Sample assessment task

Chemistry – ATAR Year 11

Task 8 – Unit 1

Assessment type: Test

Conditions
Time for the task: 50 minutes

Task weighting
2% of the school mark for this pair of units

_____

ORGANIC CHEMISTRY TEST

Structure of the test:

Section	Suggested working time	Number of questions	Marks
ONE Multiple-choice	10 minutes	10	10
TWO Written answers	40 minutes	7	30

DO NOT OPEN THE TEST UNTIL INSTRUCTED TO DO SO

Section 1: Multiple-choice questions   **10 Marks**

1.   Which one of the following is **not** a reason for carbon to be able to form large numbers of compounds?

    (a)   The ability of carbon atoms to form four covalent bonds.
    (b)   The ability of carbon atoms to bond to each other in covalent network structures.
    (c)   The ability of carbon atoms to form multiple (double and triple) covalent bonds.
    (d)   The ability of carbon atoms to bond with each other to form long stable chains.

2.   A hydrocarbon with the formula C_6H_{12} could be what type of compound?

    (a)   a straight chain alkane
    (b)   a branched chain alkane
    (c)   an alkene
    (d)   an aromatic hydrocarbon

3.   Which one of the following molecules contains a double bond?

    (a) $(CH_3)_2CHCH_3$
    (b) $(CH_3)_3CCH_2CH_3$
    (c) $CH_3CH_2C(CH_3)_2CH_3$
    (d) $(CH_3)_2CCHCH_3$

4.   Which one of the following hydrocarbons is unsaturated?

    (a) CH_4
    (b) C_7H_{16}
    (c) C_4H_{10}
    (d) C_3H_6

5.   Which one of the following sets of formulae contains only **one** saturated hydrocarbon?

    (a) C_2H_6, C_3H_6, C_4H_8
    (b) C_3H_6, C_4H_8, C_6H_{12}
    (c) C_2H_6, C_3H_6, C_8H_{18}
    (d) CH_4, C_2H_6, C_6H_{14}

6.   Which one of the following statements about the benzene molecule is **false**?

    (a)   Benzene has the molecular formula C_6H_6.
    (b)   Benzene has a planar (flat) structure with all bond angles 120°.
    (c)   Benzene will react with Br_2 in an addition reaction similar to addition of Br_2 to alkenes.
    (d)   The pi (double bond) electrons in benzene are delocalised.

7. Which one of the following is the correct equation for the complete combustion of butane?

(a) $2\ C_4H_{10}\ +\ 13\ O_2\ \rightarrow\ 8\ CO_2\ +\ 10\ H_2O$
(b) $2\ C_4H_{10}\ +\ 10\ O_2\ \rightarrow\ 8\ CO\ +\ 10\ H_2O$
(c) $C_4H_8\ +\ 6\ O_2\ \rightarrow\ 4\ CO_2\ +\ 4\ H_2O$
(d) $C_4H_8\ +\ 4\ O_2\ \rightarrow\ 4\ CO\ +\ 4\ H_2O$

8. Which one of the following compounds readily undergoes addition reactions?

(a) ethane (C_2H_6)
(b) ethene (C_2H_4)
(c) methylbenzene (C_7H_8)
(d) chloromethane $(CH_3C\ell)$

9. When pent-2-ene is reacted with chlorine water, the most likely product is

(a) 2,2-dichloropentane.
(b) 2,3-dichloropentene.
(c) 2,3-dichloropentane.
(d) 1,2-dichloropentane.

Consider the reaction of benzene shown below to answer question 10.
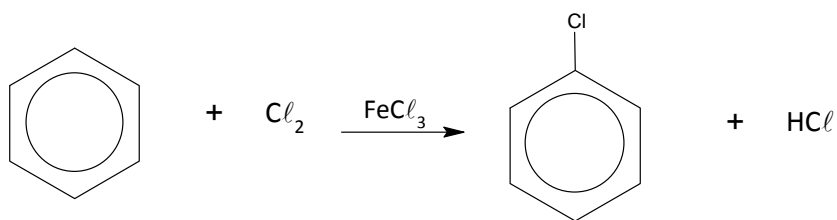
10. This type of reaction is known as
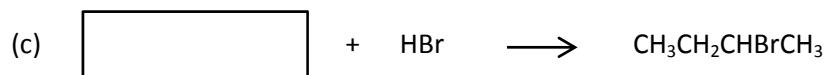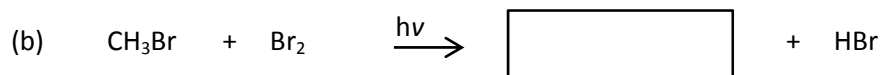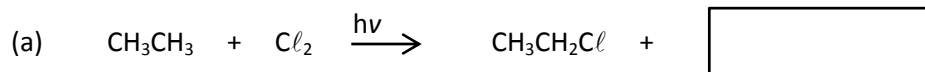
(a) combustion.
(b) redox.
(c) addition.
(d) substitution.

