AS Chemistry – Preparation Questions

Please attempt every question.

Please hand in your booklets to Miss Stephenson during the first week back in September.

1. Isotopes of europium have differences and similarities.

(i) In terms of protons, neutrons and electrons, how is an atom of ^{151}Eu **different** from an atom of ^{153}Eu?

.....

.....

[1]

(ii) In terms of protons, neutrons and electrons, how is an atom of ^{151}Eu **similar** to an atom of ^{153}Eu?

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[1]

[Total 2 marks]

2. A student carries out experiments using acids, bases and salts.

Calcium nitrate, $Ca(NO_3)_2$, is an example of a salt.

The student prepares a solution of calcium nitrate by reacting dilute nitric acid, HNO_3, with the base calcium hydroxide, $Ca(OH)_2$.

(i) Why is calcium nitrate an example of a salt?

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[1]

(ii) Write the equation for the reaction between dilute nitric acid and calcium hydroxide. Include state symbols.

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[2]

(iii) Explain how the hydroxide ion in aqueous calcium hydroxide acts as a base when it neutralises dilute nitric acid.

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[1]

[Total 4 marks]

3. (a) A student carries out a titration to find the concentration of some sulfuric acid.

The student finds that 25.00 cm^3 of 0.0880 mol dm^{-3} aqueous sodium hydroxide, NaOH, is neutralised by 17.60 cm^3 of dilute sulfuric acid, H_2SO_4.

$$H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$$

(i) Calculate the amount, in moles, of NaOH used.

answer = ... mol

[1]

(ii) Determine the amount, in moles, of H_2SO_4 used.

answer = ... mol

[1]

(iii) Calculate the concentration, in mol dm^{-3}, of the sulfuric acid.

answer = ... mol dm^{-3}

[1]

[Total 3 marks]

4. This question is about different models of bonding and molecular shapes.

Magnesium sulfide shows ionic bonding.

(i) What is meant by the term *ionic bonding*?

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.....

[1]

(ii) Draw a '*dot-and-cross*' diagram to show the bonding in magnesium sulfide. Show outer electron shells only.

[2]

[Total 3 marks]

5. Magnesium and strontium are in Group 2 of the Periodic Table.

(i) When reacted with oxygen, magnesium forms a white powder called magnesium oxide.

Write the equation for the reaction of magnesium with oxygen.

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[1]

(ii) Magnesium reacts with dilute acids.

Describe what you would expect to see when magnesium ribbon is added to an excess of dilute hydrochloric acid.

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[2]

(iii) Strontium reacts in a similar way to magnesium.

Describe **one** difference you might observe if strontium, instead of magnesium, was reacted with dilute hydrochloric acid.

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[1]

[Total 4 marks]

6. The third period of the Periodic Table features the elements magnesium and chlorine. The table below shows the melting points of these elements.

element	**melting point / °C**
magnesium	650
chlorine	–101

Describe the structure and bonding shown by these elements. Use your answer to explain the difference in melting points.

In your answer, you should use appropriate technical terms spelt correctly.

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[Total 6 marks]

7. One form of naturally occurring carbon is graphite.

The table below lists some properties of graphite.

electrical conductivity	good conductor
hardness	soft
melting point	very high

- Describe the bonding and structure in graphite.
- Explain, in terms of bonding and structure, the properties of graphite shown above.

In your answer, you should use appropriate technical terms, spelt correctly.

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[Total 5 marks]

8. Ammonium compounds such as ammonium sulfate, $(NH_4)_2SO_4$, can be used as fertilisers.

(i) Write a balanced equation to show how ammonium sulfate could be formed by the reaction between aqueous ammonia and sulfuric acid.

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[1]

(ii) Ammonium sulfate is an example of a salt formed when an acid is neutralised by a base.

Explain what is meant by the term *salt*.

.....

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[1]

(iii) Why is ammonia acting as a base in this neutralisation?

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[1]

(iv) What is the relative formula mass of $(NH_4)_2SO_4$?

Give your answer to **one** decimal place.

.....

[1]

[Total 4 marks]

9. The table below shows the melting points and atomic radii of the elements in Period 3, Na to C*l*.

element	Na	Mg	A*l*	Si	P	S	C*l*
melting point / °C	98	639	660	1410	44	113	–101
atomic radius / pm	186	160	143	118	110	102	99

1pm = 1×10^{-12} m

(a) (i) Explain the difference in melting point for the elements Na and Mg.

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[3]

(ii) Sulfur exists as S_8 molecules and chlorine as Cl_2 molecules. Use this information to explain the difference in their melting points.

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[2]

(b) Explain the decrease in the atomic radii across the period from Na to Cl.

In your answer, you should use appropriate technical terms, spelt correctly.

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[3]

[Total 8 marks]

10. This question compares the bonding, structure and properties of sodium and sodium oxide.

Sodium, Na, is a metallic element.

Explain, with the aid of a labelled diagram, what is meant by the term *metallic bonding*.

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[Total 3 marks]

11. Sodium reacts with oxygen to form sodium oxide, Na_2O, which is an ionic compound.

(i) Write the equation for the reaction of sodium with oxygen to form sodium oxide.

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[1]

(ii) Draw a '*dot-and-cross*' diagram to show the bonding in Na_2O.

Show **outer** electrons only.

[2]

[Total 3 marks]

12. Calcium carbonate, $CaCO_3$, reacts with hydrochloric acid as shown in the equation below.

$$CaCO_3(s) + 2HCl\ (aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

7.50×10^{-3} mol $CaCO_3$ reacts with 0.200 mol dm^{-3} HCl.

