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F321 Style Questions from Old Specification

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Answer **all** the questions.

1 The element indium, atomic number 49, is a very soft, silvery-white metal with a brilliant shine. One strange property of indium is that it makes a high-pitched 'scream' when bent! It occurs as a mixture of two isotopes, ^{113}In and ^{115}In.

(a) Complete the table below for the isotopes of indium.

isotope	protons	neutrons	electrons
^{113}In			
^{115}In			

[2]

(b) A sample of indium contains 4.23% of ^{113}In and 95.77% ^{115}In.

Calculate the relative atomic mass of the indium sample.

Give your answer to one decimal place.

A_r = ... [2]

(c) Indium has metallic bonding.

Draw a **labelled** diagram to show metallic bonding.

[2]

(d) A compound of indium and iodine has the following percentage composition by mass:

In, 23.19%; I, 76.81%. The relative molecular mass of this compound is 992.

(i) Define the term *relative molecular mass*.

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.....[3]

(ii) Calculate the molecular formula of this compound.

molecular formula = ... [3]

[Total: 12]

2 This question refers to the first 20 elements in the Periodic Table. These are shown below.

						H										He
Li	Be										B	C	N	O	F	Ne
Na	Mg										Al	Si	P	S	Cl	Ar
K	Ca															

(a) From these first 20 elements **only**, identify an element that fits each of the following descriptions.

(i) The element that forms a 2+ ion with the same electronic configuration as Ar.

……. [1]

(ii) The element that forms a 3– ion with the same electronic configuration as Ne.

……. [1]

(iii) The element that has atoms with a 3p subshell containing five electrons.

……. [1]

(iv) An element that forms a compound with fluorine with trigonal planar molecules.

……. [1]

(v) The element with the smallest first ionisation energy.

……. [1]

(vi) An element with a giant covalent lattice.

……. [1]

(b) Elements form many compounds.

Choose compounds, formed from the first 20 elements **only**, to illustrate ionic and covalent bonding.

Showing outer electrons only, draw '*dot-and-cross*' diagrams of your chosen examples.

(i) '*Dot-and-cross*' diagram for a compound with ionic bonding.

[2]

(ii) '*Dot-and-cross*' diagram for a compound with covalent bonding.

[2]

(c) Across a period in the Periodic Table, elements often show characteristic trends.

Describe and explain the trend in atomic radius across Period 3.

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.....[4]

[Total: 14]

3 **(a)** A student prepared some chlorine gas on a small scale by reacting hydrochloric acid with household bleach.

The reaction is shown below.

$$2HCl(aq) + NaClO(aq) \longrightarrow Cl_2(g) + NaCl(aq) + H_2O(l)$$

The student reacted 1.0 cm^3 of 6.0 mol dm^{-3} HCl with 3.0 cm^3 household bleach. 55 cm^3 of chlorine gas were produced. The hydrochloric acid was in excess and this ensured that all the NaClO in the bleach was reacted.

Under these conditions, 1.0 mol of $Cl_2(g)$ has a volume of 24 dm^3.

(i) Calculate how many moles of $Cl_2(g)$ were produced.

answer = ... mol [1]

(ii) Calculate the concentration, in mol dm^{-3}, of NaClO in the bleach.

concentration = ... mol dm^{-3} [1]

(iii) Calculate the number of moles of HCl that remained **after** the reaction.

answer = ... mol [3]

(b) A student carries out two experiments.

(i) The student bubbles some chlorine gas through a solution of sodium iodide. The solution turns a brown colour.

Explain this observation and write an equation for the reaction that takes place.

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.....[2]

(ii) The student bubbles chlorine gas through aqueous silver nitrate. A white precipitate forms.

Explain this observation including equations for any reactions that take place.

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.....[4]

(c) HCl is a polar molecule but CCl_4 is a non-polar molecule. This difference can be explained by consideration of electronegativity and molecular shapes.

(i) Explain the term *electronegativity*.

