



JEE Main – 2023

25th JAN 2023 (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 **10 Numerical Value Type Questions** Out of which **ONLY 5 (any)** questions have to be attempted. You will **NOT** be allowed to attempt the sixth question. If you wish to attempt any other question apart from the five already attempted, then you will have to delete any one response from the five previously answered and then proceed to answer the new one.
The answer to each question should be **rounded off to the nearest integer**.
5. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. inside the examination room/hall.

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, –1 (negative marking) for incorrect answer, 0 for all other cases.

7. A car is moving with a constant speed of 20 m/s in a circular horizontal track of radius 40 m . A bon is suspended from the roof of the car by a massless string. The angle made by the string with the vertical will be: (Take $g = 10\text{ m/s}^2$)
- (1) $\frac{\pi}{4}$ (2) $\frac{\pi}{2}$ (3) $\frac{\pi}{6}$ (4) $\frac{\pi}{3}$
8. A car travels a distance of ' x ' with speed v_1 and then same distance ' x ' with speed v_2 in the same direction. The average speed of the car is:
- (1) $\frac{v_1 + v_2}{2}$ (2) $\frac{v_1 v_2}{2(v_1 + v_2)}$ (3) $\frac{2v_1 v_2}{v_1 + v_2}$ (4) $\frac{2x}{v_1 + v_2}$
9. A solenoid of 1200 turns is wound uniformly in a sample layer on a glass tube 2 m long and 0.2 m in diameter. The magnetic intensity at the center of the solenoid when a current of 2 A flows through it is:
- (1) $2.4 \times 10^{-3}\text{ Am}^{-1}$ (2) $2.4 \times 10^3\text{ Am}^{-1}$
 (3) 1 Am^{-1} (4) $1.2 \times 10^3\text{ Am}^{-1}$
10. Match List I with List II.

List I (Current configuration)		List II (Magnitude of Magnetic Field at point O)	
A.		I.	$B_0 = \frac{\mu_0 I}{4\pi r} [\pi + 2]$
B.		II.	$B_0 = \frac{\mu_0 I}{4 r}$
C.		III.	$B_0 = \frac{\mu_0 I}{2\pi r} [\pi - 1]$
D.		IV.	$B_0 = \frac{\mu_0 I}{4\pi r} [\pi + 1]$

Choose the correct answer from the options given below:

- (1) A – I, B – III, C – IV, D – II (2) A – II, B – I, C – IV, D – III
 (3) A – III, B – IV, C – I, D – II (4) A – III, B – I, C – IV, D – II
11. A message signal of frequency 5 kHz is used to modulate a carrier signal of frequency 2 MHz . The bandwidth for amplitude modulation is:
- (1) 20 kHz (2) 10 kHz
 (3) 5 kHz (4) 2.5 kHz
12. In an LC oscillator, if values of inductance and capacitance become twice and eight times, respectively, then the resonant frequency of oscillator becomes x times its initial resonant frequency ω_0 . The value of x is:
- (1) $1/16$ (2) 4 (3) $1/4$ (4) 16

20. T is the time period of simple pendulum on the earth's surface. Its time period become $x T$ when taken to a height R (equal to earth's radius) above the earth's surface. Then, the value of x will be:

(1) $\frac{1}{4}$

(2) 4

(3) 2

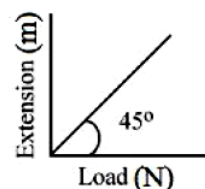
(4) $\frac{1}{2}$

SECTION-2

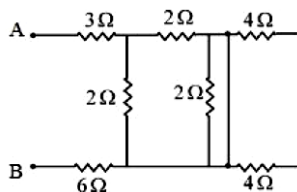
Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. The answer to each question should be rounded off to the nearest integer.

21. A ray of light is incident from air on a glass plate having thickness $\sqrt{3} \text{ cm}$ and refractive index $\sqrt{2}$. The angle of incidence of a ray is equal to the critical angle for glass-air interface. The lateral displacement of the ray when it passes through the plate is $\text{_____} \times 10^{-2} \text{ cm}$.
(Given $\sin 15^\circ = 0.26$)

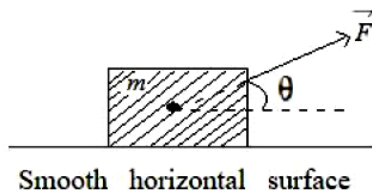
22. As shown in the figure, in an experiment to determine young's modulus of a wire, the extension-load curve is plotted. The curve is a straight line passing through the origin and makes an angle of 45° with the load axis. The length of wire is 62.8 cm and its diameter is 4 mm . The Young's modulus is found to be $x \times 10^4 \text{ Nm}^{-2}$. The value of x is _____.



