

JEE Main – 2020

8th January 2020 (Morning Shift)

General Instructions

1. The test is of **3 hours** duration and the maximum marks is **300**.
2. The question paper consists of **3 Parts** (Part I: **Physics**, Part II: **Chemistry**, Part III: **Mathematics**). Each Part has **two** sections (Section 1 & Section 2).
3. **Section 1** contains **20 Multiple Choice Questions**. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE CHOICE** is correct.
4. **Section 2** contains **5 Numerical Value Type Questions**. The answer to each question is a NUMERICAL VALUE. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places.

Marking Scheme

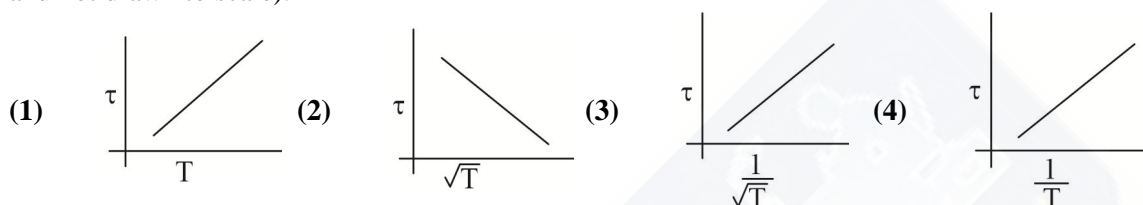
1. **Section – 1:** +4 for correct answer, –1 (negative marking) for incorrect answer, 0 for all other cases.
2. **Section – 2:** +4 for correct answer, 0 for all other cases. There is no negative marking.

SUBJECT I: PHYSICS	MARKS: 100
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SECTION 1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE CHOICE** is correct.

1. The plot that depicts the behavior of the mean free time τ (time between two successive collisions) for the molecules of an ideal gas, as a function of temperature (T), qualitatively, is : (Graphs are schematic and not drawn to scale).



2. Effective capacitance of parallel combination of two capacitors C_1 and C_2 is $10\mu F$. When these capacitors are individually connected to a voltage source of $1V$, the energy stored in the capacitor C_2 is 4 times that of C_1 . If these capacitors are connected in series, their effective capacitance will be :

- (1) $3.2\mu F$ (2) $8.4\mu F$ (3) $1.6\mu F$ (4) $4.2\mu F$

3. The magnifying power of a telescope with tube length $60cm$ is 5. What is the focal length of its eye piece ?

- (1) $40cm$ (2) $20cm$ (3) $10cm$ (4) $30cm$

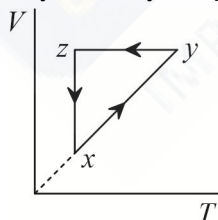
4. Proton with kinetic energy of $1MeV$ moves from south to north. It gets an acceleration of $10^{12}m/s^2$ by an applied magnetic field (west to east). The value of magnetic field : (Rest mass of proton is $1.6 \times 10^{-27}kg$)

- (1) $0.71mT$ (2) $0.071mT$ (3) $71mT$ (4) $7.1mT$

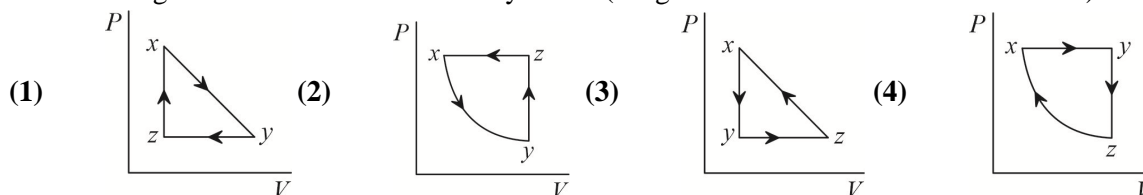
5. A particle of mass m is fixed to one end of a light spring having force constant k and unstretched length l . The other end is fixed. The system is given an angular speed ω about the fixed end of the spring such that it rotates in a circle in gravity free space. Then the stretch in the spring is :

- (1) $\frac{m\omega^2}{k - m\omega^2}$ (2) $\frac{m\omega^2}{k - \omega m}$ (3) $\frac{m\omega^2}{k + m\omega^2}$ (4) $\frac{m\omega^2}{k + m\omega}$

6. A thermodynamic cycle $xyzx$ is shown on a $V-T$ diagram.



The P-V diagram that best describes this cycle is : (Diagrams are schematic and not to scale)



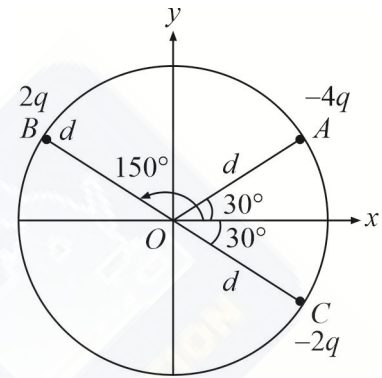
7. Consider a uniform rod of mass $M = 4m$ and length l pivoted about its centre. A mass m moving with velocity v making angle $\theta = \frac{\pi}{4}$ to the rod's long axis collides with one end of the rod and sticks to it.

