ALL SAINTS' COLLEGE

Science Department

Year 12 Chemistry ATAR

Test 6: Organic Chemistry

Name: ANSWERS

Instructions to Students:

1. One lesson 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.

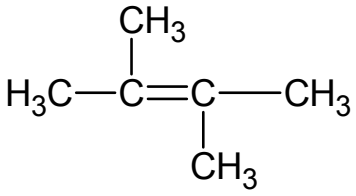
Multiple Choice	Short Answer
/10	/52

TOTAL
/62

Final Percentage

Section 1 – Multiple Choice

1. Which of the following is the correct IUPAC name for the structure shown?



(a) *cis*-2,2-dimethylbut-2-ene

(b) *trans*-2,3-dimethylbut-2-ene

(c) hexene

(d) 2,3-dimethylbut-2-ene

2. Which of the following is not a correctly named isomer of hexene?

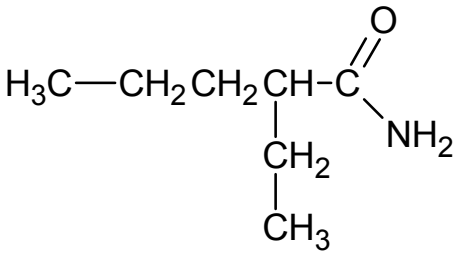
(a) 2,3-dimethylbut-1-ene

(b) cyclohexane

(c) 1,3,4-trimethylprop-2-ene

(d) 2-methylpent-1-ene

3. What is the correct IUPAC name of the structure shown below?



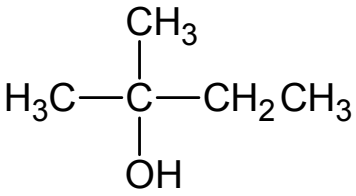
(a) 3-aminohexanal

(b) 2-ethylpentanamide

(c) 1-amino-2-ethylpentanal

(d) 2-ethylpenan-1-amine

4. The structure below represents?



(a) A primary alcohol

(b) A secondary alcohol

(c) A tertiary alcohol

(d) A ketone

5. Which of the following alcohols could be used to produce butanoic acid?

(a) butan-2-ol

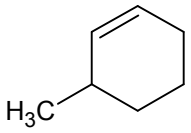
(b) 2-methylpropan-1-ol

(c) butan-1-ol

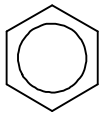
(d) butanone

6. Which of the following would not undergo an addition reaction?

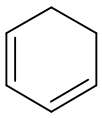
(a)



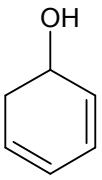
(b)



(c)



(d)



7. The correct balancing coefficients for the equation below are:

$$\_\_\ CH_3CHCHCH_2CH_3 + \_\_\ O_2 \rightarrow \_\_\ CO_2 + \_\_\ H_2O$$

(a) 1, 8, 10, 5

(b) 2, 15, 10, 10

(c) 2, 16, 20, 10

(d) 1, 7, 10, 10

8. Which of the following reactions could be identified by the use of universal indicator?

(a) butan-1-ol and acidified potassium permanganate

(b) hexan-1-ol and a limited amount of dilute acidified potassium dichromate

(c) butan-2-ol and acidified potassium permanganate

(d) 2-methylpentan-2-ol and and a limited amount of dilute acidified potassium dichromate

9. Which of the following families of organic compound is the least soluble in water?

(a) The esters

(b) The alcohols

(c) The carboxylic acids

(d) The primary amines

10. To form the ester pentyl propanoate you could react the following substances under appropriate conditions.

(a) pentan-1-ol and pentanoic acid

(b) propan-1-ol and pentanoic acid

(c) pentan-2-ol and propanal

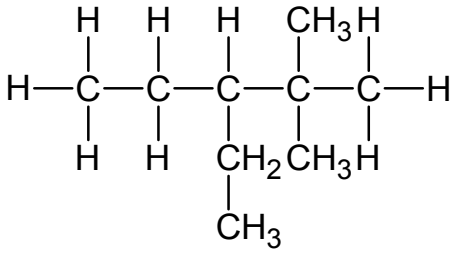
(d) pentan-1-ol and propanoic acid

Section 2 – Short Answer

YOU MUST SHOW ALL HYDROG*EN ATOMS IN YOUR STRUCTURAL DIAGRAMS*

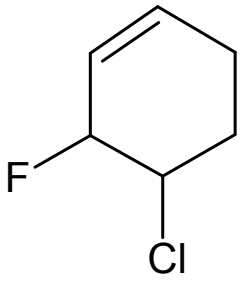
1. Give the IUPAC name of the following structures:

(a)



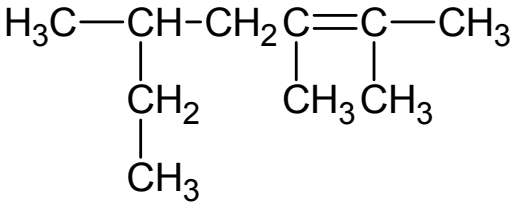
Name: 3-ethyl-2,2-dimethylpentane

(b)



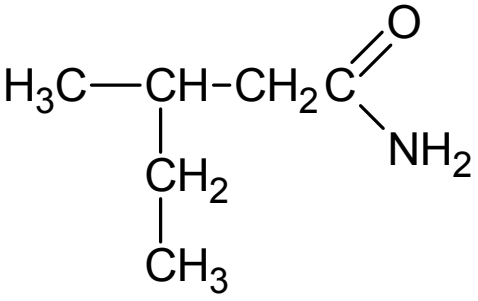
Name: 4-chloro-3-fluorocyclohex-1-ene

(c)



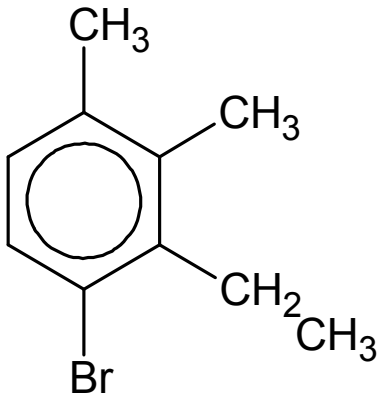
Name: 2,3,5-trimethylhept-2-ene

(d)



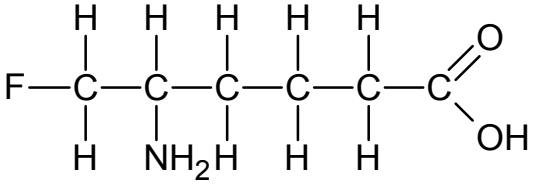
Name: 3-methylpentanamide

(e)



Name: 1-bromo-2-ethyl-3,4-dimethylbenzene

(f)

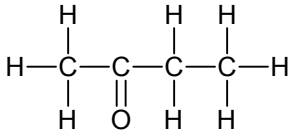


Name: 5-amino-6-fluorohexanoic acid

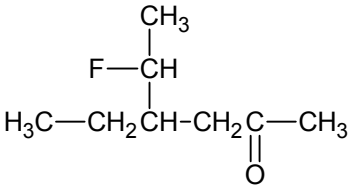
(6 marks)

