Carboxylic Acids, Esters and Acylation Practice Test

Mr Cole Chemistry

Name ..... Class: .....

Start Time ..... End Time ..... Time Taken .....

Time allowed: 53 minutes

INSTRUCTIONS TO CANDIDATES

- This document is designed to be used as a practice test.
- Complete the test under exam conditions in one sitting.
- Optional: Before marking it, go through the paper with a set of notes and improve your answers.
- Mark the test using the mark scheme make corrections on the paper.
- Complete the table of results from page.
- Improve your notes so that they better reflect your weaknesses.
- Make a note of your strengths and weaknesses for future revision.

Mark Scheme

Success Criteria	Questions in Paper	Mark	Out of	%	Rank Order
Esterification	1a, 4		1, 4		
Addition-Elimination Mechanism	1b		5		
Acid anhydrides	1c, 1d, 4b		1, 3		
Analysis	1e		3		
Triesters	2, 4c		5, 3		
Practical techniques	3, 6a, 6c, 6d, 6e, 6h		2, 1, 1, 1, 1, 6		
Testing for acyl chlorides	5		2		
Calculations	6b, 6j		2, 3		
Hydrolysis of esters	6f		1		
Solubility	6g		2		
Total			49		

Mark schemes

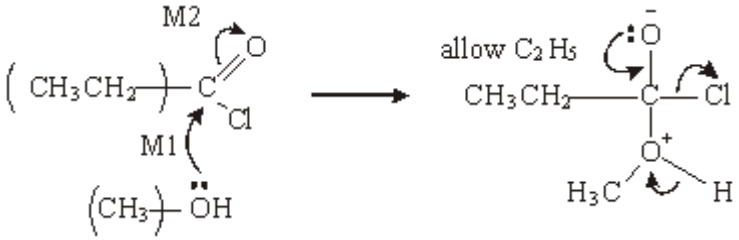
Q1.

(a) $CH_3OH + CH_3CH_2COOH \rightarrow CH_3CH_2COOCH_3 + H_2O$

1

(b) (nucleophilic) addition–elimination NOT acylation

1



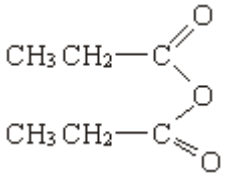
ignore use of Cl^- to remove H^+

M3 for structure

M4 for 3 arrows and lone pair

4

(c)



allow C_2H_5 and $-CO_2-$

allow $CH_3CH_2COOCOCH_2CH_3$

or *$(CH_3CH_2CO)_2O$*

1

(d) (i) faster/not reversible/bigger yield/purer product/no(acid) (catalyst) required

1

(ii) anhydride less easily hydrolysed or reaction less violent/exothermic
no (corrosive) (HCl) fumes formed or safer or less toxic/dangerous
expense of acid chloride or anhydride cheaper

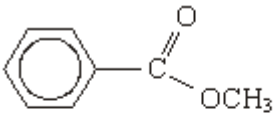
any one

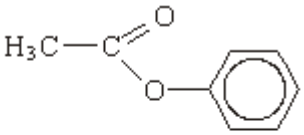
1

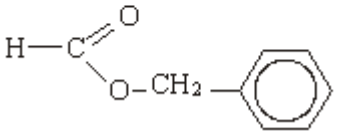
(e) (i) $C_8H_8O_2$

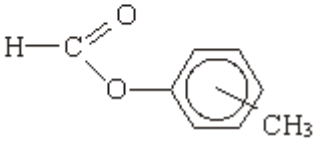
1

(ii) **any** two **from**









Allow –CO_2– allow C_6H_5

2

[12]

Q2.

(a) (i) propan(e)-1,2,3-triol or 1,2,3- propan(e)triol

not propyl
ignore hyphen, commas

1

(ii) soaps

allow anionic surfactant
not cationic surfactant
not detergents, not shampoos

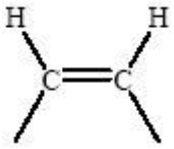
1

(b) (i) (bio)<u>diesel</u>

Allow fuel for <u>diesel</u> engines
not biofuel, not oils

1

(ii)



ignore anything else attached except any more H atoms.

1

(iii) $CH_3(CH_2)_{12}COOCH_3 + 21½O_2 \rightarrow 15CO_2 + 15\ H_2O$

OR

$C_{15}H_{30}O_2$ or 43/2

***not** allow equation doubled*

1

[5]

Q3.

Sample in capillary / melting point tube

Accept alternative as long as small container used

1

Heat in melting point apparatus / heat <u>gently / slowly</u> near melting point

1

[2]

Q4.

