Phone: +442081445350

www.chemistryonlinetuition.com

Email:asherrana@chemistryonlinetuition.com

CHEMISTRY

INORGANIC CHEMISTRY II

Level & Board	AQA (A-LEVEL)
TOPIC:	CARBOXYLIC ACIDS AND DERIVATIVES
PAPER TYPE:	QUESTION PAPER - 3
TOTAL QUESTIONS	10
TOTAL MARKS	33

Carboxylic Acids and Derivatives - 3

1. The crude aspirin can be purified by recrystallisation using hot ethanol (boiling point = 78 °C) as the solvent.

(a) Describe two important precautions when heating the mixture of ethanol and crude aspirin.

(2)

(b) The pure aspirin is filtered under reduced pressure.

A small amount of cold ethanol is then poured through the Buchner funnel.

Explain the purpose of adding a small amount of cold ethanol.

(1)

(c) A sample of the crude aspirin is kept to compare with the purified aspirin.

Describe one difference in appearance you would expect to see between these two solid samples.

(1)

(d) A 6.01 g sample of salicylic acid (Mr = 138.0) is reacted with 10.5 cm^3 of ethanoic anhydride (Mr = 102.0).

In the reaction the yield of aspirin is 84.1%
The density of ethanoic anhydride is 1.08 g cm^{-3}
Show by calculation which reagent is in excess.
Calculate the mass, in g, of aspirin (Mr = 180.0) produced.

(5)

2. Which statement about $(CH_3)_2CHCH_2COOH$ is correct?

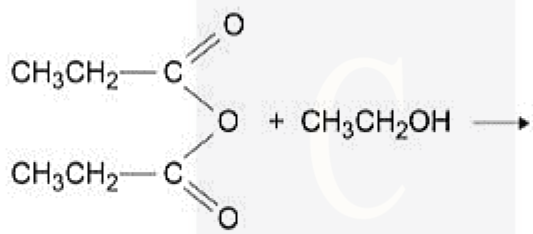
A. In aqueous solution it reacts with magnesium to form carbon dioxide.
B. It can form hydrogen bonds.
C. It has optical isomers.
D. It has the IUPAC name 2-methylbutanoic acid.

(1)

3. This question is about esters including biodiesel.

(a) An ester is formed by the reaction of an acid anhydride with CH_3CH_2OH
Complete the equation.

In your answer show clearly the structure of the ester.
Give the IUPAC name of the ester.



(3)

(b) In a reaction to form biodiesel, one mole of a vegetable oil reacts with an excess of methanol to form two moles of an ester with molecular formula $C_{19}H_{34}O_2$ and one mole of an ester with molecular formula $C_{19}H_{36}O_2$

Draw the structure of the vegetable oil showing clearly the ester links.

You should represent the hydrocarbon chains in the form CxHy where x and y are the actual numbers of carbon and hydrogen atoms.

(2)

4. Which compound forms a white precipitate when added to aqueous silver nitrate?

A. bromoethane
B. ethanal
C. ethanoic anhydride
D. ethanoyl chloride

(1)

5. An ester contains a benzene ring.
The mass spectrum of this ester shows a molecular ion peak at m/z = 136.

(a) Deduce the molecular formula of this ester.

(1)

(b) Draw two possible structures for this ester.

(3)

6. Which compound reacts with warm dilute aqueous sodium hydroxide?

A. C_6H_6
B. $CH_3CH{=}CH_2$
C. $CH_3CH_2CH_2NH_2$
D. $(CH_3CO)_2O$

(1)

7. Esters can be prepared in several ways including the reactions of alcohols with carboxylic acids, acid anhydrides, acyl chlorides and other esters.

Ethyl butanoate is used as a pineapple flavouring in sweets and cakes.

Write an equation for the preparation of ethyl butanoate from an acid and an alcohol.
Give a catalyst used for the reaction.

(4)

8. Which reaction involves addition-elimination?

A. $(CH_3)_2CHBr + KOH \rightarrow CH_3CH{=}CH_2 + KBr + H_2O$
B. $CH_3COCl + C_6H_5OH \rightarrow CH_3COOC_6H_5 + HCl$
C. $CH_3CH{=}CH_2 + Cl_2 \rightarrow CH_3CHClCH_2Cl$
D. $CH_3CH_2CH_2Br + NaOH \rightarrow CH_3CH_2CH_2OH + NaBr$

(1)

9. This question is about an ester.

(a) Write an equation for the formation of methyl propanoate, $CH_3CH_2COOCH_3$, from methanol and propanoic acid.

(1)

(b) Name and outline a mechanism for the reaction between methanol and propanoyl chloride to form methyl propanoate.

(5)

10. Which compound is formed when phenyl benzenecarboxylate is hydrolysed under acidic conditions?

A. $C_6H_5CH_2OH$
B. C_6H_5CHO
C. $C_6H_5COCH_3$
D. C_6H_5COOH

(1)

DR. ASHAR RANA

CHEMISTRY ONLINE TUITION

Phone: +442081445350
www.chemistryonlinetuition.com
Email: asherrana@chemistryonlinetuition.com

- Founder & CEO of Chemistry Online Tuition Ltd.
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CONTACT INFORMATION FOR **CHEMISTRY ONLINE TUITION**

- UK Contact: 02081445350
- International Phone/WhatsApp: 00442081445350
- Website: www.chemistryonlinetuition.com
- Email: asherrana@chemistryonlinetuition.com
- Address: 210-Old Brompton Road, London SW5 OBS, UK