GCSE Chemistry A (Gateway Science)

J248/04 Chemistry A C4-C6 and C7 (Higher Tier)

Question Set 16

1 **(a)** A student dissolves 0.6 g of zinc sulfate in 250 cm^3 of water.

(i) Calculate the volume of the water in dm^3.

$\frac{250}{1000} = \frac{1}{4} = 0.25\,dm^3$

Answer = 0.25 dm^3 **[1]**

(ii) Use your answer to part **(a)(i)** to help you calculate the concentration of the zinc sulfate in g/dm^3.

$C = \frac{m}{V} = \frac{0.6}{0.25} = 2.4$

Answer = 2.4 g/dm^3 **[1]**

(b) Zinc reacts with sulfuric acid. Zinc sulfate and hydrogen gas, H_2, are made.

$1\ Zn + H_2SO_4 \rightarrow ZnSO_4 + 1H_2$

(i) Calculate the amount of **hydrogen gas**, in mol, that could be made from 3.27 g of **zinc**.

$n\,zinc = \frac{m}{mr} = \frac{3.27}{65.4} = 0.05\,mol$

1 : 1 mole ratio

Answer = 0.05 mol **[2]**

(ii) Use your answer to part **(b)(i)** to calculate the **volume** of hydrogen gas produced at room temperature and pressure.

One mole of any gas occupies 24 dm^3 at room temperature and pressure.

$V = nV_m = 0.05 \times 24 = 1.2\,dm^3$

Answer = 1.2 dm^3 **[2]**

(c) Hydrogen can be made by reacting methane with steam.

$CH_4 + H_2O \rightarrow CO + 3H_2$

The **atom economy** for this process is 17.6%.

Hydrogen can also be produced by the decomposition of ammonia.

This reaction requires a catalyst.

$2NH_3 \rightarrow N_2 + 3H_2$

(i) Calculate the atom economy for the production of hydrogen from ammonia.

Give your answer to **3** significant figures.

$\frac{3 \times 2}{(3 \times 2) + (14 \times 2)} \times 100 = 17.6\ \%$

Answer = 17.6 % **[3]**

(ii) Suggest other factors, apart from atom economy, that must be considered when deciding which reaction pathway to choose for the manufacture of hydrogen. **[3]**

(ii) - Reaction conditions ⇒ one method may require e.g. a high temperature or pressure, which would be more costly and dangerous.

- Sustainability of reactants ⇒ methane comes from crude oil, which is not sustainable.

- Emission of harmful gasses ⇒ carbon monoxide is toxic.

- percentage yield where least of material wasted

Total Marks for Question Set 16: 12

The Periodic Table of the Elements

(1)	(2)											(3)	(4)	(5)	(6)	(7)	(0)
1																	18
1 **H** hydrogen 1.0	2											13	14	15	16	17	2 **He** helium 4.0
3 **Li** lithium 6.9	4 **Be** beryllium 9.0											5 **B** boron 10.8	6 **C** carbon 12.0	7 **N** nitrogen 14.0	8 **O** oxygen 16.0	9 **F** fluorine 19.0	10 **Ne** neon 20.2
11 **Na** sodium 23.0	12 **Mg** magnesium 24.3	3	4	5	6	7	8	9	10	11	12	13 **Al** aluminium 27.0	14 **Si** silicon 28.1	15 **P** phosphorus 31.0	16 **S** sulfur 32.1	17 **Cl** chlorine 35.5	18 **Ar** argon 39.9
19 **K** potassium 39.1	20 **Ca** calcium 40.1	21 **Sc** scandium 45.0	22 **Ti** titanium 47.9	23 **V** vanadium 50.9	24 **Cr** chromium 52.0	25 **Mn** manganese 54.9	26 **Fe** iron 55.8	27 **Co** cobalt 58.9	28 **Ni** nickel 58.7	29 **Cu** copper 63.5	30 **Zn** zinc 65.4	31 **Ga** gallium 69.7	32 **Ge** germanium 72.6	33 **As** arsenic 74.9	34 **Se** selenium 79.0	35 **Br** bromine 79.9	36 **Kr** krypton 83.8
37 **Rb** rubidium 85.5	38 **Sr** strontium 87.6	39 **Y** yttrium 88.9	40 **Zr** zirconium 91.2	41 **Nb** niobium 92.9	42 **Mo** molybdenum 95.9	43 **Tc** technetium	44 **Ru** ruthenium 101.1	45 **Rh** rhodium 102.9	46 **Pd** palladium 106.4	47 **Ag** silver 107.9	48 **Cd** cadmium 112.4	49 **In** indium 114.8	50 **Sn** tin 118.7	51 **Sb** antimony 121.8	52 **Te** tellurium 127.6	53 **I** iodine 126.9	54 **Xe** xenon 131.3
55 **Cs** caesium 132.9	56 **Ba** barium 137.3	● 57–71 lanthanoids	72 **Hf** hafnium 178.5	73 **Ta** tantalum 180.9	74 **W** tungsten 183.8	75 **Re** rhenium 186.2	76 **Os** osmium 190.2	77 **Ir** iridium 192.2	78 **Pt** platinum 195.1	79 **Au** gold 197.0	80 **Hg** mercury 200.6	81 **Tl** thallium 204.4	82 **Pb** lead 207.2	83 **Bi** bismuth 209.0	84 **Po** polonium	85 **At** astatine	86 **Rn** radon
87 **Fr** francium	88 **Ra** radium	● 89–103 actinoids	104 **Rf** rutherfordium	105 **Db** dubnium	106 **Sg** seaborgium	107 **Bh** bohrium	108 **Hs** hassium	109 **Mt** meitnerium	110 **Ds** darmstadtium	111 **Rg** roentgenium	112 **Cn** copernicium		114 **Fl** flerovium		116 **Lv** livermorium		

Key
atomic number
Symbol
name
relative atomic mass