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| **UNIT 5****ACIDS, BASES AND SALTS****Answers** |

***Lesson 1 – What are acids, bases and salts?***

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| https://image.freepik.com/free-icon/think-symbol-of-a-head-from-side-view-with-brain-shape-inside_318-61572.jpg**Thinkabout Activity 1.1: What do you know about acids and alkalis?** |
| Note: students should be encouraged to identify some common acids and alkalis and give some of their features * acids: hydrochloric acid, sulphuric acid, nitric acid, lactic acid, citric acid
* vinegar (ethanoic acid), orange/lemon juice (citric acid); many fizzy sweet drinks (coke, sprite) also contain acids
* acids taste sour and bitter and they can sting if in contact with eyes or broken skin
* Alkalis: sodium hydroxide, calcium hydroxide, ammonia, soaps, detergents, bleach
* foods tend not to be strongly alkaline as they would be harmful
* alkalis are generally not good to eat; they feel and taste soapy
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| **https://image.freepik.com/free-icon/think-symbol-of-a-head-from-side-view-with-brain-shape-inside_318-61572.jpgTest your knowledge 1.2: Recognising Acids, Bases and Salts**Deduce the formulae of the following substances and indicate whether they are acids, bases or salts: |
| 1. Na2O (base)
2. Ca(OH)2 (base)
3. NH4NO3 (salt)
4. K2CO3 (base)
5. SrSO4 (salt)
6. (NH4)2SO4 (salt)
7. HCl (acid)
8. RbOH (base)
9. MgCO3 (base)
 | 1. Ca(NO3)2 (salt)
2. H2SO4 (acid)
3. NH4Cl (salt)
4. HNO3 (acid)
5. K2SO4 (salt)
6. MgO (base)
7. CsBr (salt)
8. BaSO4 (salt)
9. Sr(NO3)2 (salt)
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| **https://image.freepik.com/free-icon/think-symbol-of-a-head-from-side-view-with-brain-shape-inside_318-61572.jpgTest your knowledge 1.3: Understanding Neutralisation Reactions**Write balanced symbol equations for the following neutralisation reactions: |
| 1. HNO3 + KOH 🡪 KNO3 + H2O
2. H2SO4 + 2NaOH 🡪 Na2SO4 + H2O
3. 2HCl + Ca(OH)2 🡪 CaCl2 + 2H2O
4. 2HNO3 + CaO 🡪 Ca(NO3)2 + H2O
5. 2HCl + BaO 🡪 BaCl2 + H2O
6. H2SO4 + MgO 🡪 MgSO4 + H2O
 | 1. HNO3 + CaCO3 🡪 Ca(NO3)2 + CO2 + H2O
2. 2HCl + BaCO3 🡪 BaCl2 + CO2 + H2O
3. H2SO4 + Na2CO3 🡪 Na2SO4 + CO2 + H2O
4. HNO3 + NH3 🡪 NH4NO3
5. H2SO4 + 2NH3 🡪 (NH4)2SO4
6. HCl + NH3 🡪 NH4Cl
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###### *Lesson 2 – What are the physical properties of acids, bases and salts?*

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| **Image result for test iconTest your knowledge 2.1: Describing properties of acids, bases and salts** |
| 1. eg potassium hydroxide, sodium carbonate, ammonia etc
2. eg magnesium oxide, calcium carbonate, aluminium hydroxide etc
3. eg sodium chloride, magnesium nitrate, ammonium sulphate etc
4. eg silver chloride, lead chloride, barium sulphate etc
5. they contain ions and so conduct electricity when in solution
6. acids are sour due to H+; bases are soapy due to OH-; salts are salty, often due to Na+
7. absorbs water from the atmosphere; eg concentrated sulphuric acid, solid sodium hydroxide, solid calcium chloride
8. absorbs water from the atmosphere and then dissolves in the water it has absorbed; eg calcium chloride
9. a salt which has water locked into its crystal structure
10. mr of Ca(NO3)2 = 164.1; xH2O = 236.1 – 164.1 = 72, so x = 72/18 = 4, so Ca(NO3)2.4H2O
11. the loss of water from a crystal structure; eg CaSO4.2H2O
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###### *Lesson 3 – What is the difference between strong and weak acids?*

