

Mark schemes

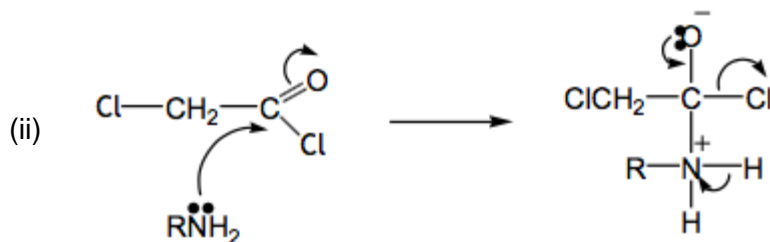
1

- (a) (i) (2-)chloroethan (-1-) oyl chloride

2 not required but penalise 1- or other numbers at start. Ignore 1 in ethanoyl

Ignore hyphens, commas, spaces

1



M1 for arrow from lp on N to C

(or to space half way between N and C)

If full amine drawn, ignore slips except in -NH₂

M2 for arrow from C=O bond to O

Not score M2 as an independent first step, but can allow M1 for attack on C+ produced

If Cl lost at this stage, Max 1 for M1

M3 for structure of ion including 2 charges

M4 for 3 arrows and lp on O

- may be scored in two steps

Ignore use of RNH₂ to remove H+ in M4, but penalise use of Cl

4

- (b) Nucleophilic substitution

Allow minor spelling errors e.g. nucleophyllic

1

- (c) 9

1

- (d) $M_r = 234(.0)$

9.4 scores 2 marks

1

$$\% \text{ H} = 9.4(0)$$

$$M2 = \frac{22}{M1} \times 100$$

If $M_r = 234$ not shown, can score M1 if their answer $\times 234 =$ their no of H

1

- (e) Tertiary amine OR 3° amine OR III° amine

Ignore N- substituted

1

- (f) (i) If **a** given: CE=0, can only score if answer given is **b**

M1 lp on N^b or on **b**

M2 alkyl groups donate electron density or positive inductive effect or electron donating groups attached

M3 (lp on N^b) more available or protonated amine stabilised or better lp donor/H⁺ acceptor

Ignore reference to nucleophiles

*NOTE – there is NO mark for **b** alone*

Alternatives

*M1 lp on N^a or on **a***

M2 lp or electrons (on N^a) delocalised into ring /towards O in C=O

M3 (lp on N^a) less available (to bond to H⁺/accept proton)

1
1
1

- (ii) Salt is ionic

Independent marks

1

(More) soluble (in blood/body fluids/water)

1

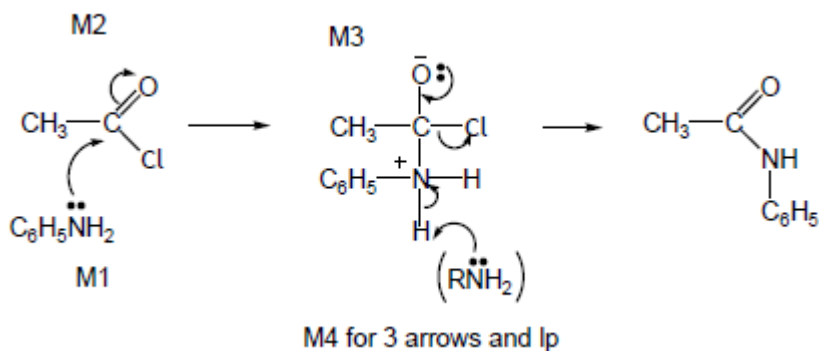
[15]

2

- (a) (nucleophilic) addition-elimination

Not electrophilic addition-elimination

1



Allow C₆H₅ or benzene ring

Allow attack by :NH₂C₆H₅

M2 not allowed independent of M1, but allow M1 for correct attack on C+

M3 for correct structure with charges but lone pair on O is part of M4

M4 (for three arrows and lone pair) can be shown in more than one structure

4

(b) **The minimum quantity of hot water was used:**

To ensure the hot solution would be saturated / crystals would form on cooling

1

The flask was left to cool before crystals were filtered off:

Yield lower if warm / solubility higher if warm

1

The crystals were compressed in the funnel:

Air passes through the sample not just round it

Allow better drying but not water squeezed out

1

A little cold water was poured through the crystals:

To wash away soluble impurities

1

(c) Water

Do not allow unreacted reagents

1

Press the sample of crystals between filter papers

Allow give the sample time to dry in air

1

(d) M_r product = 135.0

1

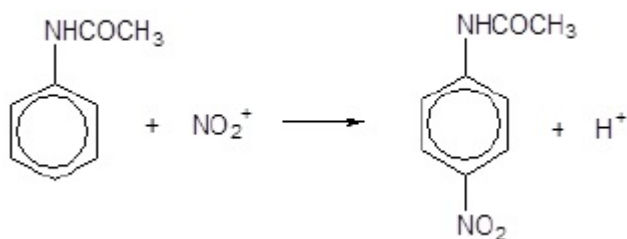
$$\text{Expected mass} = 5.05 \times \frac{135.0}{93.0} = 7.33 \text{ g}$$

