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Chemistry

Unit AS 2: Practical Manual

Questions Solutions

Practical 8.1

Test for unsaturation using bromine water (spec ref: 2.4.2)

1. Bromine water decolourises.
   Colourless solution forms.

2. $C_6H_{10} + Br_2 \rightarrow C_6H_{10}Br_2$

Practical 9.1

Prepare a halogenoalkane using the techniques of refluxing, separating with a funnel, removing acidity, drying and distillation (spec ref: 2.5.4)

1. The yield will probably be no more than 50%.
   Theoretical yield = 11.1 g
   % yield = (actual yield/11.1) × 100

2. Reasons include: reaction does not go to completion, side reactions, loss in transfer.

3. The addition of concentrated sulfuric acid is exothermic.

4. The sulfuric acid reacts with sodium bromide to form hydrogen bromide which reacts with the butan-1-ol.
   $NaBr + H_2SO_4 \rightarrow HBr + NaHSO_4$

5. Anti-bumping granules promote smooth boiling.

6. Heating under reflux allows the reaction mixture to be heated without loss from the reaction mixture.

7. The addition of concentrated HCl protonates any unreacted butan-1-ol. In this ionic form the butan-1-ol becomes more water soluble, dissolves in the aqueous layer and is removed from the 1-bromobutane.

8. Add a few drops of water, the layer that increase in volume is the aqueous layer.

9. It removes unreacted sulfuric acid.
   $2NaHCO_3 + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O + 2CO_2$

10. It acts as a drying agent and removes any remaining water.

11. Decanting involves pouring the liquid from the vessel whilst any solid remains in the vessel.

Practical 9.2

Prepare alcohols from halogenoalkanes using alkali/ investigate the relative rates of hydrolysis of halogenoalkanes (spec ref: 2.5.5/2.5.7)

1. Ethanol acts as a mutual solvent, allowing the halogenoalkane and silver nitrate solution to mix and react.

2. $C_4H_9Cl(l) + H_2O(l) \rightarrow C_4H_9OH(l) + HCl(aq)$
   $C_4H_9Br(l) + H_2O(l) \rightarrow C_4H_9OH(l) + HBr(aq)$
   $C_4H_9I(l) + H_2O(l) \rightarrow C_4H_9OH(l) + HI(aq)$

3. $AgNO_3(aq) + HCl(aq) \rightarrow AgCl(s) + HNO_3(aq)$
   $AgNO_3(aq) + HBr(aq) \rightarrow AgBr(s) + HNO_3(aq)$
   $AgNO_3(aq) + HI(aq) \rightarrow AgI(s) + HNO_3(aq)$

4. $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$
   $Ag^+(aq) + Br^-(aq) \rightarrow AgBr(s)$
   $Ag^+(aq) + I^-(aq) \rightarrow AgI(s)$

5. C_4H_9I undergoes hydrolysis quickest as the precipitate appears quickest in that test tube. C_4H_9Cl undergoes hydrolysis slowest as the precipitate appears slowest in that test tube.

6. Bond enthalpy is a more dominant factor than bond polarity.

Practical 9.3

Carry out the elimination of hydrogen halides from halogenoalkanes using ethanolic potassium hydroxide (spec ref: 2.5.8)

1. The mineral wool holds the reactants in place and in contact.

2. Methylpropene has a very low solubility in water.

3. The bromine water decolourises; this confirms the organic product is an alkene.

4. If aqueous potassium hydroxide was use, the main organic product would be 2-methylpropan-2-ol which is a liquid.

Practical 10.1

Carry out test tube reactions of alcohols with sodium, hydrogen bromide/hydrobromic acid and phosphorous pentachloride (spec ref: 2.6.5)

1. Expose the gas to a burning splint; a pop sound is observed.

2. White fumes/smoke/solid are observed with a stopper from bottle of concentrated ammonia solution/glass rod dipped in concentrated ammonia solution.

Practical 10.2

Prepare aldehydes, ketones and carboxylic acids using acidified potassium dichromate(VI) (spec ref: 2.6.6)

1. Mass ethanol = 5 × 0.79 = 3.95 g
   Moles ethanol = 3.95/46 = 0.086 = moles ethanal
   Mass ethanal = 0.086 × 44 = 3.78 g
   Mass ethanal collected = 3 × 0.82 = 2.46 g
   Percentage yield = (2.46/3.78) × 100 = 65.1%

2. A vinegary smell is observed, universal indicator paper turns red and the addition of sodium carbonate results in effervescence.

3. As the reaction proceeds, a peak at 1650 – 1800 cm^{-1} will appear, which corresponds to the C=O bond. If the aldehyde is produced, the peak at 3200 – 3600 cm^{-1}, which corresponds to the OH bond, will disappear. If the carboxylic acid is produced, a broad peak at 2500-3200 cm^{-1} will be observed.

4. Propan-2-ol is a secondary alcohol which will form the ketone propanone. Ketones are not oxidised further.

Practical 11.1

Determine the enthalpy change for combustion and neutralisation using simple apparatus (spec ref: 2.8.6)

1. Butan-1-ol as most product bonds are formed.

2. The general trend should be the same however the values will be different to the book values.

3. Most of the heat generated is lost to the surroundings/absorbed by the container and does not transfer to the water.

Practical 11.2

Determine the enthalpy change for combustion and neutralisation using simple apparatus (spec ref: 2.8.6)

1. Provides extra insulation and ensures the cup does not fall over.

2. The density of the solution is 1 g cm^{-3} and the specific heat capacity of the solution is 4.2 J g^{-1} K^{-1}.

3. Calculated value will be less exothermic due to heat loss to the surroundings.

Practical 12.1

React Group II metals and other metals with oxygen, water and dilute acids and determine the masses of solids and volumes of gases produced (spec ref: 2.11.3)

1. Moles oxygen reacting = 0.05/32 = 0.0016
   Moles magnesium oxide = 0.0016 × 2 = 0.0032
   Mass magnesium oxide = 0.0032 × 40 = 0.128
   Percentage yield = (0.128/0.25) × 100 = 51.2%
   Mass obtained will be less than that calculated due to incomplete reaction/loss of product.

2. To prevent loss of product.

3. Add a few drops of universal indicator solution, a purple colour is observed.

4. Moles Mg = 0.10/24 = 0.00417 = moles H_2
   Volume H_2 = 0.00417 × 24000 = 100 cm^3
   Volume obtained will be less due to loss of gas before bung is placed into the flask/ some magnesium could have oxidised.