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| Description: Vertical full colour positive | Safety Bay Senior High School | | | | | |
| **CHEMISTRY UNIT 1 & 2** | | | | | | |
| **Test #3:** | | | | | | |
| **Stoichiometry, Hydrocarbons** | | | | | | |
|  | | | | | | |
| **NAME:** | | |  | | | |
|  | | |  | | | |
| **Time allowed for this paper** | | | | | | |
| Reading time: | | 5 minutes | | | | |
| Working time: | | 50 minutes | | | | |
|  | | | | | | |
| **Structure of this paper:** | | | | | | |
| Section | | | Number of questions | Marks available | | Marks achieved |
| Section One: Multiple Choice | | | 6 | 6 | |  |
| Section Two: Short Answer | | | 10 | 44 | |  |
|  | | |  | | **Total** | \_\_\_\_\_\_ / 50 |

**Section One: Multiple Choice**

This section has 10 questions. Answer **all** questions by circling the correct option. If you make a mistake, put a cross through your answer and then circle your new answer. No marks will be given if more than one answer is completed for any question.

Suggested working time: 10 minutes

1. If X2O3 is the correct formula for a metal oxide, the formula for the chloride of X is:
   1. XCℓ
   2. XCℓ2
   3. **XCℓ3**
   4. X3Cℓ2
2. What values of **w**, **x**, **y** and **z** are required to balance the following equation?

**w** Aℓ + **x** H2O → **y** Aℓ2O3 + **z** H2

* 1. **w = 2 x = 3 y = 1 z = 3**
  2. w = 2 x = 4 y = 2 z = 6
  3. w = 1 x = 3 y = 1 z = 3
  4. w = 3 x = 4 y = 1 z = 6

1. Ammonia gas reacts with oxygen gas according to the following equation:

4 NH3(g) + 5 O2(g) → 4 NO(g) + 6 H2O(g)

Which of the following correctly calculates the number of moles of water produced from 7.80 moles of ammonia?

*Note: The relative molecular mass of ammonia is 45.054 and the relative molecular mass of water is 18.016.*

|  |  |
| --- | --- |
| (a) |  |
| **(b)** |  |
| (c) |  |
| (d) |  |

1. What is the general formula of an alkene?
   1. CnHn
   2. **CnH2n**
   3. CnH2n+2
   4. CnH2n-2
2. The types of chemical reactions in hydrocarbons is determined by the nature of bonding within the molecules. When reacting with halogens (e.g. Br2), hydrocarbons can either do addition or substitution reactions. Which option in the table correctly classifies the types of reactions carried out by alkanes, alkenes and benzene?

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Alkanes** | **Alkenes** | **Benzene** |
| (a) | Substitution | Addition | Addition |
| (b) | Addition | Substitution | Substitution |
| **(c)** | **Substitution** | **Addition** | **Substitution** |
| (d) | Addition | Substitution | Addition |

1. A commonly used test in chemistry is to shake a sample of an organic compound with bromine water, Br2(aq), and observe a colour change, if any, of the bromine water. Which of the following compounds would cause the colour of bromine to rapidly fade in such a test?
   1. Bromodecane
   2. Benzene
   3. **Hex-3-ene**
   4. Heptane

**Section Two: Short Answer**

Answer **all** questions in the spaces provided. When calculating numerical answers, show your working or reasoning clearly. Include appropriate units where necessary. Spare working space is provided at the back.

1. **(2 marks)**

Complete the following table:

|  |  |
| --- | --- |
| **Name** | **Chemical Formula** |
| Potassium phosphate | **K3PO4** |
| Chloromethane | **CH3Cℓ** |
| **Barium cyanide** | Ba(CN)2 |
| **Bromine** | Br­2 |

1. **(4 marks)**
   1. Calculate the number of moles of carbon monoxide molecules in 1.20 x 1025 moles of carbon monoxide. Show your working clearly. (2 marks)
   2. Calculate the number of hydrogen atoms in 6.25 moles of H2SO4. (2 marks)
2. **(4 marks)**

Zinc metal reacts with hydrochloric acid to produce zinc chloride and hydrogen gas (H2).

* 1. Write a balanced chemical equation for the reaction between zinc and hydrochloric acid. (2 marks)

**Zn(s) + 2 HCℓ(aq) 🡪 ZnCℓ2(aq) + H2(g)**

* 1. How many moles of hydrochloric acid would be needed to consume 0.350 moles of zinc?   
     Show all working, and include appropriate units. (2 marks)

1. **(3 marks)**

When heated, iron(III) nitrate is converted into iron(III) oxide, nitrogen dioxide and oxygen.

4 Fe(NO3)3(s) → 2 Fe2O3(s) + 12 NO2(g) + 3 O2(g)

A 2.16 g sample of iron(III) nitrate was completely converted into the products shown.

* 1. Calculate the moles of iron(III) nitrate in the 2.16 g sample. Give your answer to three significant figures. (2 marks)
  2. Calculate the moles of oxygen gas produced in this reaction. (1 mark)

1. **(5 marks)**

Octane (C8H1) is the primary component of petrol. The fuel tank of a car can store an average of 60 L of octane. Energy is released by combustion the octane according to the following equation:

2 C8H18(g) + 25 O2(g) → 16 CO2(g) + 18 H2O(g)

Octane has a density of 0.7025 g/mL. In other words, 1 mL of octane has a mass of 0.7025 g.

Using the information provided above, calculate the mass of carbon dioxide released when 60 L of octane is burnt in a car engine. Show all working and give your answer to three significant figures.

