FULL TEST – I

Time Allotted: 3 Hours
Maximum Marks: 432

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

A. General Instructions
1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Parts.
3. Part-I is Physics, Part-II is Chemistry and Part-III is Mathematics.
4. Each part has only one section: Section-A.
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet
1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with black pen for each character of your Enrolment No. and write your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Three Parts.
(i) Section-A (01 to 03 and 10 to 12) contains 6 multiple choice questions which have only one correct answer. Each question carries +8 marks for correct answer and – 2 mark for wrong answer.

Section-A (04 to 09 and 13 to 30) contains 24 multiple choice questions which have only one correct answer. Each question carries +4 marks for correct answer and – 1 mark for wrong answer.

Name of the Candidate

Enrolment No.
### Useful Data

**PHYSICS**

- Acceleration due to gravity \( g = 10 \text{ m/s}^2 \)
- Planck constant \( h = 6.6 \times 10^{-34} \text{ J-s} \)
- Charge of electron \( e = 1.6 \times 10^{-19} \text{ C} \)
- Mass of electron \( m_e = 9.1 \times 10^{-31} \text{ kg} \)
- Permittivity of free space \( \varepsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N-m}^2 \)
- Density of water \( \rho_{water} = 10^3 \text{ kg/m}^3 \)
- Atmospheric pressure \( P_a = 10^5 \text{ N/m}^2 \)
- Gas constant \( R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1} \)

**CHEMISTRY**

- Gas Constant \( R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1} \)
- \( = 0.0821 \text{ Lit atm K}^{-1} \text{ mol}^{-1} \)
- \( = 1.987 \approx 2 \text{ Cal K}^{-1} \text{ mol}^{-1} \)
- Avogadro's Number \( N_a = 6.023 \times 10^{23} \)
- Planck's constant \( h = 6.625 \times 10^{-34} \text{ J-s} \)
- \( = 6.625 \times 10^{-27} \text{ erg-s} \)
- 1 Faraday \( = 96500 \text{ coulomb} \)
- 1 calorie \( = 4.2 \text{ joule} \)
- 1 amu \( = 1.66 \times 10^{-27} \text{ kg} \)
- 1 eV \( = 1.6 \times 10^{-19} \text{ J} \)

Atomic No:  

- H=1, He=2, Li=3, Be=4, B=5, C=6, N=7, O=8,  
- N=9, Na=11, Mg=12, Si=14, Al=13, P=15, S=16,  
- Cl=17, Ar=18, K=19, Ca=20, Cr=24, Mn=25,  
- Fe=26, Co=27, Ni=28, Cu = 29, Zn=30, As=33,  
- Br=35, Ag=47, Sn=50, I=53, Xe=54, Ba=56,  
- Pb=82, U=92.

Atomic masses:  

- H=1, He=4, Li=7, Be=9, B=11, C=12, N=14, O=16,  
- F=19, Na=23, Mg=24, Al = 27, Si=28, P=31, S=32,  
- Cl=35.5, K=39, Ca=40, Cr=52, Mn=55, Fe=56, Co=59,  
- Ni=58.7, Cu=63.5, Zn=65.4, As=75, Br=80, Ag=108,  
- Sn=118.7, I=127, Xe=131, Ba=137, Pb=207, U=238.
Physics

PART – I

SECTION – A

Single Correct Choice Type

This section contains **30 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. In an adiabatic process where in pressure is increased by $\frac{2}{3}$% if $\frac{C_p}{C_v} = \frac{3}{2}$, then the volume decreases by about.
   
   (A) $\frac{4}{9}$%
   
   (B) $\frac{2}{3}$%
   
   (C) 4%
   
   (D) $\frac{9}{4}$%

2. A sphere of mass m and radius R is kept on a rough wedge. The acceleration of wedge for the sphere to remain in equilibrium with respect to wedge should be.
   
   (A) $g\sqrt{\frac{2}{3}}$
   
   (B) $g\sqrt{\frac{3}{2}}$
   
   (C) $g\sqrt{\frac{1}{3}}$
   
   (D) $g\sqrt{\frac{2}{3}}$

3. A solid sphere of mass m and radius R is lying on a rough horizontal plane. A constant force 4mg acts vertically at point P such that OP makes an angle 60° with horizontal. Find the minimum value of coefficient of friction so that sphere starts pure rolling.
   
   (A) $\frac{2}{7}$
   
   (B) $\frac{3}{7}$
   
   (C) $\frac{4}{7}$
   
   (D) $\frac{5}{7}$

Space for Rough work
4. The fig below shows the plots of $\frac{PV}{nT}$ versus $P$ for oxygen gas at two different temperatures. Read the following statements concerning the above curve.

(i) the dotted line corresponds to the 'ideal' gas behavior
(ii) $T_1 > T_2$
(iii) the value of $\frac{PV}{nT}$ at the point where the curves meet on the y-axis is the same
(iv) which of the following statement is true.
(A) (i) only
(B) (i) and (ii)
(C) All of these
(D) None of these

5. A uniform rod of mass $M$ and length $L$ is kept on a horizontal surface. The rod receives an impulse $J$ at its lowest point, normal to its length as shown, then choose the correct statement.

