Do not write in this margin

Random No.

Personal Number

Paper code ...../.....

-01-

JTEB – 2024 – Mock

P525/1

CHEMISTRY DRAFT MARKING GUIDE

SECTION – A (46 MARKS)

1(a) $^{235}_{92}U + {}^{1}_{0}n \longrightarrow (^{72}_{30}Zn) + 4\,{}^{1}_{0}n + {}^{160}_{62}Sm$ (01)

element shd be identified and eqn balanced.

(b) Conditions:- Passing dry chlorine over heated Zinc

- Passing (hydrogen chloride gas) over heated Zinc.

Equation(s): $Zn_{(s)} + Cl_{2(g)} \longrightarrow ZnCl_{2(s)}$ (02½)

or $Zn_{(s)} + 2HCl_{(g)} \longrightarrow ZnCl_{2(s)} + H_{2(g)}$

(c) observation: Grey-white solid dissolves forming a colourless solution effervescence/bubbles of colourless gas. (02½)

Equation(s)

$Zn_{(s)} + 2OH^-_{(aq)} + 4H_2O_{(l)} \longrightarrow [Zn(OH)_4(H_2O)_2]^{2-}_{(aq)} + H_{2(g)}$

OR $Zn_{(s)} + 2OH^-_{(aq)} + 2H_2O_{(l)} \longrightarrow Zn(OH)_4^{2-}{}_{(aq)} + H_{2(g)}$ 06

2 (a) $C_xH_{y(g)} + (x+y/4)O_{2(g)} \longrightarrow xCO_{2(g)} + y/2\,H_2O_{(g)}$ ✓✓ (01½)

(b)(i) Volume of CO_2 = 185 − 125

= 60 cm^3 ✓

20x = 60

x = 3 ✓

Volume of Oxygen used = 205 − 125

= 80 cm^3 ✓

$20(3+y/4) = 80$ (02½)

$60 + 5y = 80$

$y = 4$ ✓

Molecular formula of R is C_3H_4 ✓ (rej $CH_3C{\equiv}CH$)

(ii) R is Propyne / $CH_3C{\equiv}CH$ ✓ (01½)

(iii) $Mg_2C_{3(s)} + 4H_2O_{(l)} \longrightarrow C_3H_{4(g)} + 2Mg(OH)_{2(s)}$ (rej MgC_2)

✓✓ (01½)

FOR (All equations deduct ½ mark if state is missing or wrong)

(Equation should balance with Correct Symbols and States) [06]

3 (a) observation; Brown fumes and yellow solid

$H_2S_{(g)} + 2HNO_{3(aq)} \longrightarrow 2H_2O_{(l)} + 2NO_{2(g)} + S_{(s)}$ (02½)

OR { Brown fumes and colourless solution

$H_2S_{(g)} + 8HNO_{3(aq)} \longrightarrow 4H_2O_{(l)} + 8NO_{2(g)} + H_2SO_{4(aq)}$ (02½)

(b) observation; White solid/ppt/precipitate
Bubbles/effervescence of colourless gas (02½)

$2Al^{3+}_{(aq)} + 3H_2O_{(l)} + 3CO^{2-}_{3(aq)} \longrightarrow 3CO_{2(g)} + 2Al(OH)_{3(s)}$

OR $2Al(H_2O)^{3+}_{6(aq)} + 3CO^{2-}_{3(aq)} \longrightarrow 3CO_{2(g)} + 2Al(OH)_{3(s)} + 9H_2O_{(l)}$

(accept any other correct alternative eqn) 05

4 (a) (i) $HO-\overset{O}{\overset{\|}{C}}-(CH_2)_4-\overset{O}{\overset{\|}{C}}-OH$ hexane-1,6-dioic acid

deny for name if structure is wrong. $H_2N(CH_2)_6NH_2$ 1,6-diamino hexane (02)

(ii) Condensation polymerisation (01)

(b) $n\ HO\overset{O}{\overset{\|}{C}}(CH_2)_4\overset{O}{\overset{\|}{C}}OH + n\ H_2N(CH_2)_6NH_2 \xrightarrow[H_2O]{CCl_4} \left[\overset{H}{\overset{|}{N}}(CH_2)_6\overset{H}{\overset{|}{N}}-\overset{O}{\overset{\|}{C}}(CH_2)_4\overset{O}{\overset{\|}{C}}\right]_n + n\ H_2O$

(ignore states) (200–300°C) (01)

Do not write in this margin

Candidate's Name .....

