Section A:

For any calculations, round final answers to two decimal places.

1. Calculate the number of moles in the following masses of substance:
   a. 21 g of hydrogen gas (H_2)
   b. 60 g of carbon
   c. 88 g of lithium
   d. 100 g of calcium carbonate ($CaCO_3$)
   e. 1 kg of glucose ($C_6H_{12}O_6$)

2. What is the mass of the following?
   a. 5 moles of CO_2
   b. 0.5 moles of HCl
   c. 0.005 moles of NaOH
   d. 11 moles of BeCl
   e. 1 mole of H_2

3. Calculate the number of moles of solute that must be dissolved to make the following solutions:
   a. 200 dm^3 of 1 mol/dm^3
   b. 150 dm^3 of 5 mol/dm^3
   c. 2 litres of 0.25 mol/L
   d. 5 cm^3 of 10 mol/dm^3
   e. 100 cm^3 of 1 mol/dm^3

4. Calculate the volume of each of the following solutions of lithium chloride (LiCl) in dm^3.
   a. 1 mol/dm^3 solution containing 3 moles of solute
   b. 2 mol/dm^3 of solution containing 1 mole of solute
   c. 0.05 mol/dm^3 of solution containing 5 moles of solute
   d. 0.002 mol/dm^3 of solution containing 0.5 moles of solute
   e. 0.125 mol/dm^3 of solution containing 12 moles of solute

5. Convert each of the answers to question 5 to cm^3.

6. The equations below describe neutralisation reactions. State the mole ratio of acid:alkali in these reactions.
   a. $NaOH + HCl \rightarrow NaCl + H_2O$
   b. $HBr + KOH \rightarrow KBr + H_2O$
   c. $HNO_3 + KOH \rightarrow KNO_3 + H_2O$
   d. $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$
   e. $Al(OH)_3 + 3HNO_3 \rightarrow Al(NO_3)_3 + 3H_2O$

Section B
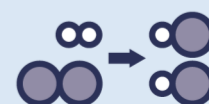
7. Calculate the mass of substance needed to make each of the following solutions:
   a. 0.25 dm^3 of sodium nitrate solution ($NaNO_{3(aq)}$), with a concentration of 0.3 mol/dm^3
   b. 0.2 dm^3 of hydrochloric acid solution, with a concentration of 0.5 mol/dm^3
   c. 50 cm^3 of sodium hydroxide solution with a concentration of 5 mol/dm^3
   d. 200 cm^3 of sulfuric acid, with a concentration of 0.25 mol/dm^3
   e. 1 L of $NaOH_{(aq)}$ with a concentration of 0.2 mol/dm^3

8. The equation below describes a neutralisation reaction:
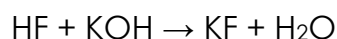
   $HF + KOH \rightarrow KF + H_2O$

   a. State the mole ratio of acid: alkali in this reaction
   b. A scientist carried out this reaction with 0.025 dm^3 of potassium hydroxide, with a concentration of 0.05 mol/dm^3. Calculate the number of moles of potassium hydroxide that reacted.
   c. Calculate the number of moles of hydrogen fluoride that reacted.
   d. Calculate the concentration of hydrogen fluoride in this reaction, if 0.02 dm^3 of hydrogen fluoride reacted.

9. A student carried out the following neutralisation reaction:
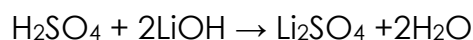
   $H_2SO_4 + 2LiOH \rightarrow Li_2SO_4 + 2H_2O$

   a. State the mole ratio of acid: alkali in this reaction
   b. A scientist carried out this reaction with 0.5 dm^3 of lithium hydroxide, which had a concentration of 0.01 mol/dm^3. Calculate the number of moles of lithium hydroxide that reacted.
   c. Calculate the number of moles of sulfuric acid that reacted.
   d. Describe what a student would observe if they added a few drops of universal indicator solution to the lithium hydroxide solution.
   e. Calculate the concentration of sulfuric acid in this reaction, if 0.003 dm^3 of sulfuric acid reacted.

10. 35.0 cm^3 of 0.100 mol/dm^3 sodium hydroxide solution is exactly neutralised by 20.0 cm^3 of a dilute solution of hydrochloric acid. Calculate the concentration of the hydrochloric acid solution.

11. 25.0 cm^3 of 0.400 mol/dm^3 sodium hydroxide solution is exactly neutralised by 25.0 cm^3 of a dilute solution of sulfuric acid. Calculate the concentration of the sulfuric acid solution.