Name of Student	Roll No.

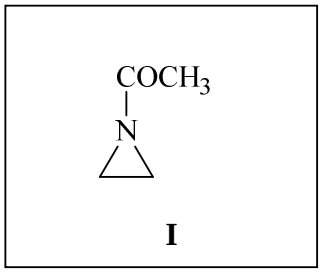
Problem 1 18 marks

Heterocyclic compounds

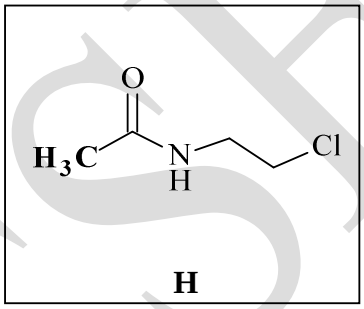
1.1 B, C

1.2 F > G > E

1.3



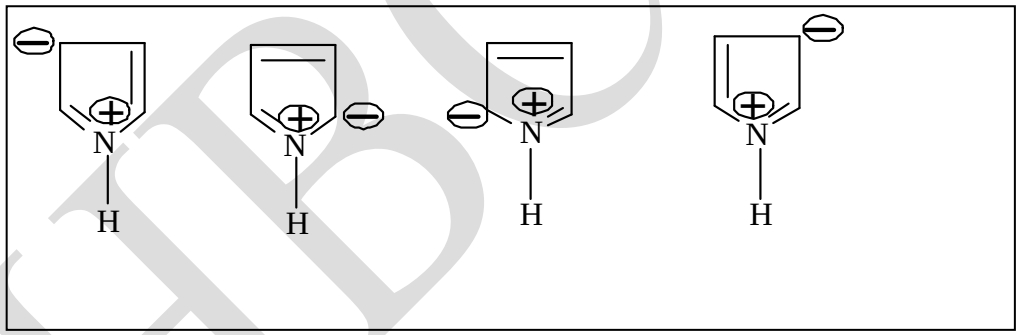
I



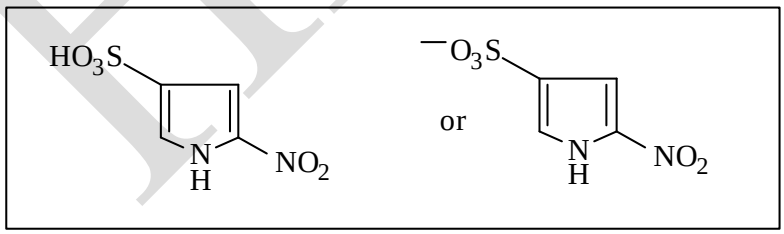
H

B.

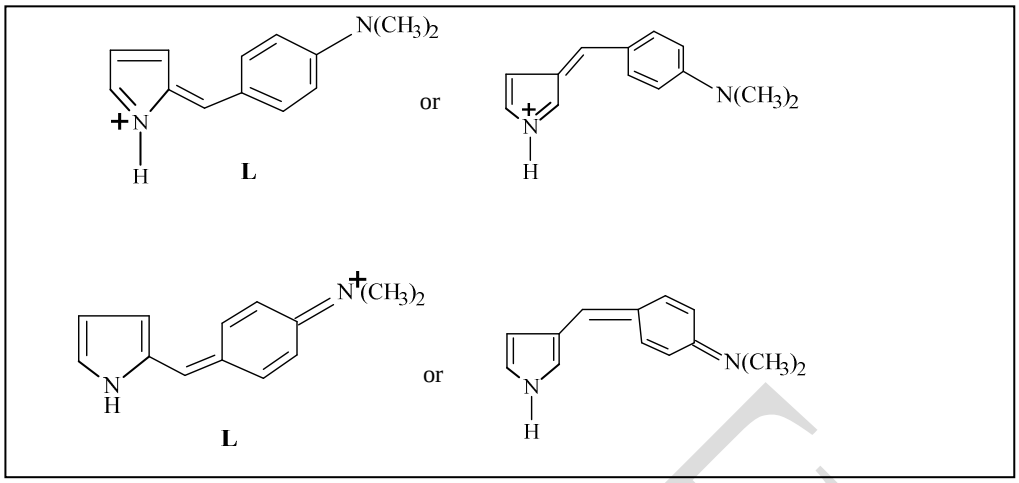
1.4 a)