Signature .....

Subject ..... Paper code ...../.....

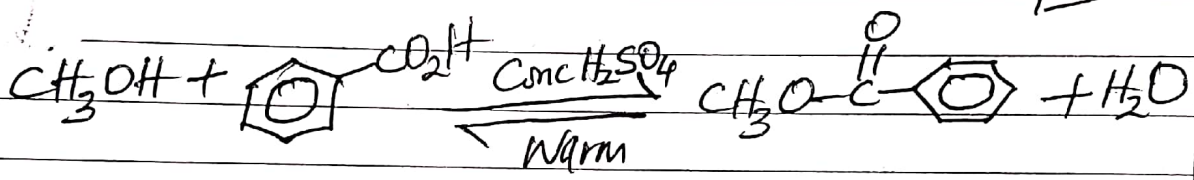
Random No.						
Personal Number						04

C(i) accept any correct use
– making fishing/mosquito nets, threads, ropes, Surgical gloves moulded gears, tyre cords, tufted carpets or curtains. ✓ (0½)

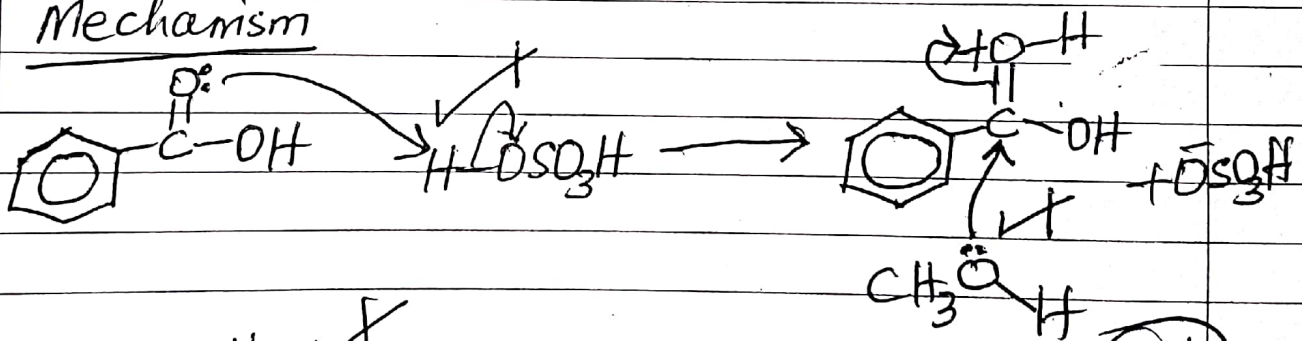
(ii) Nylon 6,6 – can be used in acidic or alkaline media, thus resistant to wear and tear. ✓ (0½)