The angular speed of the rod-mass system just after the collision is :

- (1) $\frac{3}{7\sqrt{2}} \frac{v}{l}$ (2) $\frac{3}{7} \frac{v}{l}$ (3) $\frac{3\sqrt{2}}{7} \frac{v}{l}$ (4) $\frac{4}{7} \frac{v}{l}$

8. Three charged particles A, B and C with charges $-4q, 2q$ and $-2q$ are present on the circumference of a circle of radius d . The charged particles A, C and centre O of the circle formed an equilateral triangle as shown in figure. Electric field at O along x -direction is :

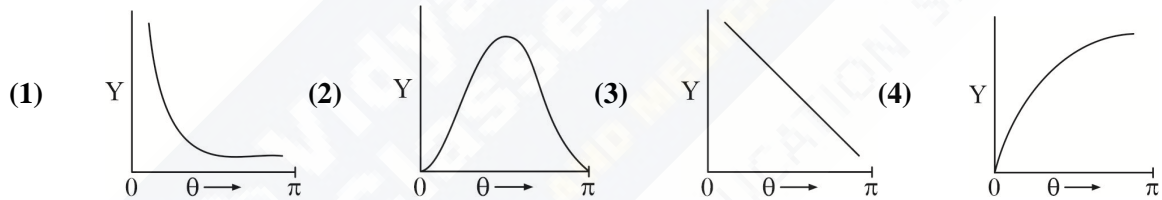
- (1) $\frac{3\sqrt{3}q}{4\pi\epsilon_0 d^2}$ (2) $\frac{\sqrt{3}q}{\pi\epsilon_0 d^2}$
 (3) $\frac{2\sqrt{3}q}{\pi\epsilon_0 d^2}$ (4) $\frac{\sqrt{3}q}{4\pi\epsilon_0 d^2}$



9. The graph which depicts the results of Rutherford gold foil experiment with α -particles is :
 θ : Scattering angle

Y : Number of scattered α -particles detected

(Plot are schematic and not to scale)



10. When photon of energy $4.0eV$ strikes the surface of a metal A, the ejected photoelectrons have maximum kinetic energy $T_A eV$ and de-Broglie wavelength λ_A . The maximum kinetic energy of photoelectrons liberated from another metal B by photon by energy $4.50eV$ is $T_B = (T_A - 1.5)eV$. If the de-Broglie wavelength of these photoelectrons $\lambda_B = 2\lambda_A$, then the work function of metal B is :

- (1) $1.5eV$ (2) $3eV$ (3) $4eV$ (4) $2eV$

11. The length of a potentiometer wire is $1200cm$ and its carries a current of $60mA$. For a cell of emf $5V$ and internal resistance of 20Ω , the null point on it is found to be at $1000cm$. The resistance of whole wire is :

- (1) 60Ω (2) 120Ω (3) 100Ω (4) 80Ω

12. In finding the electric field using Gauss law the formula $|\vec{E}| = \frac{q_{enc}}{\epsilon_0 |A|}$ is applicable. In the formula ϵ_0 is permittivity of free space, A is the area of Gaussian surface and q_{enc} is charge enclosed by the Gaussian surface. This equation can be used in which of the following situation ?

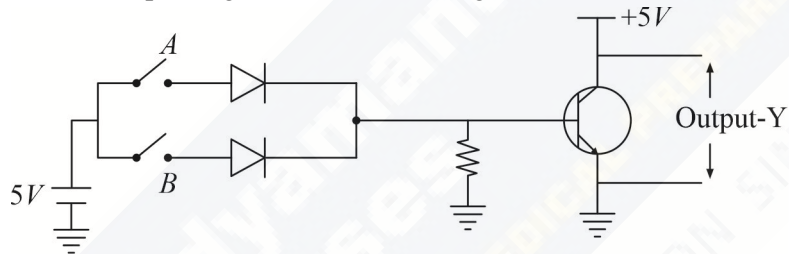
- (1) For any choice of Gaussian surface.
 (2) Only when the Gaussian surface an equipotential surface.
 (3) Only when the Gaussian is an equipotential surface and $|\vec{E}|$ is constant on the surface.
 (4) Only when $|\vec{E}| = \text{constant}$ on the surface.

