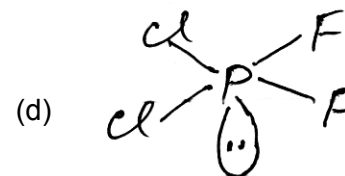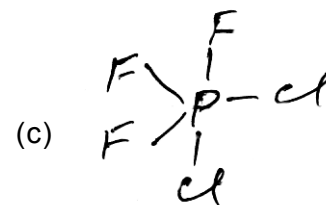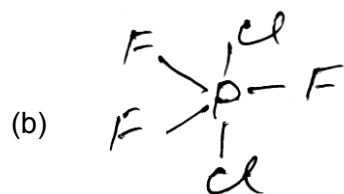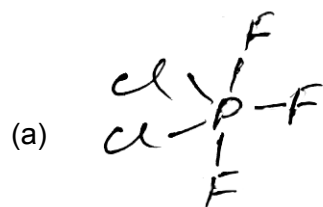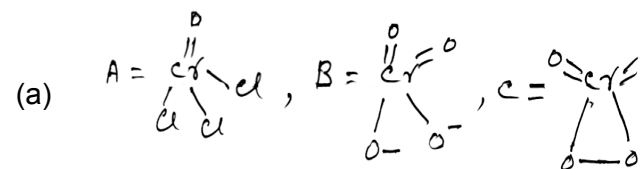# W-116

Ph.D. Entrance Examination, 2024

CHEMISTRY

*Maximum Marks : 50*

Note : Each question carrying 2 marks.

Choose correct option from following :

Q. 1. The correct structure of PCl_2F_3 is :

(a)

(b)

(c)

(d)

Q. 2. Exposing CrO_3 to HCl gas gives a red vapour of compound A. When A is passed through a dilute soultion of NaOH, it turns yellow due to formation of complex ion B. Adding acidified H_2O_2 to a solution of B results dark blue compound C. The option contain correct structure of A, B and C respectively is :

(a)

(b) $A = $ ... $B = $ ... $C = $ ...

(c) $A = $ ... $B = $ ... $C = $ ...

(d) $A = $ ... $B = $ ... $C = $ ...
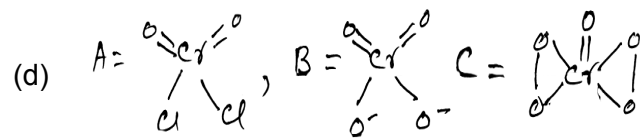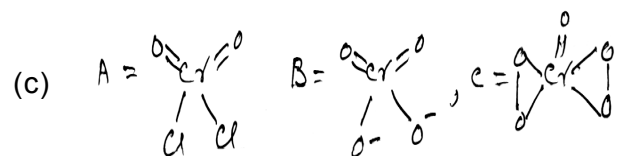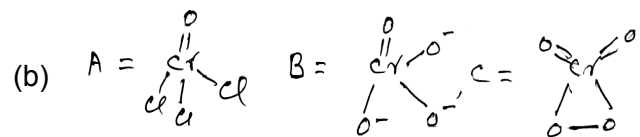
Q. 3.

(a) R, R

(b) R, S

(c) S, R

(d) S, S

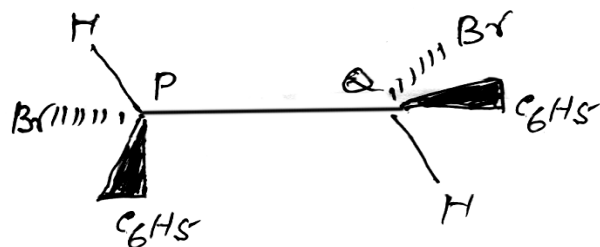**Q. 4.** The colour of the complex $[Fe(bpy)_3]^{2+}$ is due to :
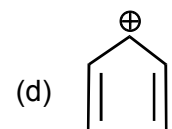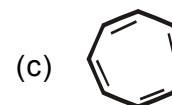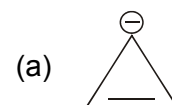
(a) d – d transition

(b) Charge transfer from bpy to Fe^{2+}

(c) Charge transfer from Fe^{2+} to π^* orbital bpy

(d) Charge transfer from bpy π^* orbital to Fe^{2+} orbital

Q. 5. The paramagnetic and colourless ion is/are :

(a) Gd^{3+}

(b) Cl^{3+}

(c) Yb^{3+}

(d) All

Q. 6. Non aromatic compound is :
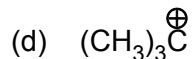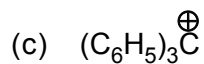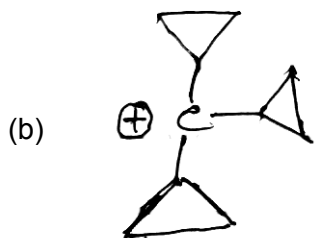
(a)

