**Fast Track CHEMISTRY 2011**

**SECTION 1**

|  |  |
| --- | --- |
| 1 | a |
| 2 | b |
| 3 | a |
| 4 | b |
| 5 | d |
| 6 | c |
| 7 | b |
| 8 | d |
| 9 | d |
| 10 | d |
| 11 | c |
| 12 | a |
| 13 | d |
| 14 | d |
| 15 | b |
| 16 | b |
| 17 | c |
| 18 | a |
| 19 | b |
| 20 | b |
| 21 | c |
| 22 | c |
| 23 | c |
| 24 | b |
| 25 | d |
| 26 | a |
| 27 | b |
| 28 | d |
| 29 | b |
| 3O | b |

**SECTION 2**

1 a) 

Two colourless solutions mix to form white precipitate.  
  
 b) 

Pale blue solution mixes with colourless solution to form deep blue solution.

c) 

Two colourless solutions combine to form a **sweet smelling** colourless solution.

d)    
 Purple solution is added to colourless solution and a colourless, odourless gas is evolved.

[12 MARKS]

2. a) 1s22s22p63s23p6   
  
 b) 1s22s22p6  
 [2 marks]  
3.

|  |  |  |
| --- | --- | --- |
| **Species** | **Structural formula**  **(showing all valence**  **shell electrons)** | **Shape**  **(sketch or name)** |
| sulfur dioxide,  SO2 |  | **BENT** |
| 2-  Sulfate ion,  SO42- |  | **TETRAHEDRAL** |
| Nitrogen trichloride,  NCl3 |  | **PYRAMIDAL** |

[6 marks]

4. a) MgCl2 consists of a strong ionic lattice which takes considerable energy to break, SCl2 is a covalent substance and only relatively weak intermolecular forces need to be overcome, therefore it melts at a lower temperature.

b) In the solid form all ions are in a rigid lattice and are not free to carry a charge. In the molten state, the ions are free to move and carry charge.

c) i) Yes, the solution contains mobile ions to carry charge.  
 ii) Yes, although PCl3 is covalent, the pH is lower than 7, so there must be ionisation of

water to some extent, therefore the solution will conduct an electric current.

[6 marks]

5.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of Compound** | **Molecular Formula** | **Empirical Formula** | **Structural Formula** |
| 1,3-dibromobenzene | C6H4Br2 | C3H2Br |  |
| 2-methyl-3-pentanol | C6H14O | C6H14O |  |
| 2,2-dimethylcyclopentanone | C7H12O | C7H12O |  |
| Ethylethanoate | C4H8O2 | C2H4O |  |
| Ethylcyclobutane | C6H12 | CH2 |  |

[7 marks]

6. (a) methanal (b) 2-butanone (c) ethoxide ion (CH3CH2O-)  
 [3 marks]

7. (a) solutions of magnesium chloride and zinc chloride.  
  
 **Description of Test**

|  |
| --- |
| e.g.: Add excess sodium hydroxide to samples of each. |

**Observation with magnesium chloride**

|  |
| --- |
| White precipitate forms that does not re-dissolve. |

**Observation with zinc chloride**

|  |
| --- |
| White precipitate forms that re-dissolves in excess sodium hydroxide  (i.e.: soluble [Zn(OH)4]2- forms) |

(b) Samples of ammonia gas and nitrogen gas.

**Description of Test**

|  |
| --- |
| e.g.: Bubble each through distilled water and test with red litmus paper. |

**Observation with ammonia gas**

|  |
| --- |
| Turns red litmus blue. |

**Observation with nitrogen gas**

|  |
| --- |
| No observable reaction with red litmus. |

[8 marks]

8. (a) bromine and chlorine incorrectly placed.  
  
 (b) e.g.: 

(c) I-, Br-, Cl-, F-  
  
 (d) e.g.: 

1. Fluorine would oxidise all of the halides present producing free halogens in the solution and fluoride ions.
2. Fluorine would also oxidise some of the water present  
     
   i.e.: 

[8 marks]

9. (a).

