JOHN XXIII
SEEK JUSTICE

Test 6   2015
Organic Chemistry
Question/Answer Booklet

CHEMISTRY
ATAR Unit 1 and 2

Student Name:	Feedback
Teacher	

Avg   61%

High   88%

Section	Mark
One	/8
Two	/42
Total	/50
	%

Time allowed for this paper
Working time for paper: 50 minutes

Material required/recommended for this paper

To be provided by the supervisor
This Question/Answer booklet
Multiple-choice Answer sheet
Chemistry Data sheet

To be provided by the candidate
Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: non-programmable calculators approved for use in the WACE examinations

Important note to candidates
No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Section One: Multiple-choice   (8 marks)
This section has **8** questions. Answer **all** questions on the grid below

Each question has only one correct answer. Select your answer by placing a cross in the box on the answering grid below. Attempt all questions.

Please mark the correct answer with an 'x' on the answer grid below.

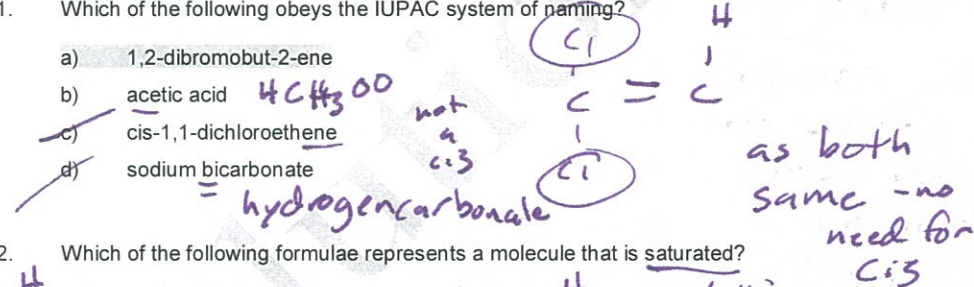| Question				
1	(A)	B	C	D
2	A	B	(C)	D
3	A	B	(C)	D
4	A	B	C	(D)
5	(A)	B	C	D
6	(A)		C	D
7		(B)	C	D
8	A	(B)		D

A
C
C
D
A
A
B
B

1. Which of the following obeys the IUPAC system of naming?

   a) 1,2-dibromobut-2-ene

   b) acetic acid HCH_3OO not a cis
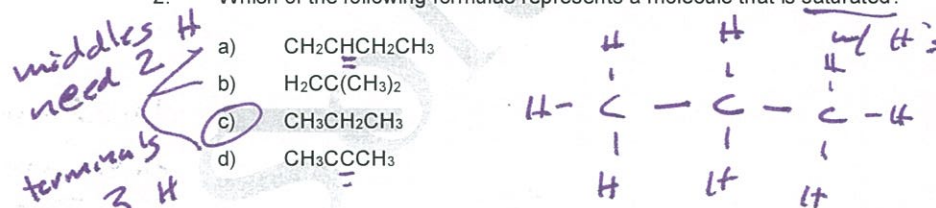
   c) cis-1,1-dichloroethene

   d) sodium bicarbonate = hydrogen carbonate

   (C) $C = C$ as both same — no need for cis

2. Which of the following formulae represents a molecule that is saturated?

   middles need 2 H

   terminals 3 H

   a) $CH_2CHCH_2CH_3$

   b) $H_2CC(CH_3)_2$

   c) $CH_3CH_2CH_3$

   d) CH_3CCCH_3

   w/ H's $H-C-C-C-H$

3. Which of the following is the correct equation for the complete combustion of Hex-1-ene? C_nH_{2n}

   a) $C_6H_{10} + 12O_2 \rightarrow 7CO_2 + 10H_2O$

   b) $C_6H_{12} + 12O_2 \rightarrow 6CO_2 + 6H_2O$

   c) $C_6H_{12} + 9O_2 \rightarrow 6CO_2 + 6H_2O$ balanced

   d) $C_6H_{12} + 3O_2 \rightarrow 6C + 6H_2O$

   $C-C-C-C-C-C$

4. Which of the following has the highest boiling point?

   a) C_5H_{12}
   b) C_6H_{14}
   c) C_7H_{16}
   d) C_8H_{18} *(circled)*

   inc
   #C atoms ↓

   inc
   bp ↓

5. When an aqueous solution of iodine is added to cyclohexane in the presence of ultraviolet light which one of the following is observed?

   a) The brown solution fades. *(circled)*
   b) A purple solid appears.
   c) A yellow precipitate is formed.
   d) A colourless gas is evolved.

   I_2

   I_2 (aq) is brown as sub rxn, it's color fades

   I_2 (organic) is a purple sohn

6. A commonly-used test in organic chemistry is to shake a sample of a 8. Which one of the following sets of formulae contains only **one** saturated hydrocarbon?

