

JEE MAIN 2026

Sample Paper - 13

Time Allowed: 3 hours

Maximum Marks: 300

General Instructions:

1. The test consists of total 75 questions.
2. Each subject (PCM) has 25 questions.
3. Each subject divided into two sections. Section A consists of 20 multiple-choice questions & Section B consists of 5 numerical value-type questions.
4. **Marking Scheme:**
 - Section A (MCQs): +4 marks for each correct answer, -1 mark for each incorrect answer, 0 marks for unattempted.
 - Section B (Numerical): +4 marks for each correct answer, 0 marks for incorrect or unattempted.
5. Any textual, printed, or written material, mobile phones, calculator etc. is not allowed for the students appearing for the test.
6. All calculations/written work should be done in the rough sheet is provided with the Question Paper.



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.

- Let $\vec{a} = (3 - 4\cos\theta)\hat{i} - (4\sin\theta)\hat{j}$, $\vec{b} = (4 - 5\sin\theta)\hat{i} - (5\cos\theta)\hat{j}$, for $\theta \in \left(0, \frac{\pi}{2}\right)$. Then the least value of $|\vec{a}| + |\vec{b}|$ is
 1) $5\sqrt{2}$ 2) 5 3) $\sqrt{34}$ 4) $\sqrt{41}$
- The perpendicular distance of point $(2, 0, -3)$ from line which passes through the point $(0, 2, -4)$ and perpendicular to the lines $\vec{r} = \begin{pmatrix} -3\hat{i} + 2\hat{k} \end{pmatrix} + \lambda \begin{pmatrix} 2\hat{i} + 3\hat{j} + 5\hat{k} \end{pmatrix}$
 $\vec{r} = \begin{pmatrix} \hat{i} - 2\hat{j} + \hat{k} \end{pmatrix} + \mu \begin{pmatrix} -\hat{i} + 3\hat{j} + 2\hat{k} \end{pmatrix}$, where $\lambda, \mu \in R$ is
 1) $\frac{\sqrt{219}}{3}$ 2) $\frac{\sqrt{78}}{3}$ 3) $\frac{\sqrt{52}}{3}$ 4) $\frac{\sqrt{126}}{3}$
- Two dice A and B are rolled. Let the numbers obtained on A and B be α, β respectively. If the variance of random variable $\alpha - \beta$ is $\frac{k_1}{k_2}$, Where k_1 and k_2 are co-prime then $k_1 - k_2 =$ _____
 1) 21 2) 29 3) 13 4) 19
- Let $P\left(\frac{\sqrt{3}}{\sqrt{7}}, \frac{1}{\sqrt{7}}\right)$, Q, R and S be four points on ellipse $9x^2 + 4y^2 = 36$. Let PQ & RS be mutually perpendicular chords and pass through the centre of ellipse then the value of $\left[\frac{50}{PQ^2} + \frac{50}{RS^2}\right] =$ _____ where $[\cdot]$ denotes GIF
 1) 4 2) 5 3) 6 4) 7

5. $\int \frac{x(x \tan^{-1} x + (\ln x)(\ln(\ln x))) + \tan^{-1} x}{(x^3 + x) \ln x} = f(x) + c$ where 'c' is integration constant & $f(e)=0$

Then $\left[\lim_{x \rightarrow 1^+} \frac{f(x)}{\tan\left(\frac{\pi x}{2}\right)} + \frac{11}{10} \right] = \text{_____}$, where $[\cdot]$ denotes GIF

- 1) 2 2) 1 3) 0 4) -1

6. Let $y = f(x)$ be a differentiable function satisfying $\int_2^x f(t) dt + 2 = \frac{x^2}{2} + \int_x^2 t^2 f(t) dt$ then

$\int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} \frac{f(x) + x^9 - x^3 + x + 1}{\cos^2 x} dx = \text{_____}$