(A) The velocity of point P just after impact is $\frac{2J}{M}$

(B) The velocity of point P just after impact is $\frac{J}{M}$

(C) Kinetic energy after impact is $\frac{J^2}{M}$

(D) Kinetic energy after impact is $\left(\frac{2J^2}{M}\right)$
6. Which one of the figure gives the temperature dependence of density of water correctly
(A) \[\text{Density}(D) \quad \text{Temperature}\]
(B) \[\text{Density}(D) \quad \text{Temperature}\]
(C) \[\text{Density}(D) \quad \text{Temperature}\]
(D) \[\text{Density}(D) \quad \text{Temperature}\]

7. In the given potentiometer circuit length of the wire AB is 3 m and resistance is \( R = 4.5 \Omega \). The length AC for no deflection in galvanometer is:
(A) 2 m
(B) 1.8 m
(C) dependent on \( r_1 \)
(D) None of these

8. A plane sinusoidal undiminished sound wave is travelling in +x direction in a gaseous medium. Excess pressure amplitude for any location is \( p_0 \). Wave speed in the medium is 360 ms\(^{-1}\). At some moment, instantaneous values of excess pressure at positions (0,0,0) & (+1, +1, 0) are +\( p_0 \) and +\( p_0/2 \). The frequency of wave is:
(A) 60HZ
(B) 120HZ
(C) \( 60\sqrt{2} \) HZ
(D) \( 120\sqrt{2} \) HZ.

Space for Rough work
9. A point charge $q = 50 \mu C$ is located in the $x - y$ plane at the point of position vector $\vec{r}_0 = 2\hat{i} + 3\hat{j}$. What is the electric field at the point of position vector $\vec{r} = 8\hat{i} - 5\hat{j}$

(A) $1200 \frac{V}{m}$
(B) $4 \times 10^2 \frac{V}{m}$
(C) $900 \frac{V}{m}$
(D) $4500 \frac{V}{m}$

10. A listener is at rest with respect to the source of sound. A wind starts blowing along the line joining the source and the observer. Which of the following quantities do not change?

(A) Wavelength  
(B) Frequency  
(C) Time period  
(D) Velocity of sound

11. A point charge $Q$ is located just above the centre of the flat face of hemisphere as shown in figure. The electric flux through the flat face and curved face of hemisphere are respectively

(A) $\frac{Q}{2 \varepsilon_0}$, $\frac{-Q}{2 \varepsilon_0}$
(B) $\frac{-Q}{2 \varepsilon_0}$, $\frac{Q}{2 \varepsilon_0}$
(C) $\frac{Q}{\varepsilon_0}$, $\frac{-Q}{\varepsilon_0}$
(D) $\frac{-Q}{\varepsilon_0}$, $\frac{Q}{\varepsilon_0}$

12. Find $\mu_{\text{min}}$ between disc and floor for equilibrium

(A) $\frac{1}{4}$
(B) $\frac{1}{3}$
(C) $\frac{2}{3}$
(D) $\frac{3}{4}$

13. In a carnival ride called the rotor, people stand on a ledge inside a large cylinder that rotates about a vertical axis. When it reaches a high enough rotational speed, the ledge drops away. If radius be $2 \text{ m}$ and the period of rotation be $2 \text{ sec}$, then the minimum coefficient of friction for the people not to slide down is

(A) 0.9  
(B) 0.8  
(C) 0.6  
(D) 0.5

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**Space for Rough work**
14. The binding energy of $^{17}_{\text{C}}\text{Cl}^{35}$ nucleus is 298 MeV. Find its atomic mass. The mass of hydrogen atom ($^1\text{H}$) is 1.008143 amu and that of a neutron is 1.008968 amu. Given 1 amu = 931 MeV.
   (A) 148    (B) 298    (C) 340    (D) 348

15. A frame made of thin homogeneous wire, is shown in figure. Assume that the number of successively embedded equilateral triangle with sides decreasing by half tends to infinity. The side AB has a resistance $R_0$. The equivalent resistance between A and B is $x$.
   (A) $x$ is infinite    (B) $x$ is zero    (C) $x = 2R_0$    (D) $x = \left(\frac{\sqrt{7} - 1}{3}\right)R_0$

16. Consider the following reaction;
   $^1\text{H} + ^{13}_{\text{C}} \rightarrow ^{14}_{\text{N}} + {}_0^n\text{n}$
   The atomic masses of the nuclei are
   $M(^1\text{H}) = 1.007825$ u, $M(^{13}_{\text{C}}) = 13.00336$ u, $M(^{14}_{\text{N}}) = 13.00574$ u and 1 amu = 931 MeV. The kinetic energy of proton ($^1\text{H}$) required to initiate the reaction is
   (A) 1.99 MeV    (B) 2.99 MeV    (C) 3.99 MeV    (D) 4.99 MeV

17. The YDSE is made in a liquid. The 10th bright fringe in the liquid lies where the 6th dark fringe lies in vacuum. The refractive index of the liquid is approximately.
   (A) 1.81     (B) 1.54     (C) 1.67     (D) 1.20