05

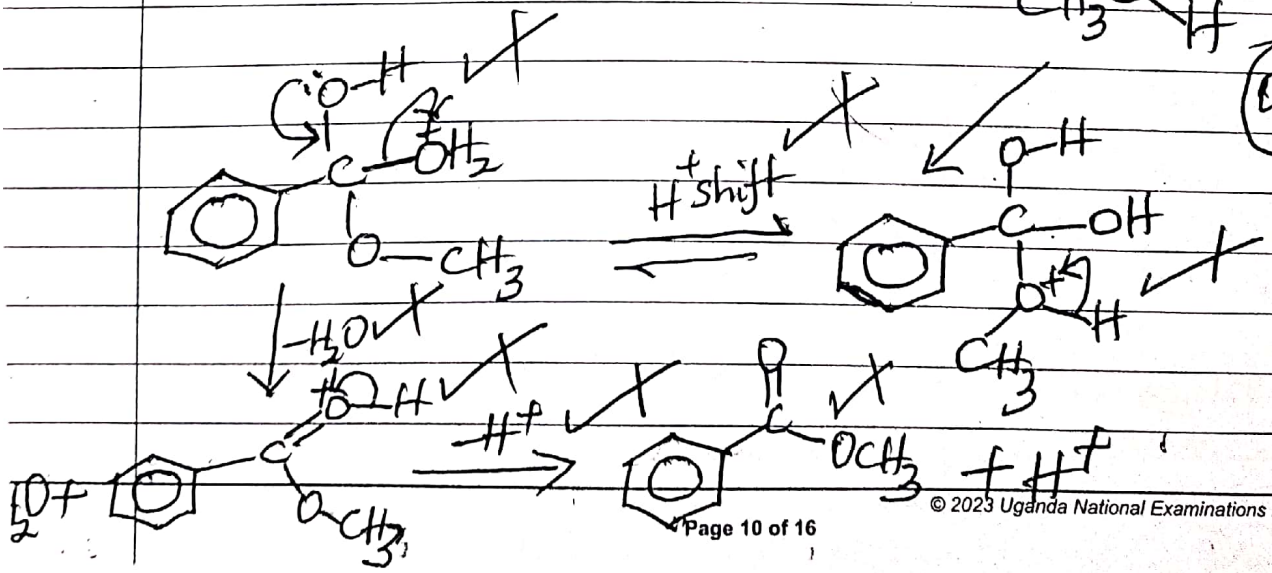
5



Mechanism



(04½)



(0½)

Candidate's Name .....

Signature .....

Subject ..... Paper code ...../.....

Random No.						
Personal Number						

Do not write in this margin

-05-

6 (a) A transition element is an element in the periodic table with a partially filled 3d-orbital as an atom or ion whereas a d-block element has electrons filling the outermost 3d-orbital ✓ (02)

(b) (i) Electronic configuration of Zn is

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10}$ ✓✗ (01½)

(ii) • Zinc compounds are white and aqueous solution containing zinc ions or compounds are colourless ✓

• Zinc forms compounds in only one oxidation state of +2 and has a completely filled 3d-orbital as an atom / ion ✓ (02)

(c) $2Zn^{2+}_{(aq)} + Fe(CN)^{4-}_{6(aq)} \longrightarrow Zn_2[Fe(CN)_6]_{(s)}$ ✓✗

observation; White ppt ✓✗ (02)

06½

rite this argin

Signature .....

Subject ..... Paper code ...../.....

Random No.					
Personal Number					

06

7 (a) Hess's law states that the heat evolved or absorbed in a chemical reaction is the same irrespective of the steps undertaken by the reaction provided the physical states of the reactants and products remain the same. (accept any other correct alternative version) ✓ (01)

(b) eqn for rxn = eqn (i) + eqn (iii) reversed + 2 eqn (ii) ✓ (03)

$\Delta H_r = -283.0 + 715 + 2(-285.8)$ ✓

$= -139.6$ ✓ (04)

OR

$CO_{(g)} + 2H_{2(g)} \xrightarrow{\Delta H_r} CH_3OH_{(l)}$

-283 $\frac{1}{2}O_2$ $2(-285.8)O_2$ $+715$ $\frac{3}{2}O_2$ ✓

$CO_{2(g)} + 2H_2O_{(l)}$

$\Delta H_r = -283 + 2(-285.8) - -715$ ✓

$= -139.6$ ✓

8 (a) The acid dissociation constants, K_a of the acids increases from HF → HI ✓ (01)

10-

Signature .....
Subject ..... Paper code ...../.....