13. The critical angle of a medium of a specific wavelength, if the medium has relative permittivity 3 and relative permeability $\frac{4}{3}$ for this wavelength, will be :
- (1) 30° (2) 15° (3) 60° (4) 45°

14. A leak proof cylinder of length 1m, made of a metal which has very low coefficient of expansion is floating vertically in water at 0°C such that its height above the water surface is 20cm. When the temperature water is increased to 4°C , the height of the cylinder above the water surface becomes 21cm. The density of water at $T = 4^\circ\text{C}$, relative to the density at $T = 0^\circ\text{C}$ is close to :
- (1) 1.26 (2) 1.03 (3) 1.01 (4) 1.04

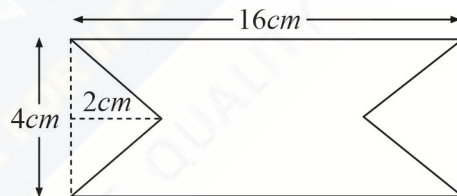
15. Consider a solid sphere of radius R and mass density $\rho(r) = \rho_0 \left(1 - \frac{r^2}{R^2}\right)$, $0 < r \leq R$. The minimum density of a liquid in which it will float is :
- (1) $\frac{\rho_0}{5}$ (2) $\frac{2\rho_0}{5}$ (3) $\frac{2\rho_0}{3}$ (4) $\frac{\rho_0}{3}$

16. Boolean relation at the output stage-Y for the following circuit is :



- (1) $\bar{A} + \bar{B}$ (2) $\bar{A} \cdot \bar{B}$ (3) $A \cdot B$ (4) $A + B$

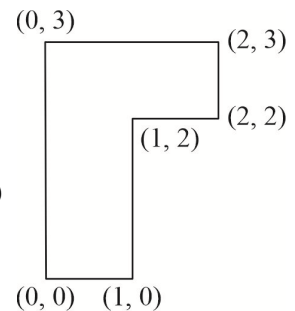
17. At time $t = 0$ magnetic field of 1000 Gauss is passing perpendicular through the area defined by the closed loop shown in the figure. If the magnetic field reduces linearly to 500 Gauss, in the next 5s, then induced EMF in the loop is :



- (1) $28\mu\text{V}$ (2) $48\mu\text{V}$ (3) $56\mu\text{V}$ (4) $36\mu\text{V}$

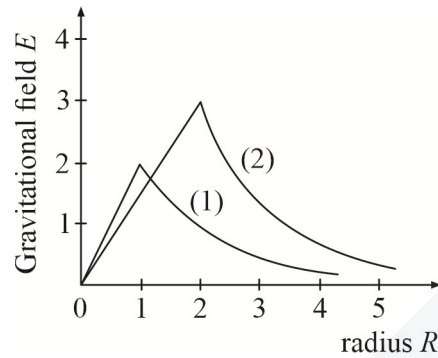
18. The coordinates of centre of mass of a uniform flag shaped lamina (thin flat plate) of mass 4kg. (The coordinates of the same are shown in figure) are :

- (1) $(0.75\text{m}, 1.75\text{m})$ (2) $(1.25\text{m}, 1.50\text{m})$
 (3) $(1\text{m}, 1.75\text{m})$ (4) $(0.75\text{m}, 0.75\text{m})$



19. The dimension of stopping potential V_0 in photoelectric effect in units of Plank's constant ' h ', speed light ' c ' and gravitational constant ' G ' and ampere A is :
- (1) $h^{2/3} c^{5/3} G^{1/3} A^{-1}$ (2) $h^2 G^{3/2} c^{1/3} A^{-1}$
 (3) $h^{1/3} G^{2/3} c^{1/3} A^{-1}$ (4) $h^{-2/3} c^{-1/3} G^{4/3} A^{-1}$

20. Consider two solid spheres of radii $R_1 = 1m$, $R_2 = 2m$ and masses M_1 and M_2 , respectively. The gravitational field due to sphere (1) and (2) are shown. The value of $\frac{M_1}{M_2}$ is :



- (1) $\frac{1}{3}$ (2) $\frac{1}{2}$ (3) $\frac{2}{3}$ (4) $\frac{1}{6}$

SECTION 2

This section has FIVE (05) Questions. The answer to each question is a NUMERICAL VALUE. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places.