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

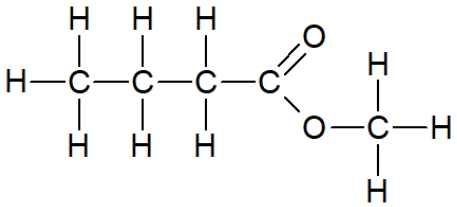
(a) butan-2-one



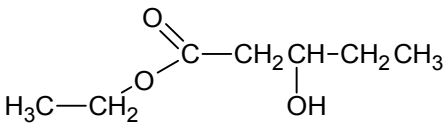
(b) 4-ethyl-5-fluorohexan-2-one



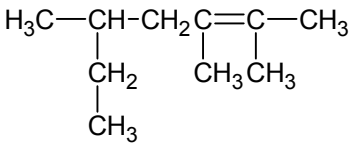
(c) methyl butanoate



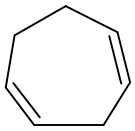
(d) ethyl 3-hydroxypentanoate



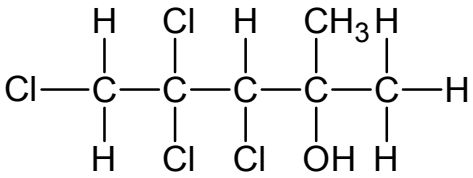
(e) 2,3,5-trimethylhept-2-ene



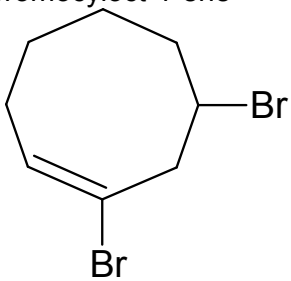
(f) cyclohepta-1,4-diene



(g) 3,4,4,5-tetrachloro-2-methylpentan-2-ol



(h) 1,7-dibromocycloct-1-ene



(8 marks)

3. A student is asked to identify four organic liquids, contained in four separate flasks.

- Octene
- Hexan-3-ol
- Hexan-3-one
- Butanoic acid

The student has access to any chemicals and glassware required.

Describe the chemical tests that should be carried out, and the observations, that enable the liquids to be identified. (Note using an acid base indicator is not a test you may use)

Include equations to justify the choice of tests.

(8 marks)

2 marks for each test
May be in different order

Mix each with bromine water
Octene will decolorise it
C_8H_{16} + Br_2 → $C_8H_{16}Br_2$

Mix the remaining three with sodium carbonate solution
Butanoic acid will produce bubbling
$2\ C_3H_7COOH$ + Na_2CO_3 → $2\ C_3H_7COONa$ + H_2O + CO_2

Mix the remaining two with acidified potassium permanganate (or potassium dichromate) solution
Hexanol will turn purple permanganate (or green dichromate) colourless
$5\ CH_3CH_2CHOHCH_2CH_2CH_3$ + $2\ MnO_4^-$ + $6\ H^+$ → 5 CH3CH2 + H_2O + $2Mn^{2+}$

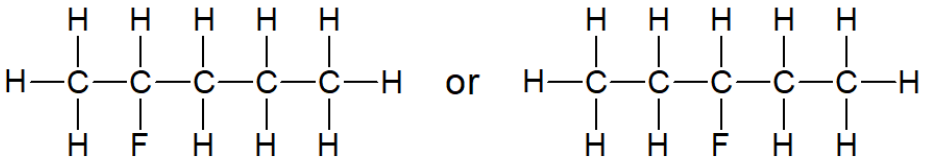
3-hexanone

Hexanone will not decolorise the solutions as ketones are not oxidised with acidified potassium permanganate (or potassium dichromate)

Some students may state that octene reacts with acidified permanganate – but so does hexanol

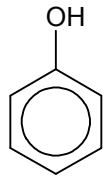
4. DRAW and NAME the major organic PRODUCT or PRODUCTS in the following reactions assuming appropriate conditions. NB. No balancing is required.

(a) Pent-2-ene and hydrogen fluoride gas.



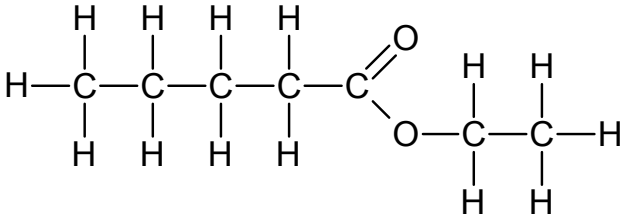
2-fluoropentane 3-fluoropentane

(b) Benzene and steam under appropriate reaction conditions.



benzenol (or phenol)

(c) Ethanol and pentanoic acid with an acid catalyst.

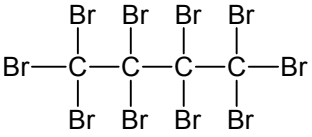


ethyl pentanoate

(d) Hept-3-ene ignited in an oxygen rich atmosphere.

No organic products produced!