- 1) 2 2) 3 3) 4 4) 0

7. Let 'q' be the maximum integral value of p in $[0,10]$ for which the roots of the equation $x^2 + px + \frac{5p}{4} = 0$ are rational then the area of region $\{(x, y) : 0 \leq y \leq (x - q)^2, 0 \leq x \leq q\}$ is (in square units)

- 1) 243 2) 25 3) $\frac{125}{3}$ 4) 164

8. Let n be the number of ways in which 5 boys and 5 girls can stand in a queue in such a way that all the girls stand consecutively in the queue. Let m be the number of ways in which 5 boys and 5 girls can stand in a queue in such a way that exactly four girls stand consecutively in the queue. Then the value of $\frac{m}{n}$ is

- 1) $\frac{7}{5}$ 2) $\frac{5}{2}$ 3) $\frac{1}{24}$ 4) 5

9. Coefficient of x^{99} in $x^{100} + 2x^{99}(1+x) + 3(1+x)^2 x^{98} + \dots + 101(1+x)^{100}$ is _____

- 1) $101C_{99} - 101C_{98}$ 2) $100(101C_{99}) - 101C_{98}$
3) $-101C_{98} + 101(101C_{99})$ 4) $101(101C_{98}) - 101C_{99}$

10. If the domain of the function $f(x) = \frac{\sqrt{x^2 - 16}}{x^2 - 4} + \log_{10}(x^2 + 3x - 10)$ is $(-\infty, p) \cup [q, \infty)$ then

$$p^2 + q = \underline{\hspace{2cm}}$$

1) 21

2) 29

3) 17

4) 34

11. Let $p = \tan\left(\frac{5\pi}{9} \cos\left(2 \sin^{-1} \frac{1}{\sqrt{5}}\right)\right)$, $q = \sin^{-1}\left(\sin \frac{2\pi}{3}\right) + \cos^{-1}\left(\cos\left(\frac{7\pi}{6}\right)\right)$ then the quadratic equation whose roots are p , $\sec q$ is (Here inverse trigonometric functions take principal values)

1) $\sqrt{3}x^2 - x + \sqrt{3} =$

2) $\sqrt{3}x^2 - 4x + 2\sqrt{3} = 0$

3) $\sqrt{3}x^2 - x - 2\sqrt{3} = 0$

4) $x^2 - \sqrt{3}x + =$

12. $A = \begin{bmatrix} 1 & -2 \\ 0 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 5 & 2 \\ 2 & 1 \end{bmatrix}$ then $(ABA^T)^5 (AB^T A^T)^{10} = X$ then trace of matrix X is _____

1) 4

2) 3

3) 8

4) 2

13. Let A be a 3×3 matrix of non – negative real numbers such that $A \begin{bmatrix} 2 \\ 2 \\ 2 \end{bmatrix} = 4 \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$ then

$(\det A)_{\max}$ is

1) 12

2) 8

3) 16

4) 32

14. $f(x) = x^3 - x^2 f'(1) + x f''(2) - f'''(3)$, $x \in R$ then which of the following is incorrect?

1) $f'(1) = 3$

2) $f'(3) = 10$

3) $f(0) = -6$

4) $f''(2) = 6$

15. **Statement – I:** $f : R \rightarrow R$ be a function such that $|f(x)| \leq x^2, \forall x \in R$ then $f(x)$ is differentiable at $x = 0$.

Statement – II: $f : R \rightarrow R$ be a function such that $|f(x)| \leq x^p, \forall x \in R$ then $f(x)$ is differentiable at $x = 0$ for any whole number 'p'

1) Both statement – I and statement II are true

2) Both statement- I and statement II are false

3) Statement I is true and statement II is false

4) Statement I is false and statement II is true

16. Let $y = f(x)$ satisfy the differential equation $\frac{dy}{dx} = 2xe^{-y}, \forall x \in R$. If $y'(1) = 1$ then the number of solutions of the equation $f(x) = f'(x)$ in $(0, \infty)$ is
- 1) 1 2) 2 3) 3 4) zero

