Chemistry 12 2009

Organic Assignment

**Multiple choice**

1. A compound has the formula $C_6H_{12}$. Which one of the following could it be?
   (a) A straight chain alkane.
   (b) A branched chain alkane.
   (c) An alkene with one double bond.
   (d) An alkyne with one triple bond.

2. Only one of the following is a correct formula. Which is it?

   (a) $CH_3 - CH - CH_2 - CH_3$

   (b) $CH_3 – CH_2 - CH - CO -C(CH_3)_3$

   (c) $CH_3 - CH_2 - NH_2 - CH - CH_2$

   (d) $(CH_3)_2CH_2$

3. How many compounds are possible with formula $C_2F_4Cl_2$?

   (a) 1

   (b) 2

   (c) 3

   (d) 4

4. Which formula represents two substances which are geometric (cis/trans) isomers?

(a) $C_3H_6$

(b) $C_3H_8$

(c) $H_2CC(CH_3)_2$

(d) $CH_3CHCHCH_3$

5. Which one of the following substances would yield a carboxylic acid when treated with a solution containing sodium dichromate and sulfuric acid?

(a) 1-propanol

(b) 2-propanol

(c) 2-methyl-2-propanol

(d) propanone

6. Which one of the following substances would yield a ketone when treated with a solution containing sodium dichromate and sulfuric acid?

(a) 1-propanol

(b) 2-propanol

(c) 2-methyl-2-propanol

(d) 1,3-propanediol

7. Which one of the following is an esterification reaction?

(a) $CH_3CH_2CH_3 + Br_2 \rightarrow CH_3CH_2CH_2Br + HBr$

(b) $CH_3COOH + CH_3OH \rightarrow CH_3COOCH_3 + H_2O$

(c) $CH_3CHCH_2 + HBr \rightarrow CH_3CH_2CH_2Br$

(d) $CH_3COOCH_3 + OH^- \rightarrow CH_3COO^- + CH_3OH$

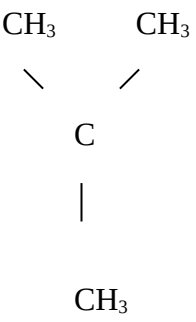
8. Which one of the following organic structural formulae is correct?

(a) $CH_3\text{-}CH_2\text{ -}CH_2 = CH_2\text{ -}CH_3$

(b) $CH_3\text{-}CH_2\text{ –O-}CH_3$

(c) $CH_3\text{-}CH_2 = C = CH$

(d)



9. Which one of the following could be formed by the reaction between sodium and ethanol?

(a) $CH_3CH_2Na$
(b) $CH_3CH_2^-$
(c) $CH_3CH_2O^-$
(d) $CH_3CHO$

10. Which one of the following substances can be made from just the materials listed?

| | **Substance** | **Starting Materials** |
|---|---|---|
| (a) | propyl ethanoate | propanoic acid, ethanol, and concentrated sulfuric acid. |
| (b) | polyvinyl chloride | dichloroethane and a catalyst. |
| (c) | soap | concentrated sodium hydroxide solution and glycerol. |
| (d) | ethanoic acid | ethanal, sodium dichromate, and dilute sulfuric acid. |

**Organic assignment 2009**

Name _____

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| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| a | a | a | a | a | a | a | a | a | a |
| b | b | b | b | b | b | b | b | b | b |
| c | c | c | c | c | c | c | c | c | c |
| d | d | d | d | d | d | d | d | d | d |

**Short answer questions**

1. A solution containing potassium permanganate and sulfuric acid is warmed with ethanol: the purple colour in the solution disappears, and a vinegar odour due to the formation of ethanoic acid is observed. Write the equation for the reaction that has occurred.

| |
|---|
| Oxidation half-equation<br>$CH_3CH_2OH + H_2O \rightarrow CH_3COOH + 4H^+ + 4e$<br><br>*2 marks* |
| $MnO_4^- + 8H^+ + 5e \rightarrow Mn^{2+} + 4H_2O$<br>*1 mark* |
| Redox equation<br><br>$\mathbf{5}C_2H_5OH + \mathbf{4}\,MnO_4^- + 12H^+ \rightarrow \mathbf{5}CH_3COOH + \mathbf{4}\,Mn^{2+} + \mathbf{11}\,H_2O$<br><br>*2 marks* |

