Chemistry Test 6: Organic Chemistry 2010

Student Name: —— ANSWERS —— Class Code: _____

Lecturers Name: Adelfo / Grant / John / Ken / Owen / Steve
(Please circle your lecturer's name)

Mark your answer with a cross (X) through the correct letter.

Part 1   Multiple Choice (15 marks)

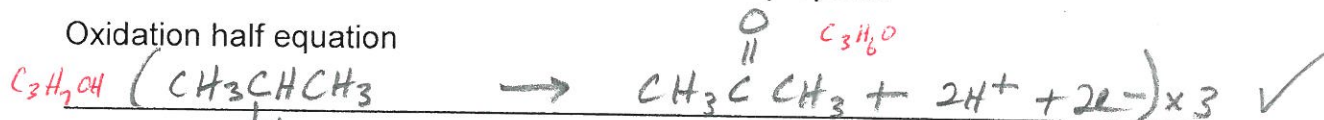|										
1	(a)	(b)	(c)	(d)✗		**9**	(a)	(b)✗	(c)	(d)
2	(a)	(b)	(c)✗	(d)		**10**	(a)	(b)	(c)✗	(d)
3	(a)	(b)	(c)✗	(d)		**11**	(a)	(b)	(c)✗	(d)
4	(a)	(b)✗	(c)	(d)		**12**	(a)✗	(b)	(c)	(d)
5	(a)✗	(b)	(c)	(d)		**13**	(a)	(b)	(c)✗	(d)
6	(a)	(b)	(c)✗	(d)		**14**	(a)	(b)✗	(c)	(d)
7	(a)	(b)	(c)	(d)✗		**15**	(a)	(b)	(c)	(d)✗
8	(a)	(b)	(c)	(d)✗						

Part 2: Short answer questions (35 marks)

Answer questions on this sheet in the spaces provided.

1.   Write balanced equations for the reactions which occur in the following experiments. Use ionic equations where appropriate. In each case give all observations.

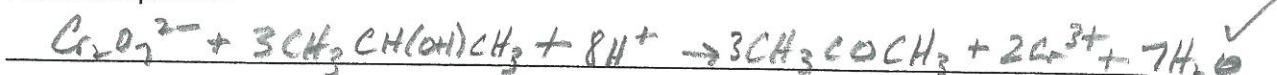a) Acidified potassium dichromate is added to 2−propanol

Oxidation half equation

C_3H_7OH $\left(CH_3CHCH_3 \underset{OH}{} \longrightarrow CH_3CCH_3 \overset{O}{\underset{\|}{}} + 2H^+ + 2e^- \right) \times 3$ C_3H_6O ✓

Reduction half equation

$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$ ✓

Redox equation

$Cr_2O_7^{2-} + 3CH_3CH(OH)CH_3 + 8H^+ \rightarrow 3CH_3COCH_3 + 2Cr^{3+} + 7H_2O$ ✓

Observation

orange solution added to a colourless liquid fades and a green solution is formed.   ✓

(4 marks)

b) Ethane gas and excess bromine water is mixed in a sealed container and the mixture exposed to ultraviolet light until the reaction is complete.

Equation

$CH_3CH_3 + 6Br_2 \longrightarrow CBr_3CBr_3 + 6HBr$ ✓

Observation

orange/brown solution fades when added to a colourless gas ✓

(2 marks)

c) Explain how you could distinguish between cyclohexane and cyclohexene. Write the observation and the equation that would distinguish between them.

Observation

add orange brown Br_2 water to both, the cyclohexene causes the colour to fade to a colourless liquid ✓ cyclohexane has no effect on the orange solution
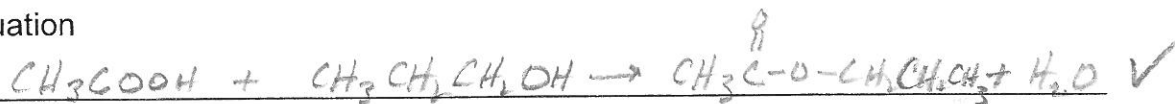
Equation

