

Name of Student

Roll No.

## Problem 1

17 Marks

1.1

$$X = 1.34 \text{ V}$$

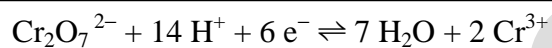
$$Y = -0.408 \text{ V}$$

1.2

$$\Delta G = -222915 \text{ J} < 0$$

 $\Rightarrow$  Cr (IV) disproportionates.

1.3



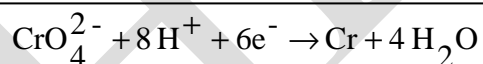
1.4

 $= -0.27 \text{V}$  is the change in potential.

1.5

$$E_{\text{sy}} = 1.140 \text{ V}$$

1.6



$$\% \text{ Efficiency} = 6.87 \%$$

1.7

The reaction at the cathode is  $2 \text{H}_3\text{O}^+ + 2 \text{e}^- \rightarrow 2 \text{H}_2\text{O} + \text{H}_2$

The reaction at the anode is  $6 \text{H}_2\text{O} \rightarrow 4 \text{H}_3\text{O}^+ + 4 \text{e}^- + \text{O}_2$ .

$v(\text{H}_2) = 6.69 \text{ m}^3$  of hydrogen.

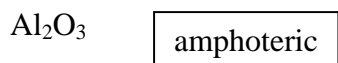
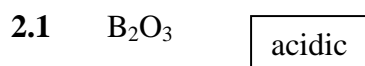
$v(\text{O}_2) = 3.50 \text{ m}^3$  of oxygen.

1.8

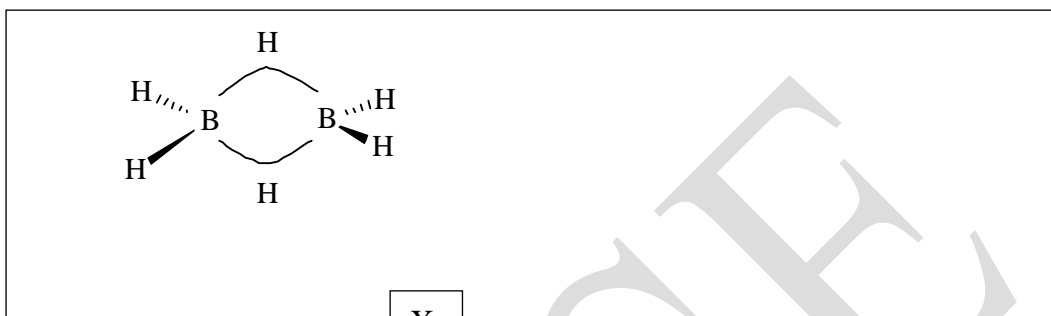
$$\% \text{ of Cu} (\text{C}_{18}\text{H}_{33}\text{O}_2)_2 = 7.66 \%$$

