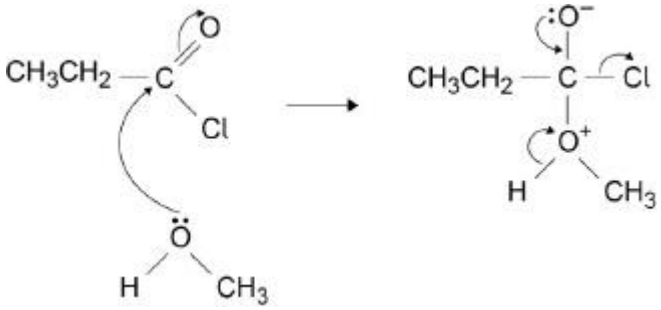
Name of the Student:_____
Max. Marks : 29 Marks **Time : 29 Minutes**

Mark Schemes

Q1.

(a)



M1 Structures of reactant species

M2 Arrow from lp on O to C

M3 Arrow from C=O bond to O

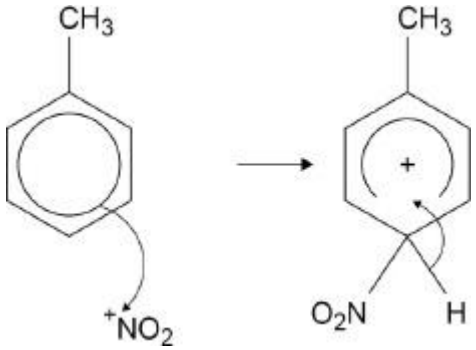
M4 3 curly arrows and lp on intermediate

Allow full marks for candidates who draw a second intermediate formed after formation of C=O and loss of Cl^- then loss of H^+

Ignore any attempt to show the final products

4

(b)



M1 Structures of reactant species including + on N of $^+NO_2$

M2 Arrow from ring (inside hexagon) to N or + on N

M3 Arrow from C-H bond into hexagon

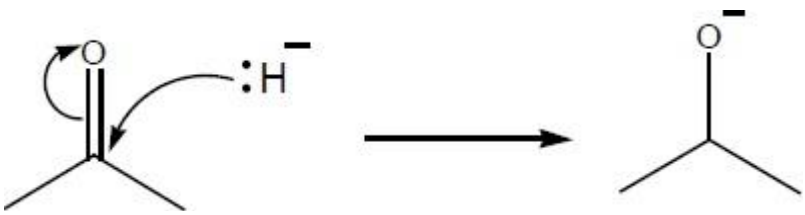
M4 Electrophilic substitution

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Apply list principle

4

(c)



M1 Arrow from lp on hydride to C

M2 Arrow from C=O to O

M3 Intermediate structure / Allow displayed or abbreviated structures
Ignore any attempt to show further steps if correct Penalise further incorrect steps

M4 Nucleophilic addition

Apply list principle

4

[12]

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Q2.

(a) catalyst

ALLOW *reduces* E_a
IGNORE *speeds up reaction*
IGNORE *provides alternative path*
IGNORE *proton donor*
IGNORE *dehydrating agent*

1

(b) electric heater/heat mantle or (hot) water bath

IGNORE *not with a Bunsen/naked flame / gently*
ALLOW *hot water*
ALLOW *heating/hot plate/ sand bath / oil bath*
ALLOW *reference to flame/Bunsen if in context of heating a water bath*
NOT *any indication of direct heat from Bunsen*

1

(c) **M1** there is a bung/stopper (in the end of the condenser)

M2 idea of pressure build up

owtte
M2 *stopper could be forced out*
IGNORE *glass shatters / explodes*

M3 water goes the wrong way through the condenser

M4 water does not fill the condenser / condenser is not cool enough

water in at top / out at bottom
IGNORE *condenser is wrong way round*
ALLOW *less condensing / vapour/gas/reactants/products will not condense / not as effective at cooling/condensing vapour/reactants/products escapes*
IGNORE *uneven cooling*
NOT *mixture in flask not cooled*
ALLOW M1/M3 *neck of flask not sealed owtte*
M2/M4 *vapour/reactants/products can escape*
IGNORE *references to clamps*

4

(d) **M1** to neutralise/react with/remove the <u>acid</u>

ALLOW *carboxylic/ethanoic and/or sulfuric*
IGNORE *react with/neutralise the distillate/mixture*
IGNORE *to act as a base*
NOT *if incorrect acid named*

M2 carbon dioxide / gas is produced

ALLOW *effervescence / bubbles / fizzes*
IGNORE *water vapour produced*
NOT *if incorrect gas named*
IGNORE *pressure build up (as in Q)*

2

(e) **M1** ethyl ethanoate/it is immiscible with / insoluble in water

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ALLOW *water/solution and ethyl ethanoate/it do not mix,*
OR *aqueous and organic layers do not mix*
ALLOW *ethyl ethanoate/it is hydrophobic*
IGNORE *references to polarity / intermolecular forces*

M2 ethyl ethanoate/it is less dense / has lower density (than water)
IGNORE *different/low density*
NOT *lighter*
ALLOW *answers for either mark from either part*

2

(f) to remove/absorb water / as a drying agent
ALLOW *reacts with water*
ALLOW *to dry the product/it*
IGNORE *dehydrates*
NOT *reference to crystals forming*
NOT *to dry the reactants*
NOT *to remove soluble impurities*

1

(g) **M1** mass of ethanol = 10 x 0.790 (= 7.90 g)

M2 amount of ethanol = $\frac{7.90}{46.0}$ (= 0.172 mol) **AND**

amount of ethanoic acid = $\frac{5.25}{60.0}$ (= 0.0875 mol)

M3 (limiting reagent is) ethanoic acid

M4 (max amount of ethyl ethanoate = 0.0875 mol)

max mass of ethyl ethanoate = 88.0 x 0.0875 (= 7.70 g)

M5 % yield = $\frac{5.47}{\text{M4}}$ x 100 = 71.0% (70.6 to 71.1 to min 2sf)
Allow ECF at each stage
M1 *scores from 0.172 mol of ethanol*
M2 *need to see numbers or sums for both substances*
M2 *10/46 can only be ECF if 10 is identified as a mass*
M3 *ECF from* ***M2*** *if both amounts clearly shown and* $n_{ethanol} < n_{ethanoic\ acid}$
M4 *independent of* ***M3***
Alternative ***M4 & 5***
M4 *Amount of ethyl ethanoate formed*
$= \frac{5.47}{88.0}$ *(=0.0622)*
M5 *% yield =* $\frac{\text{M4}}{0.0875}$ *x 100 = 71.0%*
Correct answer scores M4 and M5 but mark M1/2/3 separately
M5 *must show an attempt at mass or moles of ester formed divided by mass or moles of ester expected*

5

(h) reaction is an equilibrium/reversible
ALLOW *losses during*

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distillation/isolation/purification/transfer / incomplete distillation / side reactions / byproducts

ALLOW *incomplete reaction*

ALLOW *impurities/contamination/water present / not dry*

IGNORE *water is also produced (during the reaction)*

1

[17]

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