Random No.					
Personal Number					

write in this margin

-07-

(b) From the above data acid strength increases from (HF → HCl → HBr → HI). the atomic radius increases and electronegativity of the bonding halogen atoms decreases from F → I, thus the tendency to attract bonding electrons, bond polarity / bond energy / bond strength decreases. The tendency of the acids to dissociate in aqueous solutions to release hydrogen ions increases. (04)

Notably Hydrogen fluoride molecules tends to associate through intermolecular hydrogen bonds, this inhibits ionisation of hydrofluoric acid thus this acid is very weak compared to other halogen acids. (05)

9 (a) Steam distillation is a method of isolating a volatile liquid immiscible with water at a lower temperature from a liquid or solid also immiscible or insoluble in water by passing steam to the mixture. (01)

(b) V.P of nitrobenzene = 731 − 711.5 = 19.5 mmHg

$$\frac{n_A}{m_W} = \frac{VP_n \times Mr_n}{VP_W \times Mr_W}$$ (02½)

$$0.188 = \frac{19.5 \times Mr_n}{711.5 \times 18}$$

$$Mr_n = 123.473$$

Do not write in this margin

Signature .....

Subject ..... Paper code ...../.....

Random No.

Personal Number

(c) • Adsorption ½ accept any correct method (0½)
• Solvent extraction
• chemical method (addition of Quicklime or Concentrated Sulphuric acid)

* Distillation (rej).

04

SECTION B (54 MARKS)

10. a) $2NO_{2(g)} + H_2O_{(l)} \longrightarrow HNO_{3(aq)} + HNO_{2(aq)}$ ½½

OR

$4NO_{2(g)} + O_{2(g)} + 2H_2O_{(l)} \longrightarrow 4HNO_{3(aq)}$ (01½)

(b) i) $K_c = \dfrac{[NO_2]^2}{[NO]^2[O_2]}$ ✓ (01)

ii) No of moles of O_2 reacted = 3 − 1 = 2mols ✓

No of moles of NO_2 formed = No of moles of NO reacted

= (2 × 2) = 4mols ✓✓

No of moles of NO at eqm = 6 − 4 = 2mols ✓

$K_c = \dfrac{4^2}{2^2(1)}$ ✓ = 4 ✓ (03½)

09

(iii) No of moles of NO at eqm $= \frac{25}{100} \times 6 = 1.5$ mols

No of moles of NO reacted $= 6 - 1.5 = 4.5$ mols

∴ No of moles of NO_2 formed $= 4.5$ mols

No of moles of O_2 reacted $= \frac{1}{2} \times 4.5 = 2.25$ mols

No of moles of O_2 at eqm $= 3 - 2.25 = 0.75$ mols

$$K_c = \frac{(4.5)^2}{(1.5)^2 . 0.75} = \frac{20.25}{1.6875}$$

$K_c = 12$

(c) The forward reaction is endothermic because increase in temperature increases value for K_c (01)

09

11. (a) The carbon dioxide in air dissolves in solution forming a weak carbonic acid. Thus, the few hydrogen ions in solution from carbonic acid react with the thiosulphate ions in solution forming water, sulphur dioxide and a yellow ppt of sulphur which makes solution cloudy (03)

$$S_2O_3^{2-}(aq) + 2H^+(aq) \longrightarrow H_2O_{(l)} + SO_{2(g)} + S_{(s)}$$

(b) Sodium chloride is a giant ionic solid ✓ composed of sodium ions and chloride ions exhibiting a strong electrostatic attraction and joined by a strong and purely ionic bond which required a greater amount of energy to break. ✓

Al^{3+} ions in aluminium chloride have a higher charge density than the Na^+ ion in sodium chloride ✓ thus Al^{3+} ion strongly polarises ✓ the chloride anion than the Sodium ion, this makes the ionic bonds in $AlCl_3$ more covalent. ✓ (03)

$AlCl_3$ molecules tend dimerise as they are joined by weaker dative bonds in vapour phase. A smaller amount of energy is ✓ required to break the covalent bonds and overcome the weaker intermolecular forces.