Problem 2

11 Marks

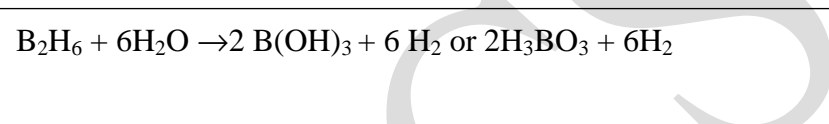


2.2

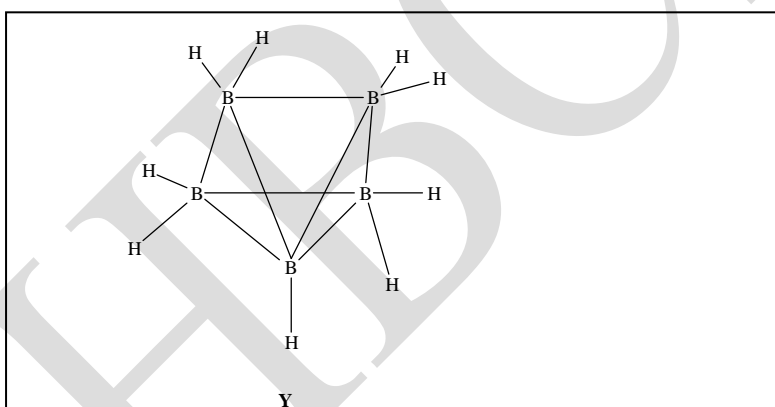


b) Three centered  $2e^-$  bond

2.3



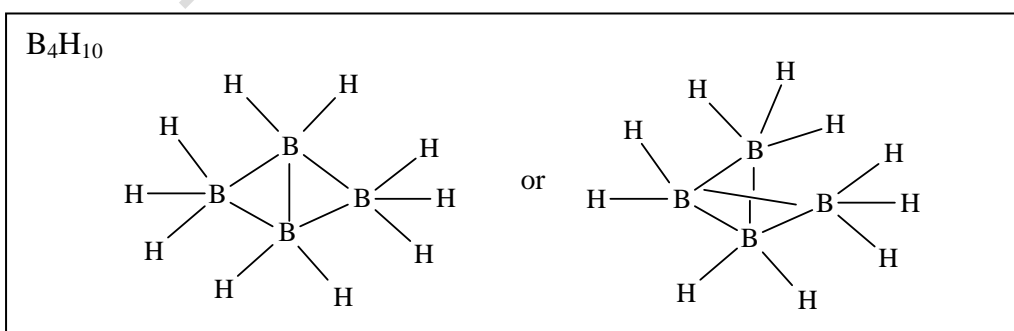
2.4



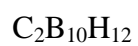
2.5



2.6

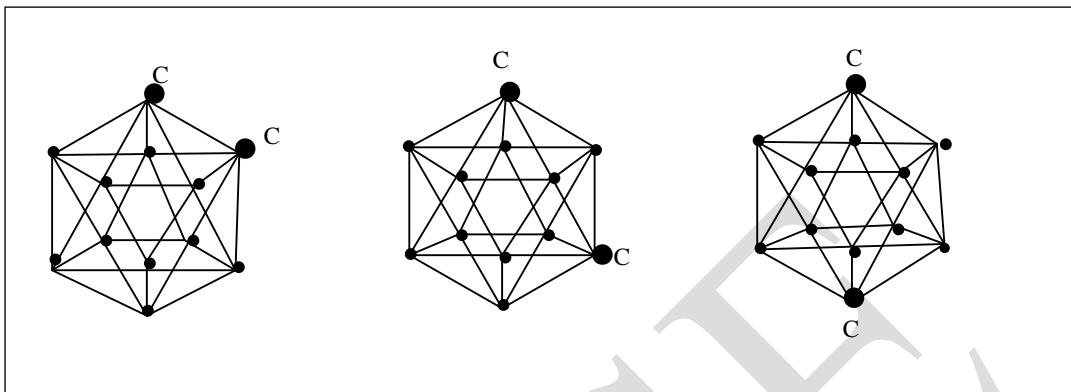


2.7



**Z**

2.8



## Problem 3

18 Marks

## Thermodynamics of a sustainable bio process

3.1

Efficiency = 32.6%

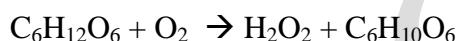
3.2

Decrease in the level of CO<sub>2</sub> (in ppm) = 256.5ppm

3.3

 $\Delta H_f = -1271.4\text{kJ}$ 

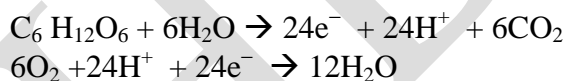
3.4



3.5

Change in current produced =  $0.672 \times 10^{-3} \text{ mA}$ 

3.6



3.7

 $E = 1.19\text{V}$ 

3.8

 $dE/dT = 8.2 \times 10^{-3} \text{ VK}^{-1}$ 

3.9

Time = 5.597 or 6.0 min

3.10  $dU_s = T_s dS \quad dG_s = 0$

3.11  $(\Delta U)_s = -60N_A hc/\lambda. (\Delta U)_{PO} = 60N_A hc/\lambda$

3.12  $(\Delta S)_{\text{step1}} = 60N_A hc/\lambda (1/T_{PO} - 1/T_s)$

3.13  $(\Delta S)_{\text{step2}} = \Delta G_{PO}/T$

3.14 Show that  $\Delta S_{\text{step3}} = 0$

In step 3 sun does not participate.

$\Delta U_{PO}$  in step 3 =  $(\Delta U_{PO}$  in step 1 -  $\Delta U_{PO}$  in step 2) = the energy transmitted to the earth

$(\Delta U_{PO}(\text{step1}) - \Delta G_{PO})/T_{PO}$  is the change in entropy of PO

Change in entropy of earth =  $-(\Delta U_{PO}(\text{step1}) - \Delta G_{PO})/T_E$

Adding  $\Delta S_E$  and  $\Delta S_{PO}$  and since  $T_E = T_{PO}$   $\Delta S_{\text{step3}} = 0$