17. Match the following

	Column - I		Column - II
1)	The number of points of discontinuity of $f(x) = (\operatorname{sgn}(x))(\operatorname{sgn}(-x))$ in R is	i)	0
2)	The number of points of continuity of $f(x) = \begin{cases} e^{ x } - 1, & x \text{ is rational} \\ \frac{1}{1+x^2}, & x \text{ is irrational} \end{cases}$ in R is	ii)	1
3)	The number of points of discontinuity of $g(x) = \lim_{n \rightarrow \infty} \frac{(f(x))^n - 1}{(f(x))^n + 1}$ in $(0, \infty)$ where $f(x) = (x-1)(x-2)(x-3) + 1$ is	iii)	2
4)	The number of points of discontinuity of $f(x) = \max.([x], x)$ in R is, where $[.]$ represents the GIF	iv)	3

Which of the following match is correct?

- 1) 1-iii, 2-iv, 3-i, 4-ii 2) 1-ii, 2-iii, 3-iv, 4-i
 3) 1-iii, 2-i, 3-iv, 4-ii 4) 1-iv, 2-i, 3-ii, 4-iii
18. Let (α, β, γ) be the mirror image of $(1, -2, 3)$ in the line $\frac{x+1}{2} = \frac{y-3}{4} = \frac{z+2}{3}$ then $2\alpha + 4\beta + 3\gamma + 2 = \underline{\hspace{2cm}}$
- 1) 5 2) 11 3) 9 4) 10
19. If $\arg\left(\frac{z-2}{z-2i}\right) = \frac{\pi}{4}$ then which of the following is correct?
- 1) $|z|_{\min} = 0$ 2) $|z|_{\min} = 2(\sqrt{2}-1)$ 3) $|z|_{\max} = 2(\sqrt{2}+1)$ 4) $|z|_{\max} = 4$



20. In a $\triangle ABC$, $AB = AC$ where A is (3,1) and the equation of the base BC is $2x + y = 4$. Also, B lies on $x + 3y = 7$. Then sum of coordinates of vertex 'C' is _____

- 1) $\frac{13}{5}$ 2) $\frac{18}{5}$ 3) $\frac{16}{5}$ 4) $\frac{7}{5}$

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. Equations of two diameters of a circle are $2x - 3y = 5$ and $3x - 4y = 7$. The line joining the points

$\left(-\frac{22}{7}, -4\right)$ and $\left(-\frac{1}{7}, 3\right)$ intersect the circle at only one point $p(\alpha, \beta)$ then $\frac{29}{6}(\beta - \alpha)$ is equal to _____

22. Let $\alpha \in \mathbb{R}$, z_1, z_2, z_3 be three distinct complex numbers such that $|z_1| = |z_2| = |z_3| = 3$ &

$\left|(kz_1 + z_2) - (kz_2 + z_3)\right|_{\min} = \alpha |z_3 - z_2| |z_3 - z_1|$, $\forall k \in \mathbb{R} - \{0\}$ then $36\alpha =$ _____

23. The number of solutions of the equation $\sin^2 x + (2 + 2x - x^2)\sin x - 3(x - 1)^2 = 0$ in $\left[0, \frac{\pi}{2}\right]$

is α , and in $[-2\pi, 2\pi]$ is β then $\alpha + \beta =$ _____

24. $\lim_{n \rightarrow \infty} \frac{\sum_{k=1}^{n-1} (k-1)(nk - k^2)}{2 \sum_{r=1}^n r^3 - \sum_{s=0}^n (s^2 + (n-s)^2)} = t$ then $[43t] =$ _____ ([.] denotes GIF)

25. An online exam is attempted by 40 candidates out of which 15 are boys. The average marks obtained by boys is 10 with variance 2. The variance of marks obtained by 25 girls is also 2 and the average marks of all 40 candidates is 12.5. If μ is average marks of the 25 girls & σ^2 is variance of marks of all 40 candidates then $20\sigma^2 - 8\mu =$ _____

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. Given below are two statements

Statement (I): Viscosity of gases is greater than that of liquids.

