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Answer ALL questions.

1. Complete the table.

Name of compound	Formula of cation	Formula of anion	Formula of compound
calcium bromide	Ca ²⁺		
	Al ³⁺	SO ₄ ²⁻	
		NO ₃ ⁻	Fe(NO ₃) ₂
chromium(III) hydroxide		OH ⁻	

(Total 8 marks)

Q1

2. Complete each of the statements.

(a) The electron configuration of a calcium atom is

.....
(1)

(b) The electron configuration of a sulphide ion, S²⁻, is

.....
(1)

(c) The number of neutrons in an atom of the zinc isotope, ⁶⁵₃₀Zn, is

.....
(1)

(d) The number of electrons in the outer shell of an iodine atom is

.....
(1)

(e) The number of moles of H₂ molecules in 10 g of hydrogen gas is

.....
(1)

(f) The number of moles of water produced by the complete combustion of one mole of butane, C₄H₁₀, is

.....
(1)

(Total 6 marks)

Q2



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3. Complete the statements by inserting the missing colours.

(a) When magnesium ribbon is burned in oxygen, the product is a

..... solid.

(1)

(b) Ammonia gas turns moist litmus paper

(1)

(c) When iodine is heated, it forms a vapour.

(1)

(d) When copper(II) carbonate is heated, the product is a
solid.

(1)

(e) Ammonia and hydrogen chloride react to form a
solid.

(1)

(f) When excess aqueous ammonia is added to aqueous copper(II) sulphate, the initial
pale blue precipitate dissolves to give a

..... solution.

(1)

Q3

(Total 6 marks)



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4. Identify, by name or formula, an element or compound that fits each of the descriptions.

(a) A monatomic gas.

.....
(1)

(b) A colourless solution with a pH less than 2.

.....
(1)

(c) A poisonous gas formed by the incomplete combustion of hydrocarbons.

.....
(1)

(d) A gas that bleaches moist litmus paper.

.....
(1)

(e) A black solid that turns brown on reduction.

.....
(1)

(f) A gas whose molecules contain five atoms covalently bonded together.

.....
(1)

(Total 6 marks)

Q4



5. There are two chlorides of phosphorus, PCl_3 and PCl_5 .

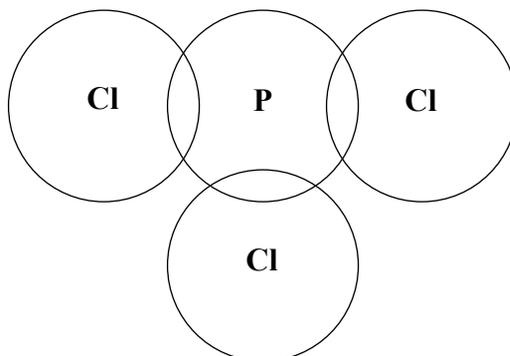
(a) A sample of one of these chlorides has the percentage composition by mass:

$$\text{P} = 22.5\% \quad \text{Cl} = 77.5\%$$

Calculate the empirical formula of this chloride.

(3)

(b) Complete the diagram to show the outer shell electron arrangement in a molecule of PCl_3 .



(2)

(c) Give the name or formula of two products of the reaction between PCl_5 and ethanol.

.....

.....

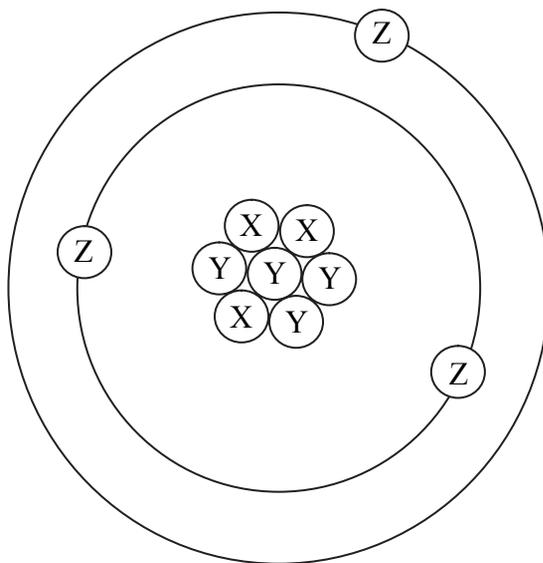
(2)

(Total 7 marks)

Q5



6. The diagram represents the structure of an atom of isotope **A** of an element.



(a) (i) Name the particles **X**, **Y** and **Z**.

X

Y

Z

(3)

(ii) Which of the particles **X**, **Y** and **Z** have approximately the same mass?

.....

(1)

(iii) Give the atomic number and mass number of this atom.

Atomic number

.....

Mass number

.....

(2)

(b) (i) This element has another isotope, **B**, with a mass number one less than isotope **A**. State the composition of the nucleus of an atom of isotope **B**.

.....

(1)

(ii) Why do these isotopes have the same chemical properties?

.....

(1)

(Total 8 marks)

Q6



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7. (a) Give the name of the physical change that occurs when steam is converted to water.

