UMTA CHEMISTRY P525/2 PROPOSED MARKING GUIDE.

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1a) (i) Colligative property; This is the physical properties of a dilute solution which depends on the number of non-volatile solute dissolved in a solvent but not on the chemical nature of the solute. (01)

Deny if the key points are missing

ii Depression in freezing point
Lowering of vapour pressure (01)

29/20

b) An experiment to determine the relative formula mass of glucose by boiling point elevation method.

A known mass of pure solvent, a g is placed in a wide tube fitted with a side arm leading to a reflux condenser. The boiling tube is closed by a stopper through which is passed a second inner tube, open at the lower end and fitted with a Beckmann thermometer.

In a liquid is immersed cottrell pump to prevent super heating (09)

- Diagram wasn't required
- Units of temperature would be specified
- Experiment would have logical flows.

The pure solvent is then heated untill the Beckmann thermometer shows a constant temperature and the boiling point T_b^o is measured.

A known mass of glucose, bg is then added through the side arm to the solvent.

The resulting solution is also heated untill the Beckmann thermometer shows a constant Temperature and the boiling point of a solution T_b is also measured.

Treatement of Results

Kb should have units and they must be correct.

Reject $\Delta T_b = (T_b^o - T_b)°C$

Mass of pure solvent = ag

Mass of solute (glucose) = bg

Let the boiling point elevation constant be K_b °C mol^{-1} kg^{-1}

Elevation in boiling point $\Delta T_b = (T_b - T_b^o)°C$

a grams of pure solvent dissolves bg of glucose

1000g of solvent dissolves $\left(\frac{b \times 1000}{a}\right)$g of glucose

ΔT_b is the elevation in boiling point caused by $\left(\frac{b \times 1000}{a}\right)$g of glucose

K_b will be the elevation in boiling point caused by $\left(\frac{b \times 1000 \times K_b}{a \times \Delta T_b}\right)$g of glucose.

The relative formula mass of glucose is $\left(\frac{1000 \times b \times K_b}{a \times \Delta T_b}\right)$

Reject; molecular mass since the question wanted RFM

Reject; with units.

1(c)

Mass of water = Volume × Density

Assumption; Density of water = $1 g cm^{-3}$

Mass of water = 250 × 1

= 250g

let $\Delta T °c$ be elevation in boiling point of

0.25Kg of water dissolves 0.009kg of glucose

1000Kgs of water dissolves $\left(\frac{1000 \times 0.009}{0.25000}\right)$kg of glucose.

$\Delta T °c$ is the elevation in boiling point caused by $\left(\frac{1000 \times 0.009}{0.25000}\right)$kg of glucose

0.52°c is the elevation in boiling point caused by $\left(\frac{1000 \times 0.009 \times 0.52}{0.25000 \times \Delta T}\right)$ kg of glucose

The Relative formula mass of glucose = $\frac{1000 \times 0.009 \times 0.52}{0.25 \times \Delta T}$

$$\frac{1000 \times 0.009 \times 0.52}{0.25 \times \Delta T} = 180$$

$$\Delta T = 0.104°c$$

Reject; substitution into a given formula; Only accepts first principles.
- The final answer must have correct units.

But $\Delta T = Tb_{solution} - Tb_{solvent}$.

$Tb_{solution}$ = 100.104°c (Boiling point of solution)

Hence,

0.25Kg of water dissolves 0.00146kg of sodium chloride

1000 Kg of water dissolves $\left(\frac{0.00146 \times 1000}{0.25}\right)$ kg of sodium chloride.

0.104°c is the elevation in boiling point caused by 5.84kg of sodium chloride

0.52°c will be the elevation in boiling point caused by $\left(\frac{5.84 \times 0.52}{0.104}\right)$

Relative molecular mass of sodium chloride in water is 29.2

RFM should not have units.