18. The time constant of charging of the circuit shown in the figure
   (A) $\frac{2RC}{3}$    (B) $2RC$    (C) $3RC$    (D) $3RC/2$
19. A fly F is sitting on a glass slab A, 45 cm thick and of refractive index \( \mu_2 = \frac{4}{3} \). The slab covers the top of a container B containing water (\( \mu_1 = \frac{3}{2} \)) upto a height of 20 cm. The bottom of container is closed by a concave mirror 'C' of radius of curvature 40 cm. The position of final image formed by all refractions and reflection, assuming paraxial rays is
(A) at the bottom of glass slab
(B) in the middle of container B
(C) in the middle of glass slab
(D) none of these

20. Find the magnetic field at P due to the arrangement shown.
(A) \( \frac{\mu_1 i}{\sqrt{2\pi d}} \left( 1 - \frac{1}{\sqrt{2}} \right) \)
(B) \( \frac{2\mu_1 i}{\sqrt{2\pi d}} \)
(C) \( \frac{\mu_2 i}{\sqrt{2\pi d}} \)
(D) \( \frac{\mu_1 i}{\sqrt{2\pi d}} \left( 1 + \frac{1}{\sqrt{2}} \right) \)

21. A conducting loop of radius R is present in a uniform magnetic field B perpendicular to the plane of the ring. If radius R varies as a function of time 't' as \( R = R_0 + t \). The e.m.f induced in the loop is
(A) \( 2\pi(R_0 + t)B \)
(B) \( \pi(R_0 + t)B \) clockwise
(C) \( 2\pi(R_0 + t)B \) anticlockwise
(D) Zero.

22. In the arrangement shown in given figure current from A to B is increasing in magnitude induced current in the loop will
(A) have clockwise direction
(B) have anticlockwise direction
(C) be zero
(D) oscillate between clockwise and anticlockwise

Space for Rough work
23. Find the time-period of SHM of mass ‘m’.
(A) \(2\pi\sqrt{\frac{3m}{2K}}\)  
(B) \(2\pi\sqrt{\frac{9m}{8K}}\)  
(C) \(2\pi\sqrt{\frac{3m}{K}}\)  
(D) \(2\pi\sqrt{\frac{m}{K}}\)

24. There is a uniform magnetic field B normal to the xy plane. A conductor ABC has length \(AB = \ell_1\), parallel to the x-axis and length \(BC = \ell_2\) parallel to y-axis. ABC moves in the xy plane with velocity \(\vec{V}_x + \vec{V}_y\). The potential difference between A and C is proportional to.
(A) \(V_x \ell_1 + V_y \ell_2\)  
(B) \(V_x \ell_2 + V_y \ell_1\)  
(C) \(V_x \ell_2 - V_y \ell_1\)  
(D) \(V_x \ell_1 - V_y \ell_2\)

25. A particle of mass ‘m’ was transferred from the centre of the base of a uniform hemisphere of mass M and radius R to infinity. The work performed by external agent in this process on the particle is
(A) \(\frac{GmM}{2R}\)  
(B) \(-\frac{GmM}{2R}\)  
(C) \(\frac{3}{2}\left(\frac{GmM}{R}\right)\)  
(D) \(-\frac{3}{2}\left(\frac{GmM}{R}\right)\)

26. A small coil of radius \(r\) is placed at the centre of a large coil of radius R, where R>>r. The coil are coplanar. The co-efficient of mutual inductance between the coils is
(A) \(\frac{\mu_o \pi r}{2R}\)  
(B) \(\frac{\mu_o \pi r^2}{2R}\)  
(C) \(\frac{\mu_o \pi r^2}{2R^2}\)  
(D) \(\frac{\mu_o \pi r}{2R^2}\)

\textit{Space for Rough work}
27. A cube of wood supporting 200 gm mass just floats in water \((\rho = 1\text{g/cc})\). When the mass is removed, the cube rises by 2 cm. The volume of cube is
(A) 1000 cc  (B) 800 cc  (C) 500 cc  (D) none of these

28. A charged particle goes undeflected in a region containing electric and magnetite fields. It is possible that:
(A) \(\vec{E} \parallel \vec{B}, \vec{V} \parallel \vec{E}\)  
(B) \(\vec{E}\) is parallel to \(\vec{B}\)
(C) \(\vec{V} \parallel \vec{B}\) but \(\vec{E}\) is not parallel to \(\vec{B}\)
(D) \(\vec{E} \parallel \vec{B}\) but \(\vec{V}\) is not parallel to \(\vec{E}\)

29. A particle of charge per unit mass \(\alpha\) is released from origin with a velocity \(\vec{v} = v_o \hat{i}\) in a uniform magnetic field \(\vec{B} = -B_o \hat{\mathbf{K}}\). If the particle passes through \((0, y, 0)\) then \(y\) is equal to.
(A) \(-\frac{2v_o}{B_o \alpha}\)  
(B) \(\frac{v_o}{B_o \alpha}\)  
(C) \(\frac{2v_o}{B_o \alpha}\)  
(D) \(-\frac{v_o}{B_o \alpha}\)

30. Spherical particles of pollen are shaken up in water and allowed to settle. The depth of water is 2 cm. What is the diameter of largest particles remaining in suspension one hour later? [The density of pollen = \(1.8 \times 10^3\) kg m\(^{-3}\), viscosity of water = \(10^{-2}\) poise, \(\rho = 10^3\) kg/m\(^3\) & g = 10 ms\(^{-2}\).

