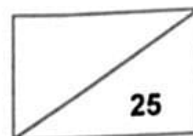




ANDERSON SERANGOON JUNIOR COLLEGE
2025 JC 1 H2 CHEMISTRY
TERM 2 LECTURE TEST (WA 1)



Duration: 45 min

Name: _____ Class: _____ Date: 21 April 2025

A Data Sheet is attached behind the question paper. Please use it where relevant.

Section A: Multiple-Choice Questions (10 marks)

Write your answers to Section A in the following table.

1	2	3	4	5	6	7	8	9	10

For each question there are four possible answers, A, B, C and D. Choose the **one** you consider to be correct.

1 The shape of each p-orbital is represented as two lobes.

How many 3d orbitals have four lobes?

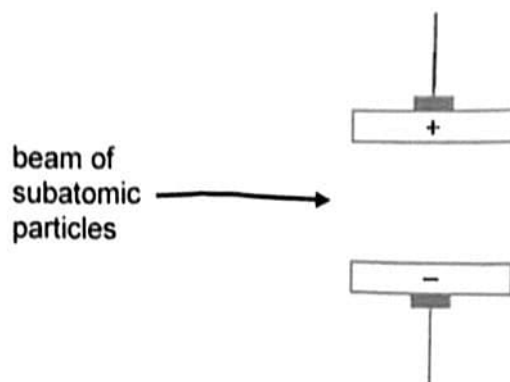
A 2 B 3 C 4 D 5

2 Which statements about the first ionisation energies of Period 2 and Period 3 elements are correct?

- 1 The first ionisation energy of Ne is greater than that of F because the nuclear charge of Ne is greater than that of F.
- 2 The first ionisation energy of Li and Na involves the removal of an electron from the same shell.
- 3 The first ionisation energy of Al is smaller than that of Mg as the p electron to be removed from Al is at a higher energy level than the s electron to be removed from Mg.

A 1, 2 and 3 B 1 and 2 only C 1 and 3 only D 1 only

- 3 Electrons and protons (subatomic particles) were fired with equal velocity into an electric field.



Which row describes the behaviour of the electrons and protons?

	electrons	protons	relative amount of deflection
A	deflected towards (-) plate	deflected towards (+) plate	electrons deflected more than protons
B	deflected towards (-) plate	deflected towards (+) plate	protons deflected more than electrons
C	deflected towards (+) plate	deflected towards (-) plate	electrons deflected more than protons
D	deflected towards (+) plate	deflected towards (-) plate	protons deflected more than electrons

- 4 Use of the Data Sheet is relevant to this question.

An unstable ion has

- a nucleon number of 217,
- 50 more neutrons than electrons,
- an atomic number of 84, 85, 86, or 87.

What could this ion be?

- A Po^{2+} B At^{3+} C Rn^{4+} D Fr^{5+}

- 5 The mineral pyrite contains sulfur and iron. A sample of pyrite was analysed and four different types of atom were identified; V, W, X and Y. The table below shows information about the four types of atom found in the sample.

atom	relative mass	relative % abundance
V	31.97	63.8
W	33.97	2.8
X	53.94	31.4
Y	55.95	2.0

What is the relative atomic mass of sulfur in this sample?

- A 32.05 B 32.97 C 39.40 D 54.06

- 6 Which statement is correct?

- A One mole of a compound, Cl_2O , is the amount that contains the same number of atoms as there are atoms in 12.000 g of carbon-12.
- B The relative molecular mass of a compound, Cl_2O , is the ratio of the mass of 1 mole of molecules to the mass of 1 mole of ^1H atoms.
- C The relative isotopic mass of chlorine-37 is given by the following expression.

$$\frac{\text{average mass of all isotopes of chlorine}}{\frac{1}{12} \text{ the mass of one atom of carbon-12}}$$

- D The relative atomic mass of oxygen is given by the following expression.

$$\frac{\text{average mass of one atom of oxygen}}{\frac{1}{12} \text{ the mass of one atom of carbon-12}}$$

- 7 10 cm³ of hydrocarbon was mixed with 100 cm³ of oxygen gas which is in excess.

The mixture was exploded and after cooling to room temperature, the residual gases occupied a volume of 80 cm³. Upon passing the residual gases through sodium hydroxide, this volume decreased to 50 cm³.

What is the formula of the unknown hydrocarbon?

- A C_3H_6
- B C_3H_8
- C C_5H_8
- D C_5H_{10}

- 8 Use of the Data Sheet is relevant to this question.

Burning sodium reacts with carbon dioxide to produce sodium carbonate and carbon only.



If $1.1 \times 10^7 \text{ dm}^3$ carbon dioxide, measured at standard temperature and pressure, is completely reacted with sodium, what is the mass of sodium carbonate produced?

- A $3.2 \times 10^7 \text{ g}$
- B $3.4 \times 10^7 \text{ g}$
- C $7.3 \times 10^7 \text{ g}$
- D $7.7 \times 10^7 \text{ g}$

- 9 Chlorine reacts with hot concentrated sodium hydroxide according to the equation below.



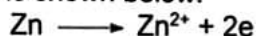
Which statements about the above reaction is true?

- 1 Sodium hydroxide acts as a reducing agent.
- 2 Chlorine undergoes disproportionation.
- 3 The oxidation state of the chlorine in one of the products is +5.

- A 1, 2 and 3 ~~B~~ 1 and 3 only C 2 and 3 only ~~D~~ 3 only

- 10 1.5 g of zinc powder was found to reduce an acidified solution of 25.50 cm^3 of $0.600 \text{ mol dm}^{-3} \text{ MO}_2^+$.

The half-equation for oxidation of Zn is shown below.