.....
(1)

(b) Describe the spacing and the movement of particles in steam and in water.

Steam

.....
.....

Water

.....
.....

(4)

(c) Suggest why it requires more heat energy to turn a given mass of water into steam than to turn the same mass of ice into water.

.....
.....
.....
.....

(2)

(Total 7 marks)

Q7



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8. Rubidium is in the same group in the Periodic Table as sodium. Use your knowledge of the reactions of sodium to answer parts (a) and (b) below.

(a) (i) Give **two** observations that would be made when a small piece of rubidium is dropped into cold water.

1

2 (2)

(ii) Write the equation for the reaction.

..... (2)

(b) Write the equation for the decomposition of rubidium nitrate on heating.

..... (2)

(Total 6 marks)

Q8



9. (a) Three experiments were set up to investigate the effect of air and water on the rate of rusting of an iron nail. The experiments were left for several days.

Experiment A: a nail was put in a test tube, covered with water and left exposed to the atmosphere.

Experiment B: a nail was put in a test tube, covered with water that had been previously boiled and a layer of oil was poured on top of the water.

Experiment C: a nail was put in a test tube that contained anhydrous calcium chloride and the top was sealed with a bung.

(i) State in which experiment(s) you would expect rusting to occur.

..... (1)

(ii) In Experiment B, explain why the water was boiled and then covered in a layer of oil.

.....
.....
..... (2)

(iii) In Experiment C, state the purpose of the anhydrous calcium chloride.

.....
..... (1)

(iv) What do the experiments show about the conditions needed for iron to rust?

.....
..... (1)



(b) (i) Explain why a block of zinc attached to the steel hull of a ship slows down the rusting process.

.....
.....
.....

(2)

(ii) Name one other metal that could be used instead of zinc.

.....

(1)

(Total 8 marks)

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Q9



N 2 9 8 9 3 A 0 1 1 2 0

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10. (a) Ethanol is made from sugar solution by fermentation.

(i) Name a catalyst for the reaction.

.....
(1)

(ii) Give a temperature at which the reaction is usually carried out.

.....
(1)

(iii) State how the oxidation of ethanol is prevented.

.....
(1)

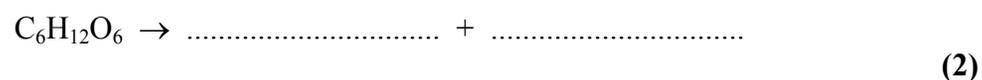
(iv) State how the solid impurities are removed.

.....
(1)

(v) Name the method used to obtain pure ethanol from the aqueous mixture.

.....
(1)

(vi) Complete the equation for the reaction



(b) Give an advantage and a disadvantage of this method of manufacture compared with using ethene as a starting material.

Advantage

Disadvantage

(2)

Q10

(Total 9 marks)



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11. Esters and polyesters can be made from the reaction between organic acids and alcohols.

- (a) Draw the structure for the ester formed by the reaction between ethanoic acid, CH_3COOH , and methanol, CH_3OH , and give its name.

Structure

Name (2)

- (b) (i) A polyester can be made from the two monomers below.



Complete the central section of the polymer chain.

— $\text{OOC}(\text{CH}_2)_4$ $\text{OOC}(\text{CH}_2)_4\text{COO}$ — (1)

- (ii) State the type of polymerisation occurring and name a polymer made this way.

Type

Name (2)

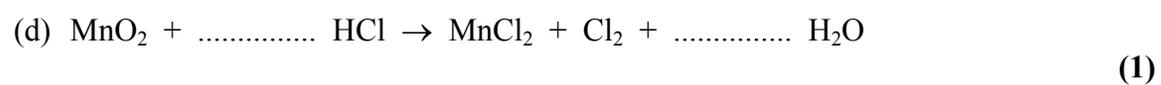
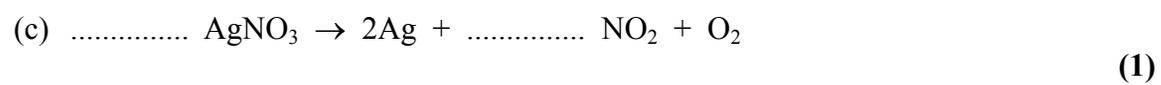
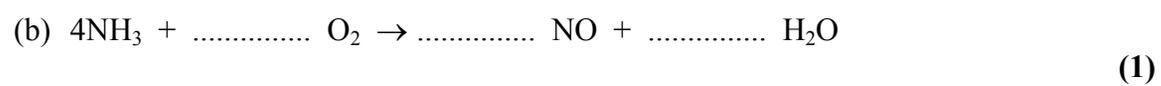
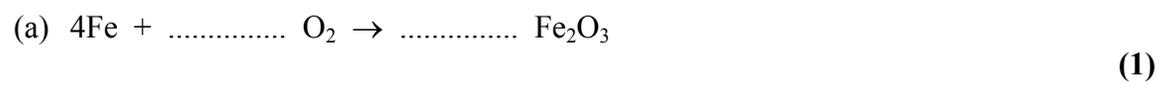
(Total 5 marks)

Q11



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12. Complete the balancing of each of the equations.



