S3 Chemistry Practice Paper 1 with Answers

Chemistry · S3 · Data-response

S3 chemistry practice paper with answers on Mr, percentage composition, combustion, concentration, neutralisation and metals. Full marking scheme included.

Part 1: Relative molecular mass and percentage composition

Data A (simulated): relative atomic masses are Ca = 40, C = 12, O = 16, Al = 27, S = 32, N = 14 and H = 1. Study the data and answer all parts.

#	Question
1	Calculate the relative molecular mass of calcium carbonate (CaCO3).
2	What percentage by mass of calcium carbonate is calcium? (1 decimal place)
3	Calculate the relative molecular mass of aluminium sulphate (Al2(SO4)3) and the percentage by mass of sulphur in it (2 decimal places).
4	Compare ammonium nitrate (NH4NO3) with ammonium sulphate ((NH4)2SO4): (1) calculate the percentage by mass of nitrogen in each (1 decimal place); (2) state which one has the higher nitrogen content; (3) calculate the mass of nitrogen in 50 g of ammonium nitrate (1 decimal place).

Part 2: Combustion and conservation of mass

Data B (simulated): 4.8 g of magnesium ribbon is heated in a crucible. The magnesium reacts completely with oxygen in the air to form magnesium oxide (2Mg + O2 → 2MgO). Relative atomic masses: Mg = 24, O = 16.

#	Question
5	Calculate the number of moles in 4.8 g of magnesium.
6	Using the equation, calculate the mass of magnesium oxide formed after complete reaction.
7	Calculate the mass of oxygen used up in the reaction.
8	(1) If the experiment actually collects only 6.4 g of magnesium oxide, calculate the percentage yield (1 decimal place). (2) Calculate the mass of magnesium oxide lost and its percentage of the theoretical yield (1 decimal place). (3) Explain why less product is collected than the theoretical mass when magnesium burns in an open crucible.

Part 3: Solution concentration and dilution

Data C (simulated): 25.0 g of sodium chloride is dissolved in water to make 500 cm3 of solution; the mass of water added is 475.0 g.

#	Question
9	Calculate the concentration of the solution in g/dm3.
10	Calculate the mass of sodium chloride contained in 120 cm3 of this solution.
11	200 cm3 of the solution is diluted with water to 500 cm3. (1) Calculate the concentration of the diluted solution in g/dm3. (2) State whether the total mass of solute changes on dilution and give that mass.

#	Question
12	(1) Calculate the percentage concentration by mass of the solution (1 decimal place). (2) How much more water must be added to halve this percentage concentration by mass?

Part 4: Neutralisation and energy change

Data D (simulated): 0.1 mol/dm3 sodium hydroxide solution is used to neutralise 25.0 cm3 of hydrochloric acid; 25.0 cm3 of the same sodium hydroxide solution is needed for complete neutralisation (NaOH + HCl → NaCl + H2O). The mixture has a total mass of 50.0 g and its temperature rises by 6.0 °C. The specific heat capacity of water is 4.2 J g-1 °C-1.

#	Question
13	Calculate the number of moles of NaOH in 25.0 cm3 of 0.1 mol/dm3 sodium hydroxide solution.
14	The mole ratio of NaOH to HCl in the neutralisation is 1:1. Calculate the concentration of the 25.0 cm3 of hydrochloric acid used.
15	If 20.0 cm3 of that hydrochloric acid is used instead, what volume of the same sodium hydroxide solution is needed for complete neutralisation?
16	For the neutralisation of 25.0 cm3 of acid with 25.0 cm3 of sodium hydroxide solution: (1) calculate the energy released in joules; (2) calculate the energy released per mole of water formed in kJ/mol (1 decimal place); (3) explain why the measured energy is usually lower than the literature value.

Part 5: Metal displacement and redox

Data E (simulated): 6.5 g of zinc is placed in copper(II) sulphate solution and the zinc reacts completely (Zn + CuSO4 → ZnSO4 + Cu). In a separate tube 4.0 g of copper(II) oxide is heated in a stream of hydrogen until fully reduced (CuO + H2 → Cu + H2O). Relative atomic masses: Zn = 65, Cu = 64, O = 16, H = 1; molar volume of a gas at room conditions is 24 dm3/mol.

#	Question
17	Calculate the number of moles in 6.5 g of zinc and the mass of copper deposited.
18	Calculate the change in mass of the solution (how many grams gained or lost) and explain the reason.
19	If 6.5 g of zinc reacts completely with excess dilute hydrochloric acid (Zn + 2HCl → ZnCl2 + H2), calculate the volume of hydrogen produced at room conditions in cm3.
20	For the copper(II) oxide reduction: (1) calculate the moles in 4.0 g of copper(II) oxide; (2) calculate the masses of copper and of water formed; (3) calculate the volume of hydrogen needed at room conditions in dm3.

Part 6: Air composition and combustion products

Data F (simulated): oxygen makes up about 21 per cent by volume of air. Burning 12 g of carbon gives carbon dioxide (C + O2 → CO2); burning 32 g of methane (CH4) also gives carbon dioxide (CH4 + 2O2 → CO2 + 2H2O). Relative atomic masses: C = 12, H = 1, O = 16.

#	Question
21	Calculate the volume of oxygen in 200 cm3 of air.

#	Question
22	Burning 12 g of carbon: calculate the mass of carbon dioxide formed.
23	Burning 32 g of methane: calculate the moles of methane and the mass of carbon dioxide formed.
24	(1) Calculate the mass of carbon dioxide produced per gram of carbon and per gram of methane burnt (2 decimal places). (2) State which fuel releases more carbon dioxide per unit mass. (3) Suggest one practical way to reduce the carbon dioxide emitted by burning fossil fuels.

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