



Science Department

Year 12 Chemistry ATAR

## Test 6: Organic Chemistry

Name: **ANSWER KEY**

### Instructions to Students:

1. 50 minutes permitted
2. Attempt all questions
3. Write in the spaces provided
4. Show all working when required
5. All answers to be in blue or black pen, diagrams in pencil.

TOTAL
/56

Final Percentage

## Organic Chemistry Test

### Section 1 – Multiple Choice

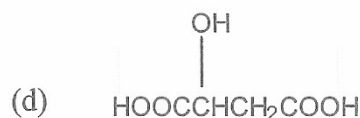
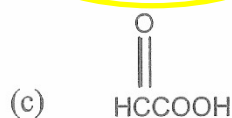
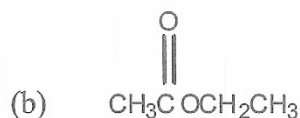
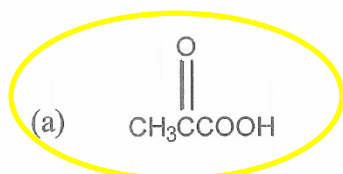
1. Which one of the following substances contains a different number of carbon atoms from all the others?

(a) 3-methylpentane  
(b) ethylbutane  
(c) 2-hexene  
(d) methylcyclohexene

2. Which one of the following lists contains only the formulae of saturated straight chain hydrocarbons?

(a)  $C_2H_6$ ,  $C_5H_{12}$ ,  $C_8H_{18}$   
(b)  $C_2H_6$ ,  $C_4H_{10}$ ,  $C_6H_6$   
(c)  $C_2H_4$ ,  $C_3H_6$ ,  $C_4H_8$   
(d)  $CH_4$ ,  $C_2H_6$ ,  $CH_3COOH$

3. Which formula represents a compound that is both a ketone and a carboxylic acid?



4. Which of the following substances has the LOWEST solubility in water?

a)  $HCOOH$   
b)  $CH_3CH_2OH$   
c)  $CH_3COONa$   
d)  $CH_3CH_2CH_3$

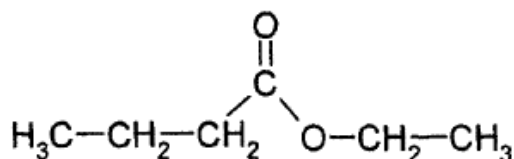
5. The chemical reactions that are TYPICAL of the compounds methane, ethene (ethylene) and benzene are known respectively as:
- a) Substitution, substitution, addition.
  - b) Substitution, addition, substitution.**
  - c) Addition, substitution, substitution.
  - d) Addition, addition, substitution.

6. Which of these compounds are isomeric with butanol ( $C_4H_9OH$ )?

- I. 2-methyl-2-propanol
- II. 2-methyl-1-propanol
- III. 2-methyl-1-butanol

- a) I only
- b) II only
- c) I and II only**
- d) II and III only.

7. The ester present in artificial strawberry flavouring is shown below:



The two compounds which were used to make the ester were

- a) Butanol and ethanoic acid.
  - b) Ethanol and butanoic acid.**
  - c) Hexanol and acidified potassium dichromate.
  - d) Hexanoic acid, hexanol and a suitable catalyst.
8. Which of the following statements concerning the compound with the following structure:



Is FALSE?

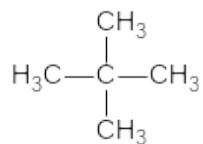
- a) It is an isomer of butanol.
- b) It is a secondary alcohol.
- c) It can be oxidised by dichromate ion, forming a ketone.
- d) It can be converted into an ester by reaction with an aldehyde.**

9. Which of the following is not an isomer of Pentane?

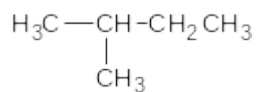
a)



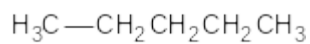
b)



