Paper 3

Questions are applicable for both core and extended candidates

1 Table 2.1 shows the masses of some of the ions in a 1000 cm^3 sample of river water.

Table 2.1

name of ion	formula of ion	mass of ion in 1000 cm^3 of river water / mg
	NH_4^+	0.4
calcium	Ca^{2+}	1.4
chloride	Cl^-	0.1
hydrogencarbonate	HCO_3^-	1.2
magnesium	Mg^{2+}	0.6
nitrate	NO_3^-	0.8
phosphate	PO_4^{3-}	1.3
sodium	Na^+	0.5
	SO_4^{2-}	0.4

(b) Give a test for sodium ions.

test .....

observations .....

[2]

2 A list of symbols and formulae is shown.

Br_2
CH_4
C_2H_4
Cl^-
CO_2
Cr^{3+}
Cu^{2+}
H_2
K^+
N_2
N^{3-}
O_2
SO_4^{2-}

Answer the following questions about these symbols and formulae.
Each symbol or formula may be used once, more than once or not at all.

State which symbol or formula represents:

(d) an ion which forms a green precipitate when a few drops of aqueous sodium hydroxide are added to it

..... [1]

3 Fig. 1.1 shows part of the Periodic Table.

I	II											III	IV	V	VI	VII	VIII
							H										He
													C	N	O		
Na	Mg											Al				Cl	
K	Ca						Fe			Cu						Br	
																I	

Fig. 1.1

Answer the following questions using only the elements in Fig. 1.1.

Each symbol of the element may be used once, more than once or not at all.

Give the symbol of the element that:

(e) forms an ion that gives a green precipitate on addition of aqueous sodium hydroxide

..... [1]

4 (b) (i) State **one** source of sulfur dioxide in the atmosphere.

..... [1]

(ii) State **one** adverse effect of sulfur dioxide in the atmosphere.

..... [1]

(iii) Choose the compound used to remove sulfur dioxide in flue gas desulfurisation.

Tick (✓) **one** box.

aluminium chloride	☐
calcium oxide	☐
methane	☐
sulfuric acid	☐

[1]

(iv) Hydrochloric acid reacts with sodium sulfite.

The products are sodium chloride, sulfur dioxide and a liquid which turns anhydrous cobalt(II) chloride pink.

Complete the symbol equation for this reaction.

$$Na_2SO_3 + ...HCl \rightarrow 2NaCl + SO_2 + ...$$ [2]

(v) Name the acidified solution used to test for sulfur dioxide gas and state the observations.

acidified solution .....

observations .....

[2]

5 **(a)** Table 2.1 shows the mass of ions present in a 100 cm^3 sample of milk.

Table 2.1

ion	formula of ion	mass of ion in 100 cm^3 milk / mg
calcium	Ca^{2+}	125
chloride	Cl^-	120
magnesium	Mg^{2+}	12
negative ions of organic acids		160
phosphate	PO_4^{3-}	95
potassium	K^+	140
sodium	Na^+	58
sulfate	SO_4^{2-}	30

(iv) Describe a test for chloride ions.

test .....

positive result .....
[2]

(v) Explain why the solutions used in qualitative chemical tests are made using distilled water and **not** tap water.

.....

..... [1]

6 This question is about chlorine and compounds of chlorine.

(a) Chlorine is an element in Group VII of the Periodic Table.

State the meaning of the term *element*.

.....

..... [1]

(b) State **one** use of chlorine.

..... [1]

(c) Chlorine reacts with phosphorus to produce phosphorus(V) chloride.

(i) Balance the equation for this reaction.

$$.....P + ...Cl_2 \rightarrow 2PCl_5$$ [2]

(ii) This reaction is exothermic.

State the meaning of the term *exothermic*.

..... [1]

(d) Chlorine reacts with aqueous sodium bromide.

(i) Complete the word equation for this reaction.

chlorine	+	sodium bromide	→	.....	+	....

[2]

(ii) Describe a test for bromide ions.

test .....

observations .....

[2]

(iii) When bromine is mixed with aqueous sodium chloride there is no reaction.

Suggest in terms of chemical reactivity why there is no reaction.

..... [1]

7 **(a)** A list of symbols and formulae is shown.

CaO
CH_4
C_2H_4
C_2H_6
Cl^-
Cu^{2+}
H_2
He
K^+
N_2
Na^+
SO_2

Answer the following questions using these symbols or formulae.
Each symbol or formula may be used once, more than once or not at all.

State which symbol or formula represents:

(ii) a positive ion that gives a blue-green colour in a flame test

..... [1]

8 The table shows the masses of some ions in a 1000 cm^3 sample of toothpaste.

name of ion	formula of ion	mass of ion in 1000 cm^3 of toothpaste / g
	NH_4^+	0.2
calcium	Ca^{2+}	1.2
	Cl^-	0.9
fluoride	F^-	1.4
magnesium	Mg^{2+}	2.0
phosphate	PO_4^{3-}	24.4
sodium	Na^+	28.1
sulfate	SO_4^{2-}	9.2
tin(II)	Sn^{2+}	0.2
zinc	Zn^{2+}	0.1

(b) Describe a test for sulfate ions.

test .....

observations .....