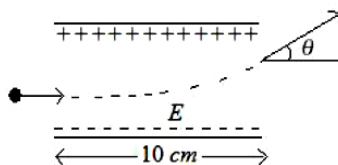
23. In the given circuit, the equivalent resistance between the terminal A and B is _____ Ω



24. An object of mass ' m ' initially at rest on a smooth horizontal plane starts moving under the action of force $F = 2N$. In the process of its linear motion, the angle θ (as shown in figure) between the direction of force and horizontal varies as $\theta = kx$, where k is a constant and x is the distance covered by the object from its initial position. The expression of kinetic energy of the object will be $E = \frac{n}{k} \sin \theta$. The value of n is _____.

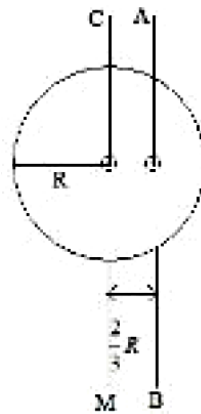


25. A uniform electric field of 10 N/C is created between two parallel charged plates (as shown in figure). An electron enters the field symmetrically between the plates with a kinetic energy 0.5 eV . the length of each plate is 10 cm . The angle (θ) of deviation of the path of electron as it comes out of the field is _____ (in degree).



26. An LCR series circuit of capacitance 62.5 nF and resistance of 50Ω , is connected to an A.C. source of frequency 2.0 kHz . For maximum value of amplitude of current in circuit, the value of inductance is _____ mH. (Take $\pi^2 = 10$)
27. The distance between two consecutive points with phase difference of 60° in a wave of frequency 500 Hz is 6.0 m . the velocity with which wave is traveling is _____ km/s .

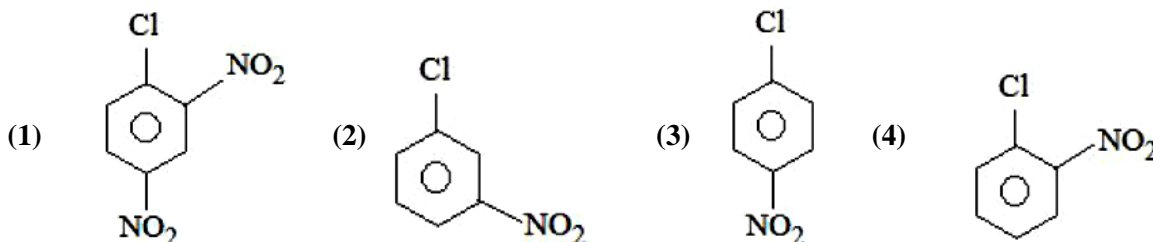
28. If $\vec{P} = 3\hat{i} + \sqrt{3}\hat{j} + 2\hat{k}$ and $\vec{Q} = 4\hat{i} + \sqrt{3}\hat{j} + 2.5\hat{k}$ then, The unit vector in the direction of $\vec{P} \times \vec{Q}$ is $\frac{1}{x}(\sqrt{3}\hat{i} + \hat{j} - 2\sqrt{3}\hat{k})$. The value of x is:
29. The wavelength of the radiation emitted is λ_0 when an electron jumps from the second excited state to the first excited state of hydrogen atom. If the electron jumps from the third excited state to the second orbit of the hydrogen atom, the wavelength of the radiation emitted will be $\frac{20}{x}\lambda_0$. the value of x is _____ .
30. I_{CM} is the moment of inertia of a circular disc about an axis (CM) passing through its center and perpendicular to the plane of disc. I_{AB} is it's moment of inertia about an axis AB perpendicular to plane and parallel to axis CM at a distance $\frac{2}{3}R$ from center. Where R is the radius of the disc. The ratio of I_{AB} and I_{CM} is $x:9$. The value of x 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.