(Total 4 marks)

Q12



13. Two experiments were carried out to investigate the change in mass on heating copper and copper(II) carbonate.

Experiment 1

A weighed piece of copper foil was heated in an open test tube for a few minutes, cooled and reweighed.

Experiment 2

A sample of copper(II) carbonate was put in a test tube and weighed. It was then heated for a few minutes, cooled and reweighed.

Complete the table below.

	Experiment 1	Experiment 2
(a) State whether mass increases or decreases.		
(b) Give the reason for the change in mass.		
(c) State the type of chemical change taking place.		
(d) Write the equation for each reaction.		

(Total 8 marks)

Q13



14. A student performed a titration to find the concentration of a solution of sodium hydroxide. Hydrochloric acid of concentration $0.200 \text{ mol dm}^{-3}$ was slowly added to 25.0 cm^3 of the sodium hydroxide in a conical flask. A suitable indicator was used to find the accurate end-point. The titration was repeated and the following results were obtained.

Titration number	1	2	3
Final reading / cm^3	28.80	29.75	28.45
Initial reading / cm^3	0.00	1.80	0.40
Volume of HCl added / cm^3			

(a) Name two different pieces of apparatus that were used to measure the volume of acid and the volume of alkali accurately.

Acid

Alkali

(2)

(b) Name a suitable indicator for this titration and give its colour at the end-point.

Indicator

Colour at end-point

(2)

(c) State why the titration was repeated.

.....

(1)

(d) Calculate the volumes of hydrochloric acid added and write the values in the table.

(2)

(e) State which volume of hydrochloric acid should be ignored and calculate the average of the other two values.

Volume to be ignored

Average value

(2)



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blank

(f) Use the average value to calculate the concentration of the sodium hydroxide in mol dm^{-3} .

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(3)

Q14

(Total 12 marks)

TOTAL FOR PAPER: 100 MARKS

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N 2 9 8 9 3 A 0 1 9 2 0

THE PERIODIC TABLE

Period 1 2 3 4 5 6 7 0

Group

1	<div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 2px;">1 H Hydrogen 1</div> <div style="border: 1px solid black; padding: 2px;">2 He Helium 4</div> </div>																																																																			
2	3	4											5	6	7	8	9	10																																																		
	Li Lithium 7	Be Beryllium 9	B Boron 11	C Carbon 12	N Nitrogen 14	O Oxygen 16	F Fluorine 19	Ne Neon 20	Al Aluminium 13	Si Silicon 28	P Phosphorus 31	S Sulphur 32	Cl Chlorine 35.5	Ar Argon 40	K Potassium 39	Ca Calcium 40	Sc Scandium 45	Ti Titanium 48	V Vanadium 51	Cr Chromium 52	Mn Manganese 55	Fe Iron 56	Co Cobalt 59	Ni Nickel 59	Cu Copper 63.5	Zn Zinc 65	Ga Gallium 70	Ge Germanium 73	As Arsenic 75	Se Selenium 79	Br Bromine 80	Kr Krypton 84	Rb Rubidium 86	Sr Strontium 88	Y Yttrium 89	Zr Zirconium 91	Nb Niobium 93	Mo Molybdenum 96	Tc Technetium 99	Ru Ruthenium 101	Rh Rhodium 103	Pd Palladium 106	Ag Silver 108	Cd Cadmium 112	In Indium 115	Sn Tin 119	Sb Antimony 122	Te Tellurium 128	I Iodine 127	Xe Xenon 131	Cs Caesium 133	Ba Barium 137	La Lanthanum 139	Hf Hafnium 179	Ta Tantalum 181	W Tungsten 184	Re Rhenium 186	Os Osmium 190	Ir Iridium 192	Pt Platinum 195	Au Gold 197	Hg Mercury 201	Tl Thallium 204	Pb Lead 207	Bi Bismuth 209	Po Polonium 210	At Astatine 210	Rn Radon 222
3	Na Sodium 23	Mg Magnesium 24																																																																		
4	Rb Rubidium 86	Sr Strontium 88	Y Yttrium 89	Zr Zirconium 91	Nb Niobium 93	Mo Molybdenum 96	Tc Technetium 99	Ru Ruthenium 101	Rh Rhodium 103	Pd Palladium 106	Ag Silver 108	Cd Cadmium 112	In Indium 115	Sn Tin 119	Sb Antimony 122	Te Tellurium 128	I Iodine 127	Xe Xenon 131	Cs Caesium 133	Ba Barium 137	La Lanthanum 139	Hf Hafnium 179	Ta Tantalum 181	W Tungsten 184	Re Rhenium 186	Os Osmium 190	Ir Iridium 192	Pt Platinum 195	Au Gold 197	Hg Mercury 201	Tl Thallium 204	Pb Lead 207	Bi Bismuth 209	Po Polonium 210	At Astatine 210	Rn Radon 222																																
5																																																																				
6																																																																				
7	Fr Francium 223	Ra Radium 226	Ac Actinium 227																																																																	

Key

Atomic number
Symbol
Name
Relative atomic mass