Take appropriate assumptions]

(A) \(1.77 \times 10^{-6}\) m  (B) \(3.54 \times 10^{-6}\) m

(C) \(2.56 \times 10^{-6}\) m  (D) \(1.28 \times 10^{-6}\) m

Space for Rough work
Chemistry PART – II

SECTION – A

Single Correct Choice Type

This section contains 30 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE is correct.

1. n-factor for HCl in reaction \( K_2Cr_2O_7 + HCl \rightarrow KCl + CrCl_3 + Cl_2 \)
   (A) \( \frac{5}{7} \)     (B) \( \frac{3}{7} \)     (C) \( \frac{7}{3} \)     (D) \( \frac{7}{5} \)

2. 
   \[
   \begin{array}{c}
   \text{CH}_3 \\
   \text{Br}_2/\text{hv} \\
   \text{Monobromoderivatives}
   \end{array}
   \]
   The number of possible monobromo products is excluding stereo isomers –
   (A) 4  (B) 5  (C) 8  (D) 10

3. The curve drawn below shows the variations of P as a function of \( \frac{1}{V} \) for a fixed mass and temp. of an ideal gas. It follows from the curve that
   (A) \( T_3 > T_2 > T_1 \)  
   (B) \( T_1 > T_2 > T_3 \)  
   (C) \( T_1 = T_2 = T_3 \)  
   (D) Nothing can be predicted about temp.

4. For adiabatic expansion of a perfect gas \( \frac{dp}{P} \) is
   (A) \( \frac{dv}{V} \)  
   (B) \( \frac{\gamma \cdot dv}{V} \)  
   (C) \( -\frac{\gamma dv}{V} \)  
   (D) \( -\gamma^2 \frac{dv}{V} \)

5. If \( E^0_{eq} \) for a given reaction is negative which gives the correct relationship for the value of \( \Delta G^0 \) and \( k_{eq} \)?
   (A) \( \Delta G^0 > 0, k_{eq} < 1 \)  
   (B) \( \Delta G^0 > 0, k_{eq} > 1 \)  
   (C) \( \Delta G^0 < 0, k_{eq} > 1 \)  
   (D) \( \Delta G^0 < 0, k_{eq} < 1 \)

Space for Rough work
6. The solubility of AgBr in water and in 0.01M CaBr$_2$, 0.01M KBr, and 0.05M AgNO$_3$ be $S_1$, $S_2$, $S_3$ and $S_4$ respectively, give the relation of solubilities.

(A) $S_1 > S_2 > S_3 > S_4$  
(B) $S_1 > S_3 > S_2 > S_4$  
(C) $S_2 > S_1 > S_3 > S_4$  
(D) $S_4 > S_3 > S_1 > S_2$

7. Which of the following traits have approximately equal size?
(A) Na$^+$, Mg$^{2+}$, Al$^{3+}$ (isoelectronic)  
(B) F$^-$, Ne, O$^{2-}$ (isoelectronic)  
(C) Fe, Co, Ni  
(D) Mn$^{2+}$, Fe$^{3+}$, Cr (isoelectronic)

8. Which of the following is zero overlapping which leads to non-bonding?

(A)  
(B)  
(C)  
(D) All

9. The resultant dipole moment $\mu$ of two compound NOF and NO$_2$F is 1.81 D and 0.47 D respectively. Which dipole moment do you predict?

(A) 1.81 D for NO$_2$F and 0.47 D for NOF  
(B) 0.47 D for NO$_2$F and 1.81 D for NOF  
(C) For both NO$_2$F and NOF, dipole moment ($\mu$) is 0.81 D.  
(D) For both NO$_2$F and NOF. Dipole moment ($\mu$) is 0.47 D.

10. $A_{(aq)} + Zn \rightarrow B_{(g)}$  
$A_{(aq)} + (C) \rightarrow PH_3$  
$A_{(aq)} + NH_3Cl \rightarrow D_{(g)}$

Find compound A which imparts golden yellow colour to the Bunsen flame.