Statement (II): Surface tension of a liquid decreases due to the presence of insoluble impurities.

In the light of the above statements, choose the most appropriate answer from the options given below:

- 1) Statement I is correct but statement II is incorrect
- 2) Statement I is incorrect but Statement II is correct
- 3) Both Statement I and Statement II are incorrect
- 4) Both Statement I and Statement II are correct

27. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): The angular speed of the moon in its orbit about the earth is more than the angular speed of the earth in its orbit about the sun.

Reason (R): The moon takes less time to move around the earth than the time taken by the earth to move around the sun.

In the light of the above statements, choose the most appropriate answer from the options given below:

- 1) (A) is correct but (R) is not correct
- 2) Both (A) and (R) are correct and (R) is the correct explanation of (A)
- 3) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
- 4) (A) is not correct but (R) is correct

28. Given below are two statements:

Statement (I): The limiting force of static friction depends on the area of contact and independent of materials.

Statement (II): The limiting force of kinetic friction is independent of the area of contact and depends on materials.



In the light of the above statements, choose the most appropriate answer from the options given below:

- 1) Statement I is correct but statement II is incorrect
- 2) Statement I is incorrect but Statement II is correct
- 3) Both Statement I and Statement II are incorrect
- 4) Both Statement I and Statement II are correct

29. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): In Vernier calliper, if positive zero error exists, then while taking measurements, the reading taken will be more than the actual reading.

Reason (R): The zero error in Vernier Calliper might have happened due to manufacturing defect or due to rough handling.

In the light of the above statements, choose the correct answer from the options given below:

- 1) Both (A) and (R) are correct and (R) is the correct explanation of (A)
- 2) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
- 3) (A) is true but (R) is false
- 4) (A) is false but (R) is true

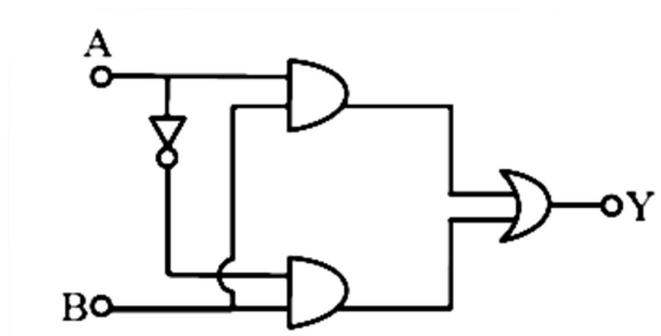
30. Match List I with List II

List I		List II	
A)	$\oint \vec{B} \cdot d\vec{l} = \mu_0 i_c + \mu_0 \epsilon_0 \frac{d\phi_E}{dt}$	I.	Gauss' law for electricity
B)	$\oint \vec{E} \cdot d\vec{l} = -\frac{d\phi_B}{dt}$	II.	Gauss' law for magnetism
C)	$\oint \vec{E} \cdot d\vec{A} = \frac{Q}{\epsilon_0}$	III.	Faraday law
D)	$\oint \vec{B} \cdot d\vec{A} = 0$	IV.	Ampere-Maxwell law

Chose the correct answer from the options given below

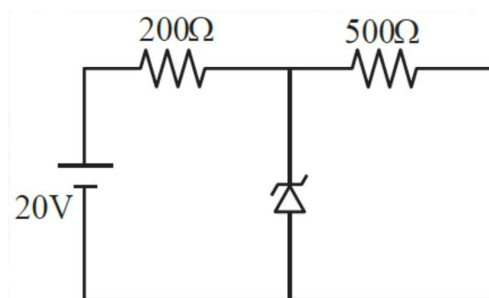
- 1) A-IV, B-I, C-III, D-II
- 2) A-II, B-III, C-I, D-II
- 3) A-IV, B-III, C-I, D-II
- 4) A-IV, B-II, C-III, D-IV