$C_6H_{10} + Br_2 \longrightarrow C_6H_{10}Br_2$ ✓
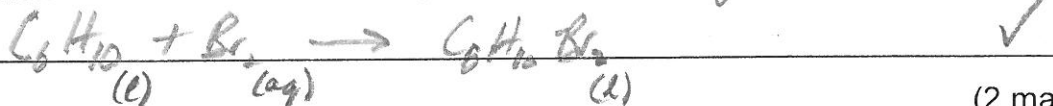
(ℓ)   (aq)   (ℓ)
(2 marks)

d) Ethanoic acid, 1-propanol and sulphuric acid are gently heated

Equation

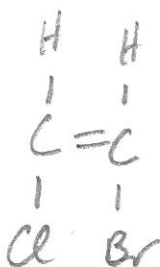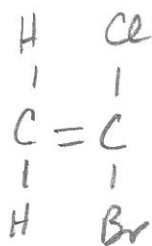$CH_3COOH + CH_3CH_2CH_2OH \longrightarrow CH_3\overset{O}{\overset{\|}{C}}-O-CH_2CH_2CH_3 + H_2O$ ✓

Observation

two colourless solutions are added, a vinegar smell disappears and sweet fragrance is produced as the liquids are gently heated ✓

(2 marks)

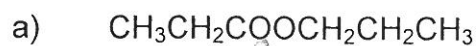2.   Draw the structural formulas for all the isomers of the molecular formula C_2H_2ClBr

H   Cl   H   H   H   Br
| | | | | |
C = C   C = C   C = C
| | | | | |
H   Br   Cl Br   Cl H

(3) ✓✓
(2) ✓
(1) ½

(2 marks)

3. Give the IUPAC name for the substances having the following condensed structural formulas.

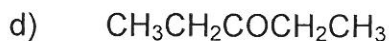   a) $CH_3CH_2COOCH_2CH_2CH_3$

        $CH_3CH_2\overset{O}{\overset{\|}{C}}-OCH_2CH_2CH_3$

        propyl propanoate ✓

    b) $CH_3CH_2CH_2NH_2$

        1-propanamine ✓

    c) $CH_3CH_2CH_2CH_2CH_2COOH$

        hexanoic acid ✓

    d) $CH_3CH_2COCH_2CH_3$

        3-pentanone ✓

    e) CH_3CHO

        ethanal ✓

    f) $CH_3CH_2CH(OH)CH_2CH_3$

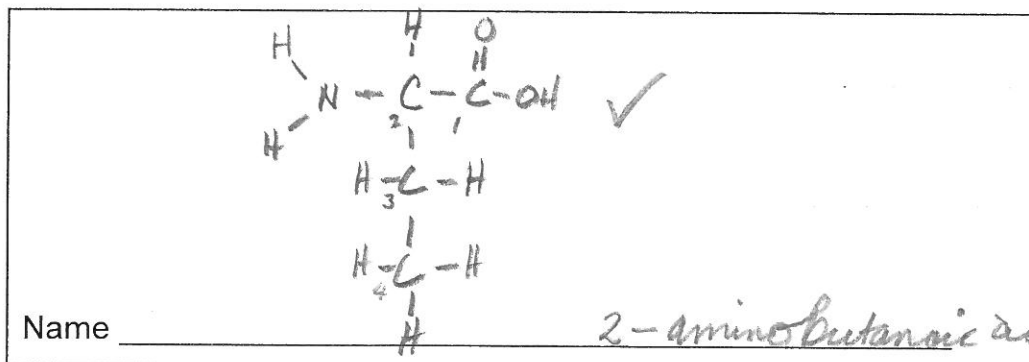   _3-pentanol_ ✓

                                                            (6 marks)
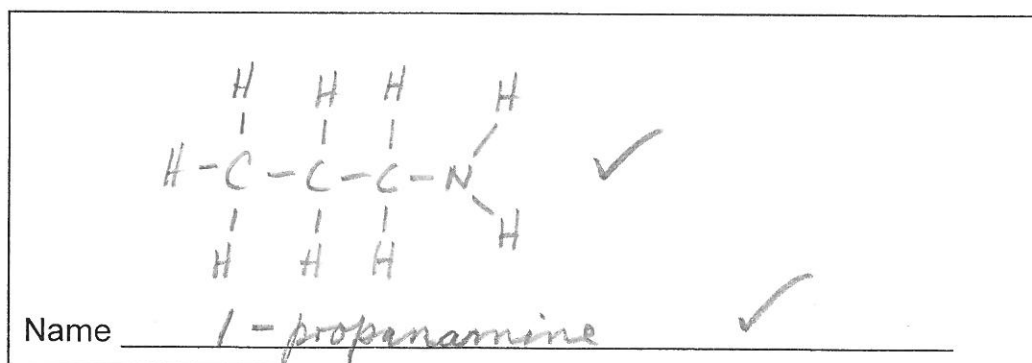
4. Draw the structural formulas (showing all hydrogen atoms) and give the IUPAC names for the following:

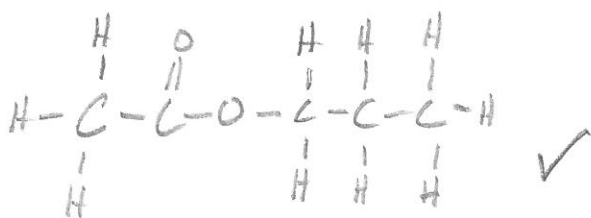   a) an α-amino acid containing four carbon atoms per molecule

        Name _____ 2-aminobutanoic acid ✓

    b) a primary amine containing 9 hydrogen atoms

        Name ____1-propanamine____ ✓

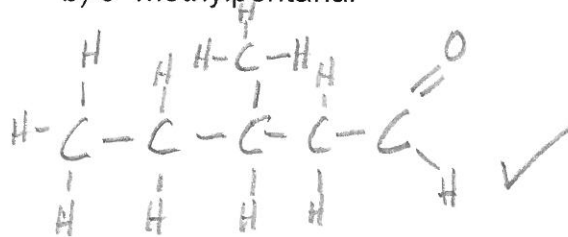   (4 marks)

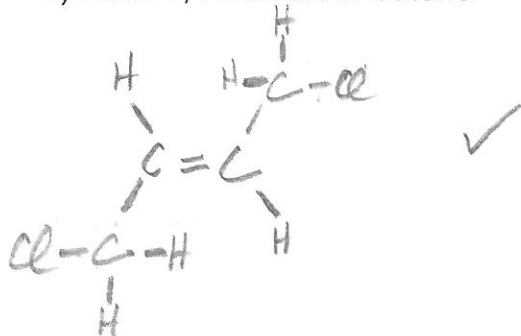5.   Draw structural formula for the following compounds.
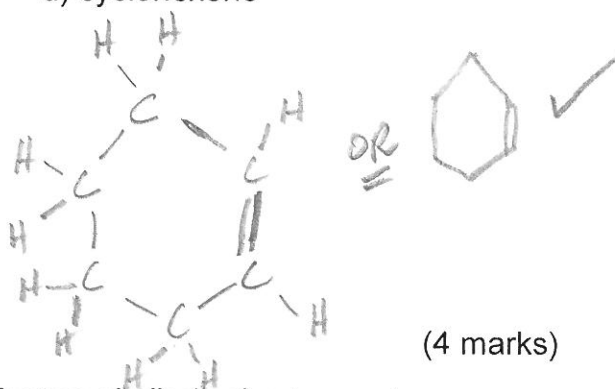
a) propyl ethanoate

b) 3—methylpentanal

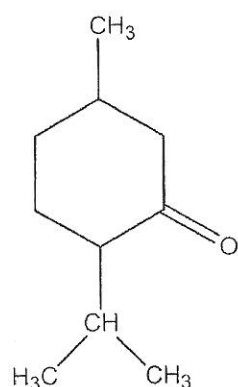c) trans-1,4-dichloro-2-butene

d) cyclohexene

(4 marks)

6. The structures and melting points are provided for two similarly sized organic substances. Explain the difference in their melting points.


Menthone
-6°C
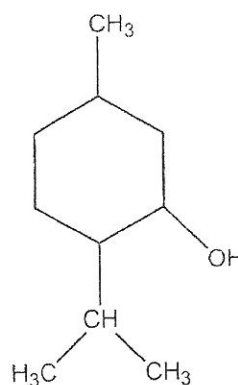
Menthol
35°C

Menthone has dipole-dipole forces whilst Menthol has H-bonding which is a stronger intermolecular force, therefore more energy is required to break the intermolecular force in Menthol, this result in a higher MP. Both have the same sized dispersion forces

(2 marks)

7. Below are the structural formulas of two monomers that can be used to produce polymers.
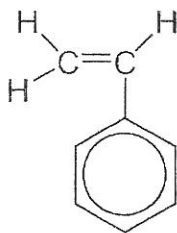
Monomer 1
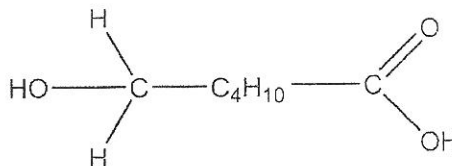
Monomer 2

a) Which one of the two monomers can be used to produce an addition polymer?

