**M1.**(a) (i) $(CH_3)_2CHOH + (CH_3CO)_2O \rightarrow CH_3COOCH(CH_3)_2 + CH_3COOH$

***Allow*** *$CH_3CO_2CH(CH_3)_2$ and $CH_3CO_2H$*

*Ignore $(CH_3)_2-C$ in equation*

**1**

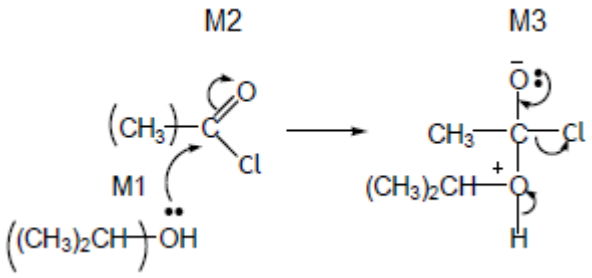
(1)-methylethyl ethanoate OR

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 δ+ on C=O loses M2*
- *If Cl lost with C=O breaking, max1 for M1*

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

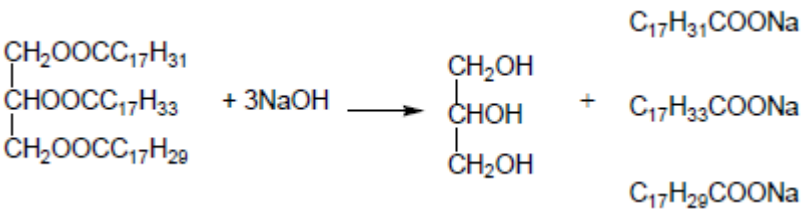
*Penalise $(CH_3)_2-C$ in M3*

*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]**

**M2.**(a) (i) $M_r$ N−phenylethanamide = 135.0

**1**

Theoretical yield = 135.0 × 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

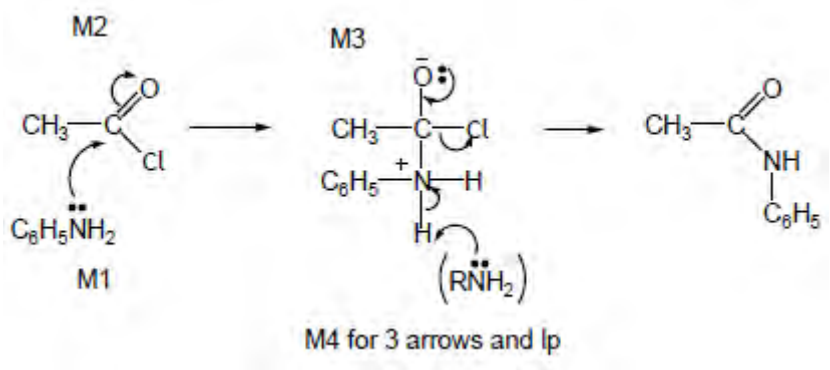
**1**

**[15]**

**M3.**(a) (nucleophilic) addition-elimination

*Not electrophilic addition-elimination*

**1**




*Allow $C_6H_5$ or benzene ring*
*Allow attack by :$NH_2C_6H_5$*
*M2 not allowed independent of M1, but allow M1 for correct*

*attack on C+*

*M3 for correct structure <u>with charges</u> 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**

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

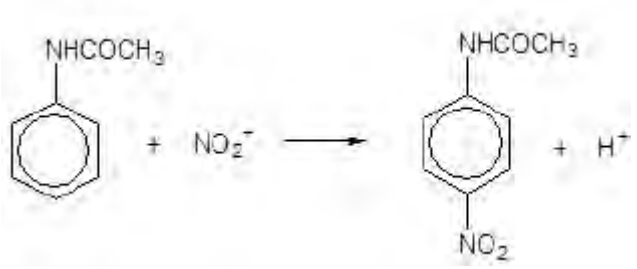
1

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

*Answer must be given to this precision*

1

(e)




OR

$C_6H_5NHCOCH_3 + NO_2^+ \rightarrow C_6H_4(NHCOCH_3)NO_2 + H^+$

1

(f) Electrophilic substitution

1

(g) Hydrolysis

1

(h) Sn / HCl

*Ignore acid concentration; allow Fe / HCl*

1

**[18]**