1. The compound which will have the lowest rate towards nucleophilic aromatic substitution on treatment with OH^- is:



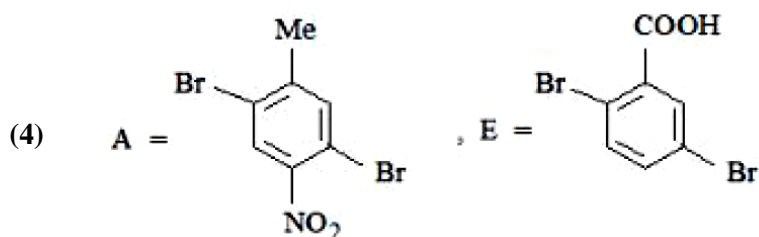
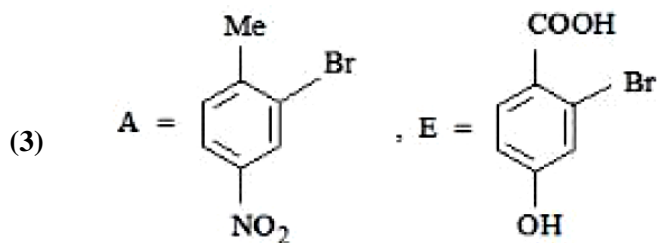
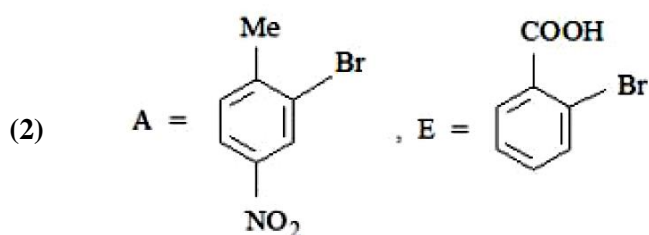
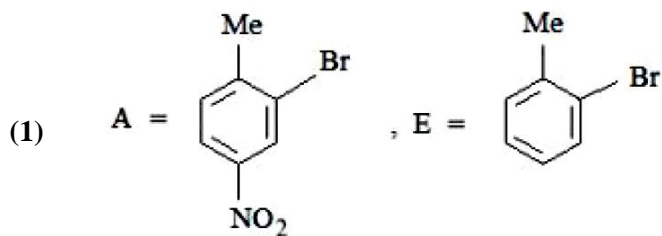
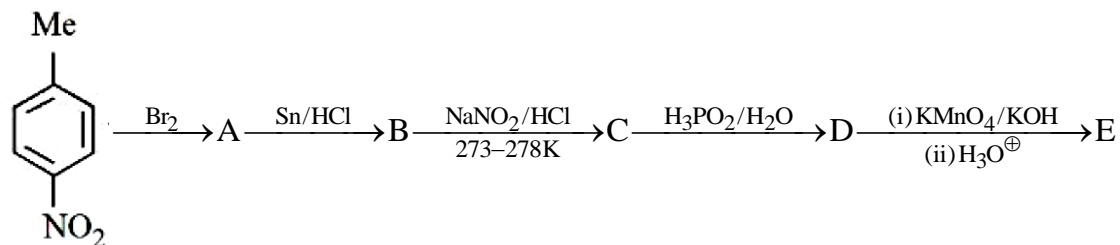
2. The correct order in aqueous medium of basic strength in case of methyl substituted amines is:
 (1) $\text{Me}_2\text{NH} > \text{MeNH}_2 > \text{Me}_3\text{N} > \text{NH}_3$ (2) $\text{NH}_3 > \text{Me}_3\text{N} > \text{MeNH}_2 > \text{Me}_2\text{NH}$
 (3) $\text{Me}_2\text{NH} > \text{Me}_3\text{N} > \text{MeNH}_2 > \text{NH}_3$ (4) $\text{Me}_3\text{N} > \text{Me}_2\text{NH} > \text{MeNH}_2 > \text{NH}_3$
3. Match List I with List II.

List I Elements		List II Colour imparted to the flame	
A.	K	I.	Brick Red
B.	Ca	II.	Violet
C.	Sr	III.	Apple Green
D.	Ba	IV.	Crimson Red

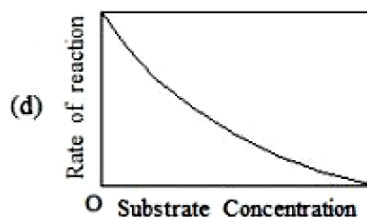
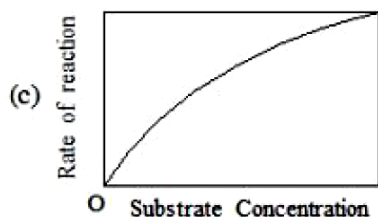
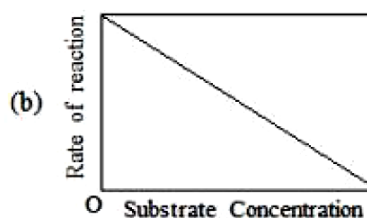
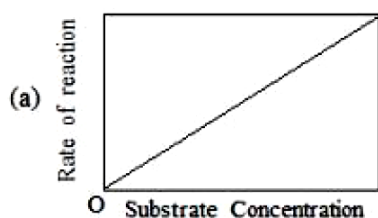
Choose the correct answer from the options given below:

- (1) A – II, B – I, C – III, D – IV
 (2) A – II, B – IV, C – I, D – III
 (3) A – IV, B – III, C – II, D – I
 (4) A – II, B – I, C – IV, D – III
4. Which one of the following reactions does not occur during extraction of copper?
 (1) $2\text{FeS} + 3\text{O}_2 \longrightarrow 2\text{FeO} + 2\text{SO}_2$ (2) $\text{CaO} + \text{SiO}_2 \longrightarrow \text{CaSiO}_3$
 (3) $\text{FeO} + \text{SiO}_2 \longrightarrow \text{FeSiO}_3$ (4) $2\text{Cu}_2\text{S} + 3\text{O}_2 \longrightarrow 2\text{Cu}_2\text{O} + 2\text{SO}_2$
5. '25 volume' hydrogen peroxide means
 (1) 1 L marketed solution contains 75 g of H_2O_2
 (2) 1 L marketed solution contains 25 g of H_2O_2
 (3) 1 L marketed solution contains 250 g of H_2O_2
 (4) 100 mL marketed solution contains 25 g of H_2O_2

6. Identify the product formed (A and E):



7. The variation of the rate of an enzyme catalyzed reaction with substrate concentration is correctly represented by graph.