(A) NaOH  
(B) LiOH  
(C) KOH  
(D) RbOH

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**Space for Rough work**
11. Relative rate of reaction of following amine with methyl iodide is

\[
\begin{align*}
\text{(A)} & \quad \text{N} \\
\text{(B)} & \quad \text{N} \\
\text{(C)} & \quad \text{N}
\end{align*}
\]

(A) A > B > C  
(B) A > C > B  
(C) B > C > A  
(D) B > A > C

12. The two compounds shown below are

\[
\begin{align*}
\text{(i)} & \quad \text{O} \\
\text{(ii)} & \quad \text{O}
\end{align*}
\]

(A) Diastereomer  
(B) Enantiomer  
(C) Epimer  
(D) None

13. Which of the following would not rearrange to a more stable form?

\[
\begin{align*}
\text{(A)} & \quad \text{H} \\
\text{(B)} & \quad \text{H} \\
\text{(C)} & \quad \text{H} \\
\text{(D)} & \quad \text{H}
\end{align*}
\]

14. Compare relative stability of following resonating structure

\[
\begin{align*}
\text{(i)} & \quad \text{C} \\
\text{(ii)} & \quad \text{C} \\
\text{(iii)} & \quad \text{C}
\end{align*}
\]

(A) I > II > III  
(B) II > I > III  
(C) I > III > II  
(D) II > III > I

Space for Rough work
15. \[ A \xrightarrow{H_2(1\text{mole})/Pt} \]  
Double bond equivalent (degree of unsaturation) of (A) is  
(A) 1  
(B) 2  
(C) 3  
(D) 4  

16. \[ \text{(A)} \xrightarrow{\text{HBr/CCl}_4} \text{(A)} \]  

17. Iso-electric point of alanine is (pH = 6). At which pH, maximum concentration of zwitter ion of alanine will be present?  
(A) pH > 6  
(B) pH < 6  
(C) pH = 6  
(D) pH = 7  

18. What is the structure of \( L^- \) glucose?  
(A)  
(B)  
(C)  
(D) None  

Space for Rough work
19. Which reactions are used for the preparation of the halogen acid?
(A) \( \text{KBr} + \text{H}_2\text{SO}_4 \text{ (conc.)} \rightarrow \text{K}_2\text{SO}_4 + 2\text{HBr} \)
(B) \( \text{CaF}_2 + \text{H}_2\text{SO}_4 \text{ (conc.)} \rightarrow \text{Ca(HSO}_4)_2 + \text{HF} \)
(C) \( \text{NaCl} + \text{H}_2\text{SO}_4 \text{ (conc.)} \rightarrow \text{NaHSO}_4 + \text{HCl} \)
(D) \( 2\text{KI} + \text{H}_2\text{SO}_4 \text{ (conc.)} \rightarrow \text{K}_2\text{SO}_4 + 2\text{HI} \)

20. Which of the following orders regarding thermal stability of hydrides \( \text{MH}_3 \) of group 15 is correct?
(A) \( \text{NH}_3 > \text{PH}_3 > \text{AsH}_3 \)
(B) \( \text{NH}_3 < \text{PH}_3 < \text{AsH}_3 \)
(C) \( \text{NH}_3 > \text{PH}_3 < \text{AsH}_3 \)
(D) \( \text{NH}_3 < \text{PH}_3 > \text{AsH}_3 \)

21. The formula of Azurite is
(A) \( \text{CuCO}_3 \cdot \text{Cu(OH)}_2 \)
(B) \( 2\text{CuCO}_3 \cdot \text{Cu(OH)}_2 \)
(C) \( \text{CuCO}_3 \cdot 2\text{Cu(OH)}_2 \)
(D) \( \text{CuSO}_4 \cdot \text{Cu(OH)}_2 \)

22. In this sequence \( X, Y, Z \) are respectively
\[
\text{Cr}^{3+} \quad \text{green solution} \quad \text{yellow solution} \quad \text{blue solution}
\]
(A) Acidified \( \text{H}_2\text{O}_2 \), Alkaline \( \text{H}_2\text{O}_2 \), Acidified \( \text{H}_2\text{O}_2 \)
(B) Alkaline \( \text{H}_2\text{O}_2 \), Acidified \( \text{H}_2\text{O}_2 \), Zn/HCl
(C) Acidified \( \text{H}_2\text{O}_2 \), Heat, alkaline \( \text{H}_2\text{O}_2 \)
(D) Alkaline \( \text{H}_2\text{O}_2 \), Acidified \( \text{H}_2\text{O}_2 \), on standing

23. What will be the colour of the solution when \( \text{Mn(OH)}_2 \) is treated with conc. \( \text{HNO}_3 \) and sodium bismuthate (or red lead or lead dioxide)?
(A) yellow
(B) Purple
(C) Green
(D) Blue

24. In \( \text{NaCl} \) the centres of two nearest like charged ions are present at a distance of
(A) \( \frac{a}{\sqrt{2}} \)
(B) \( \frac{a}{2} \)
(C) \( \frac{\sqrt{3}}{2}a \)
(D) \( \sqrt{2}a \)

Space for Rough work
25. Complexes given below shows

(A) Optical isomer
(B) Co-ordinate isomerism
(C) Geometrical isomerism
(D) Bridge isomerism

26. The C.F.S.E of \([\text{Co}(\text{NH}_3)_6\text{Cl}_3]\) is

(A) \(-7.2\Delta_0\)  
(B) \(-0.4\Delta_0\)  
(C) \(-2.4\Delta_0\)  
(D) \(-3.6\Delta_0\)

