Sri Chaitanya IIT Academy.,India.

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A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

SEC: Sr.Super60_NUCLEUS-BT	**JEE-MAIN**	**Date: 06-09-2025**
Time: 09.00Am to 12.00Pm	**RPTM-09**	**Max. Marks: 300**

IMPORTANT INSTRUCTION:

1. Immediately fill in the Admission number on this page of the Test Booklet with **Blue/Black** Ball Point **Pen** only.
2. The candidates should not write their Admission Number anywhere (except in the specified space) on the Test Booklet/ Answer Sheet.
3. The test is of **3 hours** duration.
4. The Test Booklet consists of **75 Questions.** The maximum marks are **300.**
5. There are **three** parts in the question paper 1,2,3 consisting of **Mathematics, Physics** and **Chemistry** having **25 Questions** in each subject and subject having **two sections.**
   (I) Section –I contains **20 Multiple Choice Questions** with only one correct option.
   Marking scheme: +4 for correct answer, **0** if not attempt and **-1** in all other cases.
   (II) Section-II contains **05 Numerical Value Type Questions.**
   - The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**

   To cancel any attempted question bubble on the question number box.
   For example: To cancel attempted Question 21. Bubble on 21 as shown below

Question Answered for Marking **Question Cancelled for Marking**

Marking scheme: +4 for correct answer, **0** if **not attempt** and **-1** in all other cases.

6. Use **Blue / Black Point Pen only** for writing particulars / marking responses on the Answer Sheet. **Use of pencil is strictly prohibited.**
7. No candidate is allowed to carry any textual material, printed or written, bits of papers, mobile phone any electron device etc, except the Identity Card inside the examination hall.
8. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
9. On completion of the test, the candidate must hand over the Answer Sheet to the invigilator on duty in the Hall. **However, the candidate are allowed to take away this Test Booklet with them.**
10. **Do not fold of make any stray marks on the Answer Sheet**

Name of the Candidate (in Capital): _____

Admission Number: | | | | | | | | | |

Candidate's Signature:_____ **Invigilator's Signature:** _____

06-09-2025_Sr.Super60_NUCLEUS-BT_Jee-Main_RPTM-09_Test Syllabus

MATHEMATICS : 3D and Vectors

PHYSICS : Gravitation: Law of gravitation; Gravitational potential and field; Acceleration due to gravity; Kepler's law, Motion of planets and satellites in circular orbits; Escape velocity, Geostationary orbits (Important for ADVANCED), Electrostatics: Coulomb's law; Electric field and potential; Electrical potential energy of a system of point charges and of electrical dipoles.(exclude Gauss law)

CHEMISTRY : Classification of Elements and Periodicity in Properties: Modern periodic law and the present form of periodic table; electronic configuration of elements; periodic trends in atomic radius, ionic radius, ionization enthalpy, electron gain enthalpy, valence, oxidation states, electronegativity and chemical reactivity.

Chemical bonding and Molecular Structure: Orbital overlap and covalent bond; Hybridisation involving s,p and d orbitals only(Excluding Hybridisation in complexes); Molecular orbital energy diagrams for homo nuclear diatomic species (upto Ne2); Hydrogen bond; Polarity in molecules, dipole moment; VSEPR model and shapes of molecules (linear, angular, triangular, square planar, pyramidal, square pyramidal, trigonal bipyramidal, tetrahedral and octahedral).

Hydrogen and its compounds: Position of hydrogen in periodic table, occurrence, isotopes, preparation, properties and uses of hydrogen; hydrides –ionic, covalent and interstitial; physical and chemical properties of water, heavy water; hydrogen peroxide-preparation, reactions, uses and structure; hydrogen as a fuel;hardness of water

NOTE : HYDROGEN AND ITS COMPOUNDS : DELETED FROM MAINS SYLLABUS

MATHEMATICS **Max Marks: 100**

SECTION-I
(SINGLE CORRECT ANSWER TYPE)

This section contains **20 Multiple Choice Questions.** Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

1. Let $m(\theta)=\int_{-(\hat{a}.\hat{b})^2}^{|\hat{a}\times\hat{b}|^2}(2t+1)dt$, where '$\theta$' is the angle between unit vectors $\hat{a}$ and $\hat{b}$.

If volume of the parallelepiped whose coterminous edges are represented by vectors $\hat{a}$, $\hat{a}\times\hat{b}$ and $\hat{a}\times\left(\hat{a}\times\hat{b}\right)$ (where angle between $\hat{a}$ and $\hat{b}$ is taken from the equation $2m(\theta)-1=0$) is $\frac{p}{q}$ (Where p, q $\in \mathbb{Z}^+$ and are co-primes), then the least value of $p+q$ is _____

1) 4 **2)** 5 **3)** 6 **4)** 7

2. Let $\vec{a},\vec{b}$ and $\vec{c}$ be three non – zero vectors such that no two of them are collinear and $\left(\vec{a}\times\vec{b}\right)\times\vec{c}=\frac{1}{3}|\vec{b}||\vec{c}|\vec{a}$. If θ is the angle between vectors $\vec{b}$ and $\vec{c}$, then the value of $\sin\theta$ is:

