7.2.4 (a) Define a dative covalent bond. (2)
(b) Identify the substance in this reaction that has a dative covalent bond. (1)
7.2.5 Give the formula of two substances in this reaction that are polar. (2)
7.2.6 Draw a Lewis diagram for NH_4^+. (3)

Acid-Base Reactions: Titration, Neutralisation

- An acid reacts with a base to form a salt + water.
  This means that an acid **neutralises** a base and a base neutralises an acid.
  The reaction between an acid and a base is called an **acid-base reaction** or **protolytic reaction** or **neutralisation reaction**.
- If an acid is slowly added to a base or a base is slowly added to an acid until the neutral point is reached, it is called **neutralisation**.
- An **indicator** is a substance that indicates the degree of acidity or basicity of a solution through characteristic colour changes, e.g. litmus, bromo thymol blue, methyl orange, phenolphthalein.
  An indicator can also be used to indicate the **neutral point** during a neutralisation.

	Colour in acid	Colour in base
Litmus	red	blue
Bromo thymol blue	yellow	blue
Methyl orange	red	orange
Phenolphthalein	colourless	pink

Exercise 64:

1 Give ONE word/term for

1.1 the reaction of an acid and a base to from a salt and water. (1)
1.2 a chemical substance which changes colour when it is added to an acid or base. (1)

2 A suitable indicator for an acid-base titration must show a sharp colour change

A over a relatively small pH range. B at a pH higher than 7.
C over a relatively large pH range. D at a pH of 7. (2)

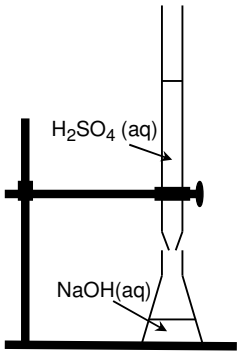
3 A learner spilled some battery acid (sulphuric acid) on the garage floor and she wanted to add a chemical substance from her kitchen, which would neutralise the acid. Which ONE of the following substances would be the most suitable and least hazardous (harmful) to use? (2)

	SUBSTANCE	pH
A	Vinegar	4
B	Lemon juice	5
C	Sodium bicarbonate	8
D	Sodium hydroxide	13

4 A sodium hydroxide solution of concentration 0,1 mol·dm^{-3} is added dropwise to an ethanoic acid solution of concentration 0,1 mol·dm^{-3}. Which ONE of the following substances will increase in concentration as sodium hydroxide is added dropwise?

A H_3O^+ B OH^-
C CH_3COO^- D H_2O (2)

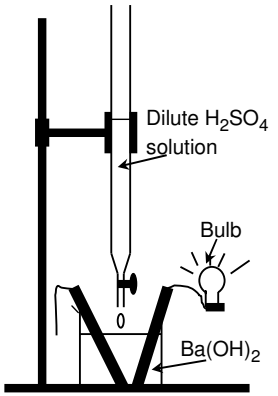
5 The following apparatus is used for the titration of a dilute alkali (NaOH) with a dilute acid (H_2SO_4).



5.1 State whether the following increases, decreases or stays the same while the acid is being added and before the endpoint has been reached:
5.1.1 [Na^+]. Explain. (4)
5.1.2 [OH^-]. Explain. (4)
5.1.3 pH. Explain. (4)

5.2 Write a balanced equation for the reaction which takes place in the conical flask. (2)

6 Two carbon rods are placed in a beaker containing a 0,1 mol·dm^{-3} barium hydroxide. The two rods are connected in a circuit along with a battery and a bulb. The bulb burns brightly. A burette, containing a dilute sulphuric acid solution of known concentration, is clamped in position above the beaker. Acid is carefully added to the beaker and the following observations noted.

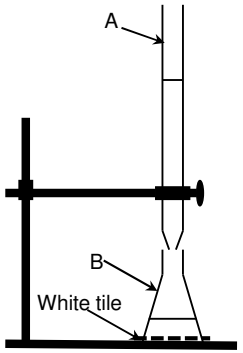


6.1 After adding 20 cm^3 of acid, the bulb dims (burns less brightly).
With the aid of a chemical equation, suggest an explanation for this. (5)
6.2 Explain why, after adding a further 20 cm^3 of acid, the bulb goes out completely. (4)
6.3 After adding a total of 60 cm^3 of acid to the beaker, the bulb lights up again. Once again suggest an explanation for this. (4)

7 Magnesium hydroxide ($Mg(OH)_2$) is often used as medicine to relieve an upset stomach. The pH of the HCℓ in a person's stomach is 1.

7.1 Will the pH in the stomach increase, decrease or stay the same after taking a dose of $Mg(OH)_2$? (2)
7.2 A person takes a dose of $Mg(OH)_2$. Write down the balanced equation for the reaction that takes place in the stomach. (3)

8 A group of learners want to determine the concentration of a sodium hydroxide solution by using a standard solution of oxalic acid.
They set up the apparatus a shown.



8.1 Name the apparatus labelled A and B respectively. (2)
8.2 Name ONE other apparatus, not shown in the diagram, which is needed for this investigation. (2)
8.3 During the above investigation, the sodium hydroxide (NaOH) reacts with the oxalic acid $(COOH)_2$ to produce a salt and water.
Write a balanced equation for the reaction between sodium hydroxide and oxalic acid. (3)
8.4 What is the household name for sodium hydroxide? (2)

Redox Reactions: Oxidation and Reduction

- **Oxidation** is the loss of electrons and **reduction** is the gain of electrons:
  (**O**xidation **i**s **l**oss and **r**eduction **i**s **g**ain of electrons - Oil rig) **OR**
  Oxidation takes place when the oxidation number/state is increased.
  Reduction takes place when the oxidation number is decreased (reduced).
- Oxidation and reduction **always** occur together, because the substance undergoing reduction has to receive the electrons that are lost by the substance undergoing oxidation – hence **redox reactions**.
- A **redox reaction** occurs when **electrons are transferred** from one substance (reducing agent) to another substance (oxidising agent) during a chemical reaction.
- An **oxidising agent** is reduced (i.e. it gains electrons or its oxidation number decreases)
- A **reducing agent** is oxidised (i.e. it donates electrons or its oxidation number increases).
- The oxidation number can be used to **identify oxidising and reducing agents**:
  In a reaction, determine the oxidation number of each element on both sides of the equation – the one whose oxidation number decreased (i.e. that was reduced), is the oxidising agent and the one whose oxidation number increased (i.e. that was oxidised), is the reducing agent.
- The oxidation numbers can also be used to **determine which reactions are redox reactions**:
  Determine the oxidation number of each element on both sides of the equation.
  If there is no change in any oxidation numbers, it is not a redox reaction, but if there is a change, it is a redox reaction. If a pure element is involved in a reaction, either as reactant or as product, it has to be a redox reaction, because the oxidation number of the pure element is zero, but in the compound it is not zero, i.e. it has changed.