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| cid:ii_jepnvfe00_1621fa54a497745d **Practical 3.1: Compare the enthalpy of neutralisation of a strong base and a weak base by the same acid** |
| **Equipment needed per group: two measuring cylinders (25 cm3), polystyrene cup (250 cm3), beaker (250 cm3), thermometer, access to 2.0 moldm-3 HCl (50 cm3 per group), 2 moldm-3 NH3 (25 cm3 each per group) and 2 moldm-3 NaOH (25 cm3 each per group)**Caution: the alkalis are corrosive at this molarity and should be handled with great care* **The temperature increase should be around 7 oC with NaOH and around 5 oC with NH3**
* **The temperature increase is higher with NaOH because the OH- ions are already in the solution; NH3 dissociates during the neutralisation to give OH- ions; this process is endothermic so the overall neutralisation process is less exothermic**
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| **Image result for test iconTest your knowledge 3.2: Distinguishing between Strong and Weak Acids and Bases** |
| 1. Strong acid fully dissociates in water to give H+ ions (eg H2SO4, HNO3, HCl); weak acid only partially dissociates in water to give H+ ions (eg ethanoic acid etc)
2. Strong base: NaOH; weak base due to low solubility: Ca(OH)2, weak base due to limited dissociation: NH3
3. Strong acids are fully dissociated into ions, so the concentration of ions is greater, and the conductivity is due to the presence of ions
4. Weak acids must dissociate into ions during neutralisation; this process is endothermic, so the overall reaction is less exothermic
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***Lesson 4 - What are the other important reactions of acids, bases and salts?***

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| **Image result for test iconTest your knowledge 4.1: Understanding Further Reactions of Acids, Bases and Salts** |
| 1. reacts with acids and bases/can behave as an acid or a base, eg NaHCO3 or Al(OH)3 or ZnO etc
2. (i) H2SO4 + 2KCl 🡪 K2SO4 + 2HCl; (ii) HNO3 + NaF 🡪 NaNO3 + HF; (iii) H3PO4 + 3KBr 🡪 K3PO4 + 3HBr
3. (i) no; (ii) yes NH4+ 🡪 NH3 + H+; (iii) yes CH3COO- + H2O 🡪 CH3COOH + OH-; (iv) no; (v) yes Al3+ + H2O 🡪 Al(OH)2+ + H+; (vi) yes CN- + H2O 🡪 HCN + OH-
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***Lesson 5 – How can we use acid-base reactions to prepare salts in the laboratory?***

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| cid:ii_jepnvfe00_1621fa54a497745d **Practical 5.1: Prepare a salt by neutralising an acid with an insoluble base** |
| **Equipment needed per group: measuring cylinder (25 cm3), beaker (100 cm3), Bunsen burner, tripod, gauze, thermometer, weighing boat, spatula, stirrer, filter paper, funnel, conical flask (100 cm3), access to a mass balance, access to 0.5 moldm-3 H2SO4 (20 cm3 per group), access to CuO (1 g per group)*** **0.02 x 0.5 = 0.01**
* **1/79.5 = 0.0126**
* **To ensure the H2SO4 fully reacts; excess CuO can be removed by filtration; it would be much more difficult to remove excess H2SO4**
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| cid:ii_jepnvfe00_1621fa54a497745d **Practical 5.2: Prepare a salt by neutralising an acid with a soluble base** |
| **Equipment needed per group: two measuring cylinders (25 cm3), beaker (100 cm3), stirring rod, Bunsen burner, tripod, gauze, evaporating dish, spatula, filter paper; access to 1.0 moldm-3 H2SO4 (25 cm3 per group), and 2.0 moldm-3 NH3 (25 cm3 each per group)*** **2NH3 + H2SO4 🡪 (NH4)2SO4**
* **0.025 x 1 = 0.025**
* **0.025 x 2 = 0.05**
* **to ensure that both reactants are fully used up and that there is no excess of either reactant in the solution at the end**
* **excess insoluble base can be removed easily by filtration; excess soluble base cannot be easily removed**
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***Lesson 6 – How are acid-base reactions useful in qualitative analysis?***

