**Australian Islamic College 2018**

**ATAR Chemistry Units 3 and 4**

**Task 11 (Weighting: 5%)**

**Esters Validation Test**

Test Time: 25 minutes

Please do not turn this page until instructed to do so.

| First Name | Surname |
|---|---|
| **ANSWERS** | |

| Teacher |
|---|
| |

| Mark / 26 | Percentage |
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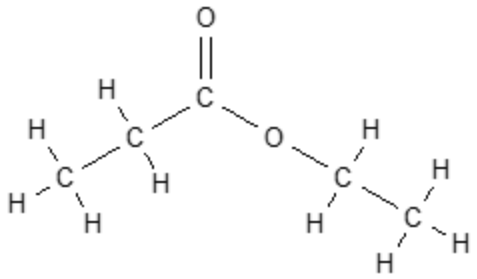
| | |

Equipment allowed: Pens, pencils, erasers, whiteout, rulers and non-programmable calculators permitted by the Schools Curriculum and Standards Authority.

1. Which of these molecules is an ester? Circle the correct answer. [1 mark]

   (a) $CH_3CHOHCH_2CH_3$
   (b) $CH_3COCH_3$
   (c) $\underline{CH_3CH_2COOCH_2CH_3}$
   (d) $CH_3CH_2CHO$

2. This question relates to the ester shown below.



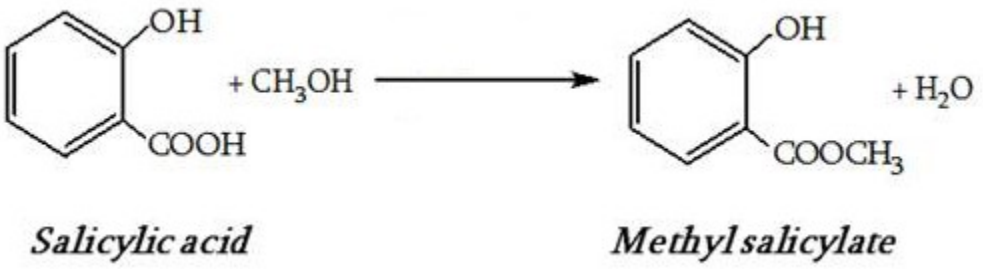
   (a) Draw the condensed structural formulae and give the names of the two organic molecules that would be required to synthesise this compound. [4 marks]

| |
|---|
| 1.**$CH_3CH_2COOH$ [1]**<br><br>Name: **propanoic acid [1]** |

| |
|---|
| 2. **$CH_3CH_2OH$ [1]**<br><br>Name: **ethanol [1]** |

3. Methyl salicylate (oil of wintergreen or wintergreen oil) is an organic compound with the formula $C_6H_4(OH)(CO_2CH_3)$. Methyl salicylate was synthesised in the laboratory by combining the appropriate alcohol and carboxylic acid.

(a) Show the reaction that occurs during the synthesis of methyl salicylate. Draw structural formulae for all organic reactants and products. [2 marks]




*Salicylic acid* *Methyl salicylate*

(b) The test tube containing the reaction mixture was placed in a beaker of water. The beaker of water was then heated using a Bunsen burner.

(1) Suggest why the reaction mixture was not heated directly using the Bunsen burner. [1 mark]

**Because the reactants are flammable / to avoid the risk of a fire. Also accept to reduce the evaporation of volatile reactants.**

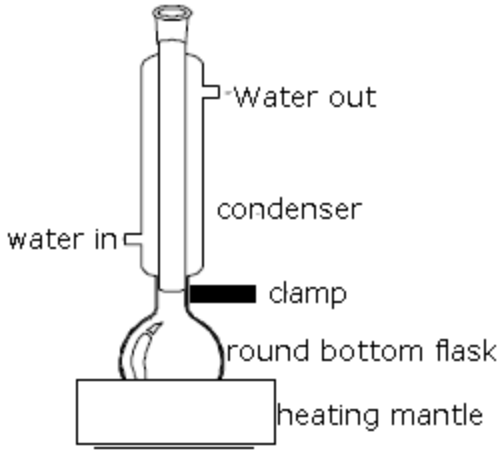
(2) What was the purpose of heating the reaction mixture? [1 mark]

**To increase reaction rate.**

c) Write observations for the reaction described above for the synthesis of oil of wintergreen. [2 marks]

**A colourless liquid is combined with a white solid. The white solid disappears and the mixture remains colourless. A colourless immiscible layer appears above the colourless liquid. The odour of oil of wintergreen / a pleasant odour appears. Any 4, ½ each.**

d) The reaction mixture was heated in an open test tube, however a better method would be to heat the reaction mixture in the reflux condenser shown below.