(e) But-2-ene is reacted **completely** with excess Bromine water.



decabromobutane

(10 marks)

5. A certain organic compound is known to contain only carbon, hydrogen and oxygen.

The compound was analysed as follows.

A 2.149 g sample was burned, and the carbon dioxide produced was bubbled through a barium hydroxide solution, producing 11.27 g of barium carbonate ($BaCO_3$).

$$CO_2 + Ba(OH)_2 \rightarrow BaCO_3 + H_2O$$

The mass of water produced by burning of the sample was 0.7721 g

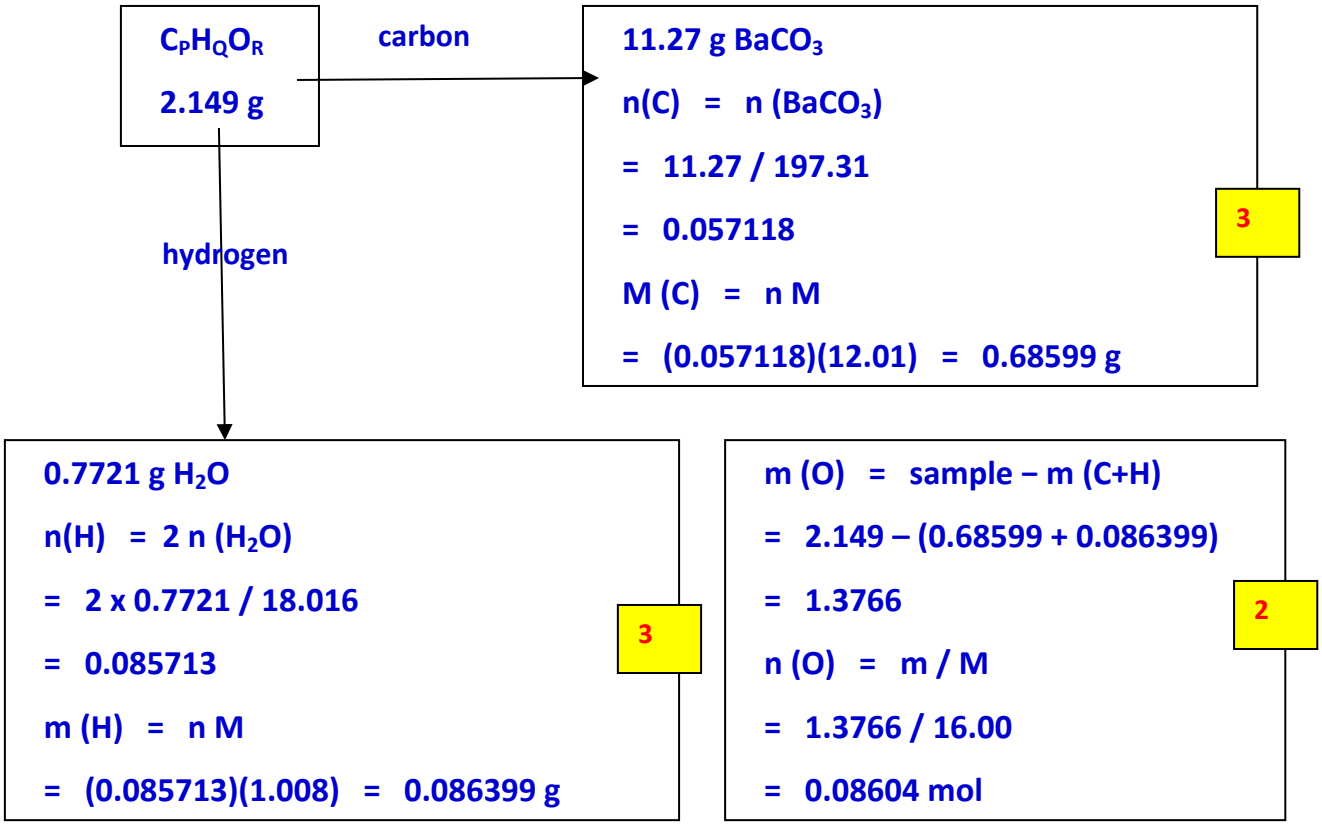
The compound was found to have a molecular weight of 150.1 g mol^{-1}

a) What is the empirical formula of the compound? (10 marks)

b) What is the molecular formula of the compound? (2 marks)

c) The compound is also known to be a carboxylic acid; that is, containing one COOH group. Write the molecular formula in the form of $C_XH_YO_ZCOOH$ (giving values for X, Y and Z).