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| cid:ii_jepnvfe00_1621fa54a497745d **Practical 6.1: Use acid-base reactions to identify cations, anions and gases** |
| Equipment needed per group: three watch glasses, four test tubes, test tube rack, bung to fit test tube with delivery tube connected; access to solid samples of: Na2SO3 (labelled A), KOH (labelled B), Na2CO3 (labelled C), NH4Cl (labelled D), each with their own spatula; access to 1 moldm-3 HCl with dropping pipette (10 cm3 per group), limewater (10 cm3 per group), 1 moldm-3 NaOH (5 cm3 per group) with dropping pipette, 1 moldm-3 NH4Cl (5 cm3 per group) with dropping pipette, powdered CaCO3 (2 g per group) with its own spatulaA: 2H+ + SO32- 🡪 SO2 + H2O; SO2(g) + Ca(OH)2(aq) 🡪 CaSO3(s) + H2O(l); CaSO3(s) + SO2(g) + H2O(l) 🡪 Ca(HSO3)2(aq)B: NH4+ + OH- 🡪 NH3 + H2OC: 2H+ + CO32- 🡪 CO2 + H2O; CO2(g) + Ca(OH)2(aq) 🡪 CaCO3(s) + H2O(l); CaCO3(s) + CO2(g) + H2O(l) 🡪 Ca(HCO3)2(aq)D: NH4+ + OH- 🡪 NH3 + H2O |
| Image result for test icon**Test your knowledge 6.2: Using acid-base reactions to identify certain cations and anions** |
| 1. add HCl (aq); odourless gas evolved which turns limewater milky and then clear again:

2H+ + CO32- 🡪 CO2 + H2O; CO2(g) + Ca(OH)2(aq) 🡪 CaCO3(s) + H2O(l); CaCO3(s) + CO2(g) + H2O(l) 🡪 Ca(HCO3)2(aq)1. add HCl (aq); gas evolved with burning-match smell which turns limewater milky and then clear again: 2H+ + SO32- 🡪 SO2 + H2O; SO2(g) + Ca(OH)2(aq) 🡪 CaSO3(s) + H2O(l); CaSO3(s) + SO2(g) + H2O(l) 🡪 Ca(HSO3)2(aq)
2. add concentrated H2SO4; if gas given off, test with filter paper soaked in concentrated NH3; a white smoke should be seen: H2SO4 + Cl- 🡪 HSO4- + HCl; NH3 + HCl 🡪 NH4Cl
3. add CaCO3(s); gas evolved: 2H+ + CO32- 🡪 CO2 + H2O
4. add NH4Cl(aq) and warm; pungent smell given off: NH4+ + OH- 🡪 NH3 + H2O
5. add NaOH(aq) and warm; pungent smell given off: NH4+ + OH- 🡪 NH3 + H2O
6. test with filter paper soaked in concentrated HCl; a white smoke should be seen: NH3 + HCl 🡪 NH4Cl
7. test with filter paper soaked in concentrated NH3; a white smoke should be seen: NH3 + HCl 🡪 NH4Cl
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***Lesson 7 - What is the pH scale?***

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| Image result for test icon**Test your knowledge 7.1: Understanding the pH scale** |
| (a) acidic; (b) alkaline; (c) neutral; (d) acidic; (e) alkaline; (f) acidic; (g) alkaline; (h) neutral; (i) alkaline; (j) neutral; (k) (very) acidic; (l) alkaline; (m) acidic; (n) neutral; (o) acidic (due to salt hydrolysis); (p) alkaline (due to salt hydrolysis) |

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| cid:ii_jepnvfe00_1621fa54a497745d**Practical 7.2: Investigate the effect of solutions of different pH values on different indicators** |
| Equipment needed per group: five test tubes and one test tube rack; access to: 0.1 moldm-3 CH3COOH (labelled pH 3); a solution containing 0.1 moldm-3 CHCOOH and 0.5 moldm-3 CHCOO-Na+ (labelled pH 5); distilled water (labelled pH = 7); a solution containing 0.1 moldm-3 NH3 and 0.5 moldm-3 NH4Cl(labelled pH 9); 0.1 moldm-3 NH3 (labelled pH = 11); 5 cm3 per group for each solution; each bottle should have its own dropping pipette; access to solutions of phenolphthalein, methyl orange and litmus, each with their own dropping pipette (1 cm3 per group)* MO changes colour at pH = 5; L changes colour at pH 7; PP changes colour at pH 9
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***Lesson 8 - What is universal indicator and why is it useful?***