27. In the extraction of copper, metal is formed in the Bessemer converter due to reaction.

(A) \(2\text{Cu}_2\text{S} + 2\text{Cu}_2\text{O} \rightarrow 6\text{Cu} + \text{SO}_2\)  
(B) \(\text{Cu}_2\text{S} \rightarrow 2\text{Cu} + \text{S}\)  
(C) \(\text{Fe} + \text{Cu}_2\text{O} \rightarrow 2\text{Cu} + \text{FeO}\)  
(D) \(2\text{Cu}_2\text{O} \rightarrow 4\text{Cu} + \text{O}_2\)

28. Which of the following curve represents the Henry’s law?

(A) \[\log P \quad \log x\]  
(B) \[\log P \quad \log x\]  
(C) \[\log P \quad \log x\]  
(D) \[\log P \quad \log x\]
29. When two half-cells of electrode potential of $E_1$ and $E_2$ are combined to form a cell of electrode $E_3$, then (where $n_1$, $n_2$ and $n_3$ are number of electrons exchanged in first, second and combined half cells):

(A) $E_3 = E_2 - E_1$  
(B) $E_3 = \frac{E_1n_1 + E_2n_2}{n_3}$

(C) $E_3 = \frac{E_1n_1 - E_2n_2}{n_3^2}$  
(D) $E_3 = E_1 + E_2$

30. For a first order homogeneous gaseous reaction $A \rightarrow 2B + C$ then initial pressure was $P_i$ while total pressure after time $t$ was $P_t$. Then expression for rate constants $K$ in terms $P_i$, $P_t$ and $t$ is.

(A) $K = \frac{2.303}{t} \log \left( \frac{2P_t}{3P_i - P_t} \right)$ 
(B) $K = \frac{2.303}{t} \log \left( \frac{2P_t}{2P_i - P_t} \right)$

(C) $K = \frac{2.303}{t} \log \left( \frac{P_t}{P_i - P_t} \right)$  
(D) None of these

**Space for Rough work**
Mathematics

PART – III

SECTION – A

Single Correct Choice Type

This section contains 30 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE is correct.

1. If \([x]\) denotes the integral part of \(x\) and \(m = \left\lfloor \frac{|x|}{1 + x^2} \right\rfloor\), \(n = \text{least integral value of} \ \frac{1}{2 - \sin 3x}\), then
   (A) \(m \neq n\) \quad (B) \(m > n\) \quad (C) \(m + n = 0\) \quad (D) \(n^m = 0\)

2. If \(1 - \cos x = \frac{\sqrt{3}}{2}|x| + a\) has no solution, then complete set of values of \(a\) is
   (A) \(\left( \frac{1}{2}, \infty \right)\) \quad (B) \(\left( \frac{3}{2} - \frac{\pi}{3}, 4 \right)\) \quad (C) \(\left( \frac{3}{2} - \frac{\pi}{\sqrt{3}}, \infty \right)\) \quad (D) \((4, \infty)\)

3. Let \(f_P(\alpha) = e^{i\alpha}\cdot e^{2i\alpha}\cdot e^{3i\alpha} \cdots e^{Pi}\) where \(i = \sqrt{-1}\) and \(P \in \mathbb{N}\), then \(\lim_{n \to \infty} f_n(\pi)\) is
   (A) 1 \quad (B) \(-1\) \quad (C) \(i\) \quad (D) \(-i\)

4. \(\sin^{-1}\left\{ \frac{1}{i}\right\}(z - 1)\) where \(z\) is non real and \(i = \sqrt{-1}\) can be then angle of a triangle if
   (A) \(\text{Re}(z) = 1, \text{Im}(z) = 2\) \quad (B) \(\text{Re}(z) \geq 1, -1 \leq \text{Im}(z) \leq 1\)
   (C) \(\text{Re}(z) + \text{Im}(z) = 0\) \quad (D) none of these

5. Let \(S = \frac{\sqrt{5}}{5} + \frac{\sqrt{6}}{6} + \frac{\sqrt{24}}{325} + \ldots + \frac{\sqrt{2^{10}}}{2^{11} + 1}\) then
   (A) \(S = \frac{1088}{545}\) \quad (B) \(S = \frac{545}{1088}\) \quad (C) \(S = \frac{1056}{545}\) \quad (D) \(S = \frac{545}{1056}\)

6. If \(a_1, a_2, a_3, \ldots, a_{20}\) are A.Ms between 13 and 67 then the maximum value of \(a_1a_2a_3 \ldots a_{20}\) is
   (A) \((20)^{20}\) \quad (B) \((40)^{20}\) \quad (C) \((60)^{20}\) \quad (D) \((80)^{20}\)

Space for Rough work
7. If \( A = \cos(\cos x) + \sin(\cos x) \), then least and greatest value of \( A \) are
(A) 0 and 2 \hspace{1cm} (B) -1 and 1 \hspace{1cm} (C) \(-\sqrt{2}\) and \(\sqrt{2}\) \hspace{1cm} (D) 0 and \(\sqrt{2}\)

8. If \( x = \sin \theta |\sin \theta| \), \( y = \cos \theta |\cos \theta| \), where \( \frac{99\pi}{2} \leq \theta \leq 50\pi \) then
(A) \( x - y = 1 \) \hspace{1cm} (B) \( x + y = -1 \) \hspace{1cm} (C) \( x + y = 1 \) \hspace{1cm} (D) \( y - x = 1 \)