Answer: _MONOMER 1_ ✓ (1 mark)

b) Draw a diagram of the addition polymer that would result from your choice. You must show at least two repeating units in the box below.

(1 mark)

8. Calculation

All working should be shown for the calculations. Marks are awarded for working and setting out as well as final answers.
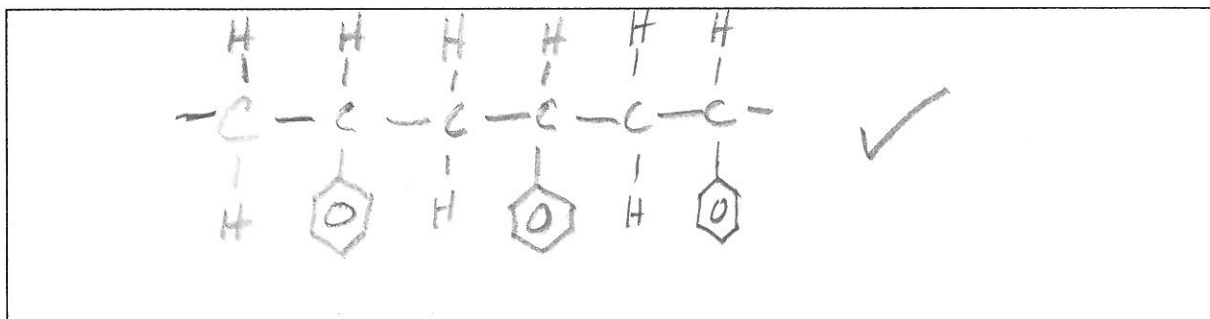
An organic compound containing only carbon, hydrogen and oxygen is analysed by combusting a 3.605 g sample in excess oxygen. All the carbon in the compound is converted to carbon dioxide, and all the hydrogen it contains is converted to water.

(a) Given that the mass of carbon dioxide produced is 8.802 g and the mass of water is 3.603 g, calculate the empirical formula of the compound.

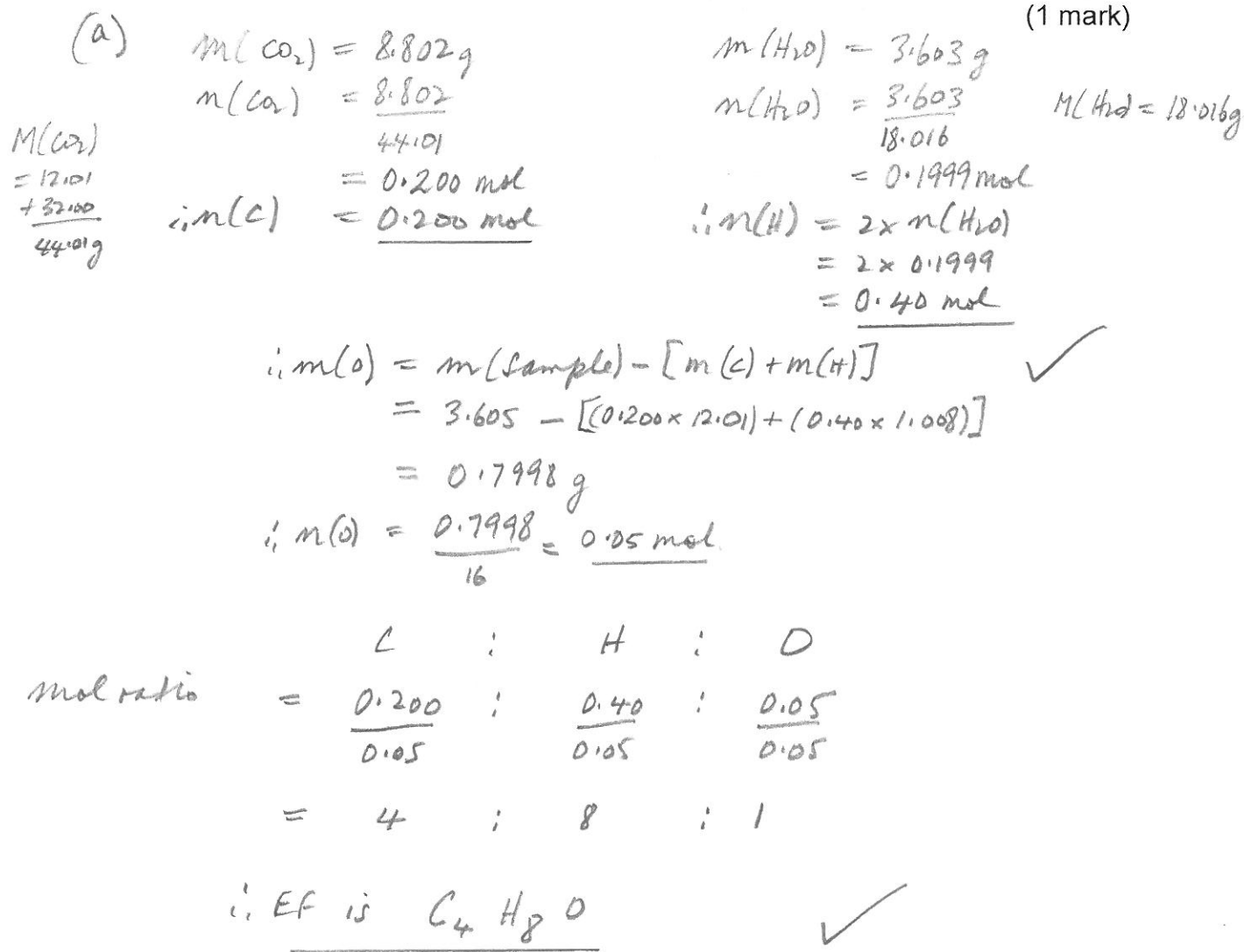(2 marks)