   (a) C_2H_6, C_3H_6, C_4H_8 *(circled)*
   (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}

   C_nH_{2n+2} → all single bonds

   Sat. = ✓

7. A commonly-used test in organic chemistry is to shake a sample of a compound with bromine water and observe the colour change, if any, of the bromine water. Which one of the following compounds would cause the colour of bromine water to fade in such a test?

   a) benzene — "1⅓" bonds
   b) ethene *(circled)* — alkene decolorizes
   c) ethane — single, saturated - sub rxn needs UV + time
   d) cyclopentane

8. 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. *(circled)*
   (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.
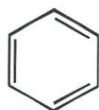
   This is true but the others allow for all organic molecules (a lot more)
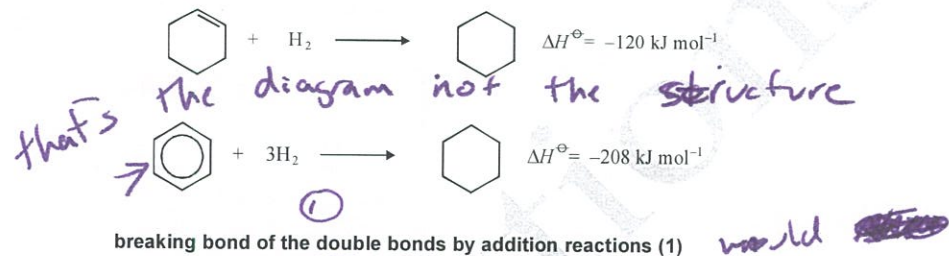
   END OF SECTION ONE

Question 2 (11 marks)

The following questions are on benzene:

The chemist Kekule in the 19th century suggested the following structure for benzene:

a. Use the following data to explain what is wrong with the Kekule model and describe the generally accepted structure of benzene. (4 marks)

$\Delta H^{\ominus} = -120 \text{ kJ mol}^{-1}$

$\Delta H^{\ominus} = -208 \text{ kJ mol}^{-1}$

that's the diagram not the structure ①

breaking bond of the double bonds by addition reactions (1) ~~would~~

release -120 kJ, therefore three bonds would release 360 kJ not 208 kJ (1)

covalent bonding: each C atom single bonded to 2 others and 1 hydrogen (1)

#6

~~four~~ **electrons delocalized between two resonance structures (1)**

b. Using the differences in structure between Benzene and the alkenes, explain why the reactions of benzene are different from the reactions of alkenes. (4 marks)

benzene – saturated – no double bonds (1)

alkenes – unsaturated -double bonds (1)

in alkenes double bond broken, add to C atoms either side (1)

in benzene – only sub rxns (1)

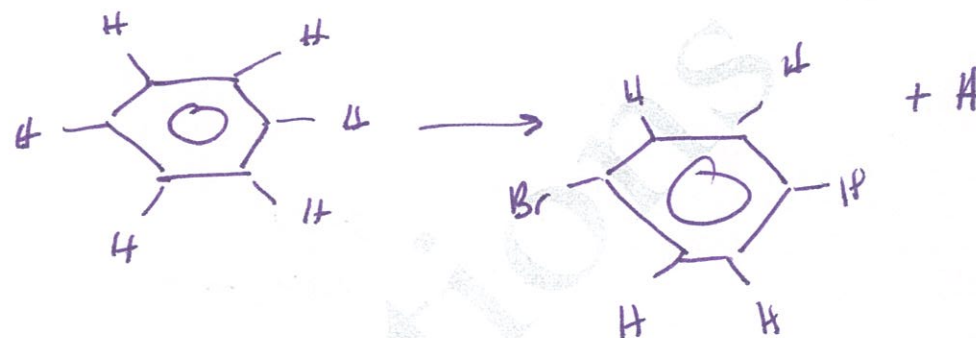*Not reactivity per se*

Explain: cause and effect

c. Write an overall equation with structural diagrams for the conversion of benzene into bromobenzene and state the conditions typically required in this conversion to occur. (3 marks)

$C_6H_6 + Br_2 \rightarrow \quad C_6H_5Br + HBr$

Correct reactants and products (1)

Correct conditions (UV and/or heat) (1)

Structural diagrams (1)

no ½ marks

no H's accepted

Section 2: Extended Answers   (42 MARKS)

Question 1   (9 marks)

The molecular formulae of two hydrocarbons M and N are given.
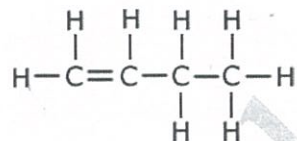
$$M = C_4H_{10}$$

$$N = C_4H_8$$

a. **M** reacts with chlorine to form C_4H_9Cl. Write a balanced chemical equation for the reaction of chlorine with **M**. Be sure to include any conditions or catalysts.   (2 marks)

$C_4H_{10} + Cl_2$ UV light→ $C_4H_9Cl + HCl$
①

Name this type of reaction: substitution   (1 mark)

b.   Draw and name a position isomer of N.   (2 marks)

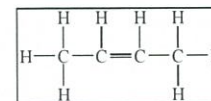H−C=C−C−C−H (with H atoms shown)