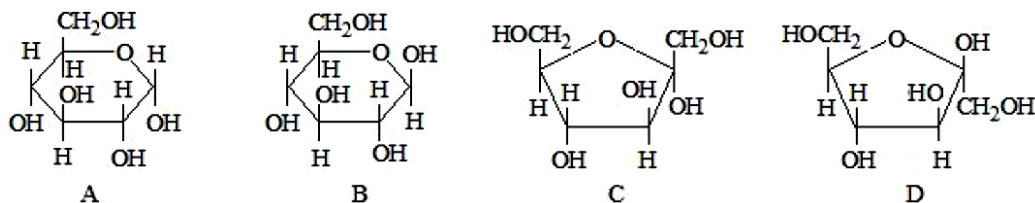
(1) (d) (2) (b) (3) (a) (4) (c)

8. A cubic solid is made up of two elements X and Y. Atoms of X are present on every alternate corner and one at the center of cube. Y is at $\frac{1}{3}$ rd of the total faces. The empirical formula of the compound is:



9. Match items of Row I with those of Row II.

Row I :



Row II :

- (i) α -D-(-)-Fructofuranose, (ii) β -D-(-)-Fructofuranose,
 (iii) α -D-(-)Glucopyranose, (iv) β -D-(-)-Glucopyranose

Correct match is:

- (1) A - iv, B - iii, C - i, D - ii (2) A - iii, B - iv, C - i, D - ii
 (3) A - iii, B - iv, C - ii, D - i (4) A - i, B - ii, C - iii, D - iv

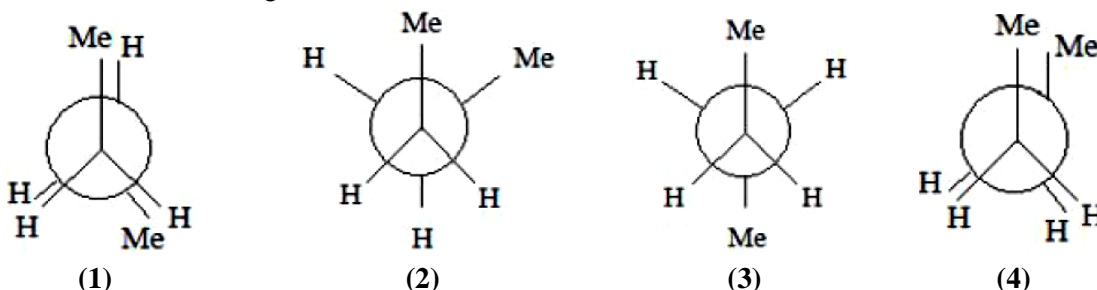
10. Match the List-I with List-II.

List I Cations		List II Group reagents	
A.	$A \longrightarrow Pb^{2+}, Cu^{2+}$	i.	H_2S gas in presence of dilute HCl
B.	$B \longrightarrow Al^{3+}, Fe^{3+}$	ii.	$(NH_4)_2CO_3$ in presence of NH_4OH
C.	$C \longrightarrow Co^{2+}, Ni^{2+}$	iii.	NH_4OH in presence of NH_4Cl
D.	$D \longrightarrow Ba^{2+}, Ca^{2+}$	iv.	H_2S in presence of NH_4OH

Choose the correct answer from the options given below:

- (1) A - iii, B - i, C - iv, D - ii (2) A - iv, B - ii, C - iii, D - ii
 (3) A - i, B - iii, C - iv, D - ii (4) A - i, B - iii, C - ii, D - iv

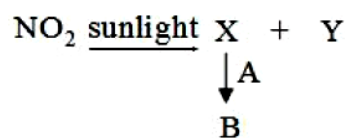
11. Which of the following conformations will be the most stable?

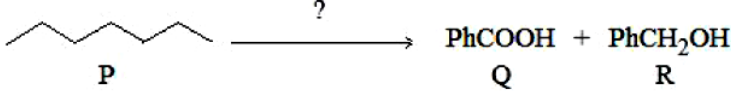


12. Some reactions of NO_2 relevant to photochemical smog formation are:

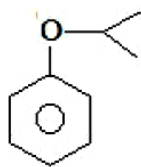
Identify A, B, X and Y

- (1) $X = [O], Y = NO, A = O_2, B = O_3$
 (2) $X = \frac{1}{2}O_2, Y = NO_2, A = O_3, B = O_2$
 (3) $X = NO, Y = [O], A = O_2, B = N_2O_3$
 (4) $X = N_2O, Y = [O], A = O_3, B = NO$