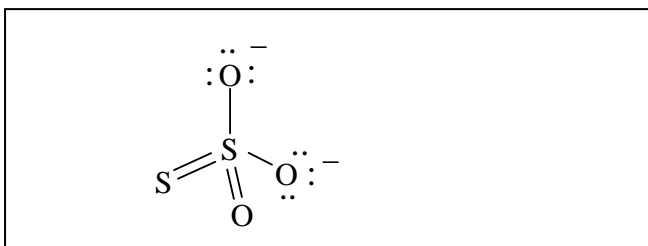
3.15  $\Delta S(\text{overall}) = 60N_A hc/\lambda - \Delta G_{PO}/T_{PO}$

Problem 4

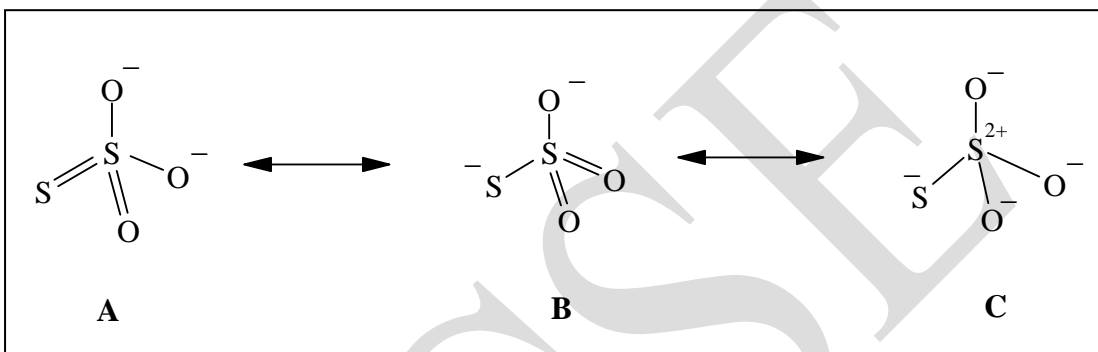
23 marks

Organosulphur Compounds

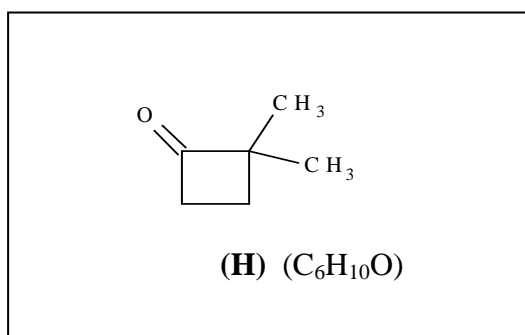
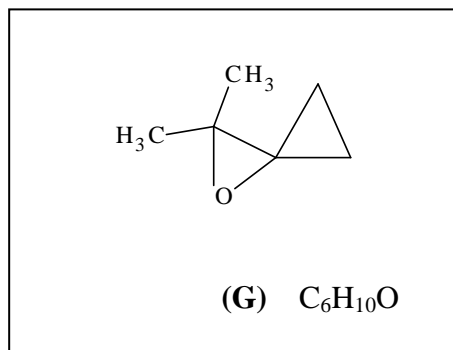
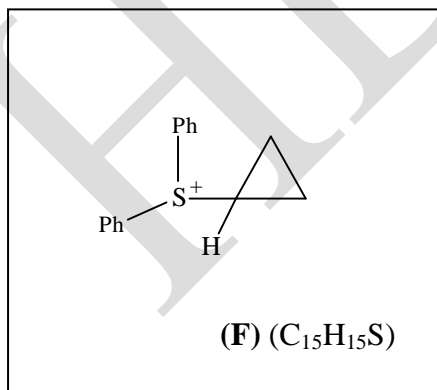
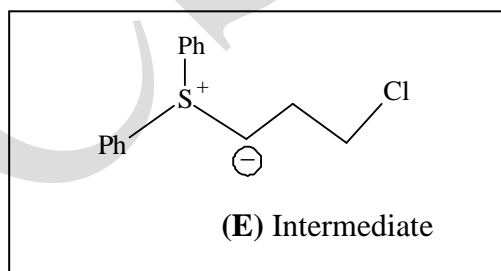
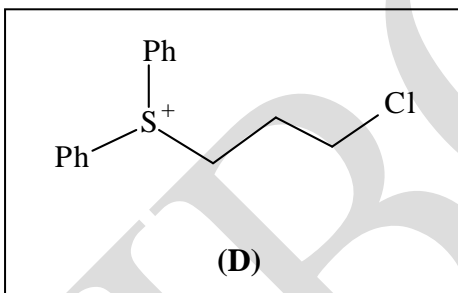
4.1