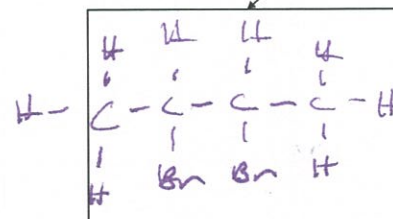Name: _____**but-1-ene**_____

or

2-methyl propene

or

cis but-2-ene

or trans

c. Complete the boxes to show the structural formula and name for each of the products formed in the following addition reactions.   (4 marks)
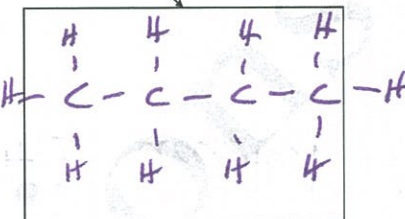
H−C−C=C−C−H (with H atoms shown)

Bromine   Hydrogen

(left box) H−C−C−C−C−H with Br Br substituents

Name:2,3-dichlorobutane → bromo

(right box) H−C−C−C−C−H

Name: butane

1 mark for each name and structure

not cis/ trans

cis but-2-ene

Question 3   (2 marks)

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. (FIRST AND LAST)

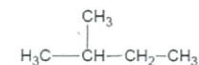| IUPAC Name	Structure
3-methylpentane (1 mark)	CH₃ (with structure $H_3C-CH_2-CH-CH_2-CH_3$)
3-chloro-2-methylhexane	$H_3C-CH-CH-CH_2-CH_2-CH_3$ with CH_3 and Cl branches (1 mark)
2-methylpent-2-ene (accept 2-methyl-2-pentene) (1 mark)	$H_3C-CH_2-CH=C-CH_3$ with H_3C branch
2,3-dimethyloct-4-ene	$H_3C-CH-CH-CH=CH-CH_2-CH_2-CH_3$ with CH₃ and H₃C branches (1 mark)

Question 4   (6 marks)

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.
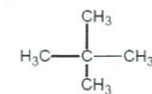
(a)

       $H_3C-CH_2-CH_2-CH_2-CH_3$

       name: pentane

(b)

       CH₃ (structure $H_3C-CH-CH_2-CH_3$)
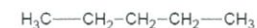
       name: methylbutane (accept 2-methylbutane)

(c)

       CH₃ (structure $H_3C-\underset{CH_3}{\overset{CH_3}{C}}-CH_3$)

       name: 2,2-dimethylpropane

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

(handwritten annotations) will accept if C—C bonds are shown but not 1,3 etc

accept dimethyl propane
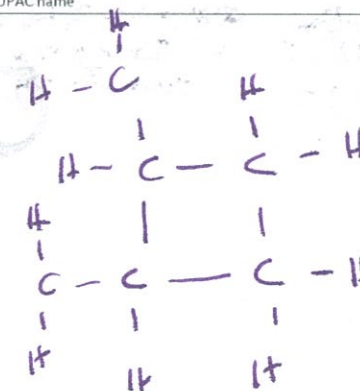
cyclic hydrocarbon will not have same general formula

Question 5 (12 marks)

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

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

a. Sketch an energy diagram to demonstrate this reaction. Label the diagram to show the Energy of Activation and the Enthalpy Change (3marks)
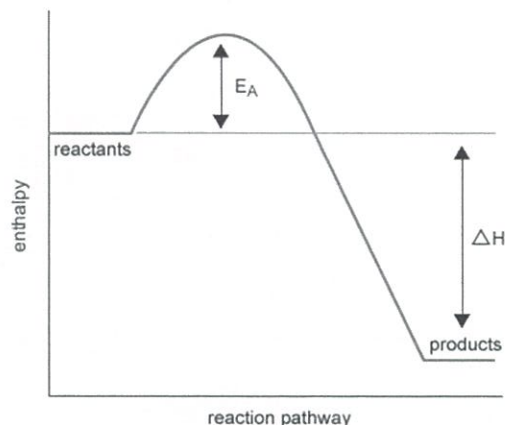
(1) hump and reactants above (1)
(1) Ea and delta H (1 mark)   need both for mark (no ½ marks)

b. In terms of bonds broken and bonds made, explain why this is an exothermic reaction. (2 marks)

Energy needed to break bonds is less than energy released when forming bonds (1)
Therefore net release of energy (1)

or ~~Energy in~~ Bonds formed is greater than when needing to break

c. 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

$n = \dfrac{m}{M}$

should be __3__ s.f

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d. We can use bond energies to calculate the energy change for the reaction between hydrogen and oxygen. (2 marks)

$$2H_2 + O_2 \rightarrow 2H_2O$$

Bond	Bond energy in kJ
H – H	436
O – H	464
O = O	498

i. Calculate the total bond energy of the reactants and products

Reactants = 2(436) + 498   (1)
Products = 2(468 + 464)   (1)

1370

Total bond energy of reactants = ...+ 1370................. kJ (1)

Total bond energy of products = ...- 1856.................. kJ (1)
(need – sign for mark)

* needed to speak of energy of bonds not just #of bonds

END OF TEST