Reactants

Products

Potential

Energy

(Enthalpy)

Reaction Co-ordinate

**EA**

**∆H**

**CAT**

[3 marks]

(b) (i) A Neon atom: 1s2 2s22p6 [1]

(ii) A Potassium ion: 1s2 2s22p3 3s23p6 [1]

[4 marks]

10. a)



b)



1. Addition Polymerision
2. For example: Add bromine water, if the bromine water decolorised it would indicate unsaturation and that the reaction was incomplete.

[6 marks]

1. a) 

b)

|  |  |  |
| --- | --- | --- |
| **CHANGE** | **EFFECT ON NUMBER OF MOLES OF COBr2** | **REASON** |
| Bromine gas is rapidly introduced to the reaction flask at a constant volume and temperature. |  | Reverse reaction favoured when extra product introduced |
| Ethene gas is rapidly introduced to the reaction flask at a constant volume and temperature. |  | Ethene is unsaturated ∴Br2 reacts and is consumed. ∴FWD reaction favoured |
| The volume of the system is allowed to expand at a constant temperature |  | Greater volume will cause equilibrium position to shift to side with greatest moles of gas ∴favour FWD reaction |

[7 marks]

**SECTION THREE**

1. 2Al3+ + 3CO32- → Al2(CO3)3

**n = cV**

n(Al(NO3)3) = 1.00 x 0.250 = 0.250 mol

∴ n(Al3+) = 0.250 mol [1]

n(Na2CO3) = .500 x 0.500 = 0.250 mol

∴ n(CO32-) = 0.250 mol [1]

n(CO32-)required = (3/2) x n(Al)

= (3/2) x 0.250 = 0.375 [1]

∴ (CO32-) is the limiting reagent as there is only 0.250 mol present. [1]

∴ n(Al2(CO3)3) = (1/3) x n(CO32-)

= (1/3) x 0.250 = 0.0833 mol [1]

**m = n x M**

∴ m(Al2(CO3)3) = 0.0833 x 233.99 **= 19.5 g** [1]

[6 marks]

(b) c(CO32-) = 0 *(as carbonate is the limiting reagent.)*

[2 marks]

2. (a) m(H)in 10.15 g = (2.016 / 18.016) x 4.40 = 0.492 g [1]

% (H) = (0.492 / 10.15) x 100 = 4.90 %

n (AgCl) = 12.54 / 143.35

= 0.0875 [1]

m (Cl)in 5.48 g = 0.0875 x 35.45

= 3.101g [1] % (Cl) = (3.101 /5.48 ) x 100 = 56.6 %

%(C) = 100% – (56.6% + 4.90%) = 38.5 % [1]

M *(12.01) (1.008) (35.45)* **C H Cl**

**n = m/M** = 38.5 / 12.01 4.90 / 1.008 56.6 / 35.45

n = 3.21 4.86 1.597 [1]

mole ratio = 3.21/1.597 4.86/1.597 1.597/1.597 [1]

2.01 : 3.04 : 1 [1]

**Empirical Formula is C 2H3 Cl** [1]

[8 marks]

(b) **PV = nRT n = PV / RT**

n = (150 x 1.05) / (8.315 x 473)

= 4.00 x 10-2 mol [1]

M = m / n = 5.00 / 4.00 x 10-2 = 125 g mol-1 [1]

M (C2H3Cl) = 62.49 g mol-1

125/ 62.49 = 2 [1]

∴ molecular Formula = 2 x Emp. Form. **= C4H6Cl2** [1]

[4 marks]

(c) *many possibilities, such as:*

1,1-dichloro-1-butene 1,1-dichloro-2-methyl-1-propene 2,4-dichloro-1- butene [1]





[1]

[2 marks]