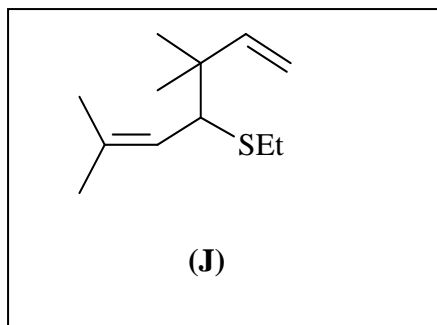
4.2



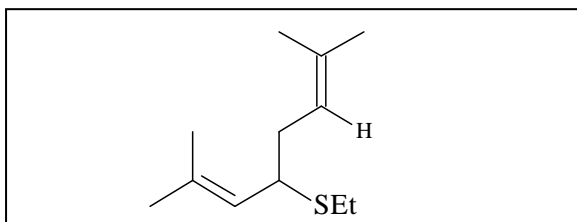
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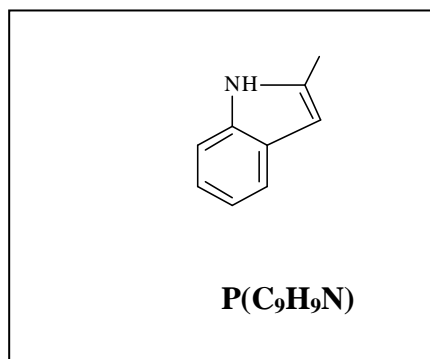
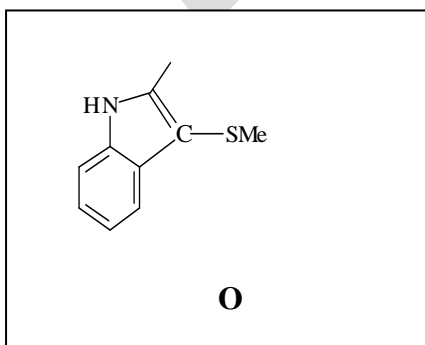
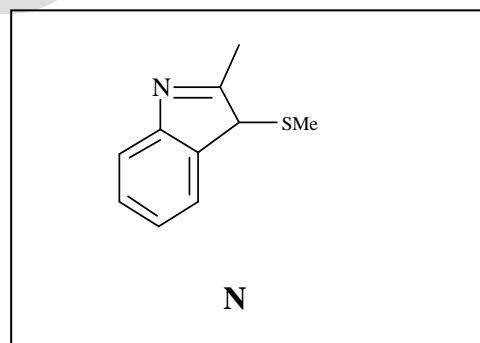
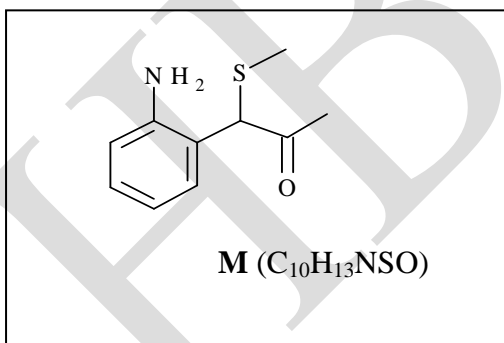
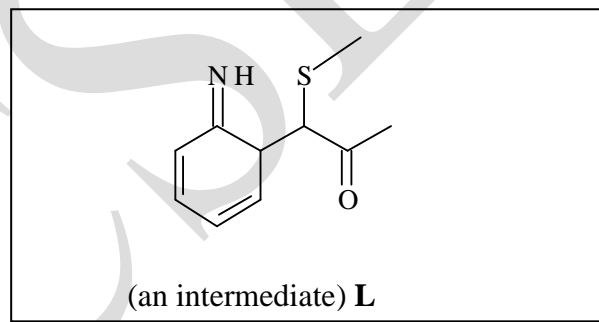
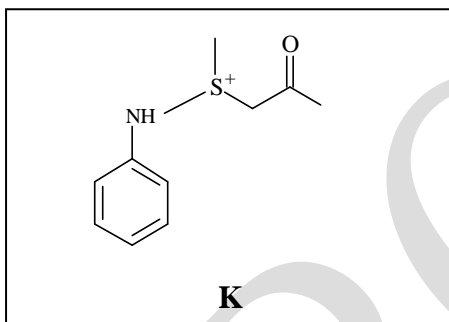
4.4