31. The output of this given circuit is:



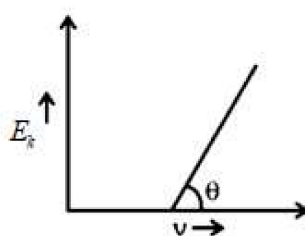
- 1)A 2)B 3)A.B 4) A+B

32. A Zener diode of breakdown voltage 10V is used as a voltage regulator as shown in the figure. The current through the Zener diode is



- 1) 50 mA 2) 0 3) 30 mA 4) 20 mA

33. For the photoelectric effect, the maximum kinetic energy (E_k) of the photoelectrons is plotted against the frequency (ν) of the incident photons as shown in figure. The slope of the graph gives

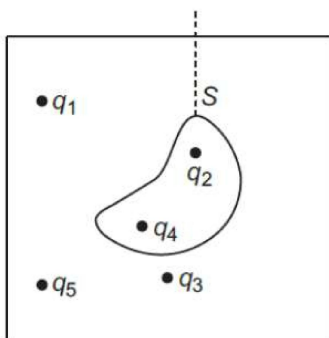


- 1) Ratio of planck's constant to electric charge
 - 2) Work function of the metal
 - 3) Charge of electron
 - 4) Planck's constant
34. The refractive index of a prism with apex angle A is $\cot A/2$. The angle of minimum deviation is:
- 1) $\delta_m = 180^\circ - A$
 - 2) $\delta_m = 180^\circ - 3A$
 - 3) $\delta_m = 180^\circ - 4A$
 - 4) $\delta_m = 180^\circ - 2A$
35. A body of mass 2 kg begins to move under the action of a time dependent force given by $\vec{F} = (6t\hat{i} + 6t^2\hat{j})N$. The power developed by the force at the time t is given by:
- 1) $(6t^4 + 9t^5) W$
 - 2) $(3t^3 + 6t^5) W$
 - 3) $(9t^5 + 6t^3) W$
 - 4) $(9t^3 + 6t^5) W$
36. The width of one of the two slits in a Young's double slit experiment is 4 times that of the other slit. The ratio of the maximum to minimum intensity in the interference pattern is:
- 1) 9:1
 - 2) 16:1
 - 3) 1:1
 - 4) 4:1
37. In an expression $a \times 10^b$:
- 1) a is order of magnitude for $b \leq 5$
 - 2) b is order of magnitude for $a \leq 5$
 - 3) b is order of magnitude for $5 < a \leq 10$
 - 4) b is order of magnitude for $a \geq 5$
38. A liquid of density ρ comes out with a velocity 'V' from a horizontal tube of area of cross section A . The reaction force exerted by the liquid on the tube is f , then Which of the following is incorrect?
- 1) $f \propto V$
 - 2) $f \propto V^2$
 - 3) $f \propto A$
 - 4) $f \propto \rho$