21. A particle is moving along the x -axis with its coordinate with time ' t ' given by $x(t) = 10 + 8t - 3t^2$. Another particle is moving along the y -axis with its coordinate as a function of time given by $y(t) = 5 - 8t^3$. At $t = 1s$, the speed of the second particle as measured in the frame of the first particle is given as \sqrt{v} . Then v (in m/s) is_____.
22. A body A, of mass $m = 0.1kg$ has an initial velocity of $3\hat{i} ms^{-1}$. It collides elastically with another body, B the same mass which has an initial velocity of $5\hat{j} ms^{-1}$. After collision, A moves with a velocity $\vec{v} = 4(\hat{i} + \hat{j})$. The energy of B after collision is written as $\frac{x}{10} J$. The value of x is_____.
23. Four resistances of 15Ω , 12Ω , 4Ω and 10Ω respectively in cyclic order to form Wheatstone's network. The resistance that is to be connected in parallel with the resistance of 10Ω to balance the network is_____ Ω .
24. A point object in air is in front of the curved surface of a plano-convex lens. The radius of curvature of the curved surface is $30cm$ and the refractive index of the lens material is 1.5, then the focal length of the lens (in cm) is_____.
25. A one metre long (both ends open) organ pipe is kept in a gas that has double the density of air at STP. Assuming the speed of sound in air at STP is $300m/s$, the frequency difference between the fundamental and second harmonic of this pipe is_____ Hz.

SECTION 1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE CHOICE is correct.

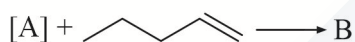
1. The complex that can show fac- and mer- isomers is :

- (1) $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$ (2) $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
 (3) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$ (4) $[\text{CoCl}_2(\text{en})_2]$

2. The predominant intermolecular forces present in ethyl acetate, a liquid, are :

- (1) London dispersion, dipole-dipole and hydrogen bonding
 (2) London dispersion and dipole-dipole
 (3) Dipole-Dipole and hydrogen bonding
 (4) Hydrogen bonding and London dispersion

3. The major products A and B in the following reactions are :

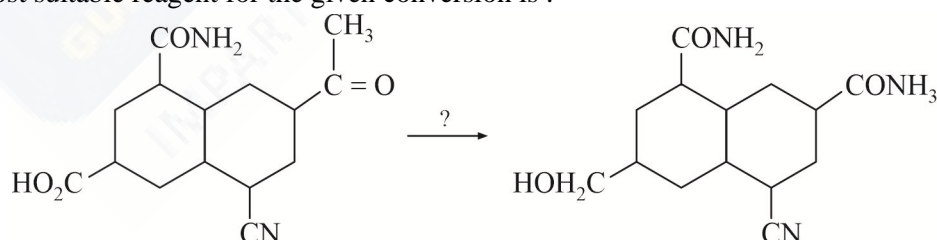


- (1) $\text{A} = \text{CH}_3\text{C}(\text{CH}_3)_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CN}$ and $\text{B} = \text{CH}_3\text{C}(\text{CH}_3)_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CN}$
 (2) $\text{A} = \text{CH}_3\text{C}(\text{CH}_3)_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CN}$ and $\text{B} = \text{CH}_3\text{C}(\text{CH}_3)_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CN}$
 (3) $\text{A} = \text{CH}_3\text{C}(\text{CH}_3)_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CN}$ and $\text{B} = \text{CH}_3\text{C}(\text{CH}_3)_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CN}$
 (4) $\text{A} = \text{CH}_3\text{C}(\text{CH}_3)_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CN}$ and $\text{B} = \text{CH}_3\text{C}(\text{CH}_3)_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CN}$

4. When gypsum is heated to 393 K, it forms :

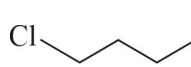
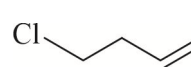
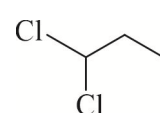
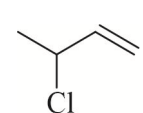
- (1) Anhydrous CaSO_4 (2) $\text{CaSO}_4 \cdot 5\text{H}_2\text{O}$
 (3) Dead burnt plaster (4) $\text{CaSO}_4 \cdot 0.5\text{H}_2\text{O}$

5. The most suitable reagent for the given conversion is :



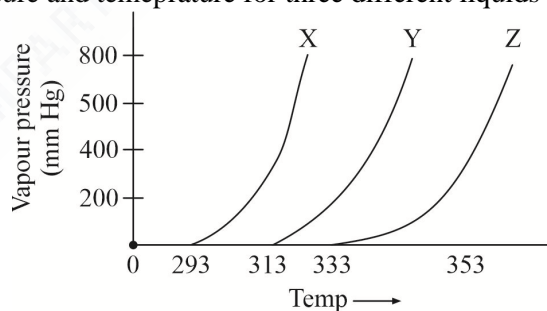
- (1) B_2H_6 (2) LiAlH_4 (3) H_2/Pd (4) NaBH_4