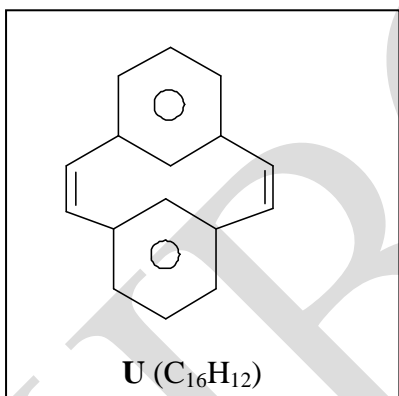
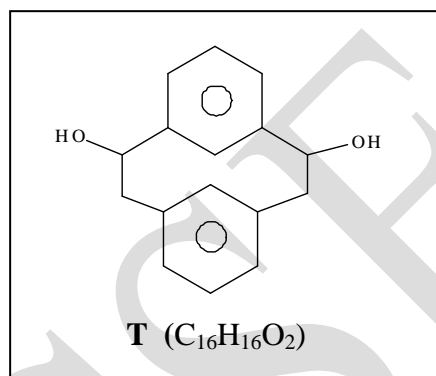
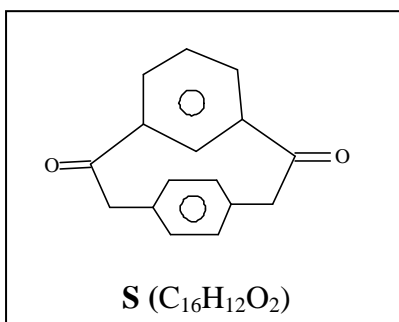
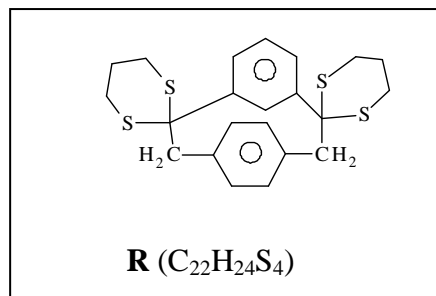
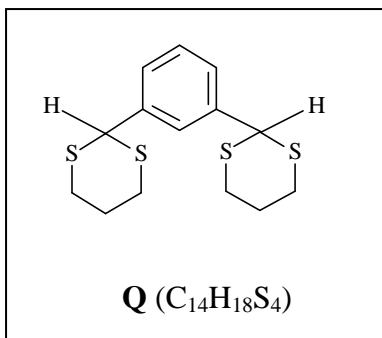
4.5



4.6



4.7



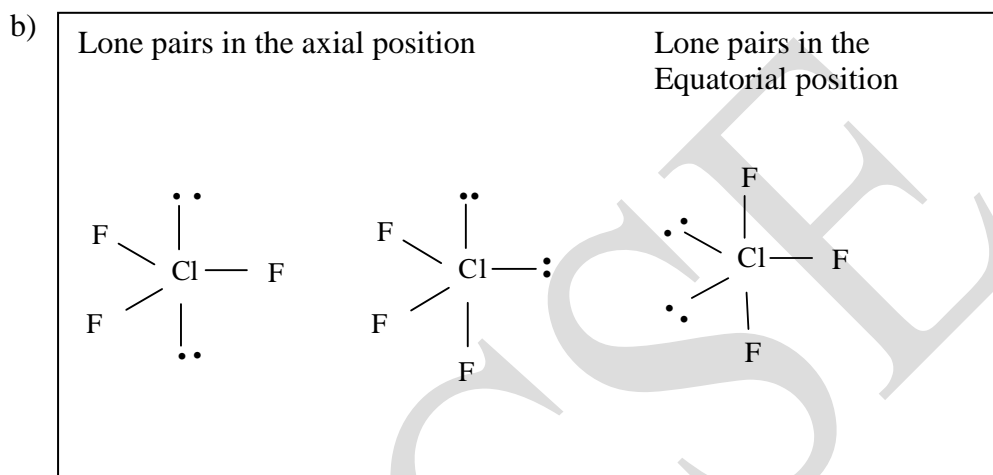
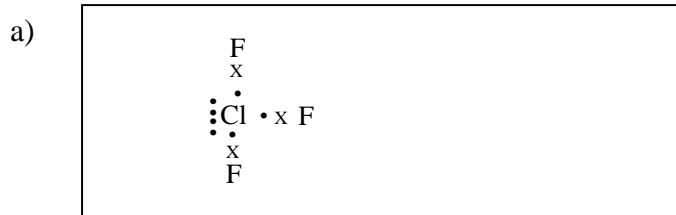