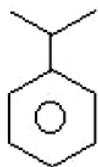


13. The radius of the 2nd orbit of Li^{2+} is x . The expected radius of the 3rd orbit of Be^{3+} is:
- (1) $\frac{4}{9}x$ (2) $\frac{9}{4}x$ (3) $\frac{27}{16}x$ (4) $\frac{16}{27}x$
14. Inert gases have positive electron gain enthalpy. Its correct order is:
- (1) $\text{He} < \text{Kr} < \text{Xe} < \text{Ne}$ (2) $\text{He} < \text{Xe} < \text{Kr} < \text{Ne}$
 (3) $\text{He} < \text{Ne} < \text{Kr} < \text{Xe}$ (4) $\text{Xe} < \text{Kr} < \text{Ne} < \text{He}$
15. Which of the following statements is incorrect for antibiotics?
- (1) An antibiotic is a synthetic substance produced as a structural analogue of naturally occurring
 (2) An antibiotic should promote the growth or survival of microorganisms
 (3) An antibiotic must be a product of metabolism
 (4) An antibiotic should be effective in low concentrations
16.  The correct sequence of reagents for the preparation of Q and R is:
- (1) (i) $\text{CrO}_2\text{Cl}_2, \text{H}_3\text{O}^+$; (ii) $\text{Cr}_2\text{O}_3, 770\text{K}, 20\text{atm}$; (iii) NaOH ; (iv) H_3O^+
 (2) (i) $\text{Cr}_2\text{O}_3, 770\text{K}, 20\text{atm}$; (ii) $\text{CrO}_2\text{Cl}_2, \text{H}_3\text{O}^+$; (iii) NaOH ; (iv) H_3O^+
 (3) (i) $\text{KMnO}_4, \text{OH}^-$; (ii) $\text{Mo}_2\text{O}_3, \Delta$; (iii) NaOH ; (iv) H_3O^+
 (4) (i) $\text{Mo}_2\text{O}_3, \Delta$; (ii) $\text{CrO}_2\text{Cl}_2, \text{H}_3\text{O}^+$; (iii) NaOH ; (iv) H_3O^+
17. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R:
Assertion A: Acetal/Ketal is stable in basic medium.
Reason R: The high leaving tendency of alkoxide ion gives the stability to acetal/ketal in basic medium.
 In the light of the above statements, choose the correct answer from the options given below:
- (1) Both A and R are true and R is the correct explanation of A
 (2) A is false but R is true
 (3) Both A and R are true but R is NOT the correct explanation of A
 (4) A is true but R is false
18. Compound A reacts with NH_4Cl and forms a compound B. Compound B reacts with H_2O and excess of CO_2 to form compound C which on passing through or reaction with saturated NaCl solution forms sodium hydrogen carbonate. Compound A, B and C, are respectively.
- (1) $\text{CaCl}_2, \text{NH}_4^{\oplus}, (\text{NH}_4)_2\text{CO}_3$
 (2) $\text{CaCl}_2, \text{NH}_3, \text{NH}_4\text{HCO}_3$
 (3) $\text{Ca}(\text{OH})_2, \text{NH}_3, \text{NH}_4\text{HCO}_3$
 (4) $\text{Ca}(\text{OH})_2, \text{NH}_4^{\oplus}, (\text{NH}_4)_2\text{CO}_3$
19. Reaction of thionyl chloride with white phosphorus forms a compound [A], which on hydrolysis gives [B], a dibasic acid. [A] and [B] are respectively.
- (1) PCl_3 and H_3PO_3 (2) P_4O_6 and H_3PO_3
 (3) PCl_5 and H_3PO_4 (4) POCl_3 and H_3PO_4

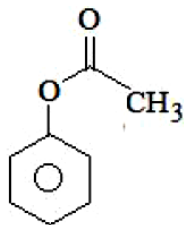
20. In the cumene to phenol preparation in presence of air, the intermediate is:



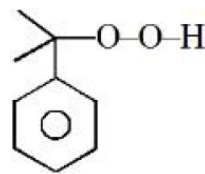
(1)



(2)



(3)

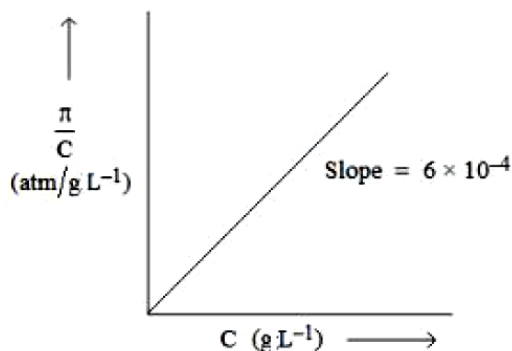


(4)

SECTION-2

Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. The answer to each question should be rounded off to the nearest integer.

