**Mearns Castle High School**

**Chemistry Department**

****

**Spring Revision Pack**

**55 Marks – Time allowed 1 hour 25**

|  |  |  |
| --- | --- | --- |
| **Question &**  **Key Area** |  | **Marks** |
| 1 – Rates | The following answer was taken from a student’s examination paper. The answer is **incorrect**. Give the correct explanation. | 1 |
| 2 –  Period-icity | Lithium starts the second period of the Periodic Table.    a) What is the trend in electronegativity values across this period from Li to F?    b) **Graph 1** shows the first four ionisation energies for aluminium.    Why is the fourth ionisation energy of aluminium so much higher that the third ionisation energy?  c) **Graph 2** shows the boiling points of the elements in Group 7 of the Periodic Table.    Why do the boiling points increase down Group 7? | 1  1  1 |

|  |  |  |
| --- | --- | --- |
| 3 a  Bonding  3b  Bond Enthalpy | a) The structures below show molecules that contain chlorine atoms    The compounds shown above are not very soluble in water.  Trichloromethane is around ten times more soluble in water than tetrachloromethane.  **Explain clearly** why trichloromethane is more soluble in water than  tetrachloromethane.  Your answer should include the names of the intermolecular forces involved.  b) Chloromethane can be produced by the reaction of methane with chlorine.  CH4(g) + Cl2(g) 🡪 CH3Cl(g) + HCl(g)  Using bond enthalpies from the data booklet, calculate the enthalpy change, in kJ mol−1, for this reaction. | 3  2 |
| 4a  Essential oils  4b  Alcohols | Many molecules in perfumes are molecules consisting of joined isoprene units.     1. What name is given to molecules in perfume consisting of joined isoprene units? 2. Geraniol is one of the compounds found in perfume. It has the following structural formula and systematic name.     Linalool can also be present. Its structural formula is shown.     1. State the systematic name for linalool. 2. Explain why linalool can be classified as a tertiary alcohol. | 1  1  1 |
| 5 a+b  Redox and Skills  5c(i)  Bonding  5cii)+iii)  Free Radicals | Sodium hypochlorite, NaOCl, is a strong oxidising agent added to water in  swimming pools.   1. State the purpose of adding sodium hypochlorite to water in swimming pools. 2. The concentration of sodium hypochlorite in swimming pool water can be determined by redox titration.   **Step 1**  A 100·0 cm3 sample from the swimming pool is first reacted with an excess of  acidified potassium iodide solution forming iodine.  NaOCl(aq) + 2I−(aq) + 2H+(aq) → I2(aq) + NaCl(aq) + H2O(l)  **Step 2**  The iodine formed in step 1 is titrated using a standard solution of sodium  thiosulfate, concentration 0·00100 mol l−1. A small volume of starch solution is added towards the endpoint.  I2(aq) + 2Na2S2O3(aq) → 2NaI(aq) + Na2S4O6(aq)  (i) Describe in detail how the burette should be prepared and set up, ready  to begin the titration.  (ii) Write the ion-electron equation for the oxidation reaction occurring in  step 1.  (iii) Calculate the concentration, in mol l−1, of sodium hypochlorite in  the swimming pool water if an average volume of 12·4 cm3 of sodium  thiosulfate was required.  c) The familiar chlorine smell of a swimming pool is not due to chlorine  but compounds called chloramines. Chloramines are produced when the  hypochlorite ion reacts with compounds such as ammonia, produced by the  human body.  OCl−(aq) + NH3(aq) → NH2Cl(aq) + OH−(aq)  Monochloramine  OCl−(aq) + NH2Cl(aq) → NHCl2(aq) + OH−(aq)  Dichloramine  OCl−(aq) + NHCl2(aq) → NCl3(aq) + OH−(aq)  Trichloramine  Chloramines are less soluble in water than ammonia due to the polarities of the molecules, and so readily escape into the atmosphere, causing irritation to the eyes.  (i) Explain the difference in polarities of ammonia and trichloramine  molecules.    Chloramines can be removed from water using ultra-violet light  treatment.  One step in the process is the formation of free radicals.  UV  NH2Cl 🡪 •NH2 + •Cl  ii) What are free radicals?  iii) Another step in the process is  NH2Cl + •Cl → •NHCl + HCl  State the name for this type of step in a free radical reaction. | 1  3  1  3  2  1  1 |