04

chloride (½)
Sodium ~~Glucose~~ chloride does not react with water ✗
Density of water is $1\,g\,cm^{-3}$ ✗
Sodium ~~Glucose~~ Chloride is non-volatile
Solution of ~~glucose~~ sodium chloride and water is dilute

Any two
Deny; if a solute and solvent in question is not clearly stated

01

d) The relative molecular mass of sodium chloride in water is a half the theoretical R.F.M of sodium chloride. This is because sodium chloride dissociates to form sodium ion and chloride ion in water. The number of sodium chloride in water solution is twice the original number in the pure solute. This elevates the boiling point further but decreasing the relative molecular mass to half the actual value.

phasize
sociates

04

QN. 3 . (a)

$$CH_3\underset{CH_3}{\overset{I}{C}}CH_2CH_3 \xrightarrow[heat]{Na(OH)\,(aq)} CH_3\underset{CH_3}{\overset{OH}{C}}CH_2CH_3 .$$

Strictly SN_1 mechanism.

Mechanism $NaOH \longrightarrow Na^+(aq) + \bar{O}H(aq)$.

$$(CH_3)_2\overset{CH_2CH_3}{C}-I \underset{}{\overset{slow}{\rightleftharpoons}} (CH_3)_2\overset{CH_2CH_3}{C^+} + I^-(aq) \longrightarrow (CH_3)_2\underset{OH}{C}CH_2CH_3$$

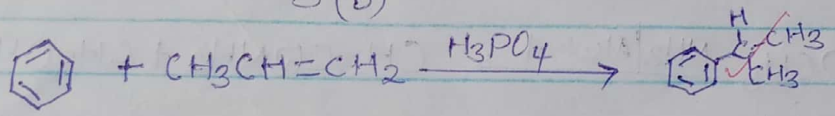
Deny;
- Hanging arrows
- Hanging bonds

$Na^+ + I^-(aq) \longrightarrow NaI(aq)$ } Can be ignored.

03

3 (b)

Stop marking where wrong mechanism starts; deny marks for all the following procedures.



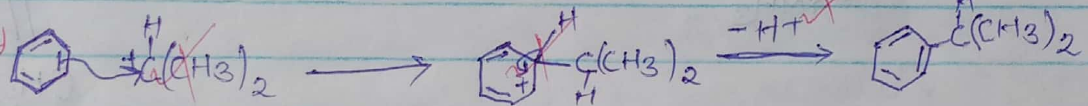
$H_3PO_4(aq) \longrightarrow H^+(aq) + H_2PO_4^-(aq)$

Deny wrong chemical symbols.

3½

Deny all marks electrophile not correctly generated

$CH_3CH=CH_2 \xrightarrow{H^+} (CH_3)_2\overset{+}{C}H$



3(c)

$$C_6H_5COOH + CH_3CH_2OH \underset{}{\overset{HCl(aq)}{\rightleftharpoons}} C_6H_5COOCH_2CH_3 + HCl$$

Emphasise ... in HCl

$HCl(aq) \longrightarrow H^+(aq) + Cl^-(aq)$.

03

½ mk

lone pairs not clearly shown.

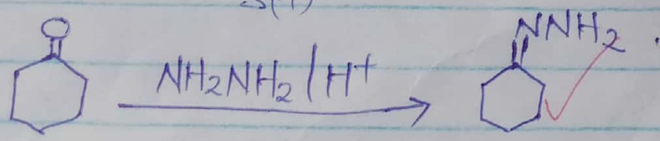
$$C_6H_5\overset{O}{\overset{\|}{C}}-OH \xrightarrow{H^+} C_6H_5\overset{\overset{+}{O}H}{C}-OH \xrightarrow{CH_3CH_2\ddot{O}H} C_6H_5\underset{OH}{\overset{OH}{C}}-\underset{H}{\overset{+}{O}}CH_2CH_3$$