21. In sulphur estimation, 0.471g of an organic compound gave 1.4439g of barium sulphate. The percentage of sulphur in the compound is _____. (Nearest Integer)
(Given: Atomic mass Ba: 137u, S:32u, O:16u)
22. The number of paramagnetic species from the following is _____.
[Ni(CN)₄]²⁻, [Ni(CO)₄], [NiCl₄]²⁻, [Fe(CN)₆]⁴⁻, [Cu(NH₃)₄]²⁺, [Fe(CN)₆]³⁻ and [Fe(H₂O)₆]²⁺
23. The total number of lone pairs of electrons on oxygen atoms of ozone is _____.
24. How many of the following metal ions have similar value of spin only magnetic moment in gaseous state _____? (Given: Atomic number: V, 23; Cr, 24; Fe, 26; Ni, 28)
V³⁺, Cr³⁺, Fe²⁺, Ni³⁺
25. A litre of buffer solution contains 0.1 mole of each of NH₃ and NH₄Cl. On the addition of 0.02 mole of HCl by dissolving gaseous HCl, the pH of the solution is found to be _____ × 10⁻³ (Nearest integer) [Given: pK_b(NH₃) = 4.745, log2 = 0.301, log3 = 0.477, T = 298 K]
26. The osmotic pressure of solutions of PVC in cyclohexanone at 300 K are plotted on the graph. The molar mass of PVC is _____ g mol⁻¹ (Nearest integer) [Given: R = 0.083 L atm K⁻¹mol⁻¹]



27. Consider the cell
Pt(s) | H₂(g) (1atm) | H⁺(aq, [H⁺] = 1) || Fe³⁺(aq), Fe²⁺(aq) | Pt(s)
Given E^o_{Fe³⁺/Fe²⁺} = 0.771 V and E^o_{H⁺/1/2H₂} = 0.V, T = 298 K
If the potential of the cell is 0.712 V, the ratio of concentration of Fe²⁺ to Fe³⁺ is _____. (Nearest integer)
28. For the first order reaction A → B, the half life is 30 min. The time taken for 75% completion of the reaction is _____ min. (Nearest integer)
(Given: log2 = 0.3010, log3 = 0.4771, log5 = 0.6989)
29. An athlete is given 100g of glucose (C₆H₁₂O₆) for energy. This is equivalent to 1800kJ of energy. The 50% of this energy gained is utilized by the athlete for sports activities at the event. In order to avoid

storage of energy, the weight of extra water he would need to perspire is _____ g (Nearest integer)

Assume that there is not other way of consuming stored energy.

Given: The enthalpy of evaporation of water is 45 kJ mol^{-1}

Molar mass of C, H & O are 12, 1 and 16 g mol^{-1} .

30. The density of a monobasic strong acid (Molar mass 24.2 g/mol) is 1.21 kg/L . the volume of its solution required for the complete neutralization of 25 mL of 0.24 M NaOH is _____ $\times 10^{-2} \text{ mL}$ (Nearest integer)

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.

- Let S_1 and S_2 be respectively the sets of all $a \in R - \{0\}$ for which the system of linear equations.
 $ax + 2ay - 3az = 1$
 $(2a+1)x + (2a+3)y + (a+1)z = 2$
 $(3a+5)x + (a+5)y + (a+2)z = 3$
 has unique solution and infinitely many solutions. Then:
 (1) $S_1 = \Phi$ and $S_2 = R - \{0\}$ (2) $S_1 = R - \{0\}$ and $S_2 = \Phi$
 (3) S_1 is an infinite set and $n(S_2) = 2$ (4) $n(S_1) = 2$ and S_2 is an infinite set
- The value of $\lim_{n \rightarrow \infty} \frac{1+2-3+4+5-6+\dots+(3n-2)+(3n-1)-3n}{\sqrt{2n^4+4n+3}-\sqrt{n^4+5n+4}}$ is:
 (1) $3(\sqrt{2}+1)$ (2) $\frac{3}{2\sqrt{2}}$ (3) $\frac{3}{2}(\sqrt{2}+1)$ (4) $\frac{\sqrt{2}+1}{2}$
- The mean and variance of the marks obtained by the students in a test are 10 and 4 respectively. Later, the marks of one of the students is increased from 8 to 12. If the new mean of the marks is 10.2, then their new variance is equal to:
 (1) 4.04 (2) 3.96 (3) 3.92 (4) 4.08
- Let $z_1 = 2 + 3i$ and $z_2 = 3 + 4i$. The set $S = \{z \in C : |z - z_1|^2 - |z - z_2|^2 = |z_1 - z_2|^2\}$ represents a:
 (1) Straight line with the sum of its intercepts on the coordinate axes equals -18
 (2) Hyperbola with eccentricity 2
 (3) Hyperbola with the length of the transverse axis 7
 (4) Straight line with the sum of its intercepts on the coordinate axes equals 14
- Let $y = y(x)$ be the solution curve of the differential equation $\frac{dy}{dx} = \frac{y}{x}(1 + xy^2(1 + \log_e x))$,
 $x > 0, y(1) = 3$. Then $\frac{y^2(x)}{9}$ is equal to:
 (1) $\frac{x^2}{5 - 2x^3(2 + \log_e x^3)}$ (2) $\frac{x^2}{2x^3(2 + \log_e x^3) - 3}$
 (3) $\frac{x^2}{7 - 3x^3(2 + \log_e x^2)}$ (4) $\frac{x^2}{3x^3(1 + \log_e x^2) - 2}$
- Let $y(x) = (1+x)(1+x^2)(1+x^4)(1+x^8)(1+x^{16})$. Then $y' - y''$ at $x = -1$ is equal to:
 (1) 944 (2) 464 (3) 496 (4) 976
- The vector $\vec{a} = -\hat{i} + 2\hat{j} + \hat{k}$ is rotated through a right angle, passing through the y-axis in its way and the resulting vector is \vec{b} . Then the projection of $3\vec{a} + \sqrt{2}\vec{b}$ on $\vec{c} = 5\hat{i} + 4\hat{j} + 3\hat{k}$ is:
 (1) $3\sqrt{2}$ (2) $\sqrt{6}$ (3) 1 (4) $2\sqrt{3}$