| 6  Esters, Fats and Oils | Pentyl butanoate is responsible for some of the flavour in apricots and  strawberries.    (a) Hydrolysis of pentyl butanoate using sodium hydroxide produces an  alcohol and the salt of the carboxylic acid.  (i) Name the alcohol that would be formed when pentyl butanoate is  hydrolysed.  (ii) Draw a structural formula for the sodium salt of the carboxylic acid  that would be formed.  (b) Fats and oils belong to the same class of compounds as pentyl butanoate.  (i) Name this class of compounds.  (ii) When a fat is hydrolysed using sodium hydroxide, sodium salts of  fatty acids are produced.  State a use for sodium salts of fatty acids. | 1  1  1  1 |
| 7a  Hess’ Law  7b  Equilibrium | Mobile phones are being developed that can be powered by methanol.  Methanol can be made by a two-stage process.  (*a*) In the first stage, methane is reacted with steam to produce a mixture of  carbon monoxide and hydrogen.    Use the data below to calculate the enthalpy change, in kJ mol–1, for the  forward reaction.    (*b*) In the second stage, the carbon monoxide and hydrogen react to produce  methanol.    Circle the correct words in the table to show the changes to temperature and  pressure that would favour the production of methanol. | 2  1 |
| 8a  Fats and Oils  8b  Skills  8c  % Yield  8d  Atom Economy | In an experiment some oils were used to make soap. The oil, triolein, was reacted with sodium hydroxide.    a) Name product X.  b) 5·0 g of triolein was dissolved in ethanol and placed in a test tube  with excess sodium hydroxide. The mixture was heated to 80 ºC.  State a suitable method for heating the reaction mixture.  c) The experiment produced 1·28 g of sodium oleate. Calculate the percentage yield.  d) Calculate the atom economy of this method of producing sodium oleate. | 1  1  2  2 |
| 9a  Molar Volume  9b  Proteins | Dishwasher tablets produce the bleach hydrogen peroxide, H2O2. One  action of this oxidising agent is to oxidise food.  a) Hydrogen peroxide decomposes to form water and oxygen.  A dishwasher tablet produces 0·051 g of hydrogen peroxide (mass of  one mole = 34 g).  Calculate the volume of oxygen that would be produced when  0·051 g of hydrogen peroxide decomposes.  *Take the volume of 1 mole of oxygen gas to be 24 litres.*  b) Enzymes are commonly added to dishwasher tablets. These are used to break down proteins.  (i) The proteins are broken down into small, water-soluble molecules.  Name the small, water-soluble molecules made when proteins are  broken down completely.  ii)The structure of a section of protein chain found in egg white is  shown.    (A) Name the functional group circled.  (B) Draw a structural formula for **one** of the molecules that  would be made when this section of egg white protein chain  is completely broken down.  (iii) As part of the program in the dishwasher, the conditions in the  dishwasher change so that the enzyme molecules no longer work  because they change shape.  (A) State the term used to describe the change in shape of  enzyme molecules.  (B) Suggest a change in conditions which would cause the  enzyme molecules to change shape. | 3  1  1  1  1  1 |
| 10a  Esters  10b  Excess  10c  Costing/Numeracy Q | Methyl benzoate is commonly added to perfumes as it has a pleasant smell.  The chemical reaction involved in the production of methyl benzoate is shown.    a) Name product X.  b) In a laboratory experiment, a student used 5·0 g of benzoic acid and 2·5 g of methanol to produce methyl benzoate. Explain why benzoic acid is the limiting reactant. You must include calculations in your answer.  c) The student produced 3·1 g of methyl benzoate from 5·0 g of benzoic acid. Benzoic acid costs £39·80 for 500 g. Calculate the cost, in £, of the benzoic acid needed to make 100 g of methyl benzoate using the student’s method. | 1  2  2 |
| 11  Enthalpy of Combustion | A student investigated the properties of methanol and ethanol  The student carried out experiments to determine the enthalpy of combustion of the alcohols.  a) The student carried out the first experiment as shown, but was told to repeat the experiment as the thermometer had been placed in the wrong position. Suggest why the student’s placing of the thermometer was incorrect.  b) The student always used 100 cm3 of water. State another variable that the student should have kept constant.  c) The student burned 1·07 g of methanol and recorded a temperature rise of 23 ºC. Calculate the enthalpy of combustion, in kJ mol−1 , for methanol using the student’s results. | 1  1  3 |