01. 0620_s14_qp_32 Q: 4

Propanoic acid is a carboxylic acid. Its formula is $CH_3$–$CH_2$–COOH.

**(a)** Propanoic acid is the third member of the homologous series of carboxylic acids.

**(i)** Give the name and structural formula of the fourth member of this series.

name .....

formula ..... [2]

**(ii)** Members of a homologous series have very similar chemical properties.
State **three** other characteristics of a homologous series.

.....

.....

.....

..... [3]

**(b)** Carboxylic acids can be made by the oxidation of alcohols.

**(i)** Draw the structural formula of the alcohol which can be oxidised to propanoic acid.
Show all atoms and bonds.

[1]

**(ii)** Name a reagent, other than oxygen, which can oxidise alcohols to carboxylic acids.

..... [2]

**(c)** Complete the following equations for some of the reactions of propanoic acid.
The salts of this acid are called propanoates.

**(i)** zinc + propanoic acid → ..... ..... + hydrogen [1]

**(ii)** calcium oxide + propanoic acid → ..... ..... + ..... [1]

**(iii)** $LiOH + CH_3CH_2COOH \rightarrow$ ..... + ..... [1]

**(d)** A piece of magnesium was added to 100 $cm^3$ of an aqueous acid. The time taken for the metal to react completely was measured. This experiment was repeated using different aqueous acids. The same volume of acid was used in each experiment and the pieces of magnesium used were identical. In one experiment the reaction was carried out at a different temperature.

| experiment | acid | concentration in mol / $dm^3$ | temperature / °C | time / minutes |
|---|---|---|---|---|
| **A** | propanoic | 1.0 | 20 | 5 |
| **B** | propanoic | 1.0 | 30 | 3 |
| **C** | propanoic | 0.5 | 20 | 8 |
| **D** | hydrochloric | 1.0 | 20 | 1 |

Explain the following in terms of collision rate between reacting particles.

**(i)** Why is the rate in experiment **C** slower than the rate in experiment **A**?

.....

.....

..... [2]

**(ii)** Why is the rate in experiment **B** faster than the rate in experiment **A**?

.....

.....

..... [2]

**(iii)** Why is the rate in experiment **D** faster than the rate in experiment **A**?

.....

.....

..... [3]

[Total: 18]

01. 0620_s14_ms_32 Q: 4

**(a) (i)** butanoic/butyric acid (1)

$CH_3CH_2CH_2COOH$/$C_2H_5CH_2COOH$ (1) [2]

**(ii)** any **three** from:

(same) general formula (1)

(consecutive members) differ by $CH_2$ (1)

same functional group (1)

common methods of preparation (1)

physical properties vary in predictable manner/show trends/gradually change
**or** example of a physical property variation i.e. melting point/boiling point/volatility (1) [3]

**(b) (i)** displayed formula of propan-1-ol, all bonds shown separately (1) [1]

**(ii)** acidified (1)

potassium manganate(VII)/potassium permanganate/$KMnO_4$ **or** potassium dichromate(VI)/$K_2Cr_2O_7$/potassium dichromate (1) [2]

**(c) (i)** zinc + propanoic acid → zinc propanoate (+ hydrogen) (1) [1]

**(ii)** calcium oxide + propanoic acid → calcium propanoate + water (1) [1]

**(iii)** $LiOH + CH_3CH_2 COOH \rightarrow CH_3CH_2COOLi + H_2O$ (1) [1]

**(d) (i)** concentration (of acid in C) is less/halved **or** concentration of A is more/doubled. (1)

less collisions **or** more collisions in A (than in C) (1) [2]

**(ii)** (higher temperature in B particles/molecules/atoms) move faster/have more energy/more have $E_a$ **or** (particles/molecules/atoms) in A move slower/have less energy/less have $E_a$ (1)

more collisions **or** less collisions in A (than in B) (1) [2]

**(iii)** It (D) has strong (acid) **and** A has weak acid/(D) stronger/(D) ionises more/(D) dissociates more **or** A is weaker/A ionises less/A dissociates less (1)

It (D) has higher concentration of hydrogen ions **or** A has a lower concentration of hydrogen ions (1)

more collisions (in D) **or** fewer collisions in A (1) [3]

[Total: 18]