(c) Zinc sulphide has a relatively higher lattice energy than hydration energy. Thus its enthalpy of solution is endothermic making it sparingly soluble in water ✓

$$ZnS_{(s)} + (aq) \rightleftharpoons Zn^{2+}_{(aq)} + S^{2-}_{(aq)}$$ ✓

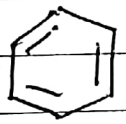
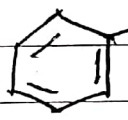
In dilute hydrochloric acid the chloride ions in solution react with zinc ions forming

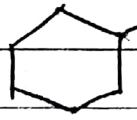
a soluble complex of tetrachlorozincate(II) ions.

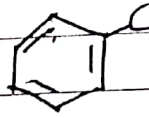
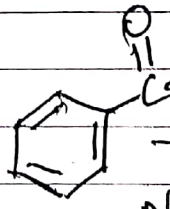
$$Zn^{2+}_{(aq)} + 4Cl^-_{(aq)} \rightleftharpoons ZnCl^{2-}_{4(aq)}$$ (03)

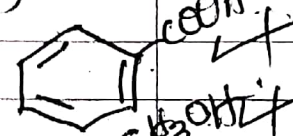
12 (a) $CH_3CH=CH_2 \xrightarrow[\text{Warm}]{H_2O/H^+} CH_3-\underset{OH}{CH}-CH_3$

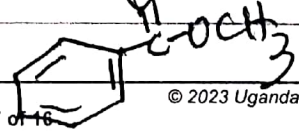
$\xrightarrow{Cr_2O_7^{2-}/H^+_{(aq)},\ \text{heat}}$ $CH_3-\underset{\underset{O}{\|}}{C}-CH_3$ (02½)

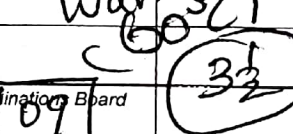
(b)  $\xrightarrow[(CH_3X/FeCl_3)]{CH_3Br/AlCl_3}$ 

$\xrightarrow[200^oC]{H_2/Ni,\ \text{heat}}$  (03)

(c)  $\xrightarrow[MnO_2,\ \text{dilute } H_2SO_4,\ \text{heat}]{\text{or } CrO_2Cl_2}$ 

$\xrightarrow[NaBH_4/H_2O]{LiAlH_4/\text{dry ether}}$ 

$\xrightarrow[H_2/Ni,\ 150^oC]{}$ 

$\xrightarrow[\text{Warm } (60^oC)]{\text{conc } H_2SO_4}$  (3½)

(09)

Do not write in this margin

Candidate's Name .....

Signature .....

Subject ..... Paper code ...../.....

Random No.

Personal Number

12

13 (a) (i) Electronic configuration of iron

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$ ✓✓ (01½)

ref $[Ar] 4s^2 3d^6$

(ii) +2 ✓ and +3 ✓ (01)

(b) Iron reacts with warm dilute ✓ sulphuric acid to form Iron(II) sulphate and hydrogen ✓

$Fe_{(s)} + H_2SO_{4(aq)} \longrightarrow FeSO_{4(aq)} + H_{2(g)}$ ✓✓ (05½)

Iron reacts with hot concentrated ✓ Sulphuric acid to form iron(III) sulphate, water and Sulphur dioxide ✓

$2Fe_{(s)} + 6H_2SO_{4(aq)} \longrightarrow Fe_2(SO_4)_{3(aq)} + 6H_2O_{(l)} + 3SO_{2(g)}$ ✓✓✓

(c) (i) Solution turns from green to brown ✓✓ (02)

$6Fe^{2+}_{(aq)} + 2NO^-_{3(aq)} + 8H^+_{(aq)} \longrightarrow 6Fe^{3+}_{(aq)} + 2NO_{(g)} + 4H_2O_{(l)}$ ✓✓

09

14. (a) % of Oxygen = 100 − (79.3 + 5.66) = 26.36 ✓

	C	H	O
No of moles	$\frac{79.3}{12}$	$\frac{5.66}{1}$	$\frac{26.36}{16}$
	6.6	5.66	1.6 ✓
Mole ratio	$\frac{6.6}{1.6}$:	$\frac{5.66}{1.6}$	$\frac{1.6}{1.6}$ (02)
	4 :	4 :	1 ✓