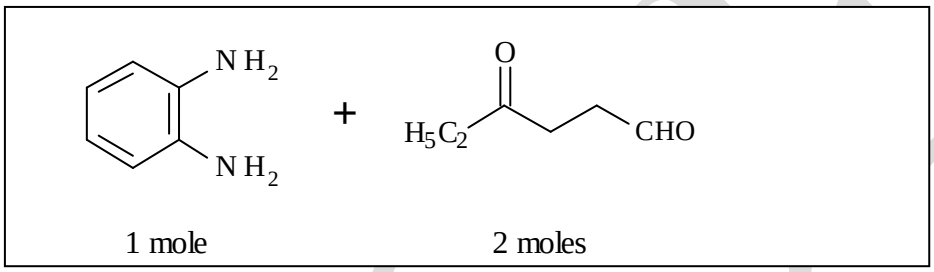
b)



1.5

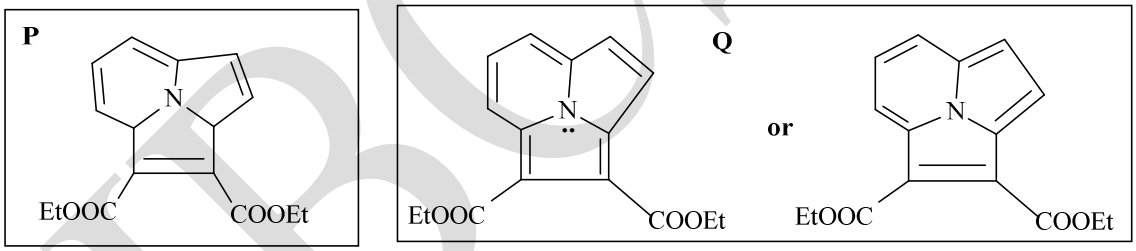


1.6



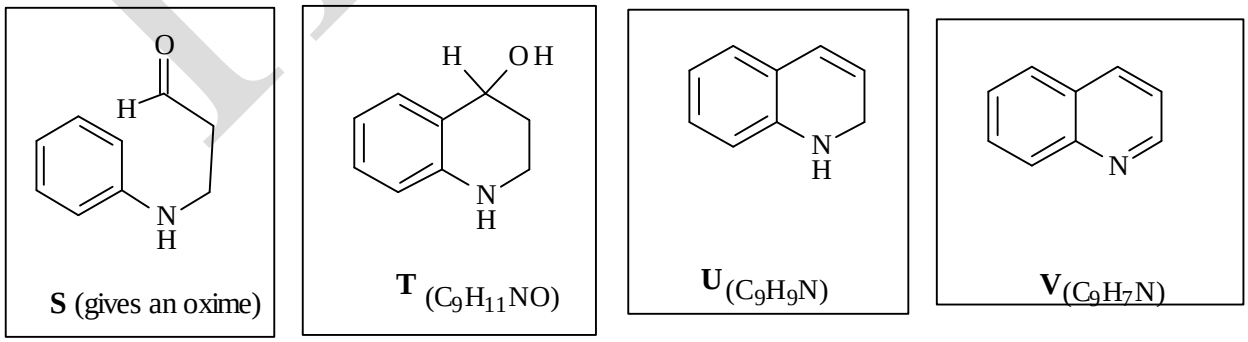
C.

1.7



1.8 Yes [X]

1.9



Problem 2 12 marks

Analysis of alloys

A.