(i) Calculate the volume, in cm^3, of 0.200 mol dm^{-3} HC*l* required to react with 7.50×10^{-3} mol $CaCO_3$.

answer = ... cm^3

[2]

(ii) Calculate the volume, in cm^3, of CO_2 formed at room temperature and pressure.

answer = ... cm^3

[1]

[Total 3 marks]

13. Calcium oxide reacts with water and with nitric acid.

State the formula of the calcium compound formed when:

(i) calcium oxide reacts with water, ...

[1]

(ii) calcium oxide reacts with nitric acid. .....

[1]

[Total 2 marks]

14. This question looks at the reaction of sodium with water and with oxygen.

A chemist reacted 0.0500 mol of sodium with water to form 50.0 cm^3 of aqueous sodium hydroxide.

$$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$$

(i) What mass of Na was reacted?

mass = ... g

[1]

(ii) Calculate the volume of H_2, in dm^3, that would be produced at room temperature and pressure, r.t.p.

1 mol of gas molecules occupies 24.0 dm^3 at r.t.p.

volume = ... dm^3

[2]

(iii) Calculate the concentration, in mol dm^{-3}, of NaOH that was formed.

concentration = ... mol dm^{-3}

[1]

[Total 4 marks]

15. Sodium reacts with excess oxygen to form sodium peroxide, Na_2O_2.

Na_2O_2 is used in laundry bleaches. When added to water a reaction takes place forming an alkaline solution and hydrogen peroxide, H_2O_2.

(i) Construct a balanced equation for the formation of sodium peroxide from sodium.

.....

[1]

(ii) Construct a balanced equation for the reaction of sodium peroxide with water.

.....

[1]

(iii) Draw a 'dot-and-cross' diagram for a molecule of H_2O_2. Show outer electrons only.

[2]

[Total 4 marks]

16. Barium metal can be extracted from barium oxide, BaO, by reduction with aluminium.

$$6BaO + 2Al \rightarrow 3Ba + Ba_3Al_2O_6$$

Calculate the mass of barium metal that could be produced from reduction of 500 g of barium oxide using this method.

answer = ... g

[Total 4 marks]

17. Old samples of magnesium oxide become contaminated with magnesium carbonate.

(i) Suggest how this contamination takes place.

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[1]

(ii) A student added an excess of hydrochloric acid to an old sample of magnesium oxide that is contaminated with magnesium carbonate.

State **two** observations that the student would make.

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[2]

(iii) Explain, with the aid of equations, why the resulting solution contained only one dissolved compound of magnesium.

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[3]

[Total 6 marks]

18. Antimony, Sb, is a metal used in alloys to make lead harder. Bullets contain about 1% of antimony for this reason.

Antimony has two main isotopes.

(i) What do you understand by the term *isotopes*?

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.....

[1]

(ii) Complete the table below to show the properties of particles that make up isotopes.

	proton	neutron	electron
relative mass			
relative charge			

[2]

[Total 3 marks]

19. The nitrate ion, NO_3^-, in $Ca(NO_3)_2$ contains both covalent and dative covalent bonds.

(i) What is the difference between a covalent bond and a dative covalent bond?

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[1]

(ii) Calcium nitrate decomposes on heating to form calcium oxide, oxygen and nitrogen(IV) oxide, NO_2.

Construct a balanced equation for this reaction.

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[1]

[Total 2 marks]

20. A student reacted 1.44 g of titanium with chlorine to form 5.70 g of a chloride **X**.

(i) How many moles of Ti atoms were reacted?

[1]

(ii) How many moles of C*l* atoms were reacted?

[2]

(iii) Determine the empirical formula of **X**.

[1]

(iv) Construct a balanced equation for the reaction between titanium and chlorine.

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[1]

[Total 5 marks]

21. A student had a stomach-ache and needed to take something to neutralise excess stomach acid. He decided to take some Milk of Magnesia, which is an aqueous suspension of magnesium hydroxide, $Mg(OH)_2$.

(a) The main acid in the stomach is hydrochloric acid, HC*l*(aq), and the unbalanced equation for the reaction that takes place with Milk of Magnesia is shown below.

.....$Mg(OH)_2$(s) + ...HC*l*(aq) → .....Mg$C*l*_2$(aq) + ...H_2O(l)

Balance the equation by adding numbers where necessary in the unbalanced equation above.

[1]

(b) The student's stomach contained 500 cm^3 of stomach fluid with an acid concentration of 0.108 mol dm^{-3}. The student swallowed some Milk of Magnesia containing 2.42 g $Mg(OH)_2$. He wondered whether this dose was sufficient to neutralise the stomach acid.

Assume that all the acid in the stomach fluid was 0.108 mol dm^{-3} hydrochloric acid.

(i) How many moles of HC*l* were in the 500 cm^3 of stomach fluid?

[1]

(ii) Calculate the mass of $Mg(OH)_2$ necessary to neutralise this stomach fluid.

[3]

(iii) Determine whether the student swallowed too much, too little, or just the right amount of Milk of Magnesia to neutralise the stomach acid.

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[1]

[Total 6 marks]

22. The Group 7 element bromine was discovered in 1826. Bromine gets its name from the Greek *brōmos* meaning stench because of its strong smell.

Bromine consists of a mixture of two isotopes, ^{79}Br and ^{81}Br.

(i) What is the difference between the atomic structures of ^{79}Br and ^{81}Br?

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[2]

(ii) State **two** similarities between the atomic structures of ^{79}Br and ^{81}Br.

.....

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[2]

[Total 4 marks]

23. A fifty pence coin contains nickel alloyed with a metal **A**.

Nickel exists as a mixture of three isotopes, nickel-58, nickel-60 and nickel-62.

Complete the table below to show the atomic structures of the isotopes in metallic nickel.

isotope	protons	neutrons	electrons
nickel-58			
nickel-60			
nickel-62			

[Total 3 marks]