Explain the advantage of synthesising the ester using a reflux condenser. [2 marks]

**The reactants are volatile and when heated will evaporate [1]. The reflux condenser will reduce the loss of reactants by condensing escaping gases [1].**

e) Concentrated sulfuric acid was used as a catalyst. Explain how a catalyst increases reaction rate. [2 marks]

**A catalyst increases reaction rate by lowering the activation energy [1] by providing an alternative reaction pathway [1]. Also accept a greater proportion of the reactant particles have the activation energy and/or there are more successful collisions.**

f) An additional benefit of adding concentrated sulfuric acid to the reaction mixture is that it reacts with water in the reaction mixture to form a hydrated form of sulfuric acid, thereby effectively removing water from the reaction mixture. Explain the advantage of removing water from the reaction mixture. [2 marks]

**This increases yield (1) by removing a product (1).**

g) Identify two safety hazards associated with the synthesis of oil of wintergreen and for each explain how the risk of that hazard was minimised. [2 marks]

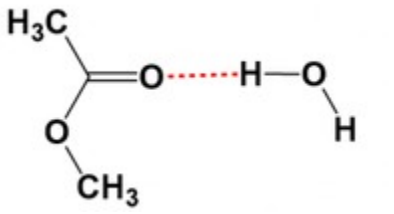
**Any two reasonable answers, for instance:**
**Concentrated sulfuric acid is corrosive – wear gloves.**
**Ethanol is flammable – heat it in a hot water bath instead of directly on the Bunsen burner flame.**

4. Esters cannot form hydrogen bonds with other ester molecules but they can form hydrogen bonds with water molecules.

(a) Explain why esters cannot form hydrogen bonds with other ester molecules. [1 mark]

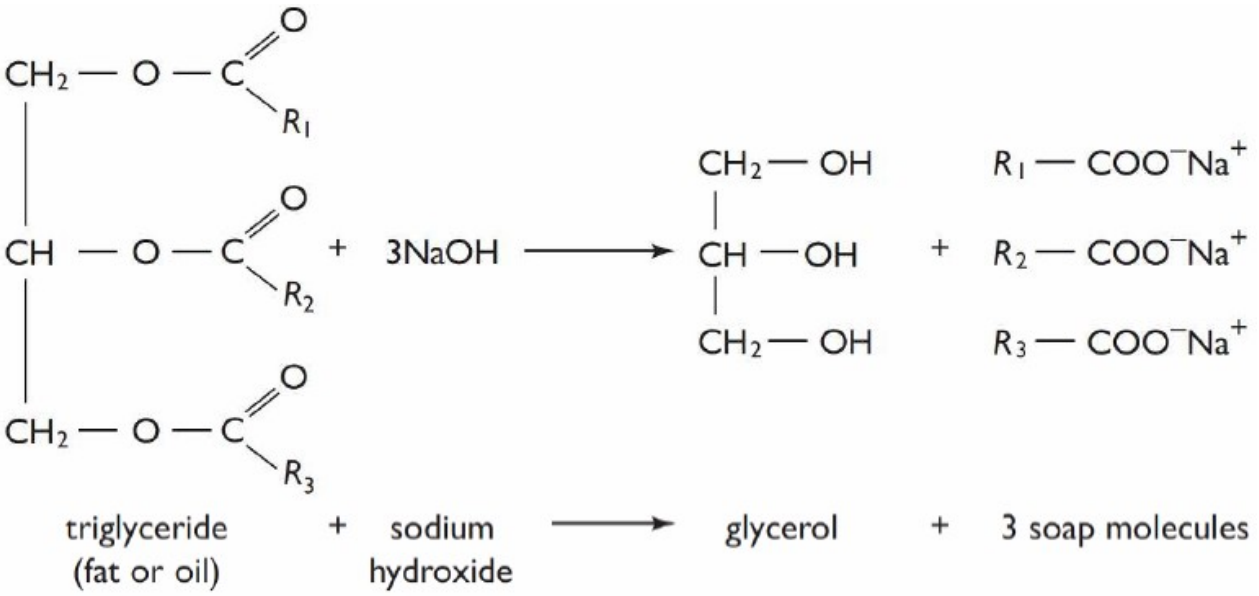
**They do not contain a hydrogen atom bonded to a highly electronegative atom.**

(b) Draw a diagram to represent a hydrogen bond between methyl ethanoate and water. [2 marks]

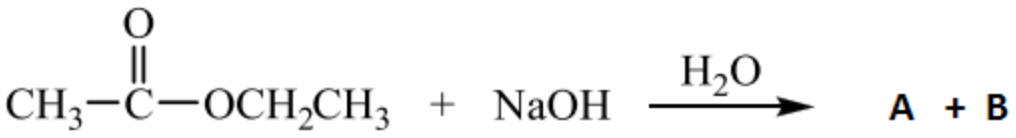



**1 mark for methyl ethanoate. 1 mark for correct location of the hydrogen bond.**

5. Using structural formulae, write the equation for the saponification of a triglyceride. Show all reactants and products. You may use 'R' to represent long hydrocarbon chains. [2 marks; 1 mark off per mistake]




6. Name the products A and B produced by the reaction below. [2 marks]




Product A: **Ethanol (1)**

Product B: **Sodium ethanoate (accept ethanoate ion) (1)**

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