Empirical formula of J is C_4H_4O ✓

(b) 120g of benzene dissolve 0.636g of J
1000g of benzene dissolve $\left(\frac{0.636}{120} \times 1000\right)$ g of J
= 5.3g ✓

0.25°C is the freezing point depression caused by 5.3g of J ✓
5.0°C is the freezing point depression caused by $\left(\frac{5.3 \times 5}{0.25}\right)$ g of J ✓
Molar mass of J = 106g. ✓

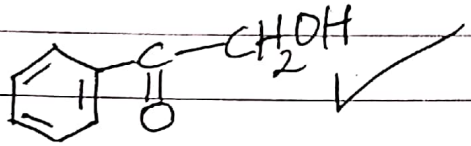
$(C_4H_4O)_n = 106$

$(12 \times 4n) + 4n + 16n = 106$ ✓+

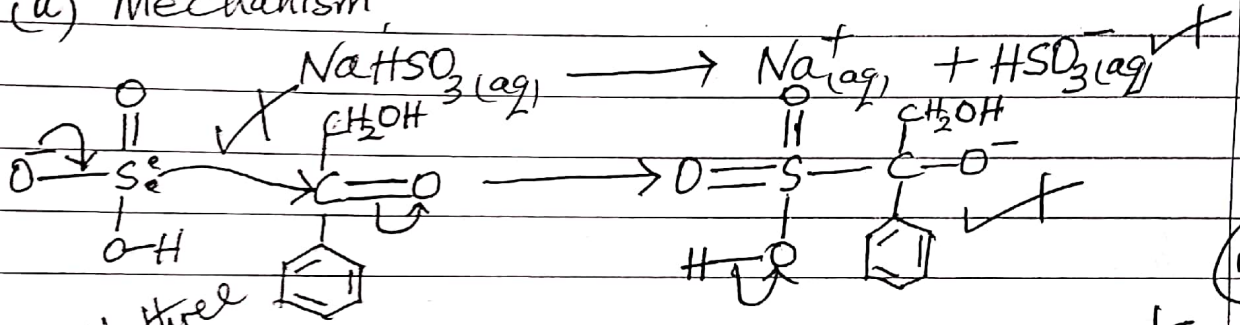
(03)

$n = 2$ ✓+

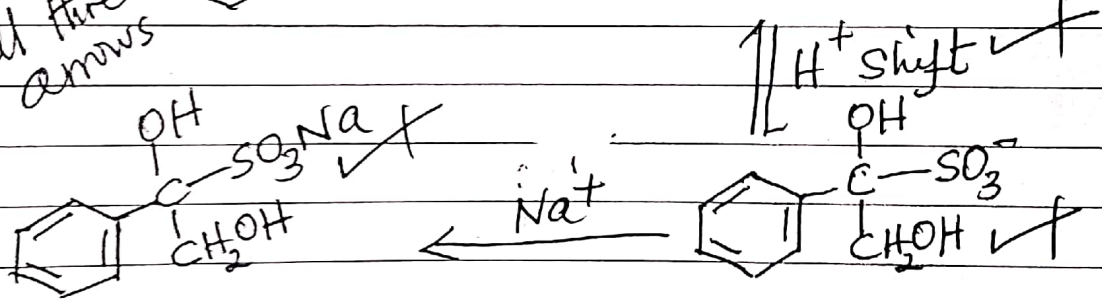
Molecular formula of J is $C_8H_8O_2$ ✓+

(c) (i) J is  ✓ (01)

(ii) Mechanism:



(03)



15 (a) On graph paper

axes labelled with units each at ½ mark = (01)

Labelled phases = ✓ (02)

Correct Shape from accurately plotted points (free hand drawn) (01)

(To be fastened together with other answers to paper)