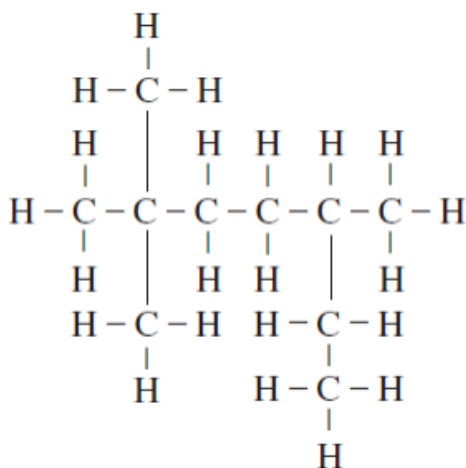
c)



d)



10. The IUPAC name for the structure below is:



a) 2,2,5-trimethylheptane

b) 3,6,6-trimethylheptane

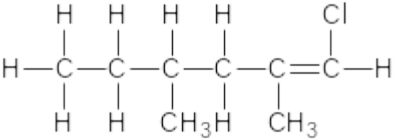
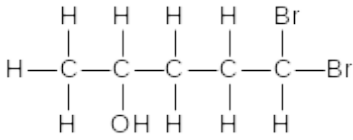
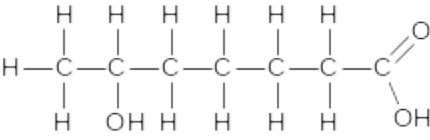
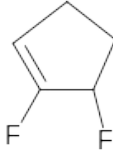
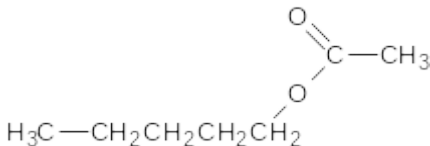
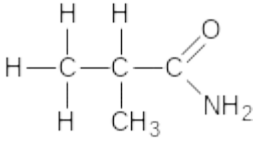
c) 2-ethyl-5,5-dimethylhexane

d) 5-ethyl-2,2-dimethylhexane

## Section 2 – Short Answer

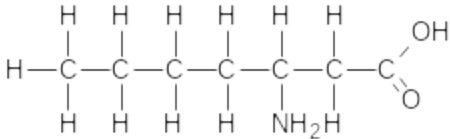
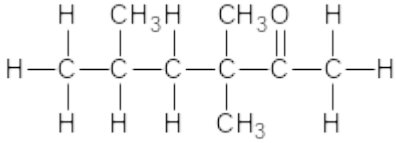
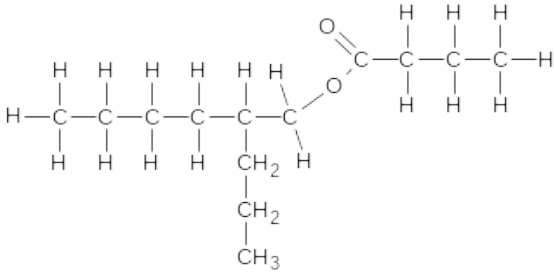
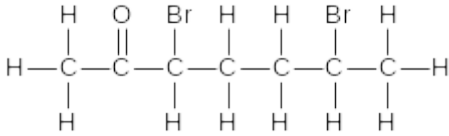
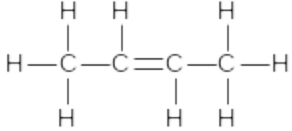
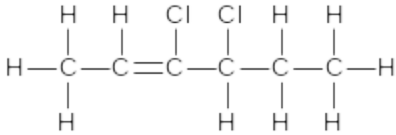
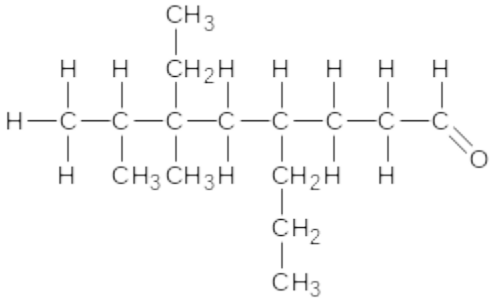
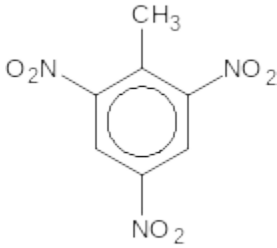
**YOU MUST SHOW ALL HYDROGEN ATOMS IN YOUR STRUCTURAL DIAGRAMMS**