Problem 5

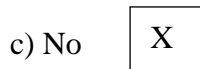
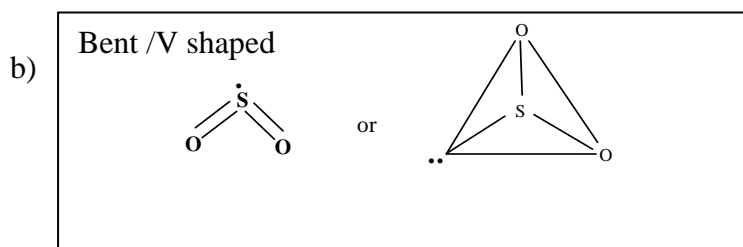
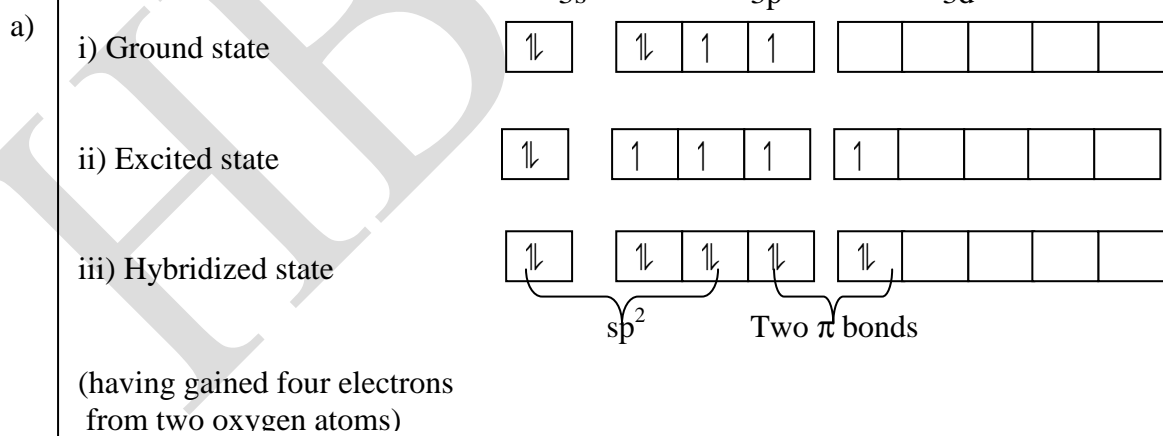
17 marks

A. Chemistry of Main Group Elements

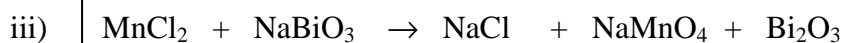
5.1



5.2



- 5.3 i) b)  $\text{Sn}^{4+}$  is more stable than  $\text{Sn}^{2+}$   X
- c)  $\text{Pb}^{2+}$  is more stable than  $\text{Pb}^{4+}$   X
- ii) oxidizing agent  X



## B. Chemistry of d and f- block elements

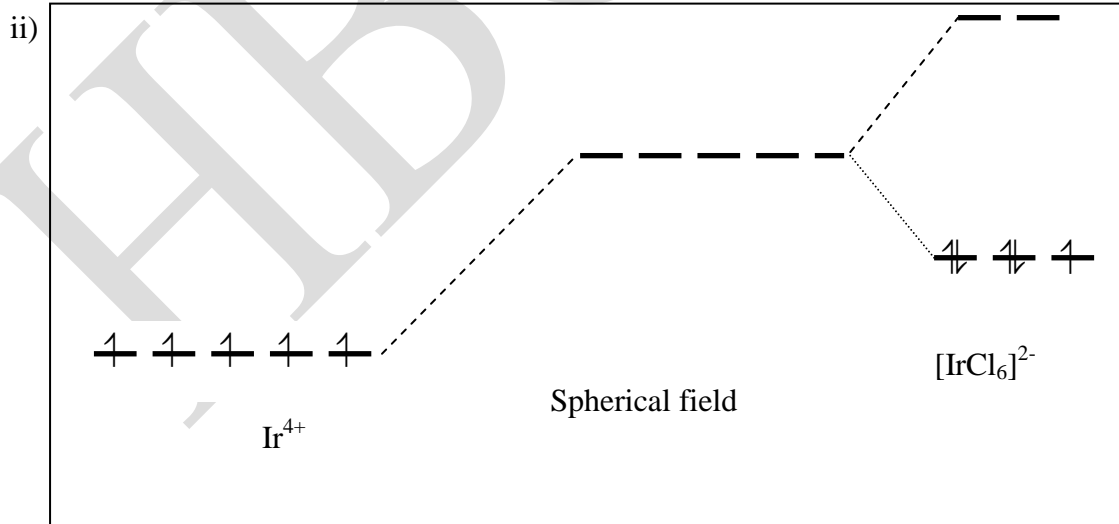
5.4

Complex	No of unpaired electrons	Spin state
$[\text{Fe}(\text{CN})_6]^{4-}$	0	diamagnetic
$[\text{Fe}(\text{CN})_6]^{3-}$	1	Low spin
$[\text{FeCl}_4]^-$	5	High spin
$[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$	4	High spin