(1 mark)



	C	H	O
mol	0.057118	0.085713	0.08604
ratio ÷ 0.057118	1 2	1.51 3	1.51 3
Empirical formula is $C_2H_3O_3$			

1

1

b) Empirical formula mass = 24 + 3 + 48 = 75

Molecular weight = 150.1 = 2 x empirical formula mass

So molecular formula is $C_4H_6O_6$

1

1

c) Taking COOH out of the formula leaves $C_3H_5O_4$

formula is $C_3H_5O_4$ COOH

1

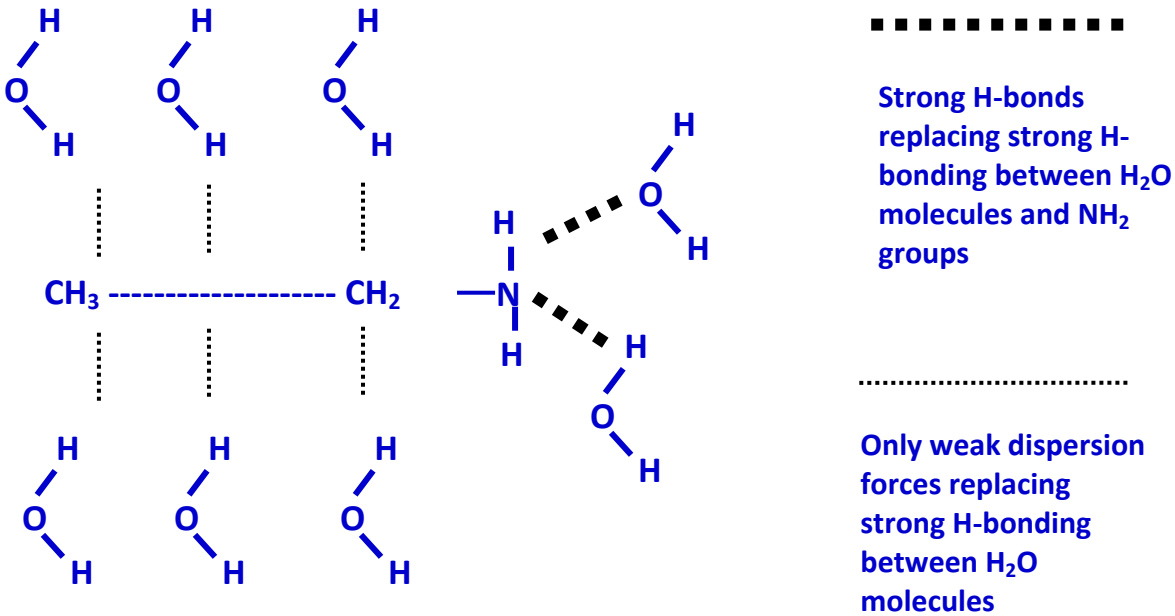
6. The following table shows the solubilities of two amines in water.

Amine	Methyl amine CH_3NH_2	Dodecyl amine $CH_3(CH_2)_{11}NH_2$
Solubility (g/100 mL)	108	0.05

Explain why their solubilities are so different. (Include a labelled diagram.)

(6 marks)

- **New solute-solvent bonds should be at least as strong as original solute-solute and solvent-solvent bonds**
- **Both can hydrogen-bond, and have dipole-dipole and dispersion forces, BUT dodecyl isomer has a long non-polar chain that can only interact with H_2O by dispersion force attraction, (may mention chain length and electrons)**
- **The new forces of attraction would be much weaker than the bonds broken between water molecules**



- **Students answer must adequately detail the IMF between the solute and solvent on their own, and then describe the solute-solvent interaction. Any incompatibility must be properly explained.**

End of Test