1) $\frac{2}{3}$ **2)** $\frac{-2\sqrt{3}}{3}$ **3)** $\frac{2\sqrt{2}}{3}$ **4)** $\frac{-\sqrt{2}}{3}$

3. Line L_1 is parallel to vector $\vec{\alpha}=-3\hat{i}+2\hat{j}+4\hat{k}$ and passes through a point $A(7,6,2)$ and line L_2 is parallel to a vector $\vec{\beta}=2\hat{i}+\hat{j}+3\hat{k}$ and passes through a point $B(5,3,4)$. Now a line L_3 parallel to a vector $\vec{\gamma}=2\hat{i}-2\hat{j}-\hat{k}$ intersects the lines L_1 and L_2 at points C and D respectively, then $|\overrightarrow{CD}|$ is equal to:

1) 9 **2) 8** **3) 7** **4) 6**

4. The line $\frac{x+6}{5}=\frac{y+10}{3}=\frac{z+14}{8}$ is the hypotenuse of an isosceles right angle triangle whose opposite vertex is $(7,2,4)$. Then the equation of one of the side is.

1) $\frac{x-7}{3}=\frac{y-2}{6}=\frac{z-4}{2}$ **2)** $\frac{x-7}{2}=\frac{y-2}{3}=\frac{z-4}{6}$

3) $\frac{x+7}{3}=\frac{y+2}{6}=\frac{z+4}{2}$ **4)** $\frac{x+7}{2}=\frac{y+2}{-3}=\frac{z+4}{6}$

5. On the basis of below two statements:

Statement 1: Let $OABC$ be a regular tetrahedron of side length unity, where O is origin. If P is a point at a unit distance from origin such that $\overrightarrow{OP}$ is equally inclined to $\overrightarrow{OA}, \overrightarrow{OB}$ and $\overrightarrow{OC}$ at an angle α, and suppose $m_1 = \cos^2\alpha$.

Statement 2: A, B, C, D are four points in the space and satisfy AB = 3, BC = 7, CD =11 and DA = 9, also if angle between AC and BD is θ and suppose $m_2 = \cos\theta$.

Then the value of $[3m_1 + m_2]$ is,

(where [.] represent Greatest Integer Function)

1) 2 **2) 3** **3) 4** **4) 5**

6. Acute angle between the lines $\frac{x-1}{\ell} = \frac{y+1}{m} = \frac{z}{n}$ and $\frac{x+1}{m} = \frac{y-3}{n} = \frac{z-1}{\ell}$ where $\ell > m > n$, and ℓ, m, n are the roots of the cubic equation $x^3 + x^2 - 4x = 4$ is equal to :

1) $\cos^{-1}\frac{3}{\sqrt{13}}$ **2)** $\sin^{-1}\frac{\sqrt{65}}{3}$ **3)** $2\cos^{-1}\sqrt{\frac{13}{18}}$ **4)** $\tan^{-1}\frac{2}{3}$

7. Given three points in the xy plane O (0, 0), A (1, 0) and B (-1, 0). Point P is moving in the plane satisfying the condition $\left(\overrightarrow{PA}\cdot\overrightarrow{PB}\right) + 3\left(\overrightarrow{OA}\cdot\overrightarrow{OB}\right) = 0$. If the maximum and minimum values of $\left|\overrightarrow{PA}\right|\left|\overrightarrow{PB}\right|$ are M and m respectively, then the value of $M^2 + m^2$ is

1) 34 **2) 35** **3) 36** **4) 37**

8. Consider a regular hexagon with consecutive vertices

$A\left(-\vec{b}\right), B\left(\frac{\sqrt{3}}{2}\vec{a} - \frac{\vec{b}}{2}\right), C\left(m\vec{a} + n\vec{b}\right), D\left(\vec{b}\right), E\left(r\vec{a} + s\vec{b}\right), F\left(p\vec{a} + q\vec{b}\right)$, (where p, q, m, n, s, r are scalar quantities) then which of the following is incorrect?

1) $m + r + p + \frac{\sqrt{3}}{2} = n + s + q - \frac{1}{2}$ **2)** m + r = n + s

3) $\frac{|p| + |s|}{|r| + |\mathrm{m}| - 1} > 1$ **4)** m + r = q + s

9. Let $\vec{r}=\left(\vec{a}\times\vec{b}\right)\sin x+\left(\vec{b}\times\vec{c}\right)\cos y+2\left(\vec{c}\times\vec{a}\right)$, where $\vec{a},\vec{b},\vec{c}$ are three non-coplanar vectors. If $\vec{r}$ is perpendicular to $\vec{a}+\vec{b}+\vec{c}$, then minimum value of x^2+y^2 is

1) π^2 **2)** $\frac{\pi^2}{4}$ **3)** $\frac{5\pi^2}{4}$ **4)** $\frac{\pi^2}{16}$

10. A unit vector which is coplanar to vector $\hat{i}+\hat{j}+2\hat{k}$ and $\hat{i}+2\hat{j}+\hat{k}$ and perpendicular to $\hat{i}+\hat{j}+\hat{k}$, is

1) $\frac{\hat{i}-\hat{j}}{\sqrt{2}}$ **2)** $\pm\left(\frac{\hat{j}-\hat{k}}{\sqrt{2}}\right)$ **3)** $\frac{\hat{k}-\hat{i}}{\sqrt{2}}$ **4)** $\pm\left(\frac{\hat{i}+\hat{j}+\hat{k}}{\sqrt{3}}\right)$

11. Let ΔPQR be a triangle. Let $\vec{a}=\overrightarrow{QR},\vec{b}=\overrightarrow{RP}$ and $\vec{c}=\overrightarrow{PQ}$. If $\left|\vec{a}\right|=12,\left|\vec{b}\right|=4\sqrt{3}$ and $\vec{b}.\vec{c}=24$, then which of the following is INCORRECT ?

