Chemistry Department
Christ Church Grammar School

**Year 12**
**2018**

# Organic Topic Test

**Time allowed:** 45 minutes

**Instructions**
Please ensure you enter your name and circle your teacher's initials below.
Scientific calculators only. Chemistry Data Sheet will be provided

**Name**
Answers

**Teacher:** (circle)

CEM NMO JPT KLW

**Mark:**_____ **/ 45**

**Section 1: Multiple Choice** **(Total 10 marks)**

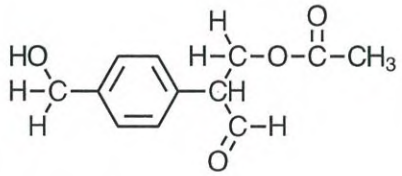
1. In how many positions can one chlorine atom be substituted in the straight chain alkane $C_6H_{14}$, to give rise to different compounds?

   A. 2
   B. 3
   C. 4
   D. 6

2. When a hydrocarbon with the molecular formula $C_6H_{12}$ is mixed with bromine water in the absence of UV light, the bromine water rapidly decolourises. From this observation, the name of the product of this reaction could be:

   A. 2,3-dibromo-1,3-dimethylbutane (would be a pentane)
   B. 2,4-dibromohexane ×
   C. 2,3-dibromo-2,3-dimethylbutane
   D. bromocyclohexane ×

3. Which of the functional groups listed is NOT present in the molecule shown below?



   A. alcohol ✓
   B. aldehyde ✓
   C. ketone ×
   D. ester ✓

4. An organic compound with the molecular formula, $C_5H_{10}O_2$ was hydrolysed to form two compounds **X** and **Y**. When **Y** was added to sodium carbonate solution, a colourless gas was produced. Oxidation of **X** with a stoichiometric quantity of acidified sodium dichromate produced one substance **Z**. What are **X** and **Y**?

   A. **X**: propan-2-ol ✓ **Y**: ethanoic acid ✓
   B. **X**: ethanal **Y**: propan-1-ol
   C. **X**: propan-2-ol ✓ **Y**: propanoic acid ✓
   D. **X**: ethanol ✓ **Y**: propanoic acid ✓

5. Which of the following is an isomer of methyl propanoate?

A. $CH_3CH_2CH_2OCH_3$

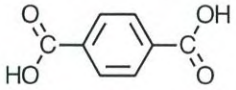
B. $HOCH_3CHCHCHO$

C. $CH_3CH_2CH_2COOH$

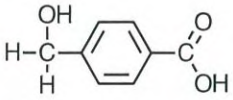
D. $HOCH_2CH_2CHO$

6. Which of the following substances could form condensation polymers?

I $HOCH_2CH_2CH_2OH$ and $H_2NCH_2CH_2NH_2$

II $CH_3CHOHCH_2OH$ and 

III $NH_2CH_2CH_2CH_2CH_2OH$ and $HOOCCH_2CH_2CH_2COOH$

IV 

A. I and II

B. II and III

C. II and IV

D. II, III and IV

7. A pellet of sodium was placed in four alcohols W, X, Y and Z. Observations are given below.

| | Observation |
|---|---|
| W | Vigorous production of gas |
| X | No visible reaction ? |
| Y | Moderate production of gas |
| Z | Vigorous production gas |

Hmmm? very slow

The identities of W, X, Y and Z respectively are:

A. ethanol, pentan-3-ol, butan-1-ol and methanol

B. propan-1-ol, cyclopropanol, butan-2-ol and ethanol

C. methanol, 1-methylcyclopropanol, cyclopropanol and ethanol

D. ethanol, pentan-3-ol, butan-2-ol and methanol

$1^\circ > 2^\circ > 3^\circ$

rate of reaction with Na.

8. Which one of the following compounds would boil at the highest temperature?

A. $CH_3CH_2CH_2CHO$

B. $CH_3CH_2\ CH_2CONH_2$

C. $CH_3CH_2CH_2CH_2NH_2$

D. $CH_3CH_2CH_2CH_2OH$

9. A compound with the empirical formula $C_2H_4O$ could be:

A. a carboxylic acid only

B. a ketone or an aldehyde only

C. an alcohol only

D. an aldehyde, a carboxylic acid or an ester.

10. Soap is a useful substance. Which of the following statements about soap is FALSE?

A. Sodium ethanoate is a soap.

B. Calcium salts of fatty acids are insoluble in water.

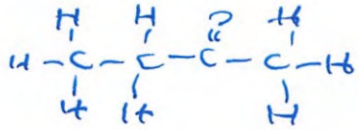
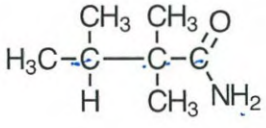
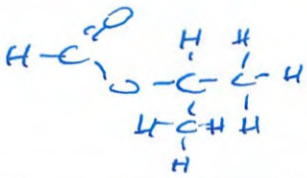
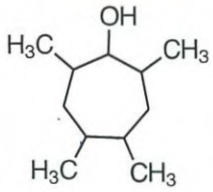
C. Soaps can form micelles.