39. There are n -null points in a triangle formed by three identical point masses at the vertices of an equilateral triangle, then n is = ?
 1) 1 2) 2 3) 3 4) 4
40. Identify the true statement(s) from the following
 1) A hot bar placed under a running tap loses heat by convection the surface of the bar and water and not by conduction with in the water
 2) Conduction is the reason behind trade wind
 3) Convection involves bulk transport of different parts of fluid
 4) Natural convection is responsible for cooling system of an automobile engine
41. In a longitudinal stationary wave
 1) There is maximum transfer of energy across displacement nodes
 2) Maximum increase of pressure occurs at displacement antinodes
 3) Maximum decrease of pressure occurs at displacement antinodes
 4) The pressure at displacement antinodes is same as what it would be in absence of the wave
42. A current is made of two components, a DC component of $I_1 = 3$ amp and an AC component given by $I_2 = 4\sqrt{2} \sin \omega t$ amp; then the reading of the hot-wire ammeter (rms value) is:
 1) 3 amp 2) $4\sqrt{2}$ amp 3) $(3 + 4\sqrt{2})$ amp 4) 5 amp
43. Consider two cylindrical rods of identical dimensions, one of rubber and the other of steel. Both the rods are fixed rigidly at one end to the roof. A mass M is attached to each of the free ends at the centre of the rods.
 1) Both the rods will elongate but there shall be no perceptible change in shape
 2) The steel rod will elongate and change shape but the rubber rod will only elongate
 3) The steel rod will elongate without any perceptible change in shape, but the rubber rod will elongate and the shape of the bottom edge will change to an ellipse.
 4) The steel rod will elongate, without any perceptible change in shape, but the rubber rod will elongate with the shape of the bottom edge tapered to a tip at the centre



44. Five charges q_1, q_2, q_3, q_4 and q_5 are fixed at their positions as shown in figure. S is a Gaussian surface. The Gauss's law is given by $\oint E \cdot ds = \frac{q}{\epsilon_0}$ Which of the following statements is correct?



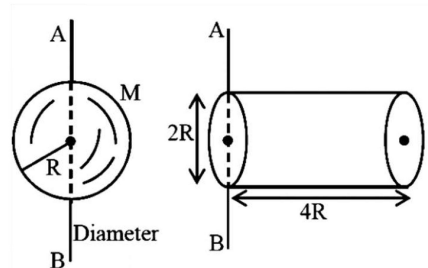
- 1) E on the LHS of the above equation will have a contribution from q_1, q_5 and q_3 , while q on the RHS will have a contribution from q_2 and q_4 only
 - 2) E on the LHS of the above equation will have a contribution from all charges while q on the RHS will have a contribution from q_2 and q_4 only
 - 3) E on the LHS of the above equation will have a contribution from all charges while q on the RHS will have a contribution from q_1, q_3 and q_5 only
 - 4) Both E on the LHS and q on the RHS will have contributions from q_2 and q_4 only.
45. The earth's surface has a negative surface charge density of 10^{-9} C/m^2 . The potential difference of 400 kV between the top of the atmosphere and the surface results (due to the low conductivity of the lower atmosphere) in a current of only 1800 A over the entire globe. If there were no mechanism of sustaining atmospheric electric field, how much time (roughly) would be required to neutralise the earth's surface (Radius of earth = $6.37 \times 10^6 \text{ m}$, assume the current is constant with time, despite the charge on the earth's surface changing)
- 1) 273 s
 - 2) 263 s
 - 3) 283 s
 - 4) 205 s

SECTION-II (NUMERICAL VALUE TYPE)

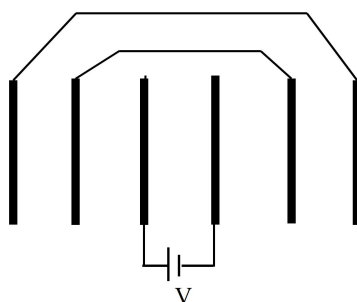
This section contains **5 Numerical Value Type Questions**. The Answer should be within **0 to 9999**. If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i.e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and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

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

46. Ratio of radius of gyration of a hollow sphere to that of a solid cylinder of equal mass, for moment of Inertia about their diameter axis AB as shown in figure is $\sqrt{\frac{8}{x}}$. The value of x is:



47. The disintegration energy Q for the nuclear fission of $^{235}\text{U} \rightarrow ^{140}\text{Ce} + ^{94}\text{Zr} + n$ is ____ MeV. (Given atomic masses of $^{235}\text{U}: 235.0439u$, $^{140}\text{Ce}: 139.9054u$, $^{94}\text{Zr}: 93.9063u$; $n: 1.0086u$, & value of $c^2 = 931 \text{ MeV/u}$.)
48. A current I flows along the length of a thin walled, long metallic hollow cylinder of radius R , distributed uniformly on its surface. If the pressure on the wall is $P = \left(\frac{\mu_0 I^2}{\pi^2 R^2} \right) \times \left(\frac{1}{x} \right)$. Find the value of x .
49. The modulus of potential difference V_{AB} between $A(0,0,0)\text{m}$ and $B(1,1,1)\text{m}$ in an electric field given by $\vec{E} = y\hat{i} + x\hat{j}$ _____ V
50. Six identical conducting plates of area A each are connected as shown. The separation 'd' between any two adjacent plates is same. ϵ_0 is permittivity of free space between the plates. The effective capacitance between the terminals of battery is $\frac{3k\epsilon_0 A}{2d}$. The value of 'k' is



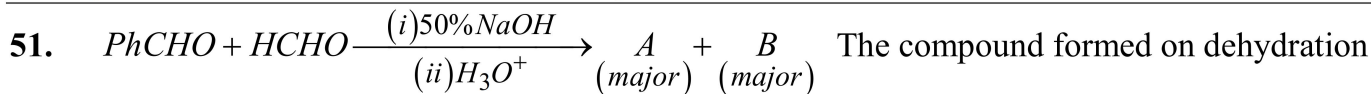
CHEMISTRY

Max Marks: 100

SECTION-I (SINGLE CORRECT ANSWER TYPE)

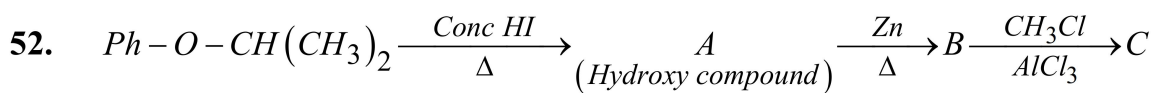
This section contains **20 Multiple Choice Questions**. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which **ONLY ONE** option can be correct.

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



of A & B is

- 1) $\text{Ph}-\text{CO}-\text{OCH}_3$
- 2) $\text{Ph}-\text{O}-\text{COCH}_3$
- 3) $\text{Ph}-\text{CH}_2-\text{O}-\text{CHO}$
- 4) $\text{Ph}-\text{CH}_2-\text{O}-\text{CH}_3$



The incorrect option among the following is

- 1) $A = PhOH$ 2) $B = Benzene$ 3) $C = PhCH_3$ 4) $A = PhI$

53. The pair having similar atomic radii is

- 1) Mn & Re 2) Ti & Zr 3) Y & La 4) Mo & W**

54. Which of the following will exhibit maximum attraction to an applied magnetic field ?

- 1) N_2 2) C_2 3) NO 4) O_2

55. The correct group of halide ions which can be oxidized by oxygen in acidic medium is

- 1) F^- only 2) I^- only 3) Br^- & I^- only 4) Cl^- , Br^- , I^- only

56. Molar depression constant for a solvent is $8.0 \text{ K Kg mol}^{-1}$. The depression in freezing point of the solvent for 0.03 mol kg^{-1} solution of K_2SO_4 is _____?

(Assume complete dissociation of the electrolyte)

- 1) 0.72K 2) 0.24K 3) 0.36K 4) 0.12K

57.

	Coloum – I (Name of the test)		Coloum – II Compound/ Group that can be identified
1)	Tollen's Test	p)	Proteins and peptides
2)	Barfoed Test	q)	Aldehydes
3)	Molisch Test	r)	Monosaccharides
4)	Biuret Test	s)	Carbohydrates

The correct matching is _____

- 1) $1 \rightarrow p, 2 \rightarrow q, 3 \rightarrow r, 4 \rightarrow s$ 2) $1 \rightarrow q, 2 \rightarrow p, 3 \rightarrow r, 4 \rightarrow s$
 3) $1 \rightarrow q, 2 \rightarrow r, 