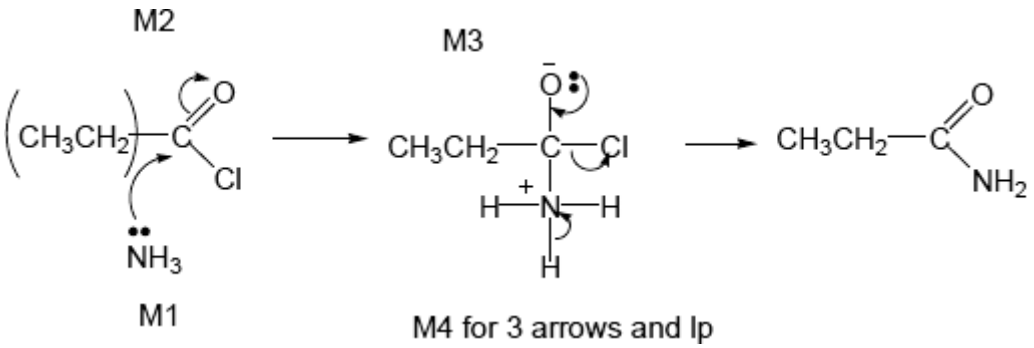
M1.(a) (Nucleophilic) addition-elimination

- *Minus sign on NH_3 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 <u>with charges</u> but lp on O is part of* ***M4***
- *only allow* ***M4*** *after correct/very close* ***M3***
- *For* ***M4****, ignore NH_3 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

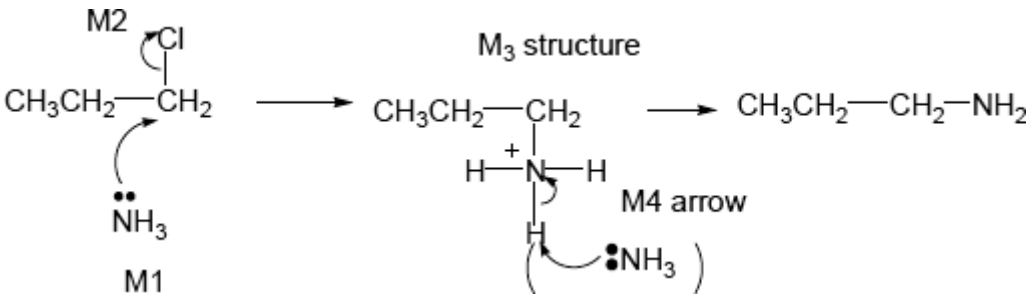
penalise propaneamide and N-propanamide

1

(b) Nucleophilic substitution

- *Minus sign on NH_3 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 NH_3 on C+ for M1*
- *only allow M4 after correct/very close M3*
- *For M4, ignore NH_3 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

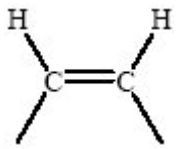
1

(b) (i) (bio)<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]

M3.(a) (i) Green

Ignore shades of green.

1

(ii) <u>Excess</u> 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

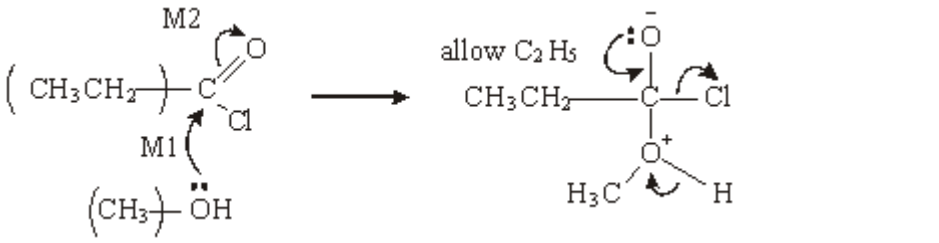
[15]

M4. (a) $CH_3OH + CH_3CH_2COOH \rightarrow CH_3CH_2COOCH_3 + H_2O$

1

(b) (nucleophilic) addition–elimination NOT acylation

1



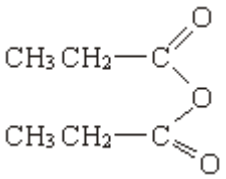
ignore use of Cl^- to remove H^+

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

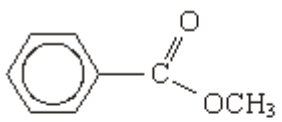
(ii) anhydride less easily hydrolysed or reaction less violent/exothermic
no (corrosive) (HCl) fumes formed or safer or less toxic/dangerous
expense of acid chloride or anhydride cheaper
any one

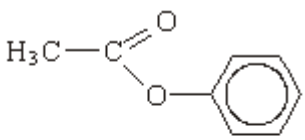
1

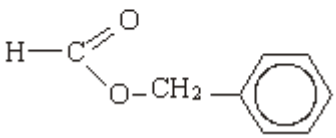
(e) (i) $C_8H_8O_2$

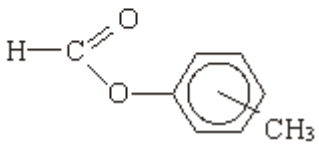
1

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









Allow $–CO_2–$ *allow C_6H_5*

2

[12]

M5. (a) mol CH_3OH = 0.07(0)

1

mol H_2 = 0.24(0)

1

(b) (i) $\frac{[CH_3OH]}{[CO][H_2]^2}$ 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 $\frac{(0.082/1.5)}{(0.210/1.5)(0.275/1.5)^2}$ $\left(= \frac{(0.05467)}{(0.14)(0.1833)^2}\right)$

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 $mol^{-2}\ dm^6$

Units conseq to their Kc in (b)(ii)

1

(iii) no effect or no change or none

1

(c) **M1** T_1

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 <u>to replace lost heat</u>

OR <u>to increase the temperature</u>

OR <u>to oppose fall in temp</u>

backward reaction takes in heat

OR to lower the temperature

not just to oppose the change

1

(d) fossil fuels used

OR

CO_2 H_2O produced/given off/formed which are <u>greenhouse gases</u>

OR

SO_2 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) $C_{17}H_{35}COOCH_3$ **or** $C_{17}H_{31}COOCH_3$ or $C_{17}H_{29}COOCH_3$

OR

$CH_3OOCC_{17}H_{35}$ or $CH_3OOCC_{17}H_{31}$ or $CH_3OOCC_{17}H_{29}$

1

[13]