2.1

$2Cu^{2+}(aq) + 4I^{-}(aq) \rightleftharpoons Cu_2I_2\downarrow + I_2(aq)\uparrow$

$2S_2O_3^{2-}(aq) + I_2(aq) \rightleftharpoons S_4O_6^{2-}(aq) + 2I^{-}(aq)$

2.2

0.484 g of copper

70%

2.3

$Cr_2O_7^{2-}(aq) + 14H^{+}(aq) + 6I^{-}(aq) \rightleftharpoons 2Cr^{3+}(aq) + 7H_2O + 3I_2\uparrow$

2.4

Molarity of thiosulphate = 0.0485 M

2.5

0.469 g of copper

Relative percentage deviation = 3.1%

B.

2.6

$NO_3^{-}(aq) + 10H^{+}(aq) + 8e^{-} \rightleftharpoons NH_4^{+}(aq) + 3H_2O$

2.7

$Pb^{2+}(aq) + 2H_2O \rightleftharpoons PbO_2\downarrow + 4H^{+}(aq) + 4e^{-}$

2.8

mmol of PbO_2 = 0.0132

2.9

Fraction of the total current = 36.1%.

C.

2.10

Amount of zinc = 0.184 g

Percentage = 26.8 % of zinc

Problem 3 18 Marks

Halogens

3.1 (c) [X]

3.2 (a) [X]

(c) [X]

3.3 No [X]

3.4 **(a)** KI_7 /I_7^-

(b) (iii) [X]

(c)

Solvent	Solubility	Solvent	Solubility
Carbon tetrachloride	19	n-Hexane	13
Diethyl ether	337	Toluene	182

3.5

Solvent	λmax	Color
Carbon tetrachloride	520 - 540 nm	Bright violet
Diethyl ether	460 - 480 nm	Deep brown

3.6

$F_2 + Br_2 \rightarrow 2BrF$ (A)

$3BrF \rightarrow Br_2(g) + BrF_3$ (B) or

$5BrF \rightarrow 2Br_2(g) + BrF_5$ (B)

3.7

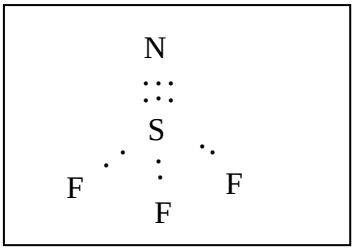
$BrF_3 + SbF_5 \longrightarrow [BrF_2]^+[SbF_6]^-$
or
$BrF_5 + SbF_5 \longrightarrow [BrF_4]^+[SbF_6]^-$

3.8

	Lewis Acid	Lewis Base
Reactants	SbF_5	F^-
Products	BrF_2^+ / BrF_4^+	SbF_6^-

3.9 a) S

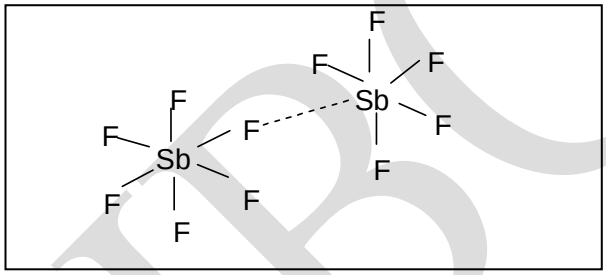
b)