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| https://image.freepik.com/free-icon/think-symbol-of-a-head-from-side-view-with-brain-shape-inside_318-61572.jpg**Activity 8.1: Universal Indicator and pH** |
| Students will need access to the different colours shown by universal indicator.Answer: 1 – 3 red; 4 - 5 orange; 6 – yellow; 7 – green; 8 – blue; 9 – 11 indigo; 12 – 14 violet  |
| https://image.freepik.com/free-icon/plus-sign_318-54005.jpg**Extension 8.2: Universal Indicator and pH** |
| Eg pH 1 stomach acid (HCl); pH 2 lemon juice/vinegar; pH 3 orange juice; pH 4 tomato juice; pH 5 black coffee; pH 6 milk; pH 7 water; pH 8 sea water; pH 9 a solution of baking soda; pH 10 milk of magnesia; pH 11 ammonia solution; pH 12 soapy water; pH 13 bleach |

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| cid:ii_jepnvfe00_1621fa54a497745d**Practical 8.3: Determine the pH value of various solutions by colorimetry** |
| Equipment needed per group: five test tubes and one test tube rack; access to: rainwater (labelled A) (you can ensure a PH of 5 by bubbling CO2 through it); distilled water (labelled B); a diluted solution of bleach (C); a solution of baking soda (D); diluted vinegar or lemon juice (E); the exact identity of the solution is not important but they should turn UI the following colours: A – orange/yellow ; B – green; C – violet; D – blue/indigo; E - red5 cm3 per group for each solution; each bottle should have its own dropping pipette; access to universal indicator solution with dropping pipette (1 cm3 per group) |

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| cid:ii_jepnvfe00_1621fa54a497745d**Practical 8.4: Determine the pH of different soil samples** |
| Equipment needed per group: one beaker (100 cm3); one measuring cylinder (50 cm3); one stirring rod; one funnel; three pieces of filter paper; three boiling tubes; access to three different soil samples (20 g per group), each with its own spoon; access to a mass balance; access to universal indicator with its own dropping pipette (1 cm3 per group)Note: the soil samples should ideally cover a range of different types, ideally with a range of different acidities.  |

***Lesson 9 – How can indicators be used in qualitative analysis?***

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| cid:ii_jepnvfe00_1621fa54a497745d**Practical 9.1: Investigate the effect of acidic, alkaline and neutral solutions on different indicators** |
| Equipment needed per group: one small beaker (<50 cm3) and one small measuring cylinder (10 cm3); four strips of red litmus paper, four strips of blue litmus paper, access to solutions of 0.1 moldm-3 HCl, NaOH, Na2CO3 and NaCl (10 cm3 per group), access to phenolphthalein and methyl orange indicator solutions (1 cm3 per group), 8 test tubes, 1 test tube rack |

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| Image result for test icon**Test your knowledge 9.2: Summary of Qualitative Analysis of Cations, Anions and Gases** |
| (a) Add CaCO3(s) - effervescence; (b) add blue litmus paper – it turns red; (c) add NH4Cl and warm – apungent smell; (d) add red litmus paper – it turns blue; (e) hydrogen chloride, sulphur dioxide and nitrogen dioxide; (f) ammonia; (g) carbon dioxide and sulphur dioxide, SO2 smells of burning matches and also turns blue litmus red; (h) hang filter paper soaked in concentrated NH3 close to the source – white smoke formed; (i) hang filter paper soaked in concentrated HCl close to the source – white smoke formed; (j) add concentrated H2SO4 and then test the gas either with filter paper soaked in concentrated NH3 – white smoke formed, or with blue litmus paper – it turns red; (k) add NaOH and warm – pungent smell; (l) add HCl and bubble gas through limewater – odourless gas which turns limewater milky and then clear again; (m) add HCl and bubble gas through limewater – burning-match-smelling gas which turns limewater milky and then clear again and also turns blue litmus paper red; (n) conducts electricity which proves that ions are present; turns universal indicator green which shows that H+, OH- and CO32- are not present |