D. Soaps are emulsifiers or surface active agents.

**END OF SECTION ONE**

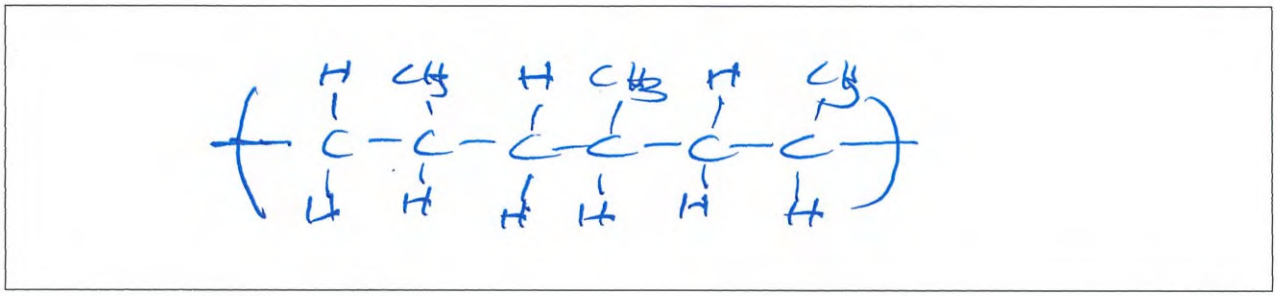
**Section 2: Short Answer** **(Total 35 marks)**

**Question 11** **4 marks**

| IUPAC Name | Full structural formula |
|---|---|
| butan-2-one ↑ (redundant) |  |
| 2,3-dimethyl-butanamide |  |
| 2-propylmethanoate |  |
| 2,4,5,7-tetramethyl-cycloheptanol |  |

**Question 12** **4 marks**

a) Draw three repeating units for polypropene in the box below.



(3 marks)

b) State a use for polypropene.

guttering etc (plastic not accepted)

(1 mark)

**Question 13** **6 marks**

Give the name of a suitable **chemical reagent** that could be used to distinguish between the following two substances and what you would observe.

a) Benzene and cyclohexene

Chemical reagent: bromine (no u.v. / no catalyst)

Observations:

| Benzene | Cyclohexene |
|---|---|
| NVR | rapid decolourisation. |

b) Butanone and butanoic acid

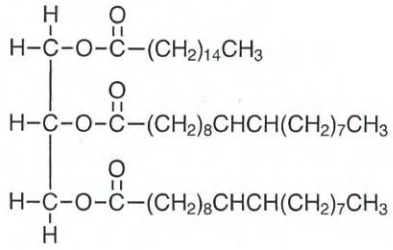
Chemical reagent: add a metal carbonate ($Na_2CO_3$, $CaCO_3$ etc) - or a reactive metal, or could prepare an ester.

Observations:

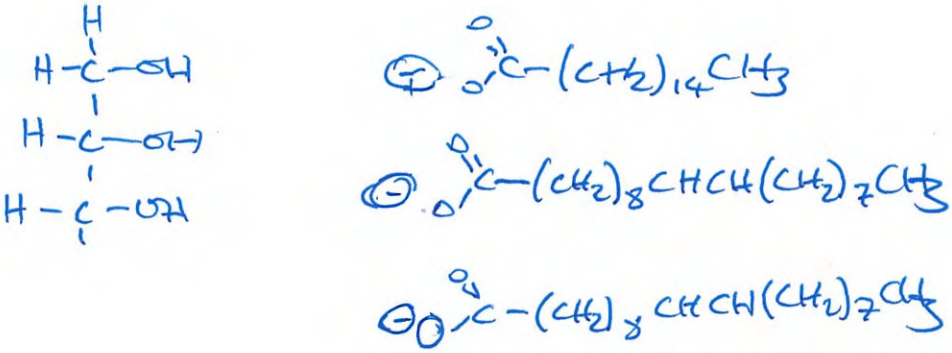
| Butanone | Butanoic acid |
|---|---|
| NVR | colourless bubbles of gas |

**Question 14** **6 marks**

a) Given the following triglyceride, complete the reaction to produce soap.