Section 2: Written answers   **30 Marks**

1.   Complete the following table by writing the IUPAC name of the compound or drawing the structure as appropriate. Show **all** hydrogen atoms for structures you draw.   (4 marks)

IUPAC Name	Structure
(1 mark)	H_3C——CH_2–CH—CH_2–CH_3 with CH_3 branch on CH
3-chloro-2-methylhexane	(1 mark)
(1 mark)	H_3C——CH_2—CH=C——CH_3 with H_3C branch on C
2,3-dimethyloct-4-ene	(1 mark)

2. Complete the following reaction equations by writing the formula for the missing molecule in the space provided. (3 marks)

(a) CH_3CH_3 + $C\ell_2$ $\xrightarrow{h\nu}$ $CH_3CH_2C\ell$ + [ ]

(b) CH_3Br + Br_2 $\xrightarrow{h\nu}$ [ ] + HBr

(c) [ ] + HBr $\longrightarrow$ $CH_3CH_2CHBrCH_3$

3. Write balanced chemical equations for the following reactions. Structural formulae can be used to write the equations. (6 marks)

(a) Butane reacts with chlorine gas in the presence of ultraviolet (UV) light.

(b) Octane burns in a plentiful supply of oxygen.

(c) Pent-2-ene reacts with bromine gas.

4. It is possible for straight chain and branched alkanes with the molecular formula C_5H_{12} to exist. Draw and name the structural formulae of the 3 possible alkanes with this molecular formula. Show **all** hydrogen atoms in your structures. (6 marks)

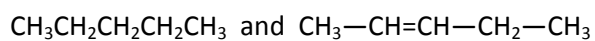(a)

name: _____

(b)

name: _____

(c)

name: _____

5. For the following pair of compounds describe a chemical test that could be used to distinguish between them. Include the distinguishing observation in your answer. (4 marks)

$CH_3CH_2CH_2CH_2CH_3$ and $CH_3—CH=CH—CH_2—CH_3$

Test:

Distinguishing observation:

6.   The structure of benzene is represented by two 6-membered rings with double bonds shown in alternate positions and a double headed arrow between the two 6-membered rings (**1**) or by a single 6-membered ring with a circle in the centre (**2**).

OR

1   **2**
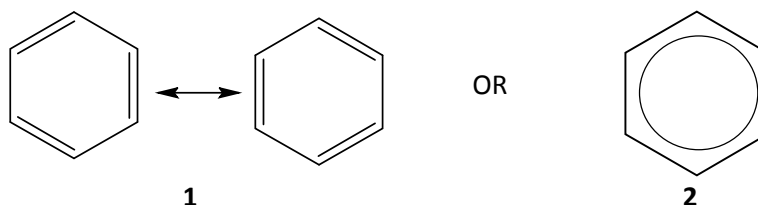
Explain why benzene is represented by structure **1** or **2** rather than a single 6-membered ring with three single bonds and three double bonds.   (3 marks)

7.   Propane gas is used in gas cylinders for barbeques. The equation for combustion of propane is shown below with its enthalpy change.

$$C_3H_8(g) \; + \; 5\,O_2(g) \; \longrightarrow \; 3\,CO_2(g) \; + \; 4\,H_2O(g) \; + \; 2202 \text{ kJ}$$
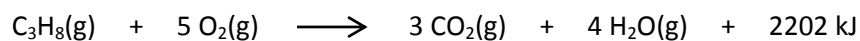
If a gas cylinder contains 45.0 kg of propane, how much energy (in kilojoules) can be produced by the combustion of the gas?   (4 marks)