8. The points of intersection of the line $ax+by=0, (a \neq b)$ and the circle $x^2+y^2-2x=0$ are $A(\alpha, 0)$ and $B(1, \beta)$. The image of the circle with AB as a diameter in the line $x+y+2=0$ is:
- (1) $x^2+y^2+3x+5y+8=0$ (2) $x^2+y^2-5x-5y+12=0$
 (3) $x^2+y^2+3x+3y+4=0$ (4) $x^2+y^2+5x+5y+12=0$
9. Let \vec{a}, \vec{b} and \vec{c} be three non zero vectors such that $\vec{b} \cdot \vec{c} = 0$ and $\vec{a} \times (\vec{b} \times \vec{c}) = \frac{\vec{b}-\vec{c}}{2}$. If \vec{d} be a vector such that $\vec{b} \cdot \vec{d} = \vec{a} \cdot \vec{b}$, then $(\vec{a} \times \vec{b}) \cdot (\vec{c} \times \vec{d})$ is equal to:
- (1) $-\frac{1}{4}$ (2) $\frac{1}{2}$ (3) $\frac{3}{4}$ (4) $\frac{1}{4}$
10. Let $f : (0, 1) \rightarrow \mathbb{R}$ be a function defined by $f(x) = \frac{1}{1-e^{-x}}$, and $g(x) = (f(-x) - f(x))$. Consider two statements.
- (I) g is an increasing function in $(0, 1)$
 (II) g is one-one in $(0, 1)$
 Then :
- (1) Only (II) is true (2) Neither (I) nor (II) is true
 (3) Only (I) is true (4) Both (I) and (II) are true
11. The statement $(p \wedge (\sim q)) \Rightarrow (p \Rightarrow (\sim q))$ is:
- (1) A contradiction (2) Equivalent to $p \vee q$
 (3) A tautology (4) Equivalent to $(\sim p) \vee (\sim q)$
12. The minimum value of the function $f(x) = \int_0^2 e^{|x-t|} dt$ is:
- (1) 2 (2) $2(e-1)$ (3) $2e-1$ (4) $e(e-1)$
13. Consider the lines L_1 and L_2 given by:
- $$L_1: \frac{x-1}{2} = \frac{y-3}{1} = \frac{z-2}{2}$$
- $$L_2: \frac{x-2}{2} = \frac{y-2}{2} = \frac{z-3}{3}$$
- A line L_3 having direction ratios $1, -1, -2$, intersects L_1 and L_2 at the points P and Q respectively. Then the length of line segment PQ is:
- (1) $3\sqrt{2}$ (2) $4\sqrt{3}$ (3) 4 (4) $2\sqrt{6}$
14. Let $x, y, z > 1$ and $A = \begin{bmatrix} 1 & \log_x y & \log_x z \\ \log_y x & 2 & \log_y z \\ \log_z x & \log_z y & 3 \end{bmatrix}$. then $|\text{adj}(\text{adj} A^2)|$ is equal to:
- (1) 4^8 (2) 2^4 (3) 2^8 (4) 6^4
15. Let $f(x) = \int \frac{2x}{(x^2+1)(x^2+3)} dx$. If $f(3) = \frac{1}{2}(\log_e 5 - \log_e 6)$, then $f(4)$ is equal to:
- (1) $\log_e 17 - \log_e 18$ (2) $\frac{1}{2}(\log_e 19 - \log_e 17)$
 (3) $\frac{1}{2}(\log_e 17 - \log_e 19)$ (4) $\log_e 19 - \log_e 20$