[2]

9 This question is about compounds of nitrogen.

(a) Fertilisers containing nitrogen are used by farmers to improve crop growth.

Name two **other** elements found in most fertilisers that improve crop growth.

..... and ..... [2]

(b) Ammonium chloride, NH_4Cl, reacts with calcium hydroxide.
The products are ammonia, a salt and a liquid that turns anhydrous copper(II) sulfate blue.

Complete the word equation for this reaction.

ammonium chloride	+	calcium hydroxide	→	ammonia	+	....	+	.....

[2]

(c) Describe a test for chloride ions.

test .....

observations .....
[2]

(d) Bacteria in the soil can convert ammonium ions into oxides of nitrogen.

(i) Give one **other** source of oxides of nitrogen in the air.

..... [1]

(ii) State **one** adverse effect of oxides of nitrogen on health.

..... [1]

[Total: 8]

Paper 4

Questions are applicable for both core and extended candidates unless indicated in the question

10 Lithium, sodium and potassium are Group I elements.

(a) Name the type of bonding in these elements.

..... [1]

(b) Sodium reacts with cold water to form hydrogen gas and a solution of a strong alkali.

(i) State the test for hydrogen gas.

test .....

positive result .....
[1]

(ii) Suggest the pH of a solution of a strong alkali.

pH = ... [1]

(iii) Name a substance which can be used to confirm the pH of a solution of a strong alkali.

..... [1]

(iv) Write the symbol equation for the reaction between sodium and cold water.

Include state symbols.

..... [3]

11 A list of gases is shown.

ammonia
carbon dioxide
carbon monoxide
ethene
fluorine
oxygen
sulfur dioxide
xenon

Answer the following questions using only the gases from the list.
Each gas may be used once, more than once or not at all.

Give the name of the gas that:

(f) is produced in the test for nitrate ions.

..... [1]

12 Aqueous hydrogen peroxide, H_2O_2, slowly forms water and oxygen at room temperature and pressure, r.t.p. This reaction is catalysed by manganese(IV) oxide.

The equation is shown.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

(a) State the test for oxygen gas.

test .....

observations .....
[1]

13 This question is about the first 30 elements in the Periodic Table.

Name the element which:

(f) has an anhydrous chloride which turns pink when water is added

..... [1]

(g) has aqueous ions which form a white precipitate when added to aqueous silver ions

..... [1]

(h) forms a blue hydroxide which dissolves in aqueous ammonia

.....[1]

14 Nitrogen dioxide, NO_2, is an atmospheric pollutant and is formed in car engines.

(c) Nitrogen dioxide emissions can be reduced by adding an aqueous solution of urea, $(NH_2)_2CO$, to car exhaust gases.

The heat of the exhaust gases breaks down the urea into simpler substances.

(i) Name the type of reaction which occurs when a substance is heated and breaks down into simpler substances.

..... [1]

(ii) One molecule of urea breaks down to form one molecule of ammonia and one other molecule.

Complete the chemical equation to show the formula of the other molecule formed in this reaction.

$$(NH_2)_2CO \rightarrow NH_3 + ...$$ [1]

(iii) State the test for ammonia.

test .....

observations .....
[2]

15 The names of the elements of Period 2 of the Periodic Table are shown.

lithium beryllium boron carbon nitrogen oxygen fluorine neon

Answer the following questions about these elements.

Each element may be used once, more than once or not at all.

Identify the element which:

(f) produces a red flame in a flame test

..... [1]

16 Potassium is a Group I element.

(c) When potassium is added to water, it reacts vigorously and a coloured flame is seen. The equation for the reaction is shown.

$$2K(s) + 2H_2O(l) \rightarrow 2KOH(aq) + H_2(g)$$

(i) State the colour of the flame seen.

..... [1]

(ii) The solution formed is potassium hydroxide, a strong alkali.

State the formula of the ion responsible for alkalinity in a solution.

..... [1]

(iii) State the colour of litmus in a strong alkali.

..... [1]

17 Magnesium, calcium and strontium are Group II elements.

(c) Calcium reacts with cold water to form two products:

- a colourless gas, **P**, which 'pops' with a lighted splint
- a weakly alkaline solution, **Q**, which turns milky when carbon dioxide is bubbled through it.

(i) Name gas **P**.

..... [1]

(ii) Identify the ion responsible for making solution **Q** alkaline.

..... [1]

(iii) Suggest the pH of solution **Q**.

..... [1]

(iv) Write a symbol equation for the reaction of calcium with cold water.

..... [2]