(a) **M1** $CH_3CH_2CH_2COOH$

not C_3H_7COOH

1

M2 CH_3CH_2OH or C_2H_5OH

1

M3 $CH_3CH_2CH_2COOCH_2CH_3 + H_2O$

allow $C_3H_7COOC_2H_5$

penalise M3 for wrong products and unbalanced equation

1

M4 H_2SO_4 or HCl or H_3PO_4 conc or dil or neither

not HNO_3

1

(b) **M1** $CH_3CH_2CH_2CH_2OH$

1

not C_4H_9OH

M2 $(CH_3CO)_2O$

1

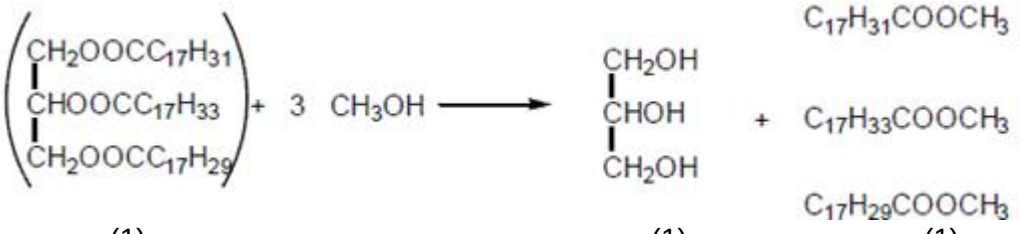
M3 $\rightarrow CH_3COOCH_2CH_2CH_2CH_3 + CH_3COOH$

allow $CH_3COOC_4H_9$

penalise M3 for wrong products and unbalanced equation

1

(d)



(1) (1) (1)

ignore errors in initial triester

First mark for $3CH_3OH$

Third mark for all three esters

3

[10]

Q5.

Test silver nitrate (solution) **(M1)**

Allow an alternative soluble silver salt eg fluoride, sulfate.

Do not allow 'silver ions' but can access second mark.

Incorrect formula loses this mark but can access second mark.

*Do not allow 'silver' or an insoluble silver salt and **cannot** access second mark.*

Ignore references to acidification of the silver nitrate.

If an acid is specified it should be nitric acid, but allow sulfuric acid in this case as there are no metal ions present.

If hydrochloric acid is used, CE = 0 / 2.

Do not allow 'add water'.

1

Observation white precipitate **(M2)**

Ignore 'cloudy'.

Do not allow 'white fumes' or 'effervescence'.

Do not allow this mark if test reagent is incorrect or missing.

*Allow named indicator paper or named indicator solution for **M1**.*

*Allow correct colour change for **M2**.*

1

[2]

Q6.

(a) allows smaller bubbles to form / prevents the formation of (very) large bubbles

ALLOW provides large surface area for bubbles to form on

IGNORE 'air'

NOT no bubbles form / prevents bubbles forming

1

(b) (Mass of ester = 1.05 × 5.0 = 5.25g)
amount of ester = 5.25 / 150.0 = 0.0350 mol

1

amount of NaOH = 30 × 2 / 1000 = 0.06 mol

1

OR

(Mass of ester = 1.05 × 5.0 = 5.25g)
amount of ester = 5.25 / 150.0 = 0.0350 mol

1

Vol of 0.035 mol of NaOH = (0.035/2) × 1000 = 17.5 cm^3
(so 30 cm^3 used is an excess)

1

OR

amount of NaOH = 30 × 2 / 1000 = 0.06 mol

1

0.06 mol of ester = 9 g = 8.57 cm^3
(only 5 cm^3 used so NaOH in excess)

1

Mark independently

Max 2

(c) To ensure that the ester is completely hydrolysed / to ensure all the ester reacts

ALLOW to ensure the other reagent has completely reacted

1

(d) Many organic compounds / the ester / ethanol are flammable

ALLOW prevent ignition of any flammable vapours formed

1

(e) Reflux allows reactant vapours (of volatile organic compounds) to be returned to the reaction mixture / does not allow any reactant vapour to escape

IGNORE reference to products

1

(f) $C_6H_5COONa + HCl \longrightarrow C_6H_5COOH + NaCl$

Allow ionic equation.

ALLOW molecular formulae ($C_7H_5O_2Na$ and $C_7H_6O_2$)

ALLOW skeletal benzene ring

1

(g) Sodium benzoate soluble because it is ionic

IGNORE polar

1

Benzoic acid insoluble because: despite the polarity of the COOH group / ability of COOH to form H-bonds, the benzene ring is non-polar.

ALLOW 'part of molecule' or 'one end' for COOH

1

(h) Dissolve crude product in <u>hot</u> solvent/water

ALLOW ethanol

If no M1 max = 4

1

of minimum volume

ALLOW reference to saturated soln as alternative to 'min vol'

1

Filter (hot to remove insoluble impurities)

IGNORE use of Buchner funnel here

1

Cool to recrystallise

apply list principle for each additional process in an incorrect method but IGNORE additional m.pt determination

1

Filter under reduced pressure / with Buchner/Hirsch apparatus

1

wash (with cold solvent) **and** dry

1

(i) 5.12 / 122 (= 0.042 mol)

method mark

1

(0.042/0.04) × 100 = 105 %

ecf for M1/0.04

or calculation that 0.04 mol of benzoic = 4.88 g (M1) so

% yield = (5.12/4.88) × 100 = 105%

1

Product not dried / impurities present in product

Only allow M3 if M2>100%

1

[18]