3. (a) MnO4-*(aq)* + 8H+*(aq)* + 5Fe2+*(aq)* → Mn2+*(aq)* + 4H2O*(l)* + 5Fe3+*(aq)* [1]

**n = cV**

n (MnO4-)titration = 0.0345 x 0.02468 [1]

= 8.515 x 10-4 mol [1]

n (MnO4-)total = (250/20) x 8.515 x 10-4

= 0.01064 mol [1]

n (Fe2+) = (5/1) x n(MnO4-)total

= 0.05322 mol [1]

**m = n x M**

m(Fe) = 0.05322 x 55.85

= 2.972 g [1]

%(Fe) = (2.972/4.910) x 100 **= 60.5%** [1]

[7 marks]

(b) H+ ions are required for the reduction of the MnO4- ion. [1]

In this reaction sulfuric acid is used to dissolve the alloy so the solution is already acidic [1]

[2 marks]

4. (a)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Titrations | | |
| 1 | 2 | 3 |
| Final Reading (mL) | 15.90 | 31.75 | 47.65 |
| Initial Reading (mL) | 0.00 | 15.90 | 31.75 |
| Titre (mL) | **15.90** | **15.85** | **15.90** |

[1]

Average Titre = 15.88 mL = 0.01588 L [1]

**n = cV**

n(HCl) = 1.05 x 0.01588 = 0.01668 mol [1]

n(NaOH)*unreacted*= n(HCl) = 0.01668 mol [1]

n(NaOH)*initial*= 0.500 x 0.0500 = 0.0250 mol [1]

*‘back titration’*

n(NaOH)*reacted*= n(NaOH)*initial* - n(NaOH)*unreacted* [1] = 0.0250 - 0.01668

= 8.32 x 10-3 mol [1]

*triprotic acid*

C6H8O7*(aq)* + 3OH-*(aq)* → C6H5O73-*(aq)* + 3H2O*(l)*[1]

∴ n(C6H8O7) = (1/3) x n(NaOH)*reacted* = (1/3) x 8.320 x 10-3 mol

= 2.773 x 10-3 mol [1]

**m = n x M** M(C6H8O7) = 192.124

m(C6H8O7) = 2.773 x 10-3 x 192.124 = 0.5327g [1]

∴ % by mass = (0.5327/8.00) x 100 **= 6.66%** [1]

[11 marks]

5. a) n(FeS2) = m/M

= 9.00 x 106/119.97

= 7.502 x 104 moles

∴ n(H2SO4)= 8/4 x 7.502 x 104

= 1.500 x 105 moles

∴ n(H+) = 1.500 x 105 x 2

= 3.00 x 105 moles

∴ [H+] = 3.00 x 105/3.00 x 107

= 1.00 x 10-2 molL-1 [3 marks]

b) pH = -log[H+]  
 = -log(1.00 x 10-2)

= 2.00 [2 marks]

c) n (NaOH)= m/M

= 9.00 x 106/39.998

= 2.25 x 105 mol

= n(OH-) [3 marks]

**i.e.: needed 3.00 x 105 moles of OH- ions to neutralise acid, ∴ insufficient base added.**

**SECTION FOUR**

**Essay One**

The following points should be included in a *good* essay:

* General discussion of electrical conductivity and how it relates to dissolved ions in solution
* Discussion of polar vs. non-polar and how the polar substances are only weakly ionised, this discussion should also include strong vs weak acids and electrolyte strength
* Discussion of how all of the purely ionics compounds are good electrolytes due to the formation of ions in solution
* A thorough discussion of the halogen halides and how although covalent, generally are good electrolytes due to their acidic nature, i.e.: they protonate to form H3O+ ions as well as halide ions so that charge can be carried.
* Notably, HF is a weak electrolyte due to the strong covalent bond between H and F. ie: F is very electronegative, ∴HF is a weak acid and a weak electrolyte. Discussion should involve distance between valence shell and charge centre for fluorine.