c) 12

d) Tetrahedral

3.10



3.11 XeO_6^{4-}

Problem 4 23 marks

Chemistry of carbocations

4.1 sp^2

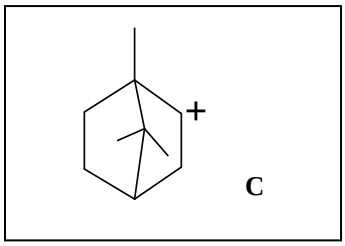
4.2 IV > III > I > II

4.3 i) Yes X

ii) No X

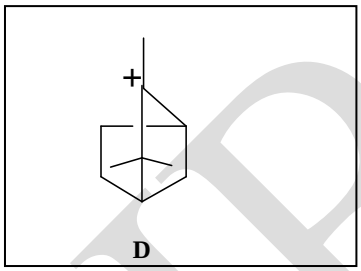
iii) Yes X

4.4



C

4.5

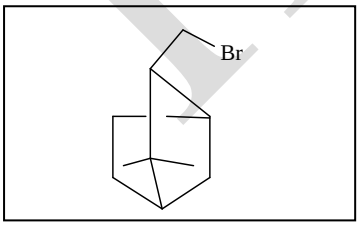


D

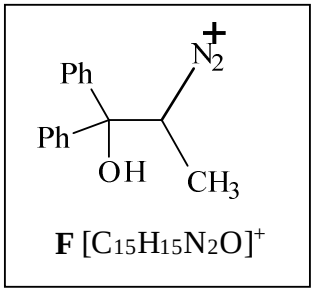
4.6 (iii) X

4.7 (ii) X

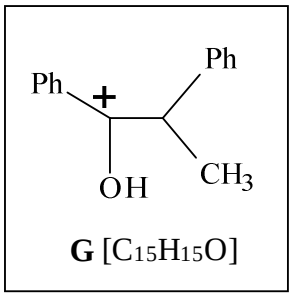
4.8



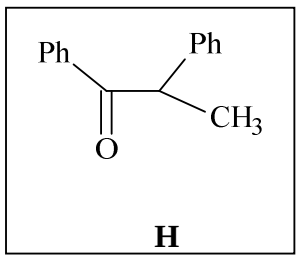
4.9



F $[C_{15}H_{15}N_2O]^+$



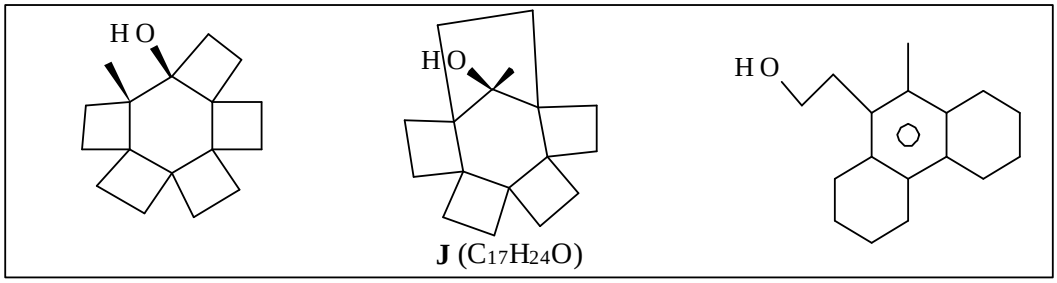
G $[C_{15}H_{15}O]$



H

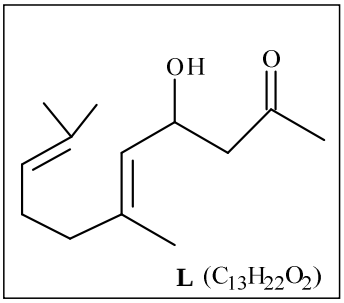
4.10

.

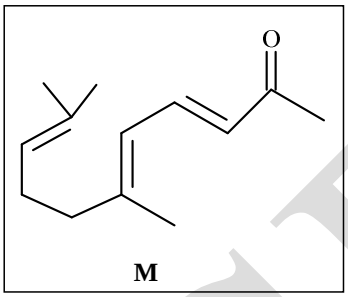


J ($C_{17}H_{24}O$)

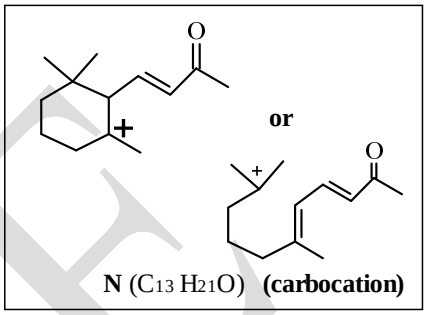
4.11



L ($C_{13}H_{22}O_2$)