1) $\frac{\left|\vec{c}\right|^2}{2}-\left|\vec{a}\right|=12$ **2)** $\frac{\left|\vec{c}\right|^2}{2}+\left|\vec{a}\right|=30$

3) $\left|\vec{a}\times\vec{b}+\vec{c}\times\vec{a}\right|=48\sqrt{3}$ **4)** $\vec{a}.\vec{b}=-72$

12. Shortest distance between the lines

$\vec{r}=\left(\hat{i}+\hat{j}+\hat{k}\right)+\lambda\left(\hat{i}+\hat{j}+\hat{k}\right)$ & $\vec{r}=\left(2\hat{i}+3\hat{j}+4\hat{k}\right)+\mu\left(\hat{i}+\hat{j}+\hat{k}\right)$.

1) $\sqrt{2}$ **2)** $\sqrt{5}$ **3)** $\sqrt{8}$ **4)** 2

13. Let $\vec{a},\vec{b},\vec{c}$ be three vectors such that $\vec{a}\cdot\vec{a}=\vec{b}\cdot\vec{b}=\vec{c}\cdot\vec{c}=3$ and $\left|\vec{a}+\vec{b}-\vec{c}\right|^2+\left|\vec{b}+\vec{c}-\vec{a}\right|^2+\left|\vec{c}+\vec{a}-\vec{b}\right|^2=36$, then which of the following is Incorrect?

1) $\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a}=\frac{-9}{2}$ **2)** $\vec{a},\vec{b},\vec{c}$ are coplanar vectors

3) $\vec{a}\times\vec{b}=\vec{b}\times\vec{c}=\vec{c}\times\vec{a}\neq\vec{0}$ **4)** $\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a}=\frac{-27}{2}$

14. If $\vec{b}$ and $\vec{c}$ are any two non-collinear unit vectors and $\vec{a}$ is any vector, then

$$\left(\vec{a}.\vec{b}\right)\vec{b}+\left(\vec{a}.\vec{c}\right)\vec{c}+\frac{\vec{a}.\left(\vec{b}\times\vec{c}\right)}{\left|\vec{b}\times\vec{c}\right|}\left(\vec{b}\times\vec{c}\right)=$$

1) $\vec{a}$ **2)** $\vec{b}$ **3)** $\vec{c}$ **4)** $\vec{0}$

15. Let 'O' be the origin and $\overrightarrow{OA}=2\hat{i}+2\hat{j}+\hat{k}$, $\overrightarrow{OB}=\hat{i}-2\hat{j}+2\hat{k}$ and $\overrightarrow{OC}=\frac{1}{2}\left(\overrightarrow{OB}-\lambda\overrightarrow{OA}\right)$ for some $\lambda>0$. If $\left|\overrightarrow{OB}\times\overrightarrow{OC}\right|=\frac{9}{2}$, then which of the following statements is incorrect ?

1) Projection of $\overrightarrow{OC}$ on $\overrightarrow{OA}$ is $-\frac{3}{2}$

2) Area of the triangle OAB is $\frac{9}{2}$

3) Area of the triangle ABC is $\frac{9}{2}$

4) The acute angle between the diagonals of the parallelogram with adjacent sides $\overrightarrow{OA}$ and $\overrightarrow{OC}$ is $\frac{\pi}{3}$

16. If $\vec{a}$ & $\vec{b}$ are two non collinear vector $\vec{a}\cdot\vec{b}\neq 0$ and

$\underbrace{\vec{a}\times(\vec{a}\times(\vec{a}\times(\vec{a}.....\times(\vec{a}}_{2026\text{ times}}\times(\vec{a}\times\vec{b}))=\lambda\left(\vec{a}\times\vec{b}\right)$. Then the value of λ is

1) $-\left|\vec{a}\right|^{2026}$ **2)** $\left|\vec{a}\right|^{2026}$ **3)** $-\left|\vec{a}\right|^{2024}$ **4)** $-\left|\vec{a}\right|^{2018}$

17. Let P and Q are two points in xy-plane on the curve $y=x^7-2x^5+5x^3+8x+5$ such that $\overrightarrow{OP}.\hat{i}=2$ and $\overrightarrow{OQ}.\hat{i}=-2$ and the magnitude of the vector $\left|\overrightarrow{OP}+\overrightarrow{OQ}\right|=2M$, (where O is origin) then the value of M is____