1

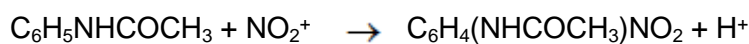
$$\text{Percentage yield} = \frac{4.82}{7.33} \times 100 = 65.75 = 65.8(\%)$$

Answer must be given to this precision

(e)



OR



1

(f) Electrophilic substitution

1

(g) Hydrolysis

1

(h) Sn / HCl

Ignore acid concentration; allow Fe / HCl

1

[18]

3

(a) (i) $(\text{CH}_3)_2\text{CHOH} + (\text{CH}_3\text{CO})_2\text{O} \rightarrow \text{CH}_3\text{COOCH}(\text{CH}_3)_2 + \text{CH}_3\text{COOH}$

Allow $\text{CH}_3\text{CO}_2\text{CH}(\text{CH}_3)_2$ and $\text{CH}_3\text{CO}_2\text{H}$

Ignore $(\text{CH}_3)_2 - \text{C}$ in equation

1

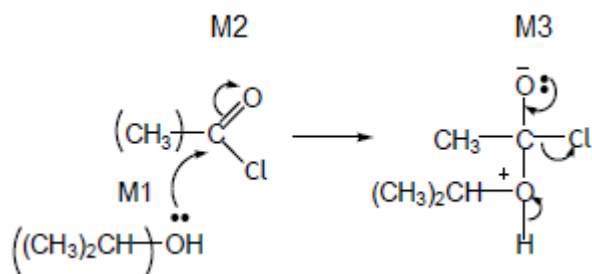
(1)-methylethyl ethanoate OR

Propan-2-yl ethanoate

Ignore extra or missing spaces, commas or hyphens

1

(ii)



M4 for 3 arrows and lp

NO Mark for name of mechanism

M1 for lone pair on O and arrow to C or to mid-point of space between O and C

M2 for arrow from C=O bond to O

- M2 not allowed independent of M1, but allow M1 for correct attack on C+
- + rather than $\delta+$ on C=O loses M2
- If Cl lost with C=O breaking, max1 for M1

M3 for correct structure with charges (penalise wrong alcohol here) but lone pair on O is part of M4

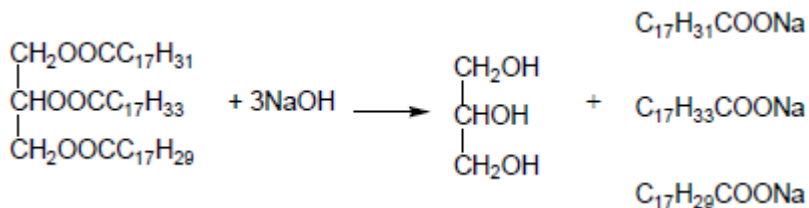
Penalise $(CH_3)_2-C$ in M3

M4 for lone pair on O and three arrows

- Only allow M4 after correct / very close M3
- M4 can be gained over more than one structure
- Ignore Cl^- removing H^+

4

(b) (i)



Penalise covalent Na e.g. -O-Na

LHS 1
RHS 1

(ii) $C_{17}H_{33}COOCH_3$

Allow $C_{19}H_{36}O_2$

1

[9]

4

- (a) (i) M_r N-phenylethanamide = 135.0 1
- Theoretical yield = $135.0 \times 2 (1.15 / 284.1) = 1.09$ g 1
- Answer recorded to 3 significant figures. 1
- (ii) $\frac{0.89}{\text{Ans to (a)}} \times 100$
= 81.4 %
Mark consequentially to (a)
Allow 81 to 82 1
- (b) (i) Dissolve the product in the **minimum** volume of water / solvent (in a boiling tube / beaker)
If dissolving is not mentioned, CE = 0 / 4 1
- Hot water / solvent
Steps must be in a logical order to score all 4 marks 1
- Allow the solution to cool and allow crystals to form. 1
- Filter off the pure product under reduced pressure / using a Buchner funnel and side arm flask
Ignore source of vacuum for filtration (electric pump, water pump, etc.) 1
- (ii) Measure the melting point 1
- Use of melting point apparatus or oil bath 1
- Sharp melting point / melting point matches data source value 1
- (iii) Any **two** from:
Product left in the beaker or glassware
Sample was still wet
Sample lost during recrystallisation.
Do not allow "sample lost" without clarification.

2 Max

(c) An identified hazard of ethanoyl chloride

*E.g. "Violent reaction", "harmful", "reacts violently with water"
Do not allow "toxic", "irritant" (unless linked with HCl gas).*

1

HCl gas / fumes released / HCl not released when ethanoic anhydride used

1

[15]

5

(a) Side-arm flask / side-arm test tube

Do not allow sealed side-arm flask.

1

Flat-bottomed filter funnel with filter paper clearly shown

Either Buchner or Hirsch versions are suitable.

Allow Hirsch funnel and horizontal filter paper.

Allow three-dimensional filter funnels.

Do not allow standard Y-shaped funnel.

Do not allow sealed funnel.

*If it is not clearly air-tight between the funnel and the flask,
maximum 1 mark.*

1

(b) Heat melting point tube in an oil bath

Accept 'melting point apparatus' or Thiele tube.

Do not accept water bath.

1

slowly near the melting point

Ignore any additional correct details.

Apply list principle for additional incorrect details.

1

[4]