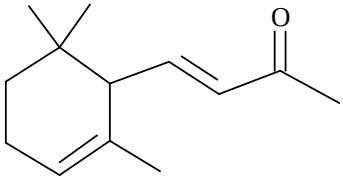


M



N ($C_{13}H_{21}O$) **(carbocation)**

4.12

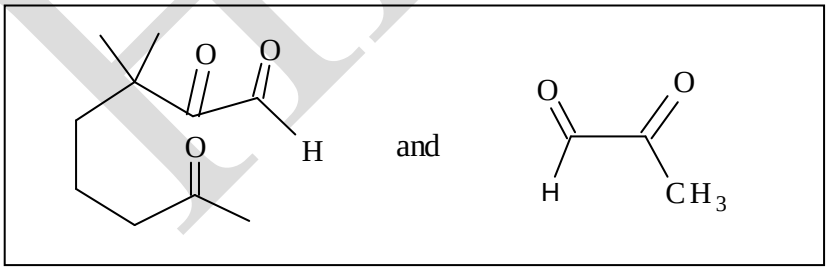


P

4.13 (i) X

4.14 (i) X **or** (ii) X (As per the given structure of **P** in **4.12)**

4.15



Problem 5 18 marks

The 'light' side of chemistry

5.1 Propagation steps: (ii) & (iii)
Termination step: (iv)

5.2

$$\frac{d[H^\bullet]}{dt} = 0 \Rightarrow k_1[Cl^\bullet][H_2] - k_2[H^\bullet][Cl_2].$$

$$\frac{d[Cl^\bullet]}{dt} = 0 \Rightarrow 2I_{abs} + k_2[H^\bullet][Cl_2] - k_1[Cl^\bullet][H_2] - 2k_3[Cl^\bullet]^2$$

$$[H^\bullet] = \frac{k_1}{k_2}\left(\frac{I_{abs}}{k_3}\right)^{1/2}\frac{[H_2]}{[Cl_2]}$$

5.3

$$\frac{d[HCl]}{dt} = k'[I_{abs}]^{1/2}[H_2] \quad \text{or} \quad 2K_1\frac{I_{abs}^{1/2}}{k_3^{1/2}}.[H_2]$$

5.4 The correct statement/s is/are

i) X

ii) X

5.5 Quantum Yield = 1.05

B.

5.6 a) . $\Delta U_{AOH} = N_A h\nu_{AOH}$

$\Delta U_{AO^-} = N_A h\nu_{AO^-}$

b) $\Delta U^* = \Delta U_{AO^-} + \Delta U - \Delta U_{AOH}$

c) $\Delta H - \Delta H^* = N_A h\,(\nu_{AOH} - \nu_{AO^-})$

5.7 a) $\Delta pk_a = N_A h\,(\nu_{AO^-} - \nu_{AOH})\,/2.303RT$

b) $\Delta pk_a = -3.5$

Problem 6 11 marks

Acids, bases and buffers

A.

6.1

$$\frac{[\mathrm{Pr\,NH_2}]}{[\mathrm{Pr\,NH_3^+}]} = 0.1$$

6.2 $\mathrm{pH} = 10.08$

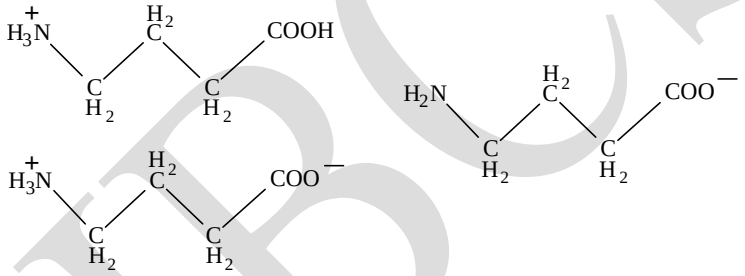
6.3

pH ≈ 6

appropriate indicator is –Methyl red. (4.2-6.2)

B.

6.4



6.5 around point **B** X around point **D** X

6.6

$$\frac{[\mathrm{H_2N-R-COO^-}]}{[\mathrm{H_3N^+-R-COOH}]} = 0.03$$

6.7 (iii) X