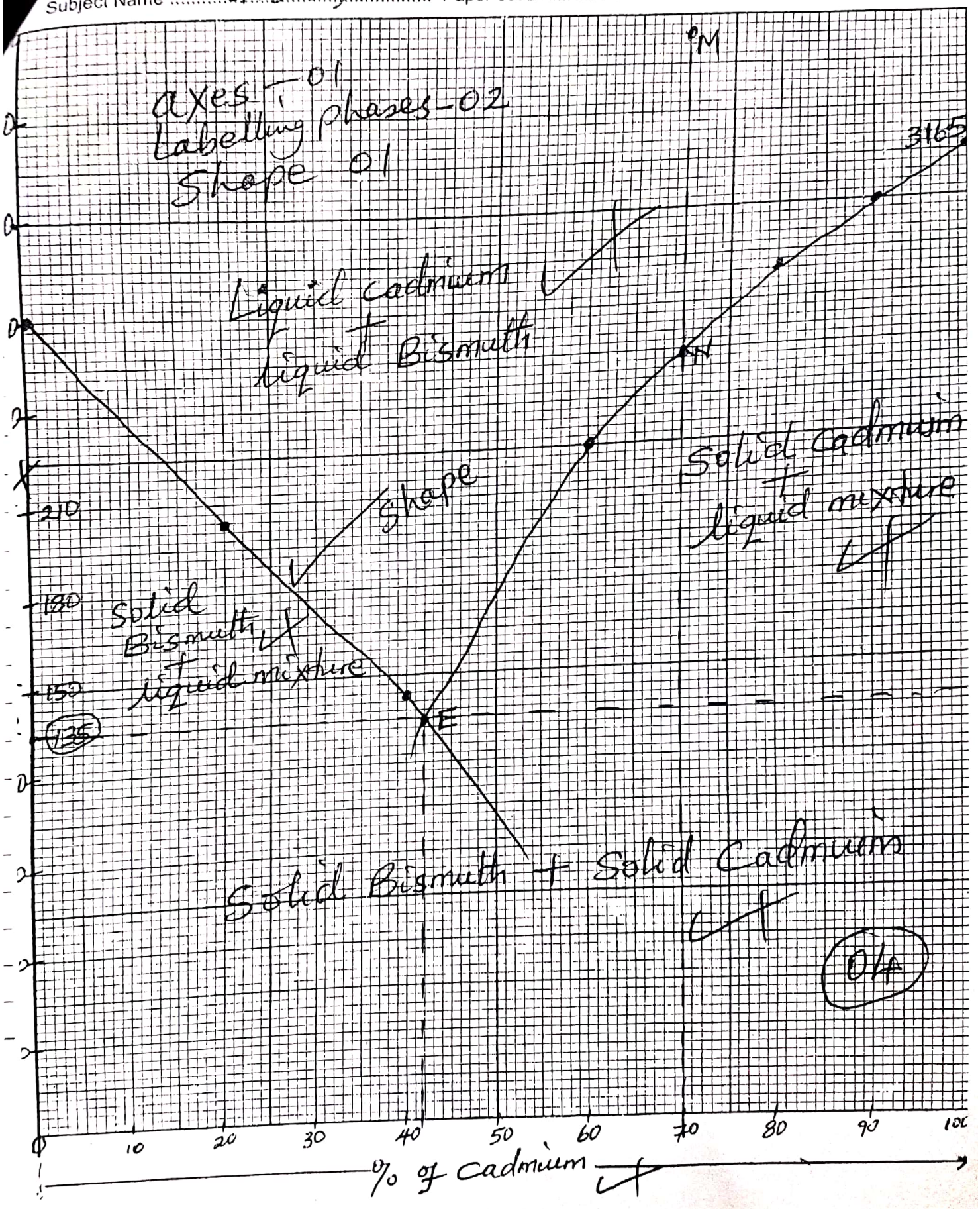
UACE

Candidate's Name ..... JTEB – P525/1 2024

Signature .....

Subject Name ..... B15 (a) ..... Paper code ..... 1 .....

Random No.					
Personal Number	–	1	5		



Do not write in this margin

Candidate's Name .....

Signature .....

Subject ..... Paper code ...../.....