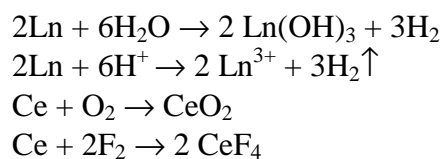
5.5

0.0 B.M

- 5.6 i) a) the central metal ion is in higher oxidation state.  X
- b) Ir belongs to third transition series.  X



5.7

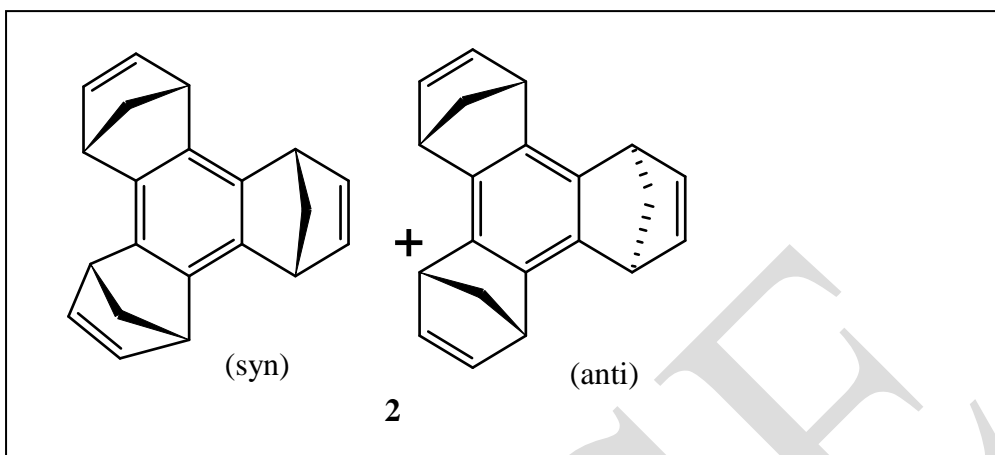


Problem 6

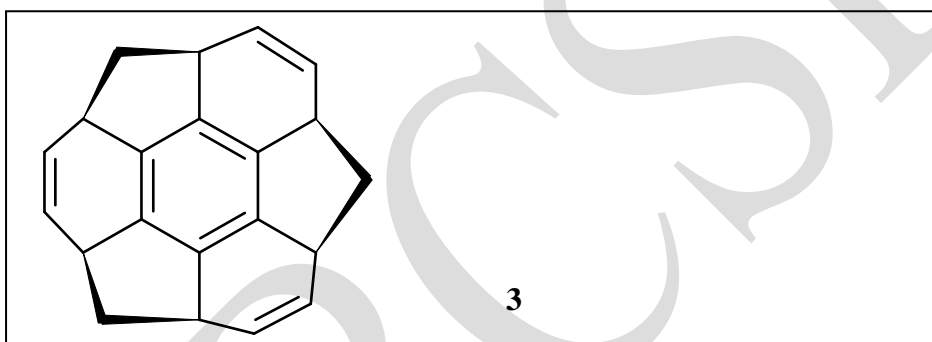
16 Marks

Chemistry of unusual organic compounds

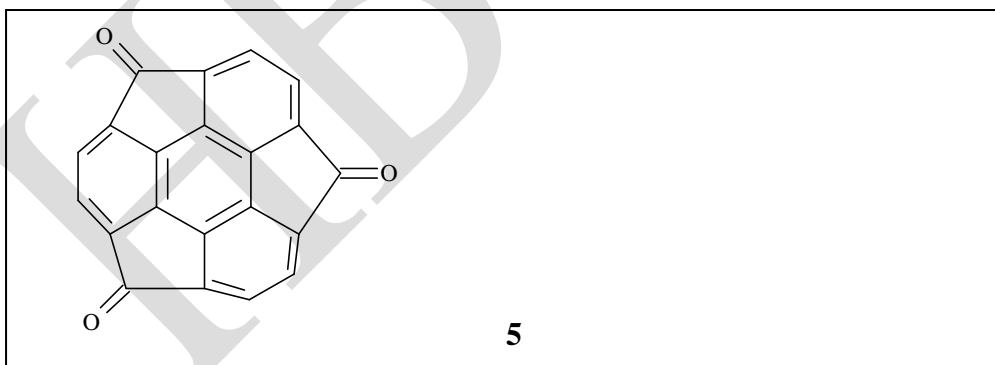
6.1



6.2



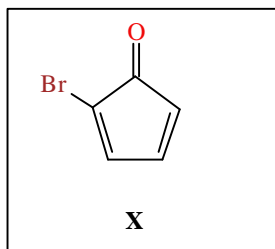
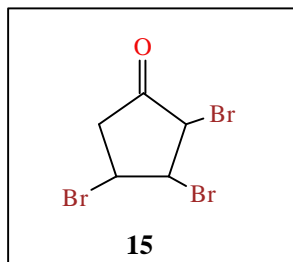
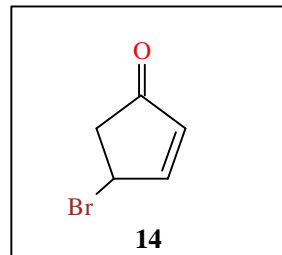