1) 2 **2) 3** **3) 4** **4) 5**

18. Let Q be the cube with the set of vertices $\{(x_1,x_2,x_3) \in R^3 : x_1,x_2,x_3 \in \{0,1\}\}$. Let F be the set of all twelve lines containing the diagonals of the six faces of the cube Q. Let S be the set of all four lines containing the main diagonals of the cube Q; for instance, the line passing through the vertices (0, 0, 0) and (1, 1, 1) is in S. For lines l_1 and l_2, let $d(l_1,l_2)$ denote the shortest distance between them. Then the maximum value of $d(l_1,l_2)$ as l_1 varies over F and l_2 varies over S, is

1) $\frac{1}{\sqrt{6}}$ **2)** $\frac{1}{\sqrt{8}}$ **3)** $\frac{1}{\sqrt{3}}$ **4)** $\frac{1}{\sqrt{12}}$

19. Match the following:

Column – I		Column – II	
(A)	$\frac{x-1}{2}=\frac{y-2}{3}=\frac{z-3}{4}$ and $\frac{x-1}{3}=\frac{y-3}{4}=\frac{z-5}{5}$ are	(p)	Coincident
(B)	$\frac{x-1}{2}=\frac{y-2}{3}=\frac{z-3}{4}$ and $\frac{x-3}{2}=\frac{y-5}{3}=\frac{z-7}{4}$ are	(q)	Parallel and different
(C)	$\frac{x-2}{5}=\frac{y+3}{4}=\frac{5-z}{2}$ and $\frac{x-7}{5}=\frac{y-1}{4}=\frac{z-2}{-2}$ are	(r)	Skew
(D)	$\frac{x-3}{2}=\frac{y+2}{3}=\frac{z-4}{5}$ and $\frac{x-3}{3}=\frac{y-2}{2}=\frac{z-7}{5}$ are	(s)	Intersecting in a point
		(t)	coplanar

1) A → s,t; B → p,t; C → q,t; D → r **2)** A → r,t; B → p,t; C → q; D → s

3) A → r,s; B → q,s; C → p; D → t **4)** A → p,q; B → s,t; C → r; D → q

20. Let A (*x, y,* z) be a point in *xy*-plane, which is equidistant from three points (0, 3, 2), (2, 0, 3) and (0, 0, 1). Let B = (1, 4, -1) and C = (2, 0, -2). Then among the statements

Statement 1: ΔABC is an isosceles right angled triangle, and

Statement 2: the area of ΔABC is $\frac{9\sqrt{2}}{2}$,

1) Statement-1 is True, Statement-2 is True

2) Statement-1 is false, Statement-2 is True

3) Statement -1 is True, Statement-2 is False.

4) Statement -1 is False, Statement-2 is False.

SECTION-II
(NUMERICAL VALUE TYPE

This section contains **5 Numerical Value Type Questions.** The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11**).

Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.

21. If a is real and the point $(\tan A, \tan B, \tan C)$ lies on the plane $\left(\sqrt{a^2-4}\right)x + ay + \left(\sqrt{4+a^2}\right)z = 6a,\ (|a| \geq 2)$ and the least value of $\tan^2 A + \tan^2 B + \tan^2 C$ *is* K then the value of $\frac{K}{6}$ is

22. Let $\vec{a} = 2\hat{i} + \hat{j} - \hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} + \hat{k}$ be two vectors. Consider a vector $\vec{c} = \alpha\vec{a} + \beta\vec{b},\ \alpha, \beta \in \mathbb{R}$. If the projection of $\vec{c}$ on the vector $\left(\vec{a} + \vec{b}\right)$ is $3\sqrt{2}$, then the minimum value of $\left(\vec{c} - \left(\vec{a} \times \vec{b}\right)\right).\vec{c}$ equals

23. Let two non-collinear vectors $\vec{a}$ and $\vec{b}$ inclined at an angle $\frac{2\pi}{3}$ be such that $|\vec{a}| = 3$ and $|\vec{b}| = 4$. A point P moves so that at any time t the position vector $\overrightarrow{OP}$ (where O is the origin) is given as $\overrightarrow{OP} = \left(e^t + e^{-t}\right)\vec{a} + \left(e^t - e^{-t}\right)\vec{b}$. If the least distance of P from origin is $\sqrt{2}\sqrt{\sqrt{a} - b}$ where a, $b \in N$, (where N denotes set of natural numbers) then the value of (a + b) is….

24. The position vectors of the four angular points of a tetrahedron OABC are (0, 0, 0); (0, 0, 2) ; (0, 4, 0) and (6, 0, 0) respectively. A point P inside the tetrahedron is at the same distance 'r' from the four plane faces of the tetrahedron. Then the value of '3r' is

25. Let $A_1, A_2, ..., A_n\ (n > 2)$ be the vertices of a regular polygon of n sides with its centre at the origin. Let $\overrightarrow{a_k}$ be the position vector of the point $A_k, k = 1, 2, ..., n$. If $\left|\sum_{k=1}^{n-1}\left(\overrightarrow{a_k} \times \overrightarrow{a_{k+1}}\right)\right| = \left|\sum_{k=1}^{n-1}\left(\overrightarrow{a_k}.\overrightarrow{a_{k+1}}\right)\right|$, then the minimum value of n is_____.