1. Give the IUPAC name of the following structures:

<p>(a)</p>  <p>Name: 1-chloro-2,4-dimethylhex-1-ene</p>	<p>(b)</p>  <p>Name: 5,5-dibromopentan-2-ol</p>
<p>(c)</p>  <p>Name: 6-hydroxyheptanoic acid</p>	<p>(d)</p>  <p>Name: 1,5-difluorocyclopentene</p>
<p>(e)</p>  <p>Name: Pentyl ethanoate</p>	<p>(f)</p>  <p>Name: methylpropanamide</p>

(6 marks)

2. Give the full structural formula for the following organic chemicals (include all Hydrogens):

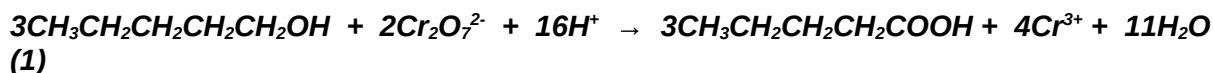
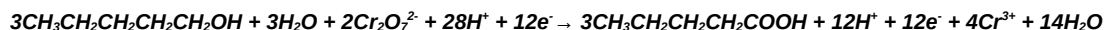
<p>(a) 3-aminoheptanoic acid</p> 	<p>(b) 3,3,5-trimethylhexan-2-one</p> 
<p>(c) 2-propylhexyl butanoate</p> 	<p>(d) 3,6-dibromoheptan-2-one</p> 
<p>(e) trans-but-2-ene</p> 	<p>(f) 3,4-dichlorohex-2-ene</p> 
<p>(g) 6-ethyl-6,7-dimethyl-4-propyloctanal</p> 	<p>(h) 1-methyl-2,4,6-trinitrobenzene</p> 

(8 marks)

3. For each of the situations described below, write a balanced redox reaction showing the changes that take place (there is no need to show the phase of the chemicals);

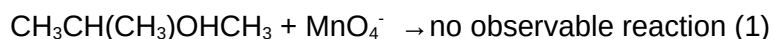
Give a brief observation of any major colour change that would be observed in any of the coloured reagents used to bring about the reaction.

- (a) Excess acidified potassium dichromate solution is added to pentan-1-ol.



*A clear, orange liquid is added to a clear, colourless solution. Upon addition, the solution turns clear and green. (1)*

- (b) Limited **dilute** acidified potassium permanganate is added to 2-methylpropan-2-ol.

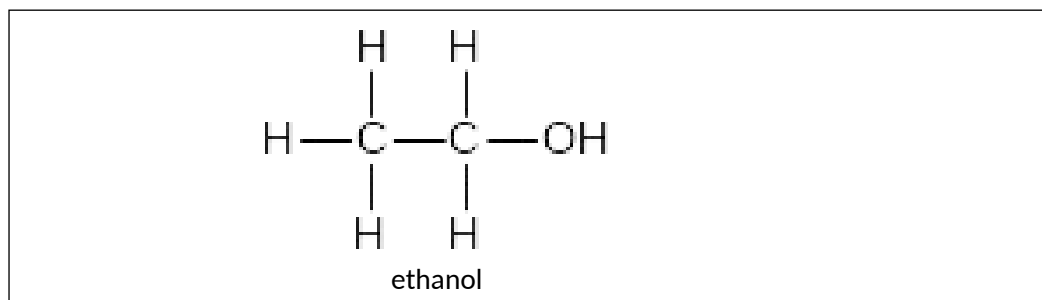


*A purple liquid is added to a clear and colourless liquid. The resulting solution is purple in colour. (1)*

