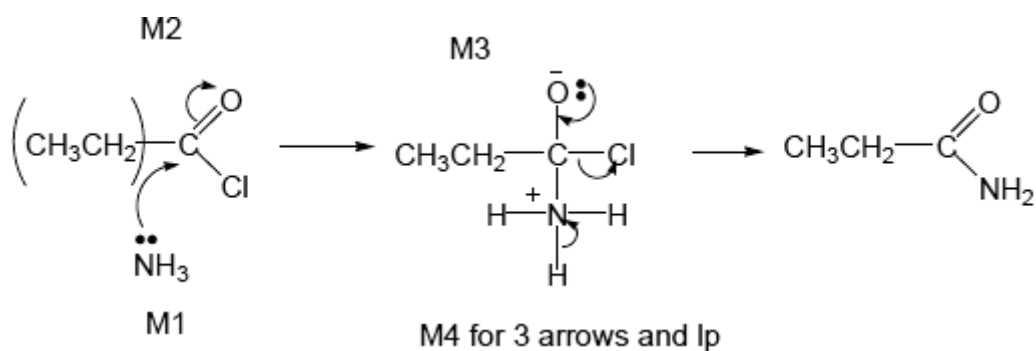


M1.(a) (Nucleophilic) addition-elimination

- *Minus sign on NH₃ loses M1 (but not M4 also)*
- *M2 not allowed independent of M1, but*

1



- *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 with charges but lp on O is part of M4***
- *only allow M4 after correct/very close M3*
- *For M4, ignore NH₃ removing H⁺ but lose M4 for Cl removing H⁺ in mechanism,*
- *but ignore HCl shown as a product*

4

propanamide (Ignore -1-)

penalise other numbers

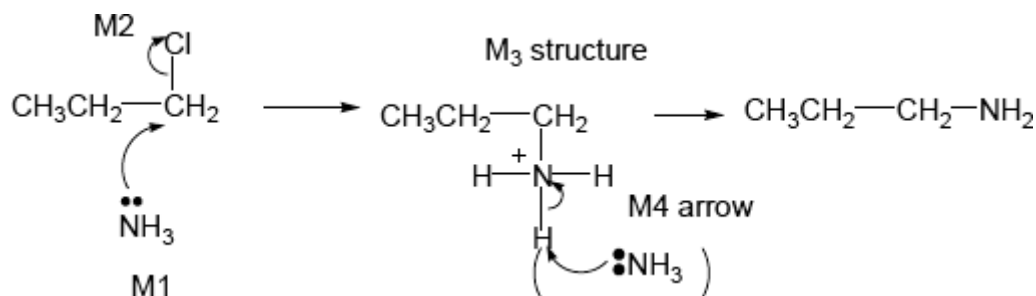
penalise propaneamide and N-propanamide

1

(b) Nucleophilic substitution

- *Minus sign on NH₃ loses M1 (not M4 also)*
- *+ rather than δ⁺ on C=O loses M2*

1



- ALLOW SN1 so allow M2 for loss of Cl⁻ before attack of NH₃ on C⁺ for M1
- only allow M4 after correct/very close M3
- For M4, ignore NH₃ removing H⁺ but lose M4 for Cl⁻ removing H⁺ in mechanism,

Propylamine (ignore number 1)

- but ignore HCl shown as a product

4

or propan-1-amine or 1-aminopropane (number 1 needed)

penalise other numbers

allow 1-propanamine

1

(c) electron rich ring or benzene or pi cloud repels nucleophile/ammonia

Allow

- C-Cl bond is short/stronger than in haloalkane
- C-Cl is less polar than in haloalkane
- resonance stabilisation between ring and Cl

1

[13]

M2. (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

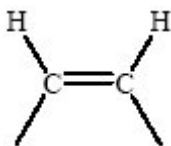
1

(b) (i) (bio)diesel

*Allow fuel for diesel engines
not biofuel, not oils*

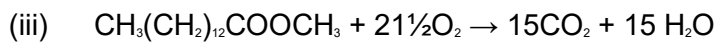
1

(ii)

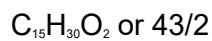


ignore anything else attached except any more H atoms.

1



OR



not allow equation doubled

1

[5]

M3.(a) (i) Green

Ignore shades of green.

1

(ii) Excess acidified potassium dichromate(VI)

1

Reflux (for some time)

1

In the diagram credit should be given for

- a vertical condenser

Lose M3 and M4 for a distillation apparatus.

1

- an apparatus which would clearly work

Do not allow this mark for a flask drawn on its own.

Penalise diagrams where the apparatus is sealed.

1

(iii) Distillation

1

Immediately (the reagents are mixed)

1

(b) Keep away from naked flames

Allow heat with water-bath or heating mantle.

If a list is given ignore eye protection, otherwise lose this mark.

