S3 Chemistry Practice Paper 2 | Atomic structure, bonding and formulae, mole calculations, concentration, titration, metal reactivity

Junior Secondary Chemistry

S3 Chemistry practice paper 2 with worked solutions: atomic structure, isotopes, bonding, formula mass, mole calculations, titration and metal reactivity.

1. Atomic structure and isotopes (16 marks)

The atomic number of element X is 17. In nature X exists as two isotopes with mass numbers 35 and 37 and abundances of 75 per cent and 25 per cent. An atom of element Y contains 12 protons and 12 neutrons.

#	Question
1	(a) Write the electronic arrangement of element X by shells, and state the period and group to which it belongs.
2	(b) Calculate the number of neutrons in each of the two isotopes.
3	(c) Calculate the relative atomic mass of element X, correct to one decimal place.
4	(d) What is the mass number of element Y, and how many electrons are in its outermost shell?

2. Chemical bonding and formulae (16 marks)

The following substances are held together by different types of bonding: sodium chloride (NaCl), sodium sulphate (Na2SO4), aluminium oxide (Al2O3), methane (CH4) and carbon dioxide (CO2). Relative atomic masses: Na 23, Al 27, S 32, O 16, C 12, H 1.

#	Question
5	(a) State the type of bonding in NaCl and in CH4, and explain how each is formed.
6	(b) Write the formula of the compound formed from Na+ and SO4 2-, and explain your answer.
7	(c) Write the formula of the compound formed from Al3+ and O2-, and justify it by charges.
8	(d) Calculate the relative formula mass of Na2SO4 and the relative molecular mass of CO2.

3. Formula mass and mole calculations (18 marks)

Relative atomic masses: C 12, O 16, Na 23, H 1. Take the Avogadro constant as 6.02 x 10 to the power 23.

#	Question
9	(a) How many moles are there in 4.4 g of carbon dioxide?
10	(b) How many molecules are there in that 4.4 g of carbon dioxide?
11	(c) What is the mass of 0.25 mol of sodium carbonate (Na2CO3)?
12	(d) 8.0 g of sodium hydroxide is dissolved in water to make 500 cm3 of solution. Find its molar concentration.

4. Solution concentration and dilution (18 marks)

A laboratory keeps 2.0 mol/dm3 hydrochloric acid as a stock solution. Separately, 20 g of a solute of molar mass 40 g/mol is dissolved completely in water to make 2.0 dm3 of solution.

#	Question
13	(a) 250 cm3 of a solution contains 0.050 mol of solute. Find its molar concentration.
14	(b) 25.0 cm3 of 2.0 mol/dm3 hydrochloric acid is diluted to 0.50 mol/dm3. What is the final volume, and how much water must be added?
15	(c) Find the molar concentration and the mass concentration in g/dm3 of the 20 g solute solution described above.
16	(d) A solution has a mass concentration of 4.0 g/dm3 and the solute has a molar mass of 40 g/mol. Find the molar concentration.

5. Acid-base neutralisation and titration (16 marks)

25.0 cm3 of sodium hydroxide solution is titrated with 0.10 mol/dm3 hydrochloric acid, and 20.0 cm3 of the acid is used to reach the end point. HCl + NaOH -> NaCl + H2O.

#	Question
17	(a) Calculate the molar concentration of the sodium hydroxide solution.
18	(b) How many moles of sodium hydroxide are needed to neutralise 0.050 mol of sulphuric acid?
19	(c) A hydrochloric acid solution has a concentration of 0.010 mol/dm3. Find its pH.
20	(d) What volume of 0.050 mol/dm3 sulphuric acid is needed to neutralise 20.0 cm3 of 0.10 mol/dm3 sodium hydroxide?

6. Metal reactivity and yield calculations (16 marks)

2.6 g of zinc (relative atomic mass 65) is added to excess copper(II) sulphate solution and copper (relative atomic mass 64) is formed. Zn + CuSO4 -> ZnSO4 + Cu.

#	Question
21	(a) Arrange potassium, sodium, magnesium and copper in order of reactivity with water and dilute acid, from most to least reactive, giving one observation for each.
22	(b) Calculate the theoretical mass of copper that 2.6 g of zinc can produce.
23	(c) The experiment gives only 2.30 g of copper. Calculate the percentage yield, correct to one decimal place.
24	(d) Explain why copper does not react with dilute hydrochloric acid.