9. Let \( n \) be a positive integer such that \( \sin \left(\frac{\pi}{2n}\right) + \cos \left(\frac{\pi}{2n}\right) = \frac{\sqrt{n}}{2} \) then
(A) \( n = 6 \) \hspace{1cm} (B) \( n = 2 \) \hspace{1cm} (C) \( n = 1 \) \hspace{1cm} (D) \( n = 3, 4, 5 \)

10. Complete set of values of \( x \) in \((0, \pi)\) satisfying \( 1 + \log_2 \sin x + \log_2 \sin 3x \geq 0 \) is
(A) \( \left[\frac{2\pi}{3}, \frac{3\pi}{4}\right] \) \hspace{1cm} (B) \( \left[\frac{\pi}{3}, \frac{2\pi}{3}\right] \) \hspace{1cm} (C) \( \left[0, \frac{\pi}{2}\right] \cup \left[\frac{2\pi}{3}, \pi\right] \) \hspace{1cm} (D) \( \left[\frac{\pi}{2}, \frac{2\pi}{3}\right] \)

11. Let \( A = \{x_1, x_2, x_3, x_4, x_5\}; B = \{y_1, y_2, y_3, y_4, y_5\} \) then the number of one-one mapping from \( A \) to \( B \) such that \( f(x_i) \neq y_i, \ i = 1, 2, \ldots 5 \) is
(A) 40 \hspace{1cm} (B) 44 \hspace{1cm} (C) 6 \hspace{1cm} (D) 24

12. Coefficient of \( x^{15} \) in \((1 + x + x^3 + x^4)^n\) is
(A) \( \sum_{r=0}^{n} C_{5r} \cdot C_{3r} \) \hspace{1cm} (B) \( \sum_{r=0}^{n} C_{5r} \) \hspace{1cm} (C) \( \sum_{r=0}^{n} C_{3r} \) \hspace{1cm} (D) \( \sum_{r=0}^{n} C_{3-r} \cdot C_{5r} \)

13. If two events \( A \) and \( B \) are such that \( P(\overline{A}) = \frac{3}{10}, \ P(B) = \frac{2}{5} \) and \( P(A \cap \overline{B}) = \frac{1}{2} \) then \( P\left(\frac{B}{A \cup \overline{B}}\right) \) is equal to
(A) \( \frac{1}{2} \) \hspace{1cm} (B) \( \frac{1}{3} \) \hspace{1cm} (C) \( \frac{1}{4} \) \hspace{1cm} (D) \( \frac{2}{3} \)

Space for Rough work
14. If \((1 + ax + bx^2)^4 = a_0 + a_1x + a_2x^2 + \ldots + a_8x^8\) when \(a, b, a_0, a_1 \ldots a_8 \in \mathbb{R}\) such that \(a_0 + a_1 + a_2 \neq 0\)

\[
\begin{vmatrix}
\begin{bmatrix}
a_0 & a_1 & a_2 \\
a_3 & a_4 & a_5 \\
a_6 & a_7 & a_8 \\
\end{bmatrix}
\end{vmatrix} = 0 \text{ then}
\]

(A) \(a = \frac{3}{4}, b = \frac{5}{8}\)
(B) \(a = \frac{1}{4}, b = \frac{5}{32}\)
(C) \(a = 1, b = \frac{2}{3}\)
(D) none of these

15. If \(A = [aij]_{2 \times 2}\) where \(aij = \begin{cases}
1 & i + j \neq j \\
0 & i - j = j
\end{cases}\) then \(A^{-1}\) is

(A) \(\begin{bmatrix}
0 & 1 \\
\frac{1}{3} & 0
\end{bmatrix}\)
(B) \(\begin{bmatrix}
\frac{2}{3} & 1 \\
\frac{1}{3} & 0
\end{bmatrix}\)
(C) \(\begin{bmatrix}
0 & 1 \\
\frac{1}{3} & 0
\end{bmatrix}\)
(D) \(\begin{bmatrix}
\frac{1}{9} & \frac{1}{3} \\
\frac{1}{9} & \frac{1}{3}
\end{bmatrix}\)

16. Equation of the circle having centre at \((3, -1)\) and cutting the intercept of length 6 unit on the line 
\(2x - 5y + 18 = 0\) is

(A) \(x^2 + y^2 - 6x + 2y - 18 = 0\)
(B) \(x^2 + y^2 - 6x + 2y - 38 = 0\)
(C) \(x^2 + y^2 - 6x + 2y - 28 = 0\)
(D) none of these

17. Minimum distance between the curve \(y^2 = 4x\) and \(x^2 + y^2 - 12x + 31 = 0\) is equal to

(A) \(\sqrt{21}\)
(B) \(\sqrt{26} - \sqrt{5}\)
(C) \(\sqrt{20} - \sqrt{5}\)
(D) \(\sqrt{28} - \sqrt{5}\)