Marking key for sample assessment task 8 – Unit 1

Section 1: Multiple-choice   **10 marks**

Question	Correct response
1	b
2	c
3	d
4	d
5	a
6	c
7	a
8	b
9	c
10	d

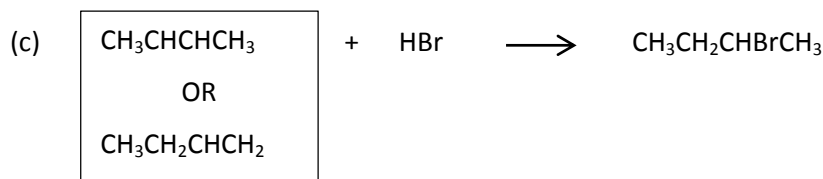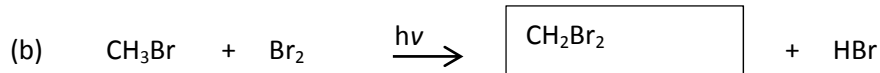**Section 2: Written answers**   **30 marks**

1.   Complete the following table by writing the IUPAC name of the compound or drawing the structure as appropriate. Show **all** hydrogen atoms for structures you draw.   (4 marks)

| IUPAC Name	Structure
3-methylpentane (1 mark)	$H_3C - CH_2 - CH(CH_3) - CH_2 - CH_3$
3-chloro-2-methylhexane	$H_3C - CH(CH_3) - CH(Cl) - CH_2 - CH_2 - CH_3$ (1 mark)
2-methylpent-2-ene (accept 2-methyl-2-pentene) (1 mark)	$H_3C - CH_2 - CH = C(CH_3) - CH_3$
2,3-dimethyloct-4-ene	$H_3C - CH(CH_3) - CH(CH_3) - CH = CH - CH_2 - CH_2 - CH_3$ (1 mark)

2. Complete the following reaction equations by writing the formula for the missing molecule in the space provided. (3 marks)

(a) CH_3CH_3 + $C\ell_2$ $\xrightarrow{h\nu}$ $CH_3CH_2C\ell$ + $\boxed{HC\ell}$

(b) CH_3Br + Br_2 $\xrightarrow{h\nu}$ $\boxed{CH_2Br_2}$ + HBr

(c) $\boxed{\begin{array}{c} CH_3CHCHCH_3 \\ OR \\ CH_3CH_2CHCH_2 \end{array}}$ + HBr $\longrightarrow$ $CH_3CH_2CHBrCH_3$

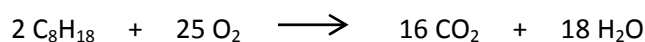| Description	Marks
1 mark for each correct molecule	3

3. Write balanced chemical equations for the following reactions. Structural formulae can be used to write the equations. (6 marks)

(a) Butane reacts with chlorine gas in the presence of ultraviolet (UV) light.

$CH_3CH_2CH_2CH_3$ + $C\ell_2$ $\xrightarrow{h\nu}$ $CH_3CH_2CH_2CH_2C\ell$ + $HC\ell$
Accept any chlorobutane
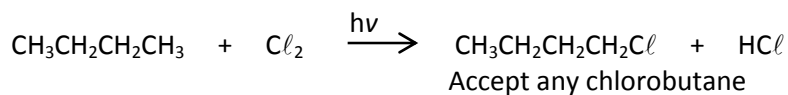
Description	Marks
1 mark for correct formulae for reactants	1
1 mark for correct formulae for product(s)	1

(b) Octane burns in a plentiful supply of oxygen.

$2\ C_8H_{18}$ + $25\ O_2$ $\longrightarrow$ $16\ CO_2$ + $18\ H_2O$

Description	Marks
1 mark for correct formulae for reactants and products	1
1 mark for balancing	1

(c) Pent-2-ene reacts with bromine gas.