PHYSICS **Max Marks: 100**

SECTION-I
(SINGLE CORRECT ANSWER TYPE)

This section contains **20 Multiple Choice Questions.** Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

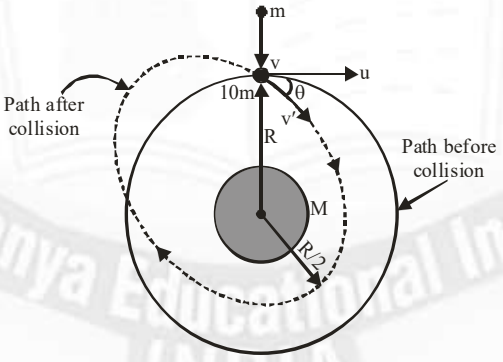
26. A boy can jump up vertically to a height 'h' ($\ll$ Radius of earth) from the surface of earth where g is the acceleration due to gravity. What should be the radius of a planet of density 'd' such that on jumping on it, he escapes out of the gravitational field of the planet?

1) $\left[\frac{4\pi}{3}\frac{Gd}{gh}\right]^{1/2}$ **2)** $\left[\frac{4\pi}{3}\frac{gh}{Gd}\right]^{1/2}$ **3)** $\left[\frac{3}{4\pi}\frac{gh}{Gd}\right]^{1/2}$ **4)** $\left[\frac{3}{4\pi}\frac{Gd}{gh}\right]^{1/2}$

27. A satellite is revolving round the earth, in a circular orbit coplanar with the equator, from west to east with a time period of rotation of 6 hours. How many times in a day, for an observer on the equator the satellite appears over head?

1) 8 times **2)** 3 times **3)** 4 times **4)** 6 times

28. A meteorite of mass m collides with a satellite of mass 10 m which was orbiting around a planet in a circular path of radius R. Due to collision, the meteorite sticks to the satellite and the satellite is seen to have gone into an orbit whose minimum distance from the planet is R/2. Mass of the planet is M.



Velocity of meteorite before collision is

1) $\sqrt{\frac{58GM}{R}}$ **2)** $\sqrt{\frac{58GM}{11R}}$ **3)** $\sqrt{\frac{10GM}{11R}}$ **4)** $\sqrt{\frac{11GM}{R}}$

29. The gravitational potential due to a particular mass distribution in space is given by $V = \frac{2}{x} - \frac{3}{xy} + \frac{4}{z}$ where x, y, z are in metres and V in J/kg. Then choose the incorrect statement

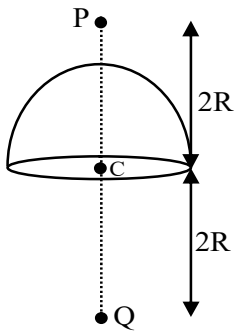
1) magnitude of gravitational force acting on a particle of mass 2 kg kept at a point (1m, 1m, 1m) is $2\sqrt{26}$N

2) External work done in moving a particle of mass 2 kg from (1m, 1m, 1m) to (2m, 2m, 2m) against the gravitational force is -1.5J

3) at y = 1.5 m, there will be no component of gravitational field along x-axis

4) at z = 4m, magnitude of potential gradient along z-axis is 1 S.I unit

30. If gravitational field due to uniform thin hemispherical shell at point P is I, then the magnitude of gravitational field at Q is (Mass of hemispherical shell is M, radius R



1) $\frac{GM}{2R^2} - I$ **2)** $\frac{GM}{2R^2} + I$ **3)** $\frac{GM}{4R} - I$ **4)** $2I - \frac{GM}{2R^2}$

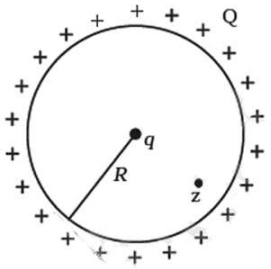
31. A positive charge Q is uniformly distributed along a circular ring of radius R. A small test charge q is placed at the centre of the ring (Fig.). Then which of the following statements are correct

(a) If q > 0 and is displaced away from the centre in the plane of the ring, it will be pushed back towards the centre.

(b) If q < 0 and is displaced away from the centre in the plane of the ring, it will never return to the centre and will continue moving till it hits the ring.

(c) If q < 0, it will perform SHM for small displacement along the axis.

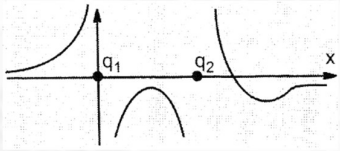
(d) q at the centre of the ring is in an unstable equilibrium within the plane of the ring for $q < 0$



1) only a, b are correct **2)** only b, c are correct

3) only c, d are correct **4)** only a, b, c, d are correct

32. Two charges q_1 & q_2 are kept on x –axis and electric field at different points an x-axis is plotted against x. Choose correct statement about nature and magnitude of q_1& q_2. Take electric field along +ve X-axis as +ve.