[5 marks]

2. Classify each of the substances in the table below as one of the following:

| | |
|---|---|
| aldehyde | ester |
| alkane | haloalkane |
| alkene | ketone |
| alkyne | primary alcohol |
| amine | secondary alcohol |
| carboxylic acid | tertiary alcohol |

| Compound | Class | Compound | Class |
|---|---|---|---|
| $CH_3CH_2CHFCHFCH_3$ | **haloalkane** | $CH_3CHCHCH_3$ | **alkene** |
| $CH_3CH_2COOH$ | **carboxylic acid** | $CH_3COCH_3$ | **ketone** |
| $CH_3COOCH_2CH_3$ | **ester** | $CH_3CHNH_2CH_3$ | **amine** |
| $CH_3CH_2CH_2CHO$ | **aldehyde** | $CH_3C(CH_3)OHCH_3$ | **tertiary alcohol** |

[4 marks]

3. Draw structural formulae for and name **four** isomers of formula $C_4H_8O_2$

(8 marks)

**propyl methanoate**

**methyl ethyl methanoate**

**ethyl ethanoate**

**methyl propanoate**

4. An amine may be regarded as a relative of ammonia. Methanamine is a liquid with a low boiling point and has a smell like stale biscuits.

When methanamine is shaken with hydrochloric acid the smell disappears. What has happened ?

**$CH_3NH_2 + H^+ \rightarrow CH_3NH_3^+$** *1 mark*

**The amine molecule accepts a proton from the acid and is neutralised** *1 mark*

When a little sodium hydroxide is added to the resulting mixture the smell returns. Why is this ?

**$CH_3NH_3^+ + OH^- \rightarrow CH_3NH_2 + H_2O$** *1 mark*

**The hydroxide ion accepts the proton and the amine is regenerated.** *1 mark*

(4 marks)

5. The table below lists some organic compounds and identifies one of the reactants needed to prepare it. Complete the table by inserting the names of suitable reagents.

| reagent 1 + | reagent 2 → | product |
|---|---|---|
| **Oxalic acid** | ethanoic (acetic) acid | ethanol |
| **butanol** | methanoic acid | 1-butyl methanoate |
| **Hydrogen fluoride** | ethyne | 1,1-difluoroethane |

(3 marks)

**Calculation**

Two different compounds, A and B, are shown on analysis to consist of 40.0% carbon, 6.70% hydrogen and 53.3% oxygen by mass.

Tests show the following:

Compound A can be vaporised so that 4.88g of it occupy 5.00L at 100 kPa and 97$^{o}$C.

Compound A can be oxidised with acidified potassium permanganate solution to yield a substance that reacts with magnesium ribbon.

Compound B has a molar mass of 60.0 gmol$^{-1}$ and reacts with 1-propanol in the presence of concentrated sulfuric acid to form a fruity smelling liquid.

(a) Determine the empirical formula of compounds A and B.

(4 marks)

(b) Determine the molar mass of compound A and state what class of compound it is.

(4 marks)

(c) Draw a structure for a molecule of compound B and name the compound.

(2 marks)

(d) Name the substance formed by the reaction of compound B with 1-propanol.

(1 mark)

(11 marks)

(a)

| C | H | O |
|---|---|---|
| % = 40.0 | 6.70 | 53.3 |
| n = 40/12.01 = 3.33 | 6.70/1.008 = 6.65 | 53.3/16 = 3.33 |
| Ratio 1 | 2 | 1 |

Empirical formula is $CH_2O$

(b) PV = nRT n = 0.1625 mol *1 mark*

Mr = m/n = 4.88/0.1625 = 30 *1 mark*

Mr / EF m = 1 true formula is $CH_2O$ *1 mark*

an aldehyde. *1 mark*

(c) Compound B has the empirical formula $CH_2O$

Mr / EF m = 2 *1 mark*

The formula is $C_2H_4O_2$

acetic acid structure *1 mark*

(d) propyl ethanoate *1 mark*