$CH_3CHCHCH_2CH_3$ + Br_2 $\longrightarrow$ $CH_3CHBrCHBrCH_2CH_3$
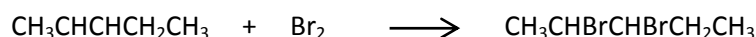
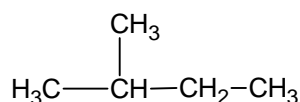| Description	Marks
1 mark for correct formulae for reactants	1
1 mark for correct formula for product	1

4. It is possible for straight chain and branched alkanes with the molecular formula C_5H_{12} to exist. Draw and name the structural formulae of 3 possible alkanes with this molecular formula. Show **all** hydrogen atoms in your structures. (6 marks)
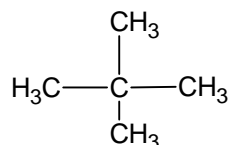
(a)

$$H_3C\text{---}CH_2\text{--}CH_2\text{--}CH_2\text{---}CH_3$$

name: pentane

(b)

$$H_3C\text{---}CH(CH_3)\text{--}CH_2\text{--}CH_3$$
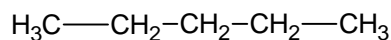
name: methylbutane (accept 2-methylbutane)

(c)

$$H_3C\text{---}C(CH_3)(CH_3)\text{---}CH_3$$

name: 2,2-dimethylpropane

Description	Marks
1 mark for each correct structure	3
1 mark for each IUPAC name	3

5. For the following pair of compounds describe a chemical test that could be used to distinguish between them. Include the distinguishing observation in your answer. (4 marks)

$CH_3CH_2CH_2CH_2CH_3$ and $CH_3\text{---}CH=CH\text{---}CH_2\text{---}CH_3$

Test:
Shake each hydrocarbon with about 10 drops of bromine water in the absence of UV light (or in dark). Quantity of bromine water used should not be in excess. (excess Br_2 water will mean orange colour will remain even if reaction occurs)

Distinguishing observation:

The bromine water will decolourise rapidly when shaken with the alkene.
The bromine water will not decolourise (or very slowly decolourise) with the alkane.

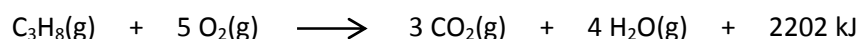| Description	Marks
Recognition that hydrocarbons are shaken with bromine water (recognition of quantity not needed to get mark)	1
Recognition that reaction is done in absence of UV light	1
Recognition that alkene decolourises bromine water	1
Recognition that alkane does not decolourise bromine water	1

6. The structure of benzene is represented by two 6-membered rings with double bonds shown in alternate positions and a double headed arrow between the two 6-membered rings (**1**) or by a single 6-membered ring with a circle in the centre (**2**).

OR

1   **2**
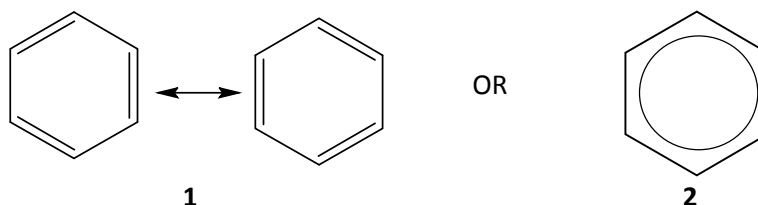
Explain why benzene is represented by structure **1** or **2** rather than a 6-membered ring with three single bonds and three double bonds.   (3 marks)

Description	Marks
Recognition that benzene does not have 3 single bonds and 3 double bonds	1
Recognition that the C to C bonds are all the same with same bond length intermediate of the typical C to C single bond and C to C double bond	1
Recognition that benzene has 6 delocalized electrons	1

7. Propane gas is used in gas cylinders for barbeques. The equation for combustion of propane is shown below with its enthalpy change.

$$C_3H_8(g) \quad + \quad 5\ O_2(g) \quad \longrightarrow \quad 3\ CO_2(g) \quad + \quad 4\ H_2O(g) \quad + \quad 2202\ kJ$$

If a gas cylinder contains 45.0 kg of propane, how much energy (in kilojoules) can be produced by the combustion of the gas?   (4 marks)

Description	Marks
$M(C_3H_8) = 44.094$ g mol^{-1}	1
$m(C_3H_8) = 45.0$ kg $= 45000$ g	1
$n(C_3H_8) = \dfrac{45000}{44.094} = 1.0205 \times 10^3$ mol	1
Energy $= 2202 \times 1.0205 \times 10^3 = 2.25 \times 10^6$ kJ	1