+ 3 $OH^-$



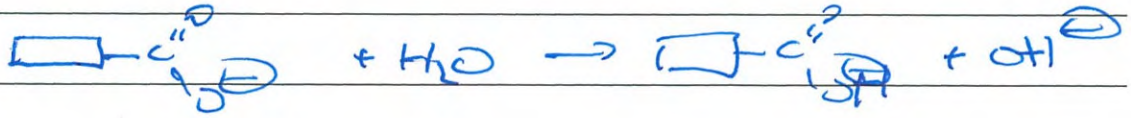
(4 marks)

b) Purified soap would have a pH:

| < 7 | = 7 | > 7 |
|---|---|---|

Provide brief reasoning, including a chemical equation, justifying your choice:

* "it is the conjugate base of a weak acid"
* "the $R-C(=O)O^-$ ion is basic.



The $[OH^-] > 10^{-7}$

(3 marks)

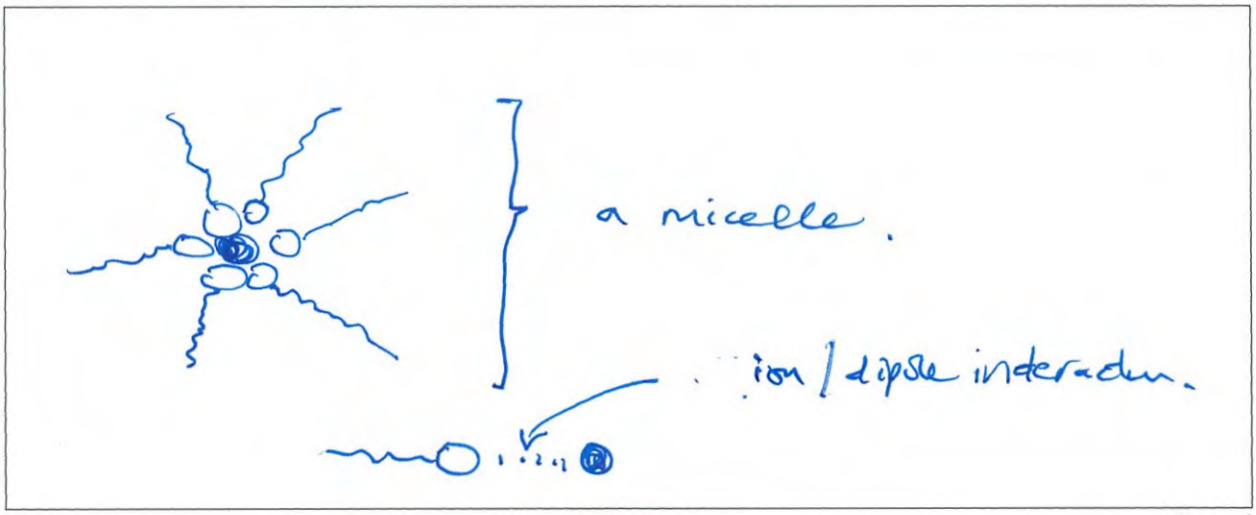
c) Dry cleaners use the solvent tetrachloroethene to clean clothes that are sensitive to being washed solely in water. Small amounts of water and a surfactant are added to the cleaning cycle to enable water soluble material to be removed from clothing.

Draw a diagram below showing the interactions between:

- Water droplets
- The dry cleaning solvent
- A micelle

You may represent a surfactant molecule as: 

Label your diagram clearly.