(b)

(c)

(d)

Q. 7. Most stable carbocation is :

(a)

(b)

(c) $(C_6H_5)_3\overset{\oplus}{C}$

(d) $(CH_3)_3\overset{\oplus}{C}$
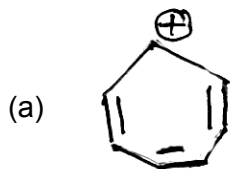
Q. 8. The most commonly used laser to Raman spectroscopy is :

(a) ND : YAG

(b) Ruby laser

(c) He – Ne laser

(d) Semiconductor laser

Q. 9. Select the correct Maxwell's relation from the following :

(a) $\left(\dfrac{\partial S}{\partial V}\right)_P = -\left(\dfrac{\partial P}{\partial T}\right)_S$

(b) $\left(\dfrac{\partial S}{\partial P}\right)_V = \left(\dfrac{\partial V}{\partial T}\right)_S$

(c) $\left(\dfrac{\partial S}{\partial V}\right)_V = \left(\dfrac{\partial P}{\partial T}\right)_S$
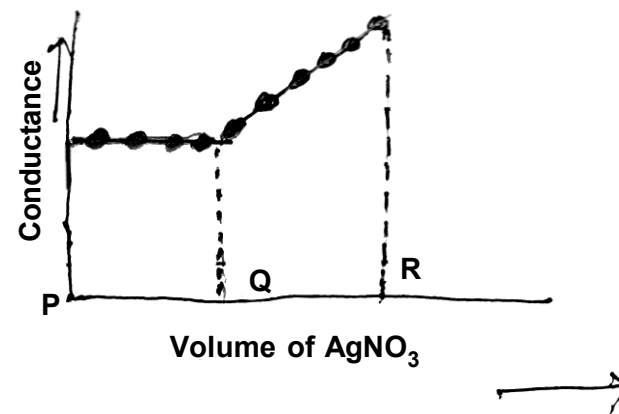
(d) $\left(\dfrac{\partial S}{\partial V}\right)_P = \left(\dfrac{\partial P}{\partial T}\right)_S$

Q. 10. Consider the following plot for a conductometric study of a reaction between KCl and $AgNO_3$ solution. Select the correct reason behind the constancy of conduction in the region PQ.
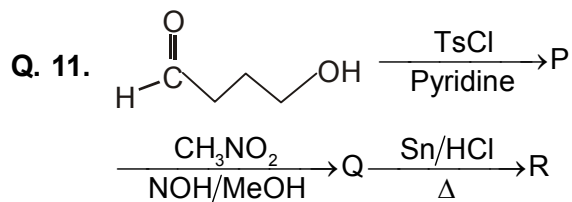

Volume of $AgNO_3$

(a) Precipitation of AgCl only
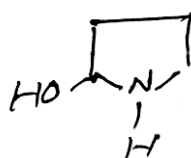
(b)　Inert behaviour instrument in this region

(c)　Replacement of Cl⁻ by NO_3^- with each

species having equal conductance

(d)　Precipitation of AgCl and replacement of

$Cl^{\ominus}$ by NO_3^- ions

Q. 11.

$$\xrightarrow[\text{Pyridine}]{\text{TsCl}} P$$

$$\xrightarrow[\text{NOH/MeOH}]{CH_3NO_2} Q \xrightarrow[\Delta]{Sn/HCl} R$$

In the above reaction R is :

(a)

(b)

(c)

(d)
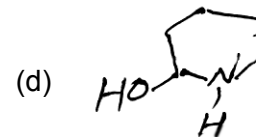
Q. 12. The coordination number of Ca^{2+} and fluoride ion in CaF_2 is :

(a)　8 and 4

(b)　4 and 8

(c)　1 and 2

(d)　2 and 1

Q. 13. Consider the following statements regarding precision and accuracy in measurements of quantity :

(1)　Precision is closeness of various experimental measurements

(2)　Precision is independent of the realizable correctness of measurements

(3)　For a good instrument high precision is prefered

(4)　An experiment with high precision will always give accurate readings

Correct statements are :

(a)   (1), (2), (3)

(b)   (2), (3), (4)

(c)   (1), (3), (4)

(d)   (1), (2), (3), (4)

Q. 14. Which of the following synthons is an example of

umpolung ?