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.....[2]

(ii) Draw a 3-D diagram to show the shape of a molecule of CCl_4. State the bond angle.

[2]

(iii) Explain why HCl is a polar molecule but CCl_4 is a non-polar molecule.

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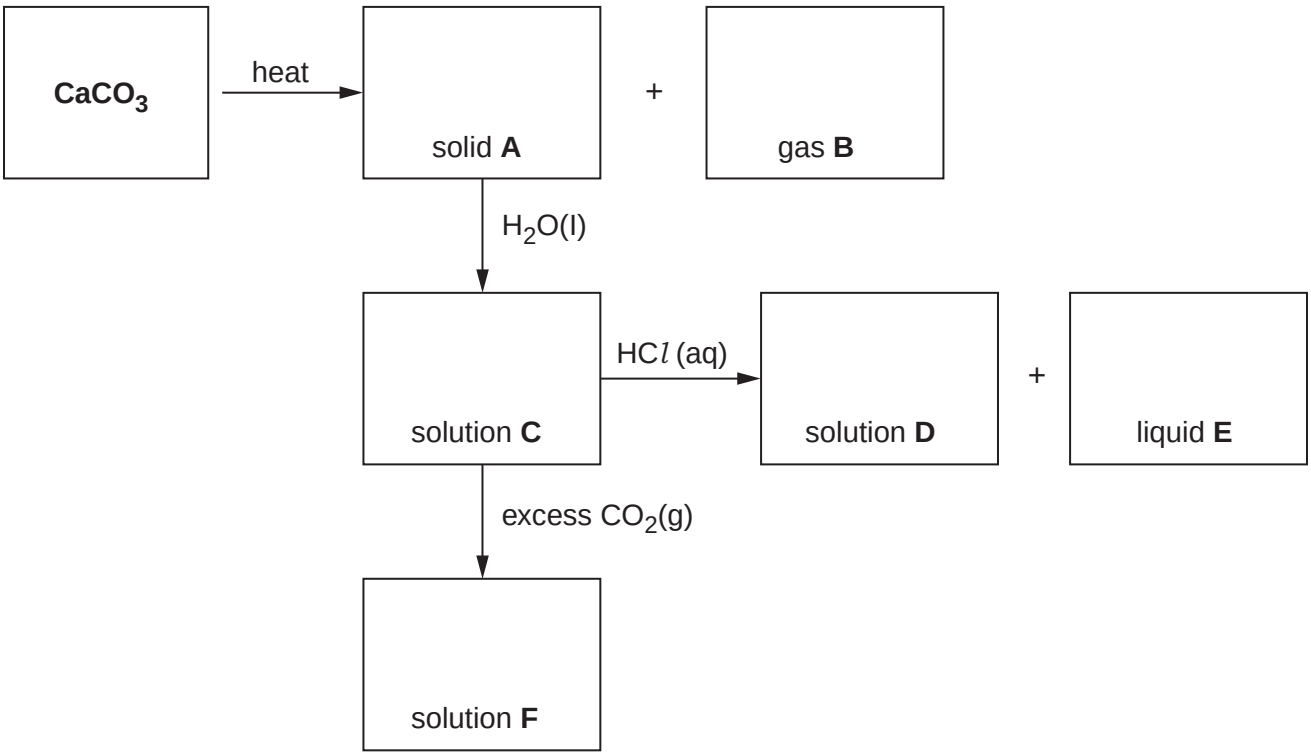
.....[3]

[Total: 18]

4 This question looks at the chemistry of Group 2 elements and their compounds.

(a) The flowchart below shows some reactions involving calcium compounds.

Identify substances **A–F** by writing their **formulae** in the boxes.



[6]

(b) In this question, one mark is available for the quality of spelling, punctuation and grammar.

All the Group 2 elements react with oxygen.

- Write a balanced equation, with state symbols, for the reaction of calcium with oxygen.

  Using this reaction, explain what is meant by oxidation and reduction in terms of electrons. [4]

- State and explain the trend in reactivity of the Group 2 elements with oxygen. [5]

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