. In which of the following options are molecule Y and molecule Z identical?

|    | Molecule Y  | Molecule Z   |
|----|---|--|
| A. |   |  |
| B. |  |  |
| C. |  |  |
| D. |  |  |

30. Which of the following graphs (not drawn to scale) correctly shows the variation in electrical conductivity of the elements in the third period of the Periodic Table at room temperature?



31. The following system attained equilibrium at a certain temperature



Which of the following statements is / are correct when the volume of the system is decreased while the temperature remains unchanged?

- (1) The value of  $K_c$  increases.
- (2) The equilibrium position shifts to the right.
- (3) The rate of decomposition of  $\text{SO}_3(\text{g})$  increases.

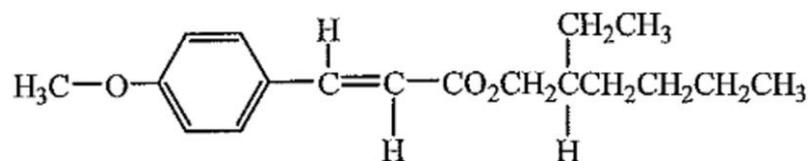
- A. (1) only
- B. (2) only
- C. (1) and (3) only
- D. (2) and (3) only

32. Which of the following statements concerning aspirin is/are correct?

- (1) It undergoes esterification with ethanoic acid in the presence of an acid catalyst.
- (2) It reacts with sodium carbonate solution to give a colourless gas.
- (3) It can be used to reduce inflammation.

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

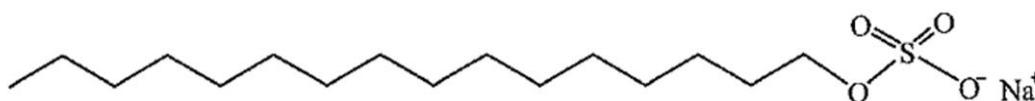
33. A sunblock cream contains the compound below as the active ingredient:



Which of the following reagents can react with this compound?

- (1) NaOH(aq)  
 (2)  $\text{PCl}_3(\text{l})$   
 (3) acidified  $\text{KMnO}_4(\text{aq})$
- A. (1) only  
 B. (2) only  
 C. (1) and (3) only  
 D. (2) and (3) only

34. The structure of a detergent is shown below:



Which of the following statements concerning the detergent are correct?

- (1) It has a cleaning function in hard water.  
 (2) Vigorous shaking it with oil and water can form a stable emulsion  
 (3) It can be formed by reacting a certain vegetable oil with NaOH(aq)
- A. (1) and (2) only  
 B. (1) and (3) only  
 C. (2) and (3) only  
 D. (1), (2) and (3)

**Directions:** Each question below (Questions 35 and 36) 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  $\hat{=}$  om 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**

- |     |   |  |
|-----|---|--|
| 35. | At chemical equilibrium state, the forward reaction rate equals zero. | At chemical equilibrium state, the reactants would not react to give the products. |
| 36. | Aluminium oxide is soluble in water.                                  | Aluminium oxide is an amphoteric oxide   |

**END OF SECTION A**



2014-DSE  
CHEM  
PAPER 1B

**B**

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY  
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2014

**CHEMISTRY PAPER 1**  
**SECTION B: Question-Answer Book B**

This paper must be answered in English

**INSTRUCTIONS FOR SECTION B**

- (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) Refer to the general instructions on the cover of the Question Paper for Section A.
- (3) This section consists of TWO parts, Parts I and II.
- (4) Answer ALL questions in both Parts I and II. 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) An asterisk (\*) has been put next to the questions where one mark will be awarded for effective communication.
- (6) 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 Question-Answer Book.
- (7) 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.

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Candidate Number

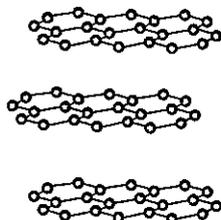
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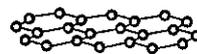
PART I

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

1. Graphite is a form of carbon and has a layer structure. Graphene is an individual single layer of graphite. Their structures are shown below:



graphite



graphene

- (a) Thin sheets of graphene can be easily peeled off from graphite using adhesive tape.
- (i) Explain why graphene can be easily peeled off.
- (ii) Explain whether graphene can conduct electricity.
- (iii) Draw the electron diagram for a molecule of the compound formed by complete combustion of graphene, showing *electrons in the outermost shells* only.

(3 marks)

- (b) Based on the fact that graphene can be easily peeled off from graphite, a student concluded that graphite should have a low melting point due to its layer structure. Explain whether you agree with this conclusion.