(a)

(b)

(c)

(d)

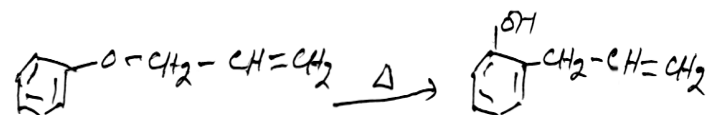**Q. 15.** A compound of molecular formula C_8H_7ClO shows a band in its IR spectrum at 1690 cm^{-1}. HNMR spectrum revealed only two signals in proton ratio (5 : 2). Which one of the following best fits the above data ?

(a)

(b)

(c)

(d)

Q. 16. Consider following rearrangement

The above reaction is :

(a)   [5, 5] sigmatropic rearrangement

(b)   [3, 3] sigmatropic rearrangement

(c) [1, 3] sigmatropic rearrangement

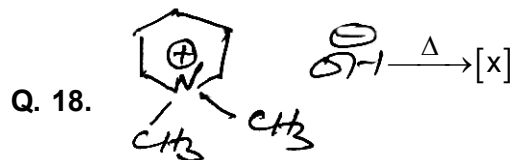(d) [3, 5] sigmatropic rearrangement

Q. 17. The limiting molar conductivities of few ionic

compounds at 25°C are given below :

Compound	Molar conductivity
	(meter^2 mol^{-1})
NaI	12.69
NaNO$_3$	12.16
AgNO$_3$	13.34

The limiting molar conductivity of AgI will be :

(a) 14.23

(b) 11.63

(c) 9.21

(d) 13.87

Q. 18.

[x] is :

(a)

(b)

(c)

(d)

Q. 19. $[F] \xleftarrow[\text{Catalyst}]{\text{Lindar's}} CH_3 - C \equiv C - CH_3 \xrightarrow[\text{liquid NH}_3]{\text{Na in}} [G]$
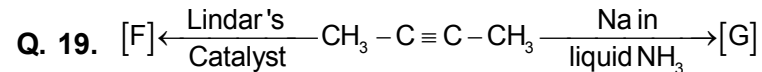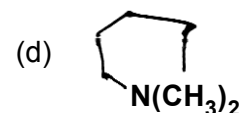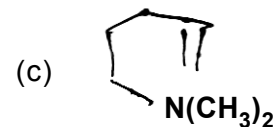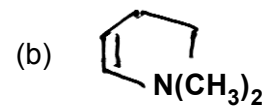
[F] and [G] are respectively :

(a) Cis-2-Butene and trans-2-butene

(b) Trans-2-Butene and Cis-2-butene

(c) Both trans-2-butene

(d) Both Cis-2-butene

Q. 20. An organic compound (A) C_7H_8O soluble in

NaOH but insoluble in NaHCO$_3$. On treatment

with Br$_2$ water it gives tribromo product.

Compound (A) is :

(a) o-cresol

(b) m-cresol

(c) p-cresol

(d) All of these

Q. 21. In a binary system of A and B, a liquid of 20% A and 80% B is coexisting with a solid of 70% A and 30% B. For an overall composition having 40% A, the fraction of solid is :

(a) 0.40

(b) 0.50

(c) 0.60

(d) 0.75

Q. 22. To study the decomposition of HI, a student fills an evacuated 3 litre flask with 0.3 mol of HI and allows the reaction to proceed at 500°C. At equilibrium he found the concentration of HI which is equal to 0.05 M. The Kc and Kp will be :

(a) 0.25 and 0.50

(b) 0.25 and 0.25

(c) 0.50 and 0.25

(d) 0.50 and 0.50

Q. 23. The correct structural types of $\left[Co\left(\eta^5 - C_5H_5 \right) B_4H_8 \right]$ and $\left[Mn\left(\eta^2 - B_3H_8 \right)\left(CO \right)_4 \right]$ are :

(a) Closo and Nido

(b) Nido and Arachno

(c) Closo and Arachno

(d) Nido and Nido

Q. 24. Consider the following metallobiomolecules

(1) Transferrin

(2) Siderophores

(3) Hydrogenase

(4) Hydroxylase

(5) Hemerythrin

Which of these contains iron ?

(a)   (1), (5)

(b)   (1), (2), (5)

(c)   (1), (3), (5)

(d)   All of given

Q. 25.   Which one of the following is hard base ?

(a) F^-

(b) Cl^-

(c) I^-

(d) Br^-

─────────