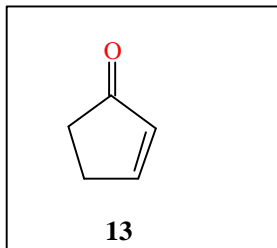
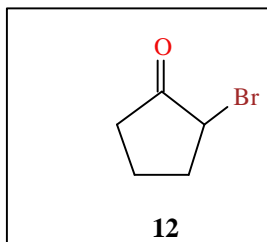
6.3



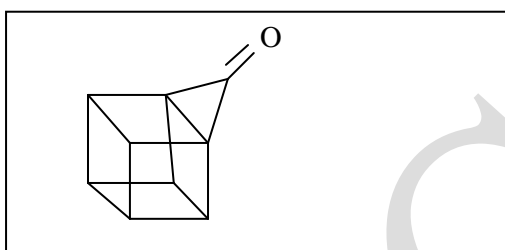
6.4 (i) carbonyl group (b) has conjugated double bond

X

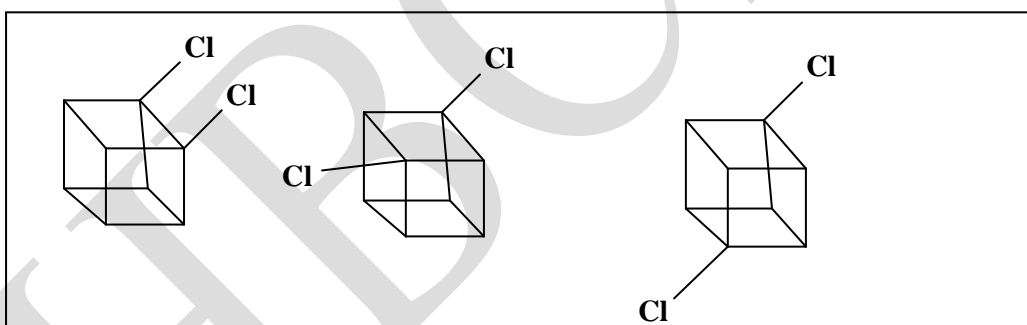
6.5



6.6



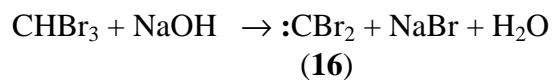
6.7



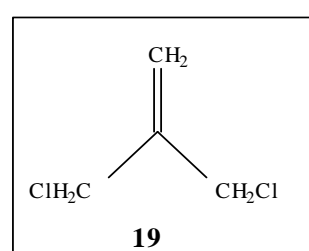
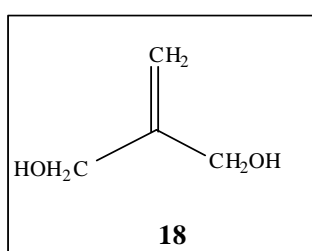
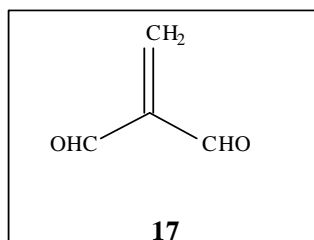
6.8

(ii) pentacyclic compound X

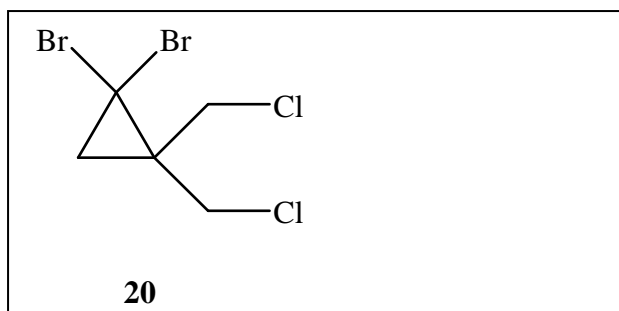
6.9



6.10



6.11



6.12