16. The distance of the point $(6, -2\sqrt{2})$ from the common tangent $y = mx + c, m > 0$, of the curves $x = 2y^2$ and $x = 1 + y^2$ is:
- (1) 5 (2) $5\sqrt{3}$ (3) $\frac{1}{3}$ (4) $\frac{14}{3}$
17. Let $x = 2$ be a local minima of the function $f(x) = 2x^4 - 18x^2 + 8x + 12, x \in (-4, 4)$. If M is local maximum value of the function f in $(-4, 4)$, then M =
- (1) $12\sqrt{6} - \frac{31}{2}$ (2) $18\sqrt{6} - \frac{31}{2}$ (3) $18\sqrt{6} - \frac{33}{2}$ (4) $12\sqrt{6} - \frac{33}{2}$
18. The distance of the point $P(4, 6, -2)$ from the line passing through the point $(-3, 2, 3)$ and parallel to a line with direction ratios $3, 3, -1$ is equal to:
- (1) $\sqrt{14}$ (2) $\sqrt{6}$ (3) 3 (4) $2\sqrt{3}$
19. If a_r is the coefficient of x^{10-r} in the Binomial expansion of $(1+x)^{10}$, then $\sum_{r=1}^{10} r^3 \left(\frac{a_r}{a_{r-1}} \right)^2$ is equal to:
- (1) 4895 (2) 5445 (3) 3025 (4) 1210
20. Let M be the maximum value of the product of two positive integers when their sum is 66. Let the sample space $S = \left\{ x \in Z : x(66-x) \geq \frac{5}{9}M \right\}$ and the event $A = \{x \in S : x \text{ is a multiple of } 3\}$. Then $P(A)$ is equal to:
- (1) $\frac{1}{3}$ (2) $\frac{7}{22}$ (3) $\frac{1}{5}$ (4) $\frac{15}{44}$

SECTION-2

Section 2 contains 10 Numerical Value Type Questions Out of which ONLY 5 (any) questions have to be attempted. The answer to each question should be rounded off to the nearest integer.

21. Let A_1, A_2, A_3 be the three A.P. with the same common difference d and having their first terms as $A, A+1, A+2$, respectively. Let a, b, c be the 7th, 9th, 17th terms of A_1, A_2, A_3 , respectively such that

$$\begin{vmatrix} a & 7 & 1 \\ 2b & 17 & 1 \\ c & 17 & 1 \end{vmatrix} + 70 = 0.$$

If $a = 29$, then the sum of first 20 terms of an AP whose first term is $c - a - b$ and common difference is $\frac{d}{12}$, is equal to _____.

22. Let the equation of the plane passing through the line $x - 2y - z - 5 = 0 = x + y + 3z - 5$ and parallel to the line $x + y + 2z - 7 = 0 = 2x + 3y + z - 2$ be $2x + by + cz = 65$. Then the distance of the point (a, b, c) from the plane $2x + 2y - z + 16 = 0$ is _____.

23. Let x and y be distinct integers where $1 \leq x \leq 25$ and $1 \leq y \leq 125$. Then, the number of ways of choosing x and y , such that $x + y$ is divisible by 5, is _____.

24. The constant term in the expansion of $\left(2x + \frac{1}{x^7} + 3x^2\right)^5$ is _____.

25. If the sum of all the solutions of $\tan^{-1}\left(\frac{2x}{1-x^2}\right) + \cot^{-1}\left(\frac{1-x^2}{2x}\right) = \frac{\pi}{3}$, $-1 < x < 1, x \neq 0$, is $a - \frac{4}{\sqrt{3}}$, then a is equal to _____.

26. If the area enclosed by the parabolas $P_1: 2y = 5x^2$ and $P_2: x^2 - y + 6 = 0$ is equal to the area enclosed by P_1 and $y = ax, a > 0$, then a^3 is equal to _____.

27. Let $S = \left\{a : \log_2(9^{2a-4} + 13) - \log_2\left(\frac{5}{3} \cdot 3^{2a-4} + 1\right) = 2\right\}$. Then the maximum value of β for which the equation $x^2 - 2\left(\sum_{a \in S} a\right)^2 x + \sum_{a \in S} (a+1)^2 \beta = 0$ has real roots, is _____.

28. Let $S = \{1, 2, 3, 5, 7, 10, 11\}$. The number of non-empty subsets of S that have the sum of all elements a multiple of 3, is _____.

29. for some $a, b, c, \in N$, let $f(x) = ax - 3$ and $g(x) = x^b + c, x \in R$. If $(f \circ g)^{-1}(x) = \left(\frac{x-7}{2}\right)^{\frac{1}{3}}$, then $(f \circ g)(ac) + (g \circ f)(b)$ is equal to _____.

30. The vertices of a hyperbola H are $(\pm 6, 0)$ and its eccentricity is $\frac{\sqrt{5}}{2}$. Let N be the normal to H at a point in the first quadrant and parallel to the line $\sqrt{2}x + y = 2\sqrt{2}$. If d is the length of the line segment of N between H and the y-axis then d^2 is equal to _____ .