(1 mark)

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1. (c) Fullerene (such as  $C_{60}$ ) is another form of carbon. Briefly describe the structure of  $C_{60}$ , and suggest why it is soluble in some organic solvents.

(3 marks)

2. Draw the structure of ethane-1,2-diol, and suggest whether it is soluble in water.

(3 marks)

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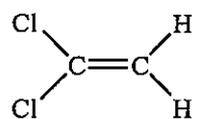
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3. Both polyethene (PE) and 'Saran' can be used to make food wrap, but 'Saran' is more suitable than PE in making food wrap for use in microwave ovens.

- (a) The monomer of PE is ethene. Suggest a chemical test to show that ethene is an unsaturated compound.

(2 marks)

- (b) 'Saran' can be formed from the polymerisation of the compound shown below:



- (i) State the systematic name of this compound.
- (ii) Name the type of polymerisation involved in forming 'Saran'.
- (iii) Draw the structure of 'Saran', showing at least THREE repeating units.

(3 marks)

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3. (c) In terms of intermolecular force, explain why 'Saran' is more suitable than PE in making food wrap for use in microwave ovens.

(2 marks)

- (d) When incinerated, why would food wrap made from 'Saran' cause more serious pollution problem than food wrap made from PE ?

(1 mark)

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5. Concentrated acids are common reagents found in laboratories.

(a) State a safety measure in handling concentrated acids in laboratories.

(1 mark)

(b) Comment on the following statement:

*'All concentrated acids are strong acids.'*

(1 mark)

(c) Explain how concentrated sulphuric acid, concentrated nitric acid and concentrated ethanoic acid can be distinguished by using copper granules.

(3 marks)

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6. Petrol is a commonly used motor car fuel. It can be obtained from petroleum by fractional distillation.

(a) (i) Explain, from molecular level, why petrol can be obtained from petroleum by fractional distillation.

(ii) Other than directly obtaining petrol from fractional distillation of petroleum, suggest a way for producing extra petrol.

(iii) Octane ( $C_8H_{18}$ ) is a component of petrol. Using octane as an example, state the meaning of the term 'standard enthalpy change of combustion' with the aid of a chemical equation.

(5 marks)

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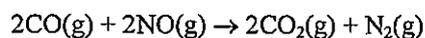
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6. (b) Motor cars powered by petrol emit air pollutants such as nitrogen monoxide and carbon monoxide. Installing a certain device in motor cars can convert these two oxides to less harmful substances.

(i) Name this device.

(ii) The equation for the reaction involved in the conversion is shown below:



The standard enthalpy changes of formation of  $\text{NO}(\text{g})$ ,  $\text{CO}(\text{g})$  and  $\text{CO}_2(\text{g})$  are as follows:

| Compound                | $\Delta H_f^\circ / \text{kJ mol}^{-1}$ |
|-------------------------|---|
| $\text{NO}(\text{g})$   | +90.3                                   |
| $\text{CO}(\text{g})$   | -110.5                                  |
| $\text{CO}_2(\text{g})$ | -394.0                                  |

Calculate the standard enthalpy change of the above reaction.

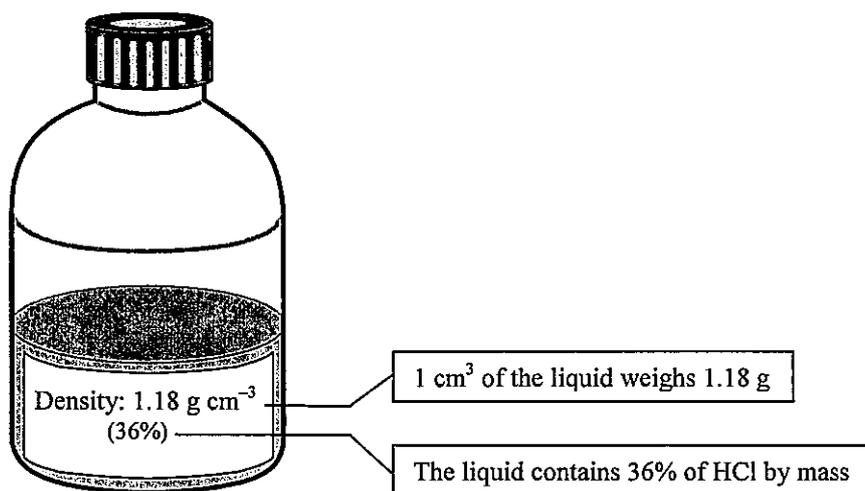
(4 marks)

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7. A bottle of concentrated hydrochloric acid HCl(aq) is shown below:



- (a) According to the information on the label, calculate the concentration of the concentrated hydrochloric acid in mol dm<sup>-3</sup>.