What is the final oxidation number of element M in the product?

- A 0
- B +1
- C +2
- D +3

Section B: Structured Questions (15 marks)

Answer all questions in Section B in the space provided.

You may lose marks if you do not show your working or if you do not use appropriate significant figures or units.

1 Fig. 1 shows a sketch of the logarithm of the first eleven ionisation energies, $\log(\text{IE})$ of element A.

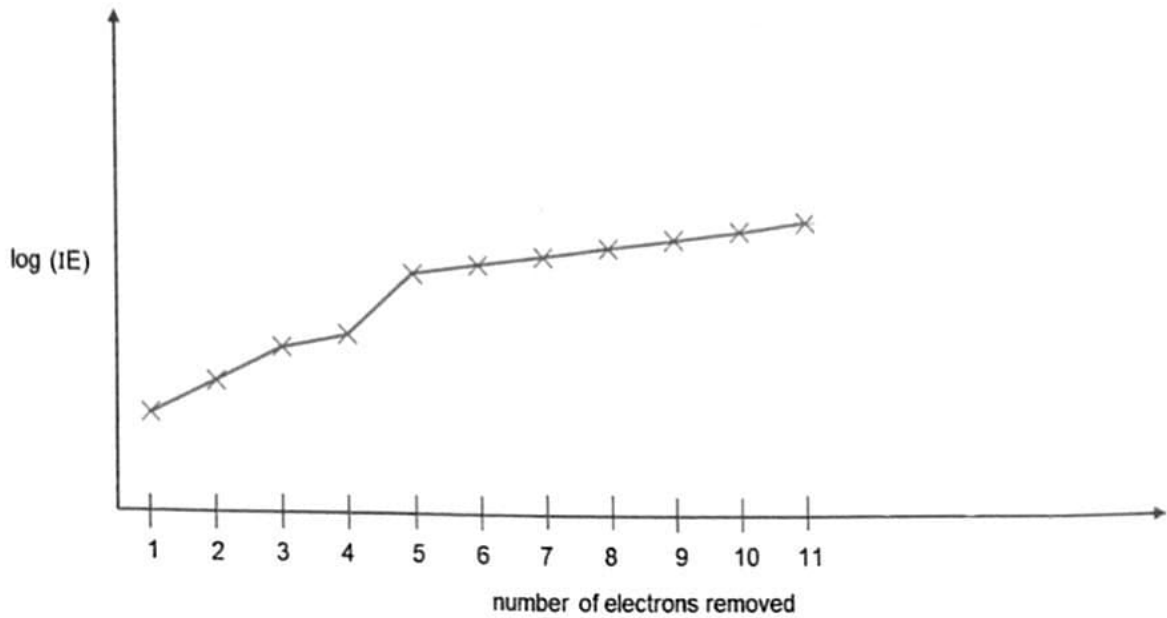


Fig. 1

(a) Write an equation for the **second** ionisation energy of element A.

.....[1]

(b) Explain the following features of Fig. 1.

(i) the general trend in ionisation energy shown in the graph

(ii) the significant increase in values from the 4th to 5th ionisation energy

(c) Element A is in Period 3.

(i) Identify element A using the information from Fig. 1 and write its full electronic configuration.

element A:

full electronic configuration: [1]

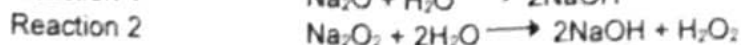
(ii) Sketch on Fig. 1 to show the trend of ionisation energies for all the remaining electrons in element A. Use a cross (×) to represent each ionisation energy. [1]

[Total: 7]

- 2 (a) Burning sodium in air produces a mixture of sodium oxide, Na_2O , and sodium peroxide, Na_2O_2 . The proportion of sodium peroxide in the mixture can be determined by the following method.

Step I A sample of the oxides mixture of mass 0.500 g was dissolved in water.

The reactions of Na_2O and Na_2O_2 with water are shown in reaction 1 and 2 respectively.



Step II The resultant solution is acidified and an excess of potassium iodide solution is added. The iodide ions, I^- , react with H_2O_2 produced in reaction 2 to liberate iodine and water.

Step III The iodine produced in step II is titrated with standard sodium thiosulfate solution, $\text{Na}_2\text{S}_2\text{O}_3(\text{aq})$.



It was found that 16.70 cm^3 of $0.200 \text{ mol dm}^{-3}$ $\text{Na}_2\text{S}_2\text{O}_3$ was required to react with all the iodine released.

- (i) By constructing relevant half equations, write a balanced equation for the reaction between I^- ions and H_2O_2 in an acidic medium described in step II.

[1]

- (ii) Student B obtained an equation which showed 1 mol H_2O_2 reacted to produce 1 mol I_2 in (a)(i).

Using student B's answers, calculate the mass of Na_2O and Na_2O_2 in the mixture.

mass of Na_2O =

mass of Na_2O_2 = [3]

(b) The following experiment was conducted to determine the proportion of calcium carbonate, CaCO_3 , in toothpaste.

Step 1 40.00 cm^3 of 0.100 mol dm^{-3} hydrochloric acid was added in excess to an aqueous solution containing 0.450 g sample of toothpaste.

Step 2 The mixture was warmed to drive off the gas produced.

Step 3 23.20 cm^3 of 0.0980 mol dm^{-3} sodium hydroxide was used to titrate with the mixture after cooling.

(i) Write an equation for the reaction in step 1.

.....[1]

(ii) Calculate the amount, in moles, of unreacted hydrochloric acid in the mixture.

[1]

(iii) Hence, determine the percentage by mass of calcium carbonate in the toothpaste.

[2]

[Total: 8]

END