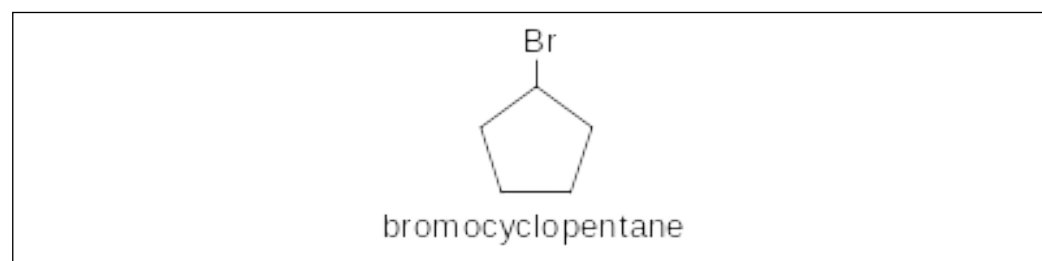
(6 marks)

4. DRAW and NAME the major organic PRODUCT or PRODUCTS in the following reactions assuming appropriate conditions. NB. No balancing is required.

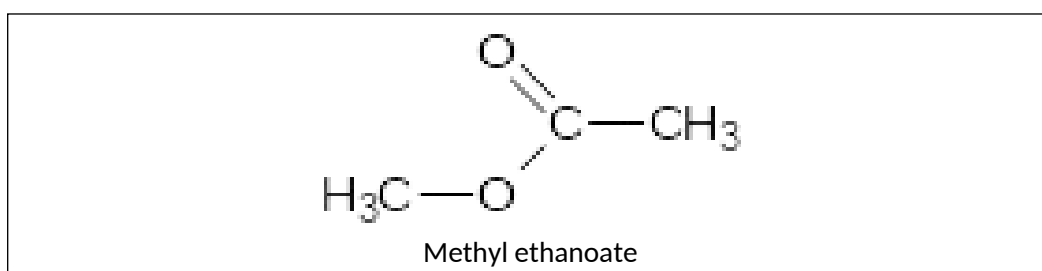
(a) Ethene and steam under appropriate reaction conditions.



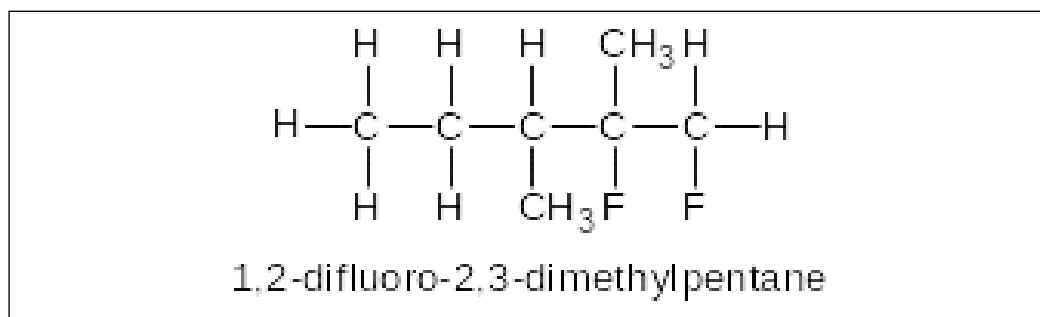
(b) cyclopentane and bromine.



(c) Ethanoic acid and methanol.



(d) 2,3-dimethylpent-1-ene and fluorine gas.



(8 marks)



5. An organic compound known to contain only C, H, N and O was analysed by initially burning a 5.2246g sample which produced 10.5632g of CO<sub>2</sub> and 4.8677 g of H<sub>2</sub>O. A second sample (1.367g) was oxidized separately to NO<sub>2</sub> and it was determined that 0.01576 mol of NO<sub>2</sub> was produced.

(a) Find the empirical formula.