(2 marks)

- (b) To find out the concentration of the concentrated acid, a laboratory technician first drew from the bottle a sample of 10.00 cm<sup>3</sup> of the concentrated acid and diluted it to 100.0 cm<sup>3</sup> in a volumetric flask. The diluted acid sample was then used to titrate a standard sodium carbonate solution placed in a conical flask using methyl orange as an indicator. 10.00 cm<sup>3</sup> of 1.06 mol dm<sup>-3</sup> sodium carbonate solution required 20.30 cm<sup>3</sup> of the diluted acid sample to reach the end point.
- (i) Briefly describe the procedure in preparing a standard sodium carbonate solution.

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7. (b) (ii) Using the titration result, calculate the concentration, in  $\text{mol dm}^{-3}$ , of the concentrated hydrochloric acid in the bottle.

(5 marks)

- (c) Suggest a possible reason why the concentration of the concentrated hydrochloric acid in the bottle obtained from (b)(ii) would be smaller than that obtained from (a) above.

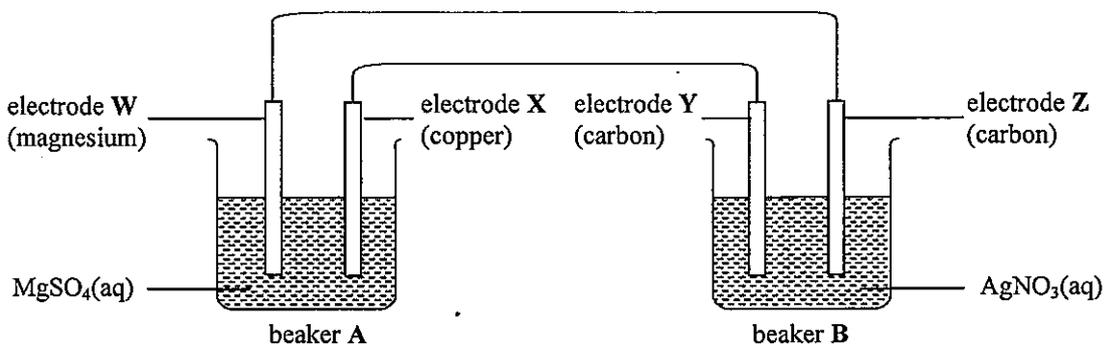
(1 mark)

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8. The diagram below shows a set-up in which electrons are flowing through the electric wires. Moreover, one of the electrodes in beaker A is forming ions.



- (a) State an expected observation at each of the following electrodes:

(i) electrode W

(ii) electrode X

(2 marks)

- (b) Write the half equation for the expected change at each of the following electrodes:

(i) electrode Y

(ii) electrode Z

(2 marks)

- (c) Complete the following table by filling in 'anode' or 'cathode' to describe the electrodes.

|                 |             |             |
|-----------------|-------------|-------------|
|                 | electrode W | electrode Z |
| anode / cathode |             |             |

(1 mark)

- (d) Predict, with reason, what would happen if the  $\text{MgSO}_4(\text{aq})$  in beaker A is replaced by ethanol.

(1 mark)

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9. Consider each of the experiments below and answer the questions that follow.

(a) Dilute sodium hydroxide solution is added to copper(II) sulphate solution.

(i) State the expected observation.

(ii) Write the chemical equation for the reaction that occurs.

(2 marks)

(b) Acidified potassium permanganate solution is added to sodium sulphite solution.

(i) State the expected colour change.

(ii) For the reaction leading to the colour change,

(1) state the name of the type of reaction; and

(2) write the ionic equation for the reaction.

(3 marks)

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11. Vanadium is a transition metal, its chemical symbol is V. The formulae and the colours of three aqueous vanadium-containing ions are shown below:

|         |                             |                            |                            |
|---------|-----------------------------|----------------------------|----------------------------|
| Formula | $\text{VO}^{2+}(\text{aq})$ | $\text{V}^{3+}(\text{aq})$ | $\text{V}^{2+}(\text{aq})$ |
| Colour  | blue                        | green                      | violet                     |

- (a) Based on the given information, suggest TWO properties of vanadium to characterise it as a transition metal.

(1 mark)

- (b) Vanadium also forms the ion  $\text{VO}_2^+(\text{aq})$ . In the presence of acid, 1.0 mol of  $\text{VO}_2^+(\text{aq})$  ions and 1.0 mol of  $\text{SO}_2(\text{g})$  react completely to form  $\text{SO}_4^{2-}(\text{aq})$  ions and one of the above aqueous vanadium-containing ions.