1) $q_1 + ve, q_2 - ve; |q_1| > |q_2|$ **2)** $q_1 + ve, q_2 - ve; |q_1| < |q_2|$

3) $q_1 - ve, q_2 + ve; |q_1| > |q_2|$ **4)** $q_1 - ve, q_2 + ve; |q_1| < |q_2|$

33. In a region of uniform electric field, equal amount of work W is done in moving a charged particle either by 1 m along a straight line or by 2 m along straight line normal to the earlier straight line path from same initial point P. When released at P, the particle has acceleration a. The mass of the particle is

1) $\frac{\sqrt{5}W}{2a}$ **2)** $\frac{2W}{\sqrt{5}a}$ **3)** $\frac{\sqrt{3}W}{2a}$ **4)** $\frac{2W}{\sqrt{3}a}$

34. Statement-1**:** If a point charge be rotated in a circle around a charge, the work done will be zero.

Statement-2**:** Electric field is conservative field.

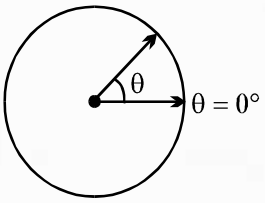
1) Statement-1 is True, Statement-2 is True

2) Statement-1 is false, Statement-2 is false

3) Statement -1 is True, Statement-2 is False.

4) Statement -1 is False, Statement-2 is True.

35. The linear charge density on a non conducting ring of radius R is varying with θ as $\lambda = \lambda_0 \cos(\theta/2)$. The potential at the centre of the ring is



1) 0 **2)** $\frac{\lambda_0}{2\pi\varepsilon_0}$ **3)** $\frac{\lambda_0}{4\pi\varepsilon_0}$ **4)** $\frac{\lambda_0}{\pi\varepsilon_0}$

36. **Statement-I:** Although the gravitational force between two particles is central, the force between two finite rigid bodies is not necessarily along the line joining their centre of mass.

Statement-II: For a spherically symmetric body however the force on a particle external to the body is as if the mass is concentrated at the centre and this force is therefore central.

1) Statement-1 is False, Statement-2 is False
2) Statement-1 is True, Statement-2 is True
3) Statement -1 is True, Statement-2 is False.
4) Statement -1 is False, Statement-2 is True.

37. The magnitude of the electric field intensity at point B (2,0,0) due to a dipole moment, $\vec{p} = \hat{i} + \sqrt{3}\hat{j}$ kept at origin is (assume that the point B is at large distance from the dipole and k = $\frac{1}{4\pi\varepsilon_0}$)(All quantities are in S.I units)

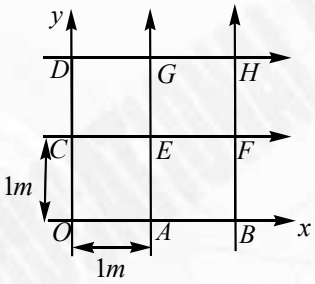
1) $\frac{\sqrt{13}K}{8}$ **2)** $\frac{\sqrt{13}K}{4}$ **3)** $\frac{\sqrt{7}K}{8}$ **4)** $\frac{\sqrt{7}K}{4}$

38. From a conducting ring of radius R which carries a charge Q (uniformly distributed) along it periphery a small length dl is cut-off. The electric field at the centre due to the remaining wire is

1) $\frac{Q\,dl}{8\pi^2\varepsilon_0 R^3}$ **2)** $\frac{Q}{4\pi\varepsilon_0 R^2}$ **3)** zero **4)** $\frac{Q\,dl}{4\pi^2\varepsilon_0 R^3}$

39. Assertion: Two equipotential surfaces cannot cut each other.
Reason: Two equipotential surfaces are parallel to each other.
1) Assertion is correct, Reason is incorrect
2) Both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
3) Both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
4) Both Assertion and Reason are correct.

40. The grid (each square of 1m x 1m), represents a region in space containing a uniform electric field. If potentials at points O, A, B, C, D, E, F, G & H are respectively 0, -1, -2, 1, 2, 0, -1, 1, and 0 volts, then find the unit vector along the direction of electric field intensity.

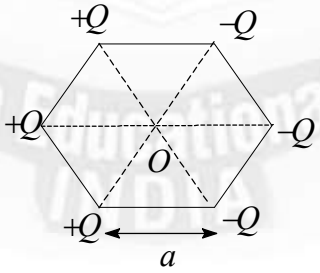


1) $\frac{(\hat{i}+\hat{j})}{\sqrt{2}}V/m$ **2)** $\frac{(\hat{i}-\hat{j})}{\sqrt{2}}V/m$ **3)** $\frac{-(\hat{i}+\hat{j})}{\sqrt{2}}V/m$ **4)** $\frac{-(\hat{i}-\hat{j})}{\sqrt{2}}V/m$

41. Three identical particles each of mass M move along a common circular path of radius R under the mutual interaction of each other. The velocity of each particle is

1) $\sqrt{\frac{GM}{R}\sqrt{\frac{2}{3}}}$ **2)** $\sqrt{\frac{GM}{\sqrt{3}R}}$ **3)** $\sqrt{\frac{GM}{3R}}$ **4)** $\sqrt{\frac{2}{3}\frac{GM}{R}}$