***Lesson 10 – How I determine how much of an acid or a base is present in a sample (practical)?***

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| **Summary Activity 10.1: What can you remember about the different instruments used to measure the volume of a solution?** |
| * Pipette: very accurate but can only deliver one volume
* Volumetric flask: very accurate but can only store one volume
* Burette: slightly less accurate than a pipette but can deliver any volume up to 50 cm3
* Measuring cylinder: not accurate
* Pipettes and burettes are most useful for carrying out titrations
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| cid:ii_jepnvfe00_1621fa54a497745d **Practical 10.2: Determine the concentration of a solution of NaOH by titration against 1.0 moldm-3 HCl** |
| Equipment needed per group: 1 burette, 1 25 cm3 pipette, 1 pipette filler, one conical flask, one funnel, two 100 cm3 beakers and the means to label them; clamp, stand, boss; access to 0.1 moldm-3 HCl, a solution of NaOH of approximately 0.08 moldm-3 but with the concentration not labelled), (100 cm3 per group) phenolphthalein indicator and suitable dropping pipetteNote: this practical is the most important practical in SS Chemistry; it is also the most challenging in terms of the techniques required; it is recommended that when carrying out this practical for the first time, each group performs each step together so that the teacher can check that the student is performing the practical correctlyParticular things to check in each group are: no air bubbles in burette tip, initial reading is recorded to 0.05 cm3 and is correct, funnel is removed* if the NaOH molarity is 0.08 moldm-3 then a typical titre volume should be around 15 cm3
* a correctly completed table would look something like this: it may be an idea to share this with the students beforehand:

* the average titre volume (using concordant results only) should be (21.55 + 21.45)/2 = 21.40 cm3 (using the above results)
* moles of HCl = 0.1 x titre volume / 1000
* moles of NaOH = moles of HCl
* molarity of NaOH = moles of NaOH / 0.025
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***Lesson 11 – How I determine how much of an acid or a base is present in a sample II?***

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| **Summary Activity 11.1: How do you prepare a standard solution?** |
| * Moles of NaOH required = 0.25 x 0.1 = 0.025 so mass of NaOH required = 0.025 x 40 = 1.0 g

Weigh out exactly 1.0 g of NaOH on a mass balance using a weighing boatPour the NaOH into a beakerRinse the weighing boat with distilled water and ensure all the rinsings run into the beakerDissolve the NaOH in a small quantity of distilled waterPour the solution into a 250 cm3 volumetric flask using a funnelRinse the beaker with distilled water and pour the rinsings into the volumetric flaskAdd distilled water until the meniscus rests exactly on the graduation mark, shaking continuously* Dilution factor = 2/0.2 = 10 so volume needed = 250/10 = 25 cm3

Pipette 25 cm3 of 2.0 moldm-3 H2O2 into a250 cm3 volumetric flaskAdd distilled water until the meniscus rests exactly on the graduation mark, shaking continuously |