- (i) By considering the amount of electrons transferred, deduce the final colour of the solution obtained.

- (ii) Write a chemical equation for the reaction in (i).

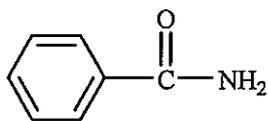
(3 marks)

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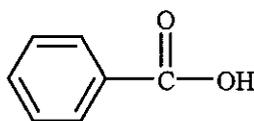
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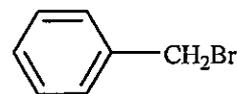
12. Benzamide, benzoic acid and benzyl bromide are commonly used organic compounds. Their structures are shown below:



benzamide



benzoic acid



benzyl bromide

- (a) In an experiment, benzoic acid is prepared from benzamide in two steps:
- Step 1: Benzamide is added to excess 1M NaOH(aq) and the mixture is heated gently. An organic compound X is formed.
- Step 2: The resulting mixture is then treated with reagent Y until no more solid benzoic acid is given out.
- (i) Name the type of reaction involved in Step 1.
- (ii) Draw the structure of X.
- (iii) Suggest what Y would be.
- (iv) Suggest why X is more soluble than benzoic acid in water.
- (v) Describe briefly how a dry benzoic acid sample can be obtained after Step 2.

(5 marks)

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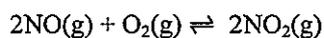
12. (b) Outline a synthetic route, *with no more than three steps*, to accomplish the conversion of benzoic acid to benzyl bromide. For each step, give the reagent(s), reaction conditions (as appropriate) and structure of the organic product.

Answers written in the margins will not be marked.

(3 marks)

Answers written in the margins will not be marked.

13. Consider the reaction represented by the equation below:



(a) In an experiment, 1.02 mol of NO(g) and 1.29 mol of O<sub>2</sub>(g) are mixed in a 50.0 dm<sup>3</sup> closed container maintained at 980 K. When equilibrium is attained, 61.0% of NO(g) is consumed.

(i) Calculate the equilibrium constant  $K_c$  for the above reaction under the experimental conditions.

(ii) Discuss whether  $K_c$  would change if additional NO(g) is introduced into the above equilibrium mixture.

(4 marks)

(b) The values of  $K_c$  (in appropriate unit) for this reaction at different temperatures are shown below:

| Temperature / K | 600                | 700                | 800                | 900                |
|-----------------|--------------------|--------------------|--------------------|--------------------|
| $K_c$           | $6.88 \times 10^6$ | $2.97 \times 10^5$ | $2.89 \times 10^3$ | $4.68 \times 10^2$ |

Based on the above data, deduce whether the forward reaction is exothermic or endothermic.

(1 mark)

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14. Butter contains a small amount of the triglyceride of butanoic acid.

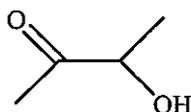
- (a) Draw the structure of the triglyceride of butanoic acid.

(1 mark)

- (b) An organic acid **Q** is an isomer of butanoic acid. State the systematic name of **Q**.

(1 mark)

- (c) The structure of **Z**, another isomer of butanoic acid, is shown below:



- (i) Using ‘\*’, label ALL chiral centre(s) in the above structure of **Z**.
- (ii) Suggest a chemical test to show how to distinguish between **Q** and **Z**.

(3 marks)

- (d) Margarine, a butter substitute, can be made from vegetable oils. What chemical reaction is involved in the production of margarine from vegetable oils?

(1 mark)