42. Six charges are placed at the vertices of a regular hexagon as shown in the figure. The electric field on the line passing through point O and perpendicular to the plane of the figure as a function of distance x from point O is $(x >> a)$



1) 0 **2)** $\frac{Qa}{\pi\varepsilon_0 x^3}$ **3)** $\frac{2Qa}{\pi\varepsilon_0 x^3}$ **4)** $\frac{\sqrt{3}Qa}{\pi\varepsilon_0 x^3}$

43. A very long uniformly charged circular cylinder (radius R) has a surface charge density σ. A very long uniformly charged line charge (linear charge density λ) is placed along the cylinder axis. If electric field intensity vector outside the cylinder is zero, then

1) $\lambda = R\sigma$ **2)** $\lambda = -R\sigma$ **3)** $\lambda = 2\pi R\sigma$ **4)** $\lambda = -2\pi R\sigma$

44. Assertion: Generally, the path of a projectile from the earth is parabolic but it is elliptical for projectiles going to a very large height.

Reason: The path of a projectile is independent of the gravitational force of earth

1) Both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion

2) Both Assertion and Reason are correct but Reason is not a correct explanation of \ the Assertion.

3) Assertion is correct, Reason is incorrect

4) Both Assertion and Reason are correct.

45. Two point charges $2Q$ and $-18Q$ are placed at a separation r. Find the location and charge of a test charge , so that the entire system is in equilibrium.

1) Outside the line joining the charges and on side of $2Q$ at $x = \frac{r}{2}, \frac{-9Q}{2}$

2) Outside the line joining the charges and on side of $2Q$ at $x = r, -9Q$

3) For any value of test charge at $x = \frac{r}{2}$ from 2Q outside the charges

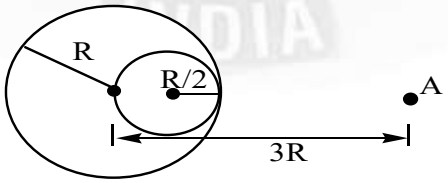
4) Not possible for all the three charges to remain in equilibrium

SECTION-II
(NUMERICAL VALUE TYPE

This section contains **5 Numerical Value Type Questions.** The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**

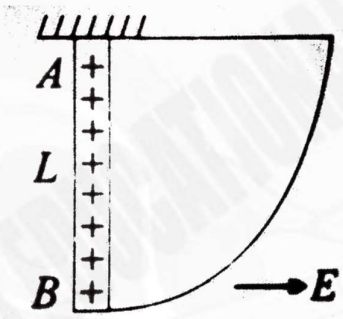
Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases

46. A solid sphere of uniform density and radius R applies a gravitational force of attraction equal to F_1 on a particle placed at a distance 3R form the centre of the sphere. A spherical cavity of radius $\frac{R}{2}$ is now made in the sphere as shown in the figure. The sphere with cavity now applies a gravitational force F_2 on the same particle. If the ratio $\frac{F_2}{F_1} = \frac{41}{n}$ then n=



47. The gravitational field in a region is given by $\vec{g} = \left(2\hat{i} + 3\hat{j}\right) N/kg$. What is the work done in moving a particle of mass 2 kg from $(1m, 1m)$ to $\left(2m, \frac{1}{3}m\right)$ along the line $3y + 2x = 5$ is

48. A rod AB of length L and mass m is uniformly charged with a charge Q and it is freely suspended from end A as shown in fig. An electric field E is suddenly switched on in the horizontal direction due to which the rod gets turned by a maximum angle 90^0. If the magnitude of E is $\frac{Mg}{nQ}$. The value of n is



49. A skylab of mass *m* kg is first launched from the surface of the earth in a circular orbit of radius 2R (from the centre of the earth) and then it is shifted from this circular orbit to another circular orbit of radius 3R. The minimum energy required to place the lab in the first orbit and to shift the lab from first orbit to the second orbit are E_1 and E_2 then E_1/E_2 is

50. Two spheres of the same material but of radius R and 2R are initially very far from each other. They move under mutual gravitational forces only. They collide with $e = \frac{1}{2}$. If their maximum separation after collision is nR find the value of n

CHEMISTRY

Max Marks: 100

SECTION-I
(SINGLE CORRECT ANSWER TYPE)

This section contains **20 Multiple Choice Questions.** Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

51. Which of following is Incorrect

1) $Cl_2O_7 > SO_3 > P_2O_5 > SiO_2$ (acidic nature)

2) $N_2O_5 > SO_3 > P_2O_5 > SiO_2$ (acidic)

3) $N_2O_5 > NO_2 > N_2O_3$ (acidic)

4) $Na_2O > MgO$ (basic)

52. Which of the following elements have electron affinity greater than S? (consider magnitude)

1) O **2)** Se **3)** Te **4)** F

53. The smallest size cation and anion that can exist are respectively

1) $H^+ and H^-$ **2)** $H^+ and F^-$ **3)** $Li^+ and F^-$ **4)** $Li^+ and H^-$

54. If an element X forms the highest oxide of the formula XO_3, it belongs to Group

1) 14 **2)** 15 **3)** 16 **4)** 17

55. Match list I with List II

	List I		List II
A	XeF_6	I	sp
B	SOF_4	II	sp^3
C	H_3O^+	III	sp^3d
D	BeF_2	IV	sp^3d^3

1) A – IV, B – III, C – II, D - I **2)** A – III, B – IV, C – II, D – I

3) A – IV, B – II, C – III, D – I **4)** A – IV, B – I, C – II, D – I

56. Assertion (A): According to MOT, O_2 is paramagnetic

Reason (R): O_2 Contain two unpaired electron

1) A is false but R is true

2) A is true but R is false

3) Both A and R are true but R is not correct explanation of A

4) Both A and R are true and R is correct explanation of A.