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| cid:ii_jepnvfe00_1621fa54a497745d**Practical 11.2: Determine the relative formula mass, and hence water of crystallisation, of hydrated sodium carbonate, Na2CO3.xH2O, by titration (Na2CO3 + 2HCl 🡪 2NaCl + CO2 + H2O)** |
| Equipment needed per group: 1 burette, 1 25 cm3 pipette, 1 pipette filler, clamp, boss, stand, one conical flask, two funnels, two 100 cm3 beakers with the means to label them, one 250 cm3 volumetric flask, one weighing boat; access to a mass balance, access to 0.1 moldm-3 HCl, a sample of hydrated sodium carbonate with the formula not labelled, with spatula, methyl orange indicator and suitable dropping pipette* If the student uses 3.5 g of solid the titre volume should be around 24 cm3
* Using 24 cm3, moles of HCl = 0.1 x 0.0224 = 0.00224 so moles of Na2CO3 in conical flask is 0.00224/2 = 0.00112
* Moles of Na2CO3 in volumetric flask = 0.00112 x 10 = 0.012
* Molar mass of Na2CO3 = 3.5/0.012 = 292
* 106 + 18x = 292 so x = 10
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| cid:ii_jepnvfe00_1621fa54a497745d**Practical 11.3: Determine the percentage purity of a sample of vinegar (CH3COOH + NaOH 🡪 CH3COONa + H2O)** |
| Equipment needed per group: 1 burette, 1 25 cm3 pipette, 1 pipette filler, one conical flask, two funnels, two 100 cm3 beakers with the means to label them, one 250 cm3 volumetric flask; access to 0.1 moldm-3 NaOH, a sample of ethanoic acid (approx 1 moldm-3) labelled “vinegar 62.3 gdm-3”), phenolphthalein indicator and suitable dropping pipette* If the ethanoic acid is around 1 moldm-3 the titre volume should be around 13 cm3
* moles of NaOH = 0.05 x 25/1000 = 0.00125 so moles of CH3COOH in titration = 0.00125
* molarity of = CH3COOH / (titre volume/1000); using 13 cm3, C = 0.00125/0.013 = 0.096 moldm-3
* so molarity before dilution = 0.096 x 250/25 = 0.96 moldm-3
* mass concentration = 0.96 x 60 = 57.7 gdm-3
* percentage purity = 57.7/62.3 x 100 = 92.6 %
* phenolphthalein necessary because acid is weak so methyl orange will not work
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| Image result for test icon**Test your knowledge 11.4: Volumetric Analysis – Titrations** |
| 1. Moles of NaOH = 0.0025; moles of SA used = 0.0025/2 = 0.00125; moles of SA in volumetric flask = 0.00125 x 250/18.4 = 0.016984, mr of SA = 2/0.016984 = 118; (CH2)n = 118 – 90 = 24 so n = 28/14 = 2
2. Moles of HCl = 0.0245 x 0.1 = 0.00245; moles of Na2CO3 used = 0.00245/2 = 0.001225; moles of in volumetric flask = 0.001225 x 10 = 0.01225, molar mass of Na2CO3 = 3.5/0.001225 = 286; xH2O = 280 – 106 = 180; x = 180/18 = 10
3. Moles of NaOH = 0.025 x 0.1 = 0.0025; moles of CH3COOH used = 0.0025; molarity of CH3COOH used = 0.0025/(13.9/1000) = 0.180; molarity before dilution = 0.180 x 250/25 = 1.80 moldm-3; mass concentration = 1.8 x 60 = 108 gdm-3
4. Moles of NaOH = 0.0025; moles of acid used = 0.0025/2 = 0.00125; moles of acid in volumetric flask = 0.00125 x 250/21.3 = 0.0147; mass of pure acid = 0.0147 x 126 = 1.85 g; % purity = 1.85/2.5 x 100 = 73.9 %
5. Moles of NaOH = 0.0025; moles of acid used = 0.0025; moles of acid in volumetric flask = 0.0025 x 250/21.3 = 0.0271; mass of acid = 0.0271 x 120.1 = 3.25; % purity = 57.2 %
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***Lesson 12 – What have you understood about Acids, Bases and Salts?***

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| 12.1 END-OF-TOPIC QUIZUNIT 5 – ACIDS, BASES AND SALTSImage result for test icon |
| 1. (a) HCl + NaOH 🡪 NaCl + H2O

(b) H2SO4 + MgO 🡪 MgSO4 + H2O(c) CaCO3 + 2HNO3 🡪 Ca(NO3)2 + CO2 + H2O1. Deliquescent – absorbs water from atmosphere and dissolves in it (eg NaOH or CaCl2)

Hygroscopic – absorbs water from atmosphere (eg conc. H2SO4 or any deliquescent substance)Efflorescent – contains water which it releases (eg CaSO4.2H2O)1. (a) strong acid – lower pH

(b) strong acid – more exothermic enthalpy of neutralisation(c) strong acid – faster reaction with calcium carbonate(d) strong acid – greater electrical conductivity1. (a) no - neutral (salt of strong acid and strong base)

(b) yes - acidic (salt of weak base)(c) yes – basic (salt of weak acid)1. (a) Add CaCO3; observe fizzing

(b) Add NH4Cl and warm – pungent smell(c) Add NaOH and warm – pungent smell(d) Add concentrated H2SO4 – white fumes which turn blue litmus red and give white smoke in presence of filter paper soaked in NH3(e) Add acid; gas given off which smells like burning matches(f) Gives white smoke in presence of filter paper soaked in concentrated HCl1. (a) water – green; lemon juice – red; bleach – violet

(b) HCl turns blue litmus red; NH3 turns red litmus blue1. Moles of HCl = 0.2 x 10.8/1000 = 0.00216; M2CO3 + 2HCl 🡪 2MCl + CO2 + H2O so moles of M2CO3 used = 0.00216/2 = 0.00108; moles of M2CO3 in volumetric flask = 0.00108 x 10 = 0.0108; molar mass = 2.5/0.0108 = 231; 2M = 231 – 60 = 171; M = 171/2 = 85.5; M = Rb
 |