6. The decreasing order of reactivity towards dehydrogenation (E_1) reaction of the following compounds is :

- (A)  (B)  (C)  (D) 
 (1) $\text{D} > \text{B} > \text{C} > \text{A}$ (2) $\text{B} > \text{A} > \text{D} > \text{C}$ (3) $\text{B} > \text{D} > \text{A} > \text{C}$ (4) $\text{B} > \text{D} > \text{C} > \text{A}$

7. The third ionization enthalpy is minimum for :
 (1) Co (2) Ni (3) Mn (4) Fe
8. The number of bonds between sulphur and oxygen atoms in $S_2O_8^{2-}$ and the number of bonds between sulphur and sulphur atoms in rhombic sulphur, respectively, are :
 (1) 4 and 8 (2) 4 and 6 (3) 8 and 6 (4) 8 and 8
9. As per Hardy-Schulze formulation, the flocculation values of the following for ferric hydroxide sol are in the order :
 (1) $AlCl_3 > K_3[Fe(CN)_6] > K_2CrO_4 > KBr = KNO_3$
 (2) $K_3[Fe(CN)_6] < K_2CrO_4 < KBr = KNO_3 = AlCl_3$
 (3) $K_3[Fe(CN)_6] > AlCl_3 > K_2CrO_4 > KBr > KNO_3$
 (4) $K_3[Fe(CN)_6] < K_2CrO_4 < AlCl_3 < KBr < KNO_3$
10. Arrange the following compounds in increasing order of C–OH bond length :
 methanol, phenol, p-ethoxyphenol
 (1) methanol < p-ethoxyphenol < phenol (2) phenol < p-ethoxyphenol < methanol
 (3) phenol < methanol < p-ethoxyphenol (4) methanol < phenol < p-ethoxyphenol
11. The rate of a certain biochemical reaction at physiological temperature (T) occurs 10^6 times faster with enzyme than without. The change in the reaction energy upon adding enzyme is :
 (1) $+6RT$ (2) $-6RT$ (3) $+6(2.303)RT$ (4) $-6(2.303)RT$
12. For the Balmer series in the spectrum of H-atom, $\bar{\nu} = R_H \left\{ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right\}$, the correct statements among (I) to (IV) are :
 I. As wavelength decreases, the lines in the series converge
 II. The integer n_1 is equal to 2
 III. The lines of longest wavelength corresponds to $n_2 = 3$
 IV. The ionization energy of hydrogen can be calculated from wave number of these lines
 (1) II, III and IV (2) I, II and IV (3) I, III and IV (4) I, II and III
13. Which of the following statement is not true for glucose ?
 (1) Glucose exists in two crystalline forms α and β
 (2) Glucose gives Schiff's test aldehyde
 (3) The pentaacetate of glucose does not react with hydroxylamine to give oxime
 (4) Glucose reacts with hydroxylamine to form oxime

14. A graph of vapour pressure and temperature for three different liquids X, Y and Z is shown below :



The following inferences are made :

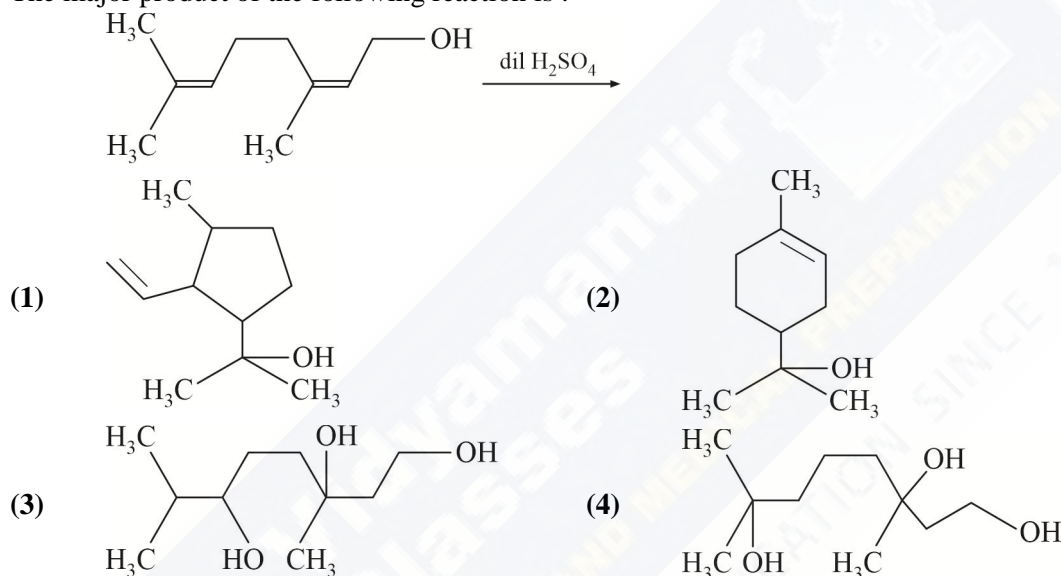
- (A) X has higher intermolecular interactions compared to Y.
 (B) X has lower intermolecular interactions compared to Y.
 (C) Z has lower intermolecular interactions compared to Y.