$\rightleftharpoons$ H^+ shift

Strictly reversible should be used for H^+ shift

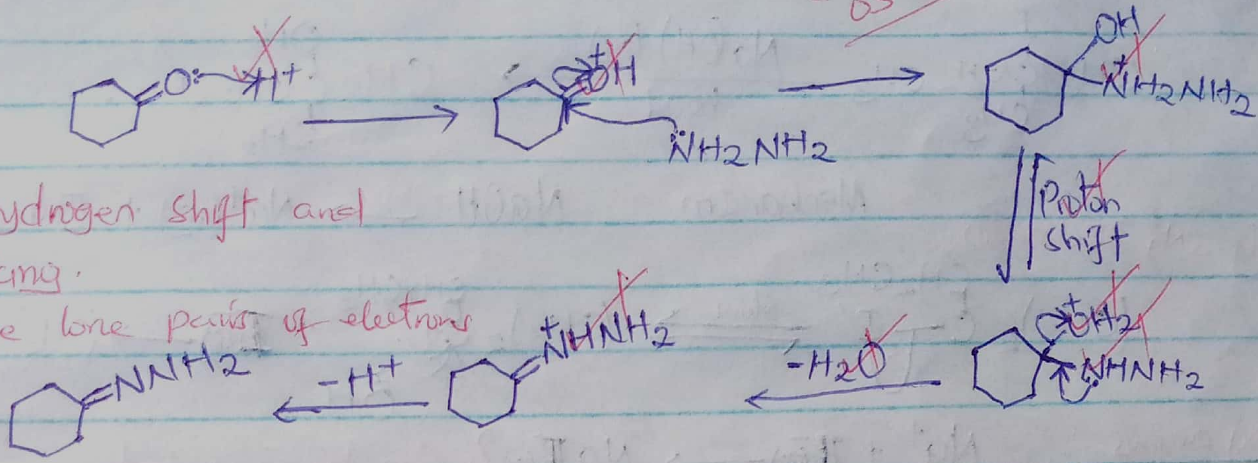
$$C_6H_5\overset{O}{\overset{\|}{C}}OCH_2CH_3 \xleftarrow{-H^+} C_6H_5\overset{\overset{+}{O}H}{\overset{\|}{C}}OCH_2CH_3 \xleftarrow{-H_2O} C_6H_5\underset{OH}{\overset{\overset{+}{O}H_2}{C}}-OCH_2CH_3$$

3(d)



Mechanism.

05



Deny; Hydrogen shift and stop marking.
Emphasize lone pairs of electrons

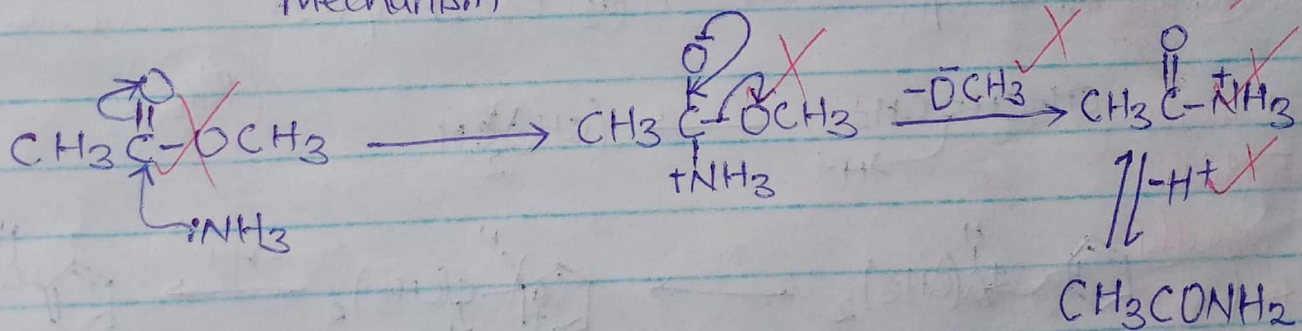
3(e).

$CH_3COOCH_3 \xrightarrow{NH_3/Alcohol} CH_3CONH_2 + CH_3OH$.

Accept; conc. Ammonia.

03½

Mechanism



QN