(9 marks)

(b) A 2.090g sample is vapourised and occupied 200mL at 150 kPa and 25°C. Determine the molecular formula.

(2 marks)

(c) Had the organic compound turned blue litmus pink, draw a possible molecular structure and name it.

(2 marks)

CO <sub>2</sub> m=10.5632g M=44.01 g/mol  $n = \frac{m}{M} = \frac{10.5632}{44.01} = 0.2400$ mol  n(C) = n(CO <sub>2</sub> ) = 0.2400 mol  m(C) = n x M = 0.2400 x 12.01 = <b>2.883g</b> (1)	H <sub>2</sub> O m=4.8677g M=18.016 g/mol  $n = \frac{m}{M} = \frac{4.8677}{18.016} = 0.2702$ mol  n(H) = 2 x n(H <sub>2</sub> O) = 0.5404 mol  m(H) = n x M = 0.5404 x 1.008 = <b>0.5447g</b> (1)	N m(comp) = 1.367g n(NO <sub>2</sub> ) = 0.01576 mol  n(N) = n(NO <sub>2</sub> ) = 0.01576 mol  m(N) = n x M = 0.01576 x 14.01 = 0.221g (1)  $\%N = \frac{m(N)}{m(comp)} \times 100$ = $\frac{0.221}{1.367} \times 100$ = 16.04% (1)  m(N) = % x m(large sample) = 16.04% x 5.224 = 0.8384g  $n(N) = \frac{m}{M} = \frac{0.8384}{14.01}$ = 0.05989mol (1)
m(O) = m(compound) – (m(C) + m(H) + m(N)) = 5.224 – (2.883+0.5447+0.8384) = 0.9585g (1)		$n(O) = \frac{0.9585}{16} = 0.05990$ mol  (1)

	C	H	O	N
Moles	0.2400	0.5404	0.0599	0.0589
÷ smallest	$\frac{0.2400}{0.0589}$	$\frac{0.5404}{0.0589}$	$\frac{0.0599}{0.0589}$	$\frac{0.0589}{0.0589}$
(1)	4	9	1	1

EF = C<sub>4</sub>H<sub>9</sub>ON (1)

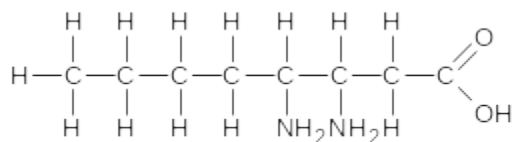
$$EFW = 87 \text{ g/mol}$$

$$n = \frac{PV}{RT} = \frac{150 \times 0.200}{8.314 \times 298} = 0.0120 \text{ mol}$$

$$MFW = \frac{m}{n} = \frac{2.090}{0.0120} = 174 \text{ g/mol}$$

$$C_8H_{18}O_2N_2$$

$$MF = \frac{MFW}{EFW} \times EF = \frac{174}{87} \times C_4H_9ON =$$



3,4-diaminooctanoic acid

(or similar)

6. Hexane, hexanal and hexanoic acid all contain the same number of carbon atoms but display different physical properties. Their boiling points are given in the table below.

Organic compound	Boiling point (°C)
hexane	68
hexanal	130
hexanoic acid	205

Account for the difference in boiling points of the three compounds.

(5 marks)

### Description

### Marks

Recognition that differences in boiling points is primarily due to the differences in **strength of the sum of the intermolecular forces**

1

or

Recognition that higher boiling points result from more energy being required to overcome the total intermolecular forces in the substance

Recognition that they will have similar dispersion forces (due to their size/structure)

1

Recognition that hexane **only** exhibits **dispersion forces**

1

Recognition that hexanal has **dipole-dipole** forces in **addition** to **dispersion forces**

1

Recognition that hexanoic acid has **hydrogen bonding** in **addition** to **dipole-dipole** and **dispersion forces**

1

**Total**

**5**

**Note:** If the cumulative effect of the intermolecular forces are not discussed a maximum of 4 marks

**End of Test**