2 marks

**Question 15** **8 marks**

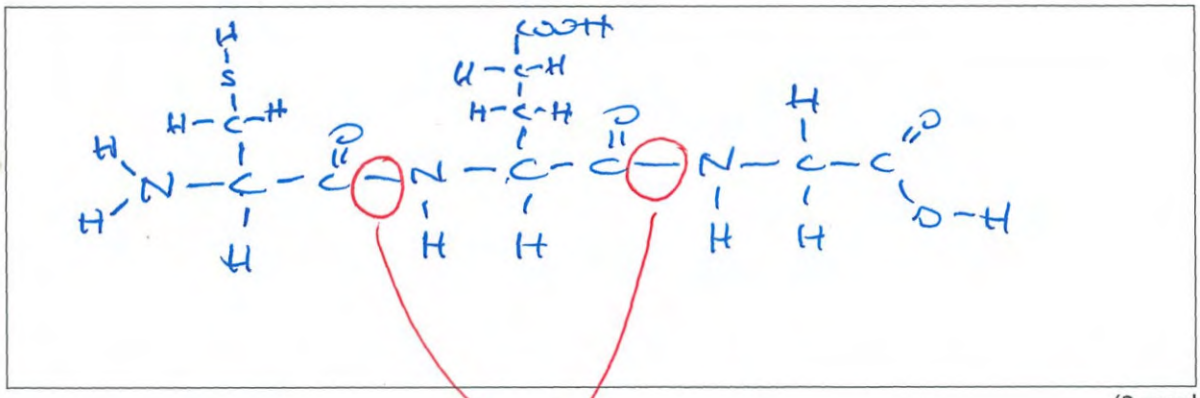
A section of a protein has the amino acid residue sequence: ---**Cys-Glu-Gly**---

a) This section is part of the protein's structure. The complete sequence would represent what type of structure?

primary.

(1 mark)

b) A tripeptide formed by the amino acid sequence above is called glutathione. Draw the tripeptide below, showing the position of a peptide bond.




(3 marks)

*NB. This structure accepted, but at pH 7, the $NH_2$ and both COOH groups would exist as $NH_3^+$ & $COO^-$

c) A polypeptide contains 100 amino acid residues with the repeating sequence Gly-Ala. Given this, calculate the molar mass of this polypeptide.

M(gly) ≈ 75 and M(ala) ≈ 89

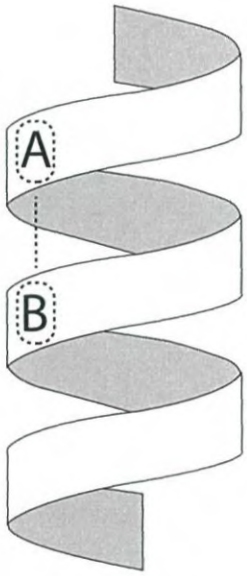
M(polypept.) = (50 × 75) + (50 × 89) − (99 × 18)

= 3,750 + 4,450 − 1,782

= 9,982

(2 marks)

d) The following diagram shows the structure of part of a protein.

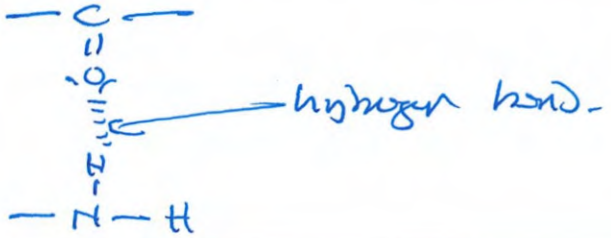



i) What is the name of the structure shown?

α - helix

(1 mark)

ii) Draw the interaction shown by the letters **A** and **B** in the diagram above, clearly showing all atoms involved.

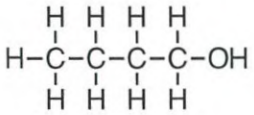
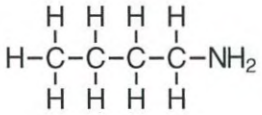
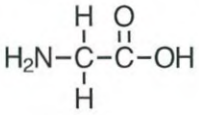



(2 marks)

**Question 16** **6 marks**

Assign the following boiling points to the correct substance below.

78°C 117°C 233°C

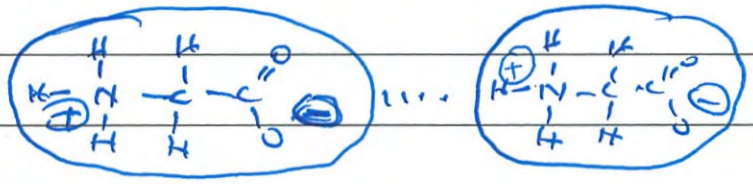
| | | |
|---|---|---|
|  butan-1-ol (74.121 $gmol^{-1}$) |  butan-1-amine (73.14 $gmol^{-1}$) |  glycine (75.07 $gmol^{-1}$) |
| Boiling Point: 117 | Boiling Point: 78 | Boiling Point: 233 |

(2 marks)

Justify your answer.

* all CM with similar M, so dispersion forces comparable.

* glycine highest because it exists as a zwitterion, with ionic interactions between its molecules



* butan-1-ol and butan-1-amine both have H-bonding. O is more electronegative than N, so we expect size of dipole to be greater, and hydrogen bonding stronger.

(4 marks)

**END OF TEST**