(b) When a 1.234 g sample of the compound is vaporised in the absence of air, the vapour occupies 441.8 mL at 22.0°C and 95.0 kPa. From this data, calculate the molecular formula of the compound.

(2 marks)

(c) Further analysis shows the compound is an aldehyde. From this information, draw the structural formula of the compound and then give the molecule a systematic name.

(1 mark)

(a) $m(CO_2) = 8.802 g$ $m(H_2O) = 3.603 g$
     $n(CO_2) = \dfrac{8.802}{44.01}$ $n(H_2O) = \dfrac{3.603}{18.016}$ $M(H_2O) = 18.016 g$

$M(CO_2)$
$= 12.01$ $= 0.200 mol$ $= 0.1999 mol$
$+ 32.00$ $\therefore n(C) = 0.200 mol$ $\therefore n(H) = 2 \times n(H_2O)$
$\overline{44.01 g}$ $= 2 \times 0.1999$
                                                                               $= 0.40 mol$

$\therefore m(O) = m(sample) - [m(C) + m(H)]$ ✓

$= 3.605 - [(0.200 \times 12.01) + (0.40 \times 1.008)]$

$= 0.7998 g$

$\therefore n(O) = \dfrac{0.7998}{16} = 0.05 mol$

	C	:	H	:	O

mol ratio $= \dfrac{0.200}{0.05} : \dfrac{0.40}{0.05} : \dfrac{0.05}{0.05}$

$= 4 : 8 : 1$

$\therefore EF$ is C_4H_8O ✓

(b)

$$PV = nRT$$

$$PV = \frac{m}{M}RT$$

$$M = \frac{mRT}{PV}$$

$T = 22°$
$= 22 + 273$
$= 295K$

$V = 441.8$
$= 0.4418 L$

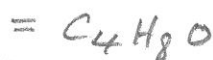$$= \frac{1.234 \times 8.315 \times 295}{95 \times 0.4418}$$

$$= 72.119$$

$$\underline{M = 72.12 \text{ g mol}^{-1}}$$

$$\frac{MF}{EF} = \frac{M}{EFW}$$

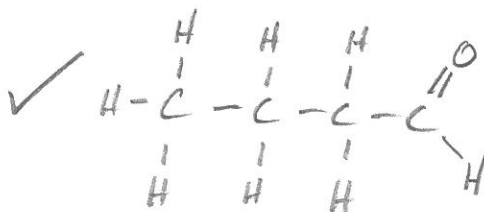$$= \frac{72.12}{72.1}$$

$$= 1$$

$\therefore MF = EF$

$$= C_4H_8O$$

$EFW(C_4H_8O) = $
$\begin{array}{l} 4 \times 12.01 \\ 8 \times 1.008 \\ 1 \times 16 \\ \hline 72.1 \end{array}$

(c)

$$H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\displaystyle O}{\underset{\displaystyle H}{C}}$$ (butanal)

END OF TEST Total 50 marks