1. **(6 marks)**

Ammonium nitrate is commonly used as a fertiliser. It is a good nitrogen source for plants due to the fact that is contains nitrogen in both the ammonium ion and nitrate ion.

* 1. Write the formula for ammonium nitrate. (1 mark)

**NH4NO3**

* 1. Ammonium nitrate is water soluble. Write an equation showing the products formed when solid ammonium nitrate dissolves. Include state symbols in your answer. (2 marks)

**NH4NO3(s) 🡪 NH4+(aq) + NO3–(aq)**

* 1. Calculate the percentage by mass of nitrogen in ammonium nitrate. (2 marks)
  2. A farmer wants to apply ammonium nitrate fertiliser to his crop. He would like to apply enough fertiliser so that a particular crop receives a total of 62.6 kg of nitrogen atoms. What mass of ammonium nitrate would he need to use? (1 mark)

1. **(3 marks)**

Name the following compounds:

|  |
| --- |
| CH3  |  CH3–CH–CH2–CH3 |
| Name: **methylbutane (award 0.5/1 for “2-methylbutane”)** |
| CH3  |  CH3–C–CH2CH3  |  CH2CH3 |
| Name: **3,3-dimethylpentane** |
| CH3 H  | /  CH3–C–CH=C  | \  Cℓ H |
| Name: **3-chloro-3-methylbut-1-ene** |

1. **(2 marks)**

In a testing on naming compounds, a student’s answer to a question was 2,3-dichloropropane. To their surprise, they were marked wrong.

* 1. Why was the student’s answer incorrect? (1 mark)

**Did not give lowest possible number to sidechains**

* 1. What should the compound have been named instead? (1 mark)

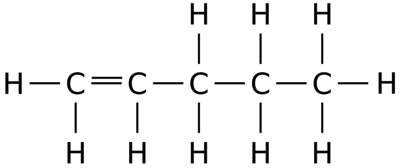
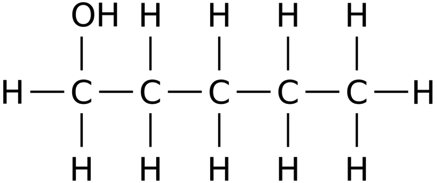
**1,2-dichloropropane**

1. **(8 marks)**

Draw structures and give the names of organic molecules which fit the descriptions given in the table below.

|  |  |
| --- | --- |
| A branched-chain alkane containing six carbon atoms | Structural formula:  http://www.sciencegeek.net/APchemistry/organic/ochem_files/image007.gif or http://www.sciencegeek.net/APchemistry/organic/ochem_files/image008.gif  **2-methylpentane 3-methylpentane**  *Also possible: 2,2-dimethylbutane, 2,3-dimethylbutane* |
| An aromatic hydrocarbon that contains a halogen atom | Structural formula:  http://upload.wikimedia.org/wikipedia/commons/6/6e/Fluorobenzene-2D-skeletal.png http://f.tqn.com/y/chemistry/1/S/H/D/1/Chlorobenzene.jpg http://upload.wikimedia.org/wikipedia/commons/thumb/1/15/Brombenzol_-_Bromobenzene.svg/100px-Brombenzol_-_Bromobenzene.svg.png http://www.sigmaaldrich.com/content/dam/sigma-aldrich/structure4/164/mfcd00001029.eps/_jcr_content/renditions/mfcd00001029-medium.png  **fluorobenzene chlorobenzene bromobenzene iodobenzene**  *More complicated variations are possible, but must contain a benzene ring and one of fluorine, chlorine, bromine or iodine.* |
| Two isomers which share the molecular formula C4H8 | http://alevelchem.com/img/structures/alkenes/but-1-ene.gif http://alevelchem.com/img/structures/but-2-ene.gif  **but-1-ene but-2-ene methylpropene**  **or 1-butene or 2-butene**  *Also possible: cyclobutane, methylcyclopropane* |

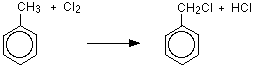
1. **(7 marks)**
2. Water is added to pent-1-ene in the presence of a sulfuric acid catalyst. (2 marks)

**

+ H2O 🡪

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| **Answer** | **Marks** |
| **Reactants are correct**   * Correct structure of pent-1-ene | **1 mark** |
| **Products are correct**   * Correct structure of pentan-1-ol **OR** pentan-2-ol | **1 mark** |
| **Total marks:** | **2 marks** |

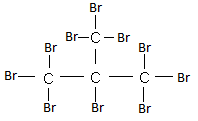
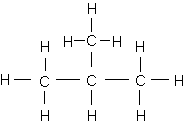
1. A small amount of chlorine gas is bubbled through methylbenzene: (2 marks)



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| **Answer** | **Marks** |
| **Reactants are correct**   * Correct structure of methylbenzene | **1 mark** |
| **Products are correct**   * http://www.dagama-mnc.com/up_product/small/2013-4-11-16514692964.gifSubstitution has replaced a hydrogen atom with a chlorine atom * HCl is a by-product * *Note: Also accept substitution on the benzene ring. Example:* | **1 mark** |
| **Total marks:** | **2 marks** |

1. A small amount of methylpropane is added to an excess of bromine in the presence of UV light.

(3 marks)



**+ 10 Br2 🡪 + 10 HBr**

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| **Answer** | **Marks** |
| Correct structure for methylpropane | **1 mark** |
| Shows a fully substituted product | **1 mark** |
| Includes HBr as a byproduct and balances equation | **1 mark** |
| **Total marks:** | **3 marks** |

*Note: If student writes a correctly balanced equation for single substitution award 2/3 marks*