Random No.						
Personal Number						

(b) (i) Eutectic temperature = 135 ± 1 ✓ (0½)

(ii) Composition of eutectic mixture
42% Cd, 58% Bi ✓ (0½)
(±1)

(iii) Freezing point of pure cadmium = 316.5°C ✓
±1 (0½)

(c) Temperature of liquid mixture falls without change in phase and composition until a temperature of about 255°C when solid cadmium ✓ separates out of liquid mixture, on further cooling more crystals of cadmium continue to separate out of solution ✓ solution becomes saturated with bismuth until a temperature of 135°C when solid bismuth also separates out of liquid mixture. ✓ (03)
At this temperature the composition of the solid mixture and liquid mixture remains constant (42% Cd and 58% Bi). ✓
On further cooling from 135°C → 100°C the temperature of solid mixture cools ✓ without change in phase and composition.

(d) Eutectic mixtures are used to make alloys such solder for welding, plugs in fire sprinklers, cryolite to lower melting points of ores in extraction. ✓ (0½)
(accept any correct use)

Signature .....

Subject ..... Paper code ...../.....

Random No. | | | | | |

Personal Number | | | |

Do not write in this margin

16 (a) (i) Differences

Galvanic cell (electrochemical cell)	Voltaic cell (electrolytic cell)
• Redox reaction occurs spontaneously releasing energy ✓	Redox reaction occurs due to energy provided by an external source
• Anode is negatively charged, cathode is positively charged ✓	Anode is positively charged, cathode is negatively charged
• direction of flow of electrons between electrodes is reversed	

(02)

(ii) Similarity

• In both cells oxidation reaction takes place at the anode and reduction reaction at the cathode. ✓ (01)

• Both cells require a porous partition or salt bridge, anode and cathode for consistent flow of ions

(b) (i) $Ag^{+}_{(aq)} + e^{-} \longrightarrow Ag_{(s)}$ ✓

(ii) $Cd_{(s)} \longrightarrow Cd^{2+}_{(aq)} + 2e^{-}$ ✓

(02)

(c) $2Ag^{+}_{(aq)} + Cd_{(s)} \longrightarrow 2Ag_{(s)} + Cd^{2+}_{(aq)}$ ✓ if (01)

(d) (i) $E^{\ominus}_{cell} = E^{\ominus}_{RHS} - E^{\ominus}_{LHE}$

$= +0.799 - 0.403$ ✓ (01½)

$= +0.396\,V$ ✓

(ii) Cell reaction is feasible because cell voltage is positive ✓ (01)

09

17 a)(i) $CuFeS_2$ ✓ (0½)

(ii) Froth flotation ✓ (0½)
rej floatation

(b) The pulverised ore is agitated/mixed with ✓ water containing slaked lime, frothing agent. Air is then blown into the mixture. ✓ The froth formed rises to the surface with the sulphide ore particles ✓ earthly impurities wetted sink to the bottom of vessel. ✓ The froth is skimmed off the surface.

signature .....

Subject ..... Paper code ...../.....

Random No.						
Personal Number						

Do not write in this margin

19--

Acid is added to break the froth. The concentrated ore is then filtered and dried. (02½)

(c) $2CuFeS_{2(s)} + 4O_{2(g)} \longrightarrow Cu_2S_{(s)} + 2FeO_{(s)} + 3SO_{2(g)}$ ✓

$FeO_{(s)} + SiO_{2(l)} \longrightarrow FeSiO_{3(l)}$ ✓ (04)

$2Cu_2S_{(l)} + 3O_{2(g)} \longrightarrow 2Cu_2O_{(l)} + 2SO_{2(g)}$ ✓

$Cu_2S_{(l)} + 2Cu_2O_{(l)} \longrightarrow 6Cu_{(l)} + SO_{2(g)}$ ✓

(d) $3Cu_{(s)} + 8HNO_{3(aq)} \longrightarrow 3Cu(NO_3)_{2(aq)} + 4H_2O_{(l)} + 2NO_{(g)}$ ✓✓ (01½)

END