**END OF SECTION B**

**END OF PAPER**

PERIODIC TABLE 周期表

GROUP 族

| atomic number 原子序 |                | relative atomic mass 相對原子質量 |                |                |                |                |                |                |                  |                  |                  |                  |                  |                 |                 |                  |                  |                 |                  |                  |                  |                 |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                 |                  |                  |                  |                  |                   |                   |                   |                   |                   |                   |                   |                   |                   |                  |                   |                   |                   |                     |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                  |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                      |                   |                   |                  |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
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| I                 | II             | III                         | IV             | V              | VI             | VII            | 0              |                |                  |                  |                  |                  |                  |                 |                 |                  |                  | 0               |                  |                  |                  |                 |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                 |                  |                  |                  |                  |                   |                   |                   |                   |                   |                   |                   |                   |                   |                  |                   |                   |                   |                     |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                  |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                   |                      |                   |                   |                  |                   |                   |                   |                   |                   |                   |                   |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |                    |
| 1<br>H<br>1.0     | 2<br>He<br>4.0 | 3<br>Li<br>6.9              | 4<br>Be<br>9.0 | 5<br>B<br>10.8 | 6<br>C<br>12.0 | 7<br>N<br>14.0 | 8<br>O<br>16.0 | 9<br>F<br>19.0 | 10<br>Ne<br>20.2 | 11<br>Na<br>23.0 | 12<br>Mg<br>24.3 | 13<br>Al<br>27.0 | 14<br>Si<br>28.1 | 15<br>P<br>31.0 | 16<br>S<br>32.1 | 17<br>Cl<br>35.5 | 18<br>Ar<br>40.0 | 19<br>K<br>39.1 | 20<br>Ca<br>40.1 | 21<br>Sc<br>45.0 | 22<br>Ti<br>47.9 | 23<br>V<br>50.9 | 24<br>Cr<br>52.0 | 25<br>Mn<br>54.9 | 26<br>Fe<br>55.8 | 27<br>Co<br>58.9 | 28<br>Ni<br>58.7 | 29<br>Cu<br>63.5 | 30<br>Zn<br>65.4 | 31<br>Ga<br>69.7 | 32<br>Ge<br>72.6 | 33<br>As<br>74.9 | 34<br>Se<br>79.0 | 35<br>Br<br>79.9 | 36<br>Kr<br>83.8 | 37<br>Rb<br>85.5 | 38<br>Sr<br>87.6 | 39<br>Y<br>88.9 | 40<br>Zr<br>91.2 | 41<br>Nb<br>92.9 | 42<br>Mo<br>95.9 | 43<br>Tc<br>(98) | 44<br>Ru<br>101.1 | 45<br>Rh<br>102.9 | 46<br>Pd<br>106.4 | 47<br>Ag<br>107.9 | 48<br>Cd<br>112.4 | 49<br>In<br>114.8 | 50<br>Sn<br>118.7 | 51<br>Sb<br>121.8 | 52<br>Te<br>127.6 | 53<br>I<br>126.9 | 54<br>Xe<br>131.3 | 55<br>Cs<br>132.9 | 56<br>Ba<br>137.3 | 57 *<br>La<br>138.9 | 58<br>Ce<br>140.1 | 59<br>Pr<br>140.9 | 60<br>Nd<br>144.2 | 61<br>Pm<br>(145) | 62<br>Sm<br>150.4 | 63<br>Eu<br>152.0 | 64<br>Gd<br>157.3 | 65<br>Tb<br>158.9 | 66<br>Dy<br>162.5 | 67<br>Ho<br>164.9 | 68<br>Er<br>167.3 | 69<br>Tm<br>168.9 | 70<br>Yb<br>173.0 | 71<br>Lu<br>175.0 | 72<br>Hf<br>178.5 | 73<br>Ta<br>180.9 | 74<br>W<br>183.9 | 75<br>Re<br>186.2 | 76<br>Os<br>190.2 | 77<br>Ir<br>192.2 | 78<br>Pt<br>195.1 | 79<br>Au<br>197.0 | 80<br>Hg<br>200.6 | 81<br>Tl<br>204.4 | 82<br>Pb<br>207.2 | 83<br>Bi<br>209.0 | 84<br>Po<br>(209) | 85<br>At<br>(210) | 86<br>Rn<br>(222) | 87<br>Fr<br>(223) | 88<br>Ra<br>(226) | 89 **<br>Ac<br>(227) | 90<br>Th<br>232.0 | 91<br>Pa<br>(231) | 92<br>U<br>238.0 | 93<br>Np<br>(237) | 94<br>Pu<br>(244) | 95<br>Am<br>(243) | 96<br>Cm<br>(247) | 97<br>Bk<br>(247) | 98<br>Cf<br>(251) | 99<br>Es<br>(252) | 100<br>Fm<br>(257) | 101<br>Md<br>(258) | 102<br>No<br>(259) | 103<br>Lr<br>(260) | 104<br>Rf<br>(261) | 105<br>Db<br>(262) | 106<br>Sg<br>(266) | 107<br>Bh<br>(264) | 108<br>Hs<br>(277) | 109<br>Mt<br>(268) | 110<br>Ds<br>(271) | 111<br>Rg<br>(272) | 112<br>Cn<br>(285) | 113<br>Nh<br>(284) | 114<br>Fl<br>(289) | 115<br>Mc<br>(288) | 116<br>Lv<br>(293) | 117<br>Ts<br>(294) | 118<br>Og<br>(294) |

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