1

(c) (i) Tollens' or Fehling's reagents

*Incorrect reagent(s) loses **both** marks.*

Accept mis-spellings if meaning is clear.

1

Silver mirror / red ppt. formed

Accept 'blue to red' but not 'red' alone.

1

(ii) Sodium carbonate (solution) / Group II metal

Allow indicator solutions with appropriate colours.

Accept any named carbonate or hydrogen carbonate.

1

Effervescence / evolves a gas

Accept 'fizzes'.

1

(d) Propanoic acid

If this mark is lost allow one mark if there is reference to stronger intermolecular forces in the named compound.

Lose M1 and M3.

1

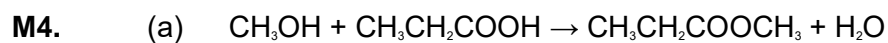
Contains hydrogen bonding

1

Some comparison with other compounds explaining that the intermolecular forces are stronger in propanoic acid

1

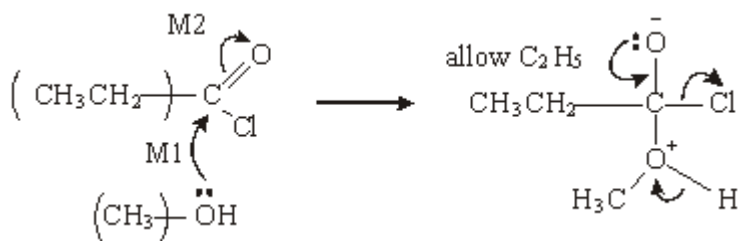
[15]



1

(b) (nucleophilic) addition-elimination NOT acylation

1



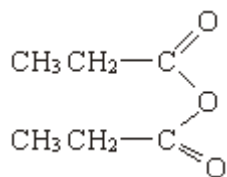
ignore use of Cl- to remove H+

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
- (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

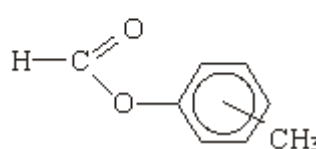
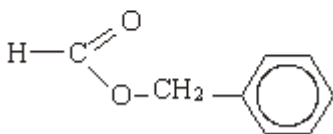
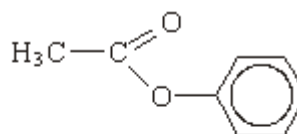
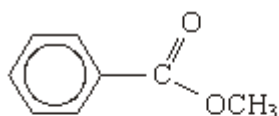
1

1

- (e) (i) $C_8H_8O_2$

1

- (ii) **any two from**



Allow $-CO_2-$ allow C_6H_5

2

[12]

- M5.** (a) mol $CH_3OH = 0.07(0)$

1

mol $H_2 = 0.24(0)$

(b) (i)
$$\frac{[\text{CH}_3\text{OH}]}{[\text{CO}][\text{H}_2]^2} \text{ or } \frac{(0.082/1.5)}{(0.210/1.5)(0.275/1.5)^2}$$

allow () but expression using formulae must have brackets
alternative expression using numbers must include volumes

1

- (ii) **M1** divides by vol
Mark independently from (b)(i)
any AE is -1
if volume missed, can score only M3 and M4

1

M2
$$\frac{(0.082/1.5)}{(0.210/1.5)(0.275/1.5)^2} \quad \left(= \frac{(0.05467)}{(0.14)(0.1833)^2} \right)$$

mark is for correct insertion of correct numbers in correct Kc expression in b(ii)
If Kc expression wrong, can only score M1 & M4
If numbers rounded, allow M2 but check range for M3

1

- M3** 11.6 or 11.7
mark for answer
above 11.7 up to 12.2 scores 2 for M1 and M2
if vol missed, can score M3 for 5.16 (allow range 4.88 to 5.21)

1

- M4** mol⁻² dm⁶
Units conseq to their Kc in (b)(ii)

1

- (iii) no effect or no change or none

1

- (c) **M1** T₁
if wrong - no further marks

1

- M2** (forward) reaction is exothermic **OR** gives out heat
backward reaction is endothermic
only award M3 if M2 is correct

1

M3 shifts to RHS to replace lost heat

OR to increase the temperature

OR to oppose fall in temp

backward reaction takes in heat

OR to lower the temperature

not just to oppose the change

1

(d) fossil fuels used

OR

CO₂ H₂O produced/given off/formed which are greenhouse gases

OR

SO₂ produced/given off/formed which causes acid rain

OR

Carbon produced/given off/formed causes global dimming

not allow electricity is expensive

ignore just global warming

ignore energy or hazard discussion

1

(e) C₁₇H₃₅COOCH₃ or C₁₇H₃₁COOCH₃ or C₁₇H₂₉COOCH₃

OR

CH₃OOCC₁₇H₃₅ or CH₃OOCC₁₇H₃₁ or CH₃OOCC₁₇H₂₉

1

[13]