The correct inference(s) is/are :

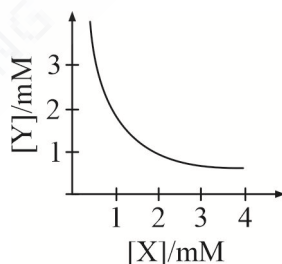
- (1) A and C (2) A (3) B (4) C

15. Among the gases (a) - (e), the gases that cause greenhouse effect are :
 (a) CO_2 (b) H_2O (c) CFCs (d) O_2 (e) O_3
 The correct interference(s) is are :
 (1) a, b, c and d (2) a, b, c and e (3) a and d (4) a, c, d and e
16. The strength of an aqueous NaOH solution is most accurately determined by titrating :
 (Note : consider that the appropriate indicator is used)
 (1) Aq. NaOH in a volumetric flask and concentrated H_2SO_4 in a conical flask
 (2) Aq. NaOH in a burette and oxalic acid in a conical flask
 (3) Aq. NaOH in a burette and concentrated H_2SO_4 in a conical flask
 (4) Aq. NaOH in a pipette and oxalic acid in a burette

17. The major product of the following reaction is :



18. A flask contains a mixture of isohexane and 3-methylpentane. One of the liquids boils at 63°C while the other boils at 60°C . What is the best way to separate the two liquids and which one will be distilled out first ?
 (1) simple distillation, 3-methyl pentane (2) fractional distillation, 3-methyl pentane
 (3) simple distillation, isohexane (4) fractional distillation, isohexane
19. The stoichiometry and stability product of a salt with the solubility curves given below is, respectively :

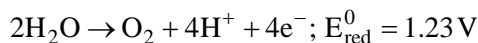


- (1) $\text{XY}_2, 4 \times 10^{-9} \text{M}^3$ (2) $\text{XY}_2, 1 \times 10^{-9} \text{M}^3$
 (3) $\text{X}_2\text{Y}, 2 \times 10^{-9} \text{M}^3$ (4) $\text{XY}, 2 \times 10^{-6} \text{M}^3$
20. The first ionization energy (in kJ/mol) of Na, Mg, Al and Si respectively, are :
 (1) 496, 577, 737, 786 (2) 786, 737, 577, 496
 (3) 496, 577, 786, 737 (4) 496, 737, 577, 786

SECTION 2

This section has FIVE (05) Questions. The answer to each question is a NUMERICAL VALUE. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places.

21. What would be the electrode potential for the given half cell reaction at $\text{pH} = 5$?



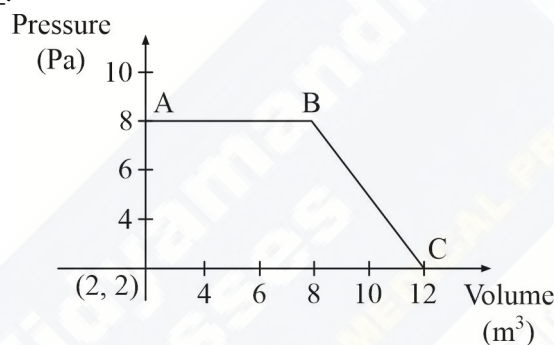
($R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$; Temp = 298 K; oxygen under std. atm. pressure of 1 bar)

22. Ferrous sulphate heptahydrate is used to fortify foods with iron. The amount (in gram) of the salt required to achieve 100 ppm of iron in 100 kg of wheat is _____.

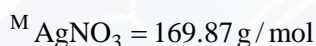
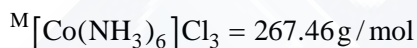
Atomic weight : Fe = 55.85; S = 32.00; O = 16.00

23. The number of chiral centres in penicillin is _____.

24. The magnitude of work done by a gas that undergoes a reversible expansion along the path ABC shown in the figure is _____.



25. The volume (in mL) of 0.125 M AgNO_3 required to qualitatively precipitate chloride ions in 0.3 g of $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ is _____.



SECTION 1

This section contains 20 Multiple Choice Questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE CHOICE** is correct.