18. Locus of the mid point of the chords of the hyperbola \(x^2 - y^2 = a^2\), that touch the parabola \(y^2 = 4ax\) is

(A) \(x^2 (x - a) = y^3\)
(B) \(y^3 (x - a) = x^3\)
(C) \(x^3 (x - a) = y^2\)
(D) \(y^3 (x - a) = x^2\)

19. If the tangents from the point \((\lambda, 3)\) to the ellipse \(\frac{x^2}{9} + \frac{y^2}{4} = 1\) are at right angles then \(\lambda\) is

(A) \(\pm 1\)
(B) \(\pm 3\)
(C) \(\pm 2\)
(D) none of these

Space for Rough work
20. \[ \lim_{x \to 0} \frac{x^4 \sin^5 x}{\sin(x^5)}, \text{ a, b, c} \in \mathbb{R} - \{0\} \text{ exists and has non-zero values then} \]
   (A) a, b, c are in AP  (B) a, b, c are in GP  (C) a, b, c are in HP  (D) none of these

21. Suppose \( f : \mathbb{R} \to \mathbb{R} \) is a differentiable function and \( f(1) = 4 \) then the value of \( \lim_{x \to 1} \frac{1}{4} \int_4^{f(x)} 2\,dt \)
   (A) 8\( f' \)(1)  (B) 4\( f' \)(1)  (C) 2\( f' \)(1)  (D) \( f' \)(1)

22. If \( f(x) = x + \tan x \) and \( f \) is inverse of \( g \) then \( g'(x) \) is equal to
   (A) \( \frac{1}{1+(g(x)-x)^2} \)  (B) \( \frac{1}{1-(g(x)-x)^2} \)  (C) \( \frac{1}{2+(g(x)-x)^2} \)  (D) \( \frac{1}{2-(g(x)-x)^2} \)

23. If the function \( f(x) = \cos|x| - 2ax + b \) increases along the centre number scale, the range of value of \( a \) is given by
   (A) \( a \leq b \)  (B) \( a = \frac{b}{2} \)  (C) \( a \leq -\frac{1}{2} \)  (D) \( a \geq -\frac{3}{2} \)

24. The value of \( \int \frac{1 + \log x}{\sqrt{(x^4)^2} - 1} \,dx \) is
   (A) \( \sec^{-1}(x^4) + c \)  (B) \( \tan^{-1}(x^4) + c \)  (C) \( \log \left( x + \sqrt{(x^4)^2} - 1 \right) \)  (D) none of these

25. \( \lim_{n \to \infty} \frac{2^k + 4^k + 6^k + \ldots (2n)^k}{n^{k+1}} \) for \( K \neq -1 \) is equal to
   (A) \( 2^K \)  (B) \( \frac{2K}{K+1} \)  (C) \( \frac{1}{K+1} \)  (D) none of these

26. \( I = \int_1^4 e^{g} \,dx \) equals to
   (A) \( e^2 \)  (B) \( e \)  (C) 2\( e \)  (D) 2\( e^2 \)

Space for Rough work
27. Area bounded by the curve \( y = \sin^{-1} x \), y-axis and \( y = \cos^{-1} x \) is equal to
   (A) \((2 + \sqrt{2})\) sq unit  \hspace{1cm} (B) \((2 - \sqrt{2})\) sq unit  \hspace{1cm} (C) \((1 + \sqrt{2})\) sq unit  \hspace{1cm} (D) \((\sqrt{2} - 1)\) sq unit

28. The solution of the differential equation \( \frac{dy}{dx} + \frac{\tan y}{x} = (e^x \sec y \cdot x) \) is equal to
   (A) \( x \sin y = e^x (x^2 - 2x + 2) + c \)  \hspace{1cm} (B) \( x^2 \sin y = e^x (x + 1)^2 + e^x + c \)
   (C) \( x^2 \sin y = e^x (x - 1)^2 + e^x + c \)  \hspace{1cm} (D) \( x \sin y = e^x (x^2 + 2x + 2) + c \)

29. Value of \( \begin{vmatrix} \mathbf{a} \times \mathbf{b} & \mathbf{a} \times \mathbf{c} & \mathbf{a} \times \mathbf{d} \end{vmatrix} \) is always equal to
   (A) \( \mathbf{a} \cdot \mathbf{d} \mathbf{abc} \)  \hspace{1cm} (B) \( \mathbf{a} \cdot \mathbf{c} \mathbf{a} \cdot \mathbf{b} \cdot \mathbf{c} \)
   (C) \( \mathbf{a} \cdot \mathbf{b} \mathbf{a} \cdot \mathbf{b} \cdot \mathbf{c} \)  \hspace{1cm} (D) none of these

30. The equation of the plane passing through the points \((2, -1, 0), (3, -4, 5)\) and parallel to the line \(2x = 3y = 4z\) is
   (A) \( 125x - 90y - 79z = 340 \)  \hspace{1cm} (B) \( 32x - 21y - 36z = 85 \)
   (C) \( 73x + 61y - 22z = 85 \)  \hspace{1cm} (D) \( 29x - 27y - 22z = 85 \)

*Space for Rough work*