57. Assertion (A): Bond dissociation energy of N_2 is greater than O_2

Reason (R): Bond order of N_2 is 3 and bond order of O_2 is 2

1) A is false but R is true **2)** A is true but R is false

3) Both A and R are false **4)** Both A and R are true

58. Which of the following compounds are planar as well as non polar

1) XeF_4 **2)** XeO_3 **3)** XeF_5^- **4)** XeF_5^+

59. Statement I: The Hybridization of P in PCl_5 is sp^3d

Statement II: In sp^3d, d_z^2 is used in Hybridization

1) Statement I is false and statement II is true

2) Statement I is true and Statement II is false

3) Both statement I and Statement II are false

4) Both statement I and Statement II are true

60. Which of following is incorrect

1) In sp^3d angle between Axial & equatorial bonds is 90^0

2) In sp^3d angle between equatorial & equatorial bonds is 120^0

3) In sp^3d angle between axial & axial bonds is 180^0

4) In sp^3d angle between equatorial & equatorial bonds is 180^0

61. In which of the following compound central atom have SP^3d^2 hybridization

1) SF_6 **2)** $XeOF_4$ **3)** XeF_4 **4)** All of these

62. Which of the following have linear structure

1) I_3^- **2)** ClF_3 **3)** BeF_2 **4)** 1 & 3

63. Which of the following is incorrect

1) $NH_3 > NF_3$ (Bond angle) **2)** $H_2O > F_2O$ (Bond angle)

3) $CH_4 > CF_4$ (Bond angle) **4)** $PCl_3 > PF_3$ (Bond angle)

64. Which of the following molecule has minimum number of lone pairs?

1) ICl_3 **2)** BF_4^- **3)** $SnCl_2$ **4)** XeF_4

65. Which of the following is correct

1) $R_3Si-OH > R_3C-OH$ (acidity)

2) $R_3C-OH > R_3Si-OH$ (acidity)

3) $R_3P^+-O^- > R_3N^+-O^-$ (Dipole moment)

4) $CH_3-F > CH_3-Cl$ (Dipole moment)

66. Which of following is correct :

1) $d_{N-N(Bond\ length)}$ in $N_2H_4 > d_{N-N}$ in N_2F_4

2) $d_{C-C(Bond\ length)}$ in $C_2H_6 > d_{C-C}$ in C_2F_6

3) $d_{O-O(Bond\ length)}$ in $O_2H_2 > d_{O-O}$ in O_2F_2

4) All of these

67. Which of the following is not correct about I_2Cl_6

1) Hybridization of I is sp^3d^2 **2)** Hybridization of I is sp^3d

3) I_2Cl_6 have planar structure **4)** I_2Cl_6 is dimer of ICl_3

68. In Which of following magnetic character change?

1) $O_2 \longrightarrow O_2^{2-}$ **2)** $N_2^- \longrightarrow N_2^+$ **3)** $Zn \longrightarrow Zn^{2+}$ **4)** $O_2 \longrightarrow O_2^+$

69. Which of the following compound does not exist

1) H_2^+ **2)** H_2 **3)** He_2 **4)** He_2^+

70. Which of the following having bond order greater than 2

1) N_2 **2)** O_2^+ **3)** CO **4)** All of these

SECTION-II
(NUMERICAL VALUE TYPE

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Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases

71. Number of species having bond order is equal to or greater than 2

$H_2, H_2^+, He_2^+, O_2, N_2, O_2^+, O_2^{2-}$

72. Number of species whose magnetic nature is paramagnetic

$O_2, O_2^+, O_2^-, O_2^{2-}, N_2, N_2^+, N_2^-$

73. Total number of species having diamagnetic nature

$O_2, N_2, F_2, H_2, H_2^+, He_2^+$

74. Among B_2H_6, $B_3N_3H_6$, N_2O, N_2O_4, $H_2S_2O_3$ and $H_2S_2O_8$, the total number of molecules containing covalent bond between two atoms of the same kind is

75. Number of compound which do not follow octet rule

NO, NO_2, BCl_3, H_2SO_4, CO_2, C_2H_2

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BELOW 100	BELOW 500	BELOW 1000	BELOW 1000	NUMBER OF QUALIFIED RANKS
ALL INDIA OPEN CATEGORY RANKS	ALL INDIA OPEN CATEGORY RANKS	ALL INDIA OPEN CATEGORY RANKS	ALL INDIA CATEGORY RANKS COUNT	
29	113	205	745	4,212

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