- If c is a point at which Rolle's theorem holds for the function, $f(x) = \log_e \left(\frac{x^2 + \alpha}{7x} \right)$ in the interval $[3, 4]$, where $\alpha \in R$, then $f''(c)$ is equal to :
 (1) $\frac{1}{12}$ (2) $-\frac{1}{24}$ (3) $\frac{\sqrt{3}}{7}$ (4) $-\frac{1}{12}$
- Let $f : R \rightarrow R$ be such that for all $x \in R$ $(2^{1+x} + 2^{1-x})$, $f(x)$ and $(3^x + 3^{-x})$ are in A.P., then the minimum value of $f(x)$ is :
 (1) 2 (2) 4 (3) 3 (4) 0
- Let the volume of a parallelepiped whose coterminous edges are given by $\vec{u} = \hat{i} + \hat{j} + \lambda \hat{k}$, $\vec{v} = \hat{i} + \hat{j} + 3\hat{k}$ and $\vec{w} = 2\hat{i} + \hat{j} + \hat{k}$ be 1 cu. unit. If θ be the angle between the edges \vec{u} and \vec{w} , then $\cos \theta$ can be :
 (1) $\frac{5}{3\sqrt{3}}$ (2) $\frac{7}{6\sqrt{6}}$ (3) $\frac{5}{7}$ (4) $\frac{7}{6\sqrt{3}}$
- $\lim_{x \rightarrow 0} \left(\frac{3x^2 + 2}{7x^2 + 2} \right)^{1/x^2}$ is equal to :
 (1) $\frac{1}{e^2}$ (2) e^2 (3) $\frac{1}{e}$ (4) e
- If the equation, $x^2 + bx + 45 = 0 (b \in R)$ has conjugate complex roots and they satisfy $|z + 1| = 2\sqrt{10}$, then :
 (1) $b^2 - b = 30$ (2) $b^2 + b = 12$ (3) $b^2 + b = 72$ (4) $b^2 - b = 42$
- Which one of the following is a tautology ?
 (1) $P \wedge (P \vee Q)$ (2) $(P \wedge (P \rightarrow Q)) \rightarrow Q$
 (3) $Q \rightarrow (P \wedge (P \rightarrow Q))$ (4) $P \vee (P \wedge Q)$
- For $a > 0$, let the curves $C_1 : y^2 = ax$ and $C_2 : x^2 = ay$ intersect at origin O and a point P . Let the line $x = b (0 < b < a)$ intersect the chord OP and the x -axis at points Q and R respectively. If the line $x = b$ bisects the area bounded by the curves, C_1 and C_2 , and the area of $\Delta OQR = \frac{1}{2}$, then 'a' satisfies the equation :
 (1) $x^6 - 12x^3 - 4 = 0$ (2) $x^6 - 6x^3 + 4 = 0$
 (3) $x^6 - 12x^3 + 4 = 0$ (4) $x^6 + 6x^3 - 4 = 0$
- The mean and the standard deviation (s.d.) of 10 observations are 20 and 2 respectively. Each of these 10 observations is multiplied by p and then reduced by q , where $p \neq 0$ and $q \neq 0$. If the new mean and new s.d. becomes half of their original values, then q is equal to :
 (1) -10 (2) 10 (3) -20 (4) -5

9. Let $y = y(x)$ be a solution of the differential equation, $\sqrt{1-x^2} \frac{dy}{dx} + \sqrt{1-y^2} = 0, |x| < 1$.
- If $y\left(\frac{1}{2}\right) = \frac{\sqrt{3}}{2}$, then $y\left(\frac{-1}{\sqrt{2}}\right)$ is equal to :
- (1) $-\frac{\sqrt{3}}{2}$ (2) $\frac{\sqrt{3}}{2}$ (3) $\frac{1}{\sqrt{2}}$ (4) $-\frac{1}{\sqrt{2}}$
10. If $\int \frac{\cos x dx}{\sin^3 x(1+\sin^6 x)^{2/3}} = f(x)(1+\sin^6 x)^{1/\lambda} + c$ where c is a constant of integration, then $\lambda f\left(\frac{\pi}{3}\right)$ is equal to :
- (1) $-\frac{9}{8}$ (2) -2 (3) 2 (4) $\frac{9}{8}$
11. The shortest distance between the lines $\frac{x-3}{3} = \frac{y-8}{-1} = \frac{z-3}{1}$ and $\frac{x+3}{-3} = \frac{y+7}{2} = \frac{z-6}{4}$ is :
- (1) $3\sqrt{30}$ (2) 3 (3) $2\sqrt{30}$ (4) $\frac{7}{2}\sqrt{30}$
12. For which of the following ordered pairs (μ, δ) , the system of linear equations
- $$\begin{aligned} x+2y+3z &= 1 \\ 3x+4y+5z &= \mu \\ 4x+4y+4z &= \delta \end{aligned}$$
- is inconsistent ?
- (1) $(1, 0)$ (2) $(4, 3)$ (3) $(4, 6)$ (4) $(3, 4)$
13. Let A and B be two independent events such that $P(A) = \frac{1}{3}$ and $P(B) = \frac{1}{6}$. Then, which of the following is TRUE?
- (1) $P(A' / B') = \frac{1}{3}$ (2) $P(A / B') = \frac{1}{3}$ (3) $P(A / B) = \frac{2}{3}$ (4) $P(A / (A \cup B)) = \frac{1}{4}$
14. Let two points be $A(1, -1)$ and $B(0, 2)$. If a point $P(x', y')$ be such that the area of $\Delta PAB = 5$ sq. units and it lies on the line, $3x + y - 4\lambda = 0$, then a value of λ is:
- (1) 1 (2) -3 (3) 4 (4) 3
15. The locus of a point which divides the line segment joining the point $(0, -1)$ and a point on the parabola, $x^2 = 4y$, internally in the ratio $1 : 2$, is:
- (1) $x^2 - 3y = 2$ (2) $4x^2 - 3y = 2$ (3) $9x^2 - 3y = 2$ (4) $9x^2 - 12y = 8$
16. The inverse function of $f(x) = \frac{8^{2x} - 8^{-2x}}{8^{2x} + 8^{-2x}}, x \in (-1, 1)$, is _____ .
- (1) $\frac{1}{4}(\log_8 e) \log_e \left(\frac{1-x}{1+x}\right)$ (2) $\frac{1}{4} \log_e \left(\frac{1-x}{1+x}\right)$
- (3) $\frac{1}{4} \log_e \left(\frac{1+x}{1-x}\right)$ (4) $\frac{1}{4}(\log_8 e) \log_e \left(\frac{1+x}{1-x}\right)$

17. Let $f(x) = x \cos^{-1}(-\sin |x|), x \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$, then which of the following is true?
- (1) f' is increasing in $\left(-\frac{\pi}{2}, 0\right)$ and decreasing in $\left(0, \frac{\pi}{2}\right)$
- (2) f' is decreasing in $\left(-\frac{\pi}{2}, 0\right)$ and increasing in $\left(0, \frac{\pi}{2}\right)$
- (3) $f'(0) = -\frac{\pi}{2}$
- (4) f is not differentiable at $x = 0$
18. Let $f(x) = (\sin(\tan^{-1} x) + \sin(\cot^{-1} x))^2 - 1, |x| > 1$. If $\frac{dy}{dx} = \frac{1}{2} \frac{d}{dx}(\sin^{-1}(f(x)))$ and $y(\sqrt{3}) = \frac{\pi}{6}$, then $y(-\sqrt{3})$ is equal to:
- (1) $\frac{5\pi}{6}$ (2) $\frac{2\pi}{3}$ (3) $-\frac{\pi}{6}$ (4) $\frac{\pi}{3}$
19. Let the line $y = mx$ and the ellipse $2x^2 + y^2 = 1$ intersect at a point P in the first quadrant. If the normal to this ellipse at P meets the co-ordinate axes at $\left(-\frac{1}{3\sqrt{2}}, 0\right)$ and $(0, \beta)$, then β is equal to :
- (1) $\frac{2}{\sqrt{3}}$ (2) $\frac{2}{3}$ (3) $\frac{2\sqrt{2}}{3}$ (4) $\frac{\sqrt{2}}{3}$
20. If a, b and c are the greatest values of ${}^{19}C_p, {}^{20}C_q$ and ${}^{21}C_r$ respectively, then :
- (1) $\frac{a}{10} = \frac{b}{11} = \frac{c}{21}$ (2) $\frac{a}{11} = \frac{b}{22} = \frac{c}{42}$ (3) $\frac{a}{11} = \frac{b}{22} = \frac{c}{21}$ (4) $\frac{a}{10} = \frac{b}{11} = \frac{c}{42}$

SECTION 2

This section has FIVE (05) Questions. The answer to each question is a NUMERICAL VALUE. For each question, enter the correct numerical value of the answer. If the answer is a decimal numerical value, then round-off the value to TWO decimal places.

21. The least positive value of 'a' for which the equation, $2x^2 + (a-10)x + \frac{33}{2} = 2a$ has real roots is_____.
22. The number of all 3×3 matrices A, with entries from the set $\{-1, 0, 1\}$ such that the sum of the diagonal elements of AA^T is 3, is_____.
23. Let the normal at a point P on the curve $y^2 - 3x^2 + y + 10 = 0$ intersect the y-axis at $\left(0, \frac{3}{2}\right)$. If m is the slope of the tangent at P to the curve, then $|m|$ is equal to_____.
24. An urn contains 5 red marbles, 4 black marbles and 3 white marbles. Then the number of ways in which 4 marbles can be drawn so that at the most three of them are red is_____.
25. The sum $\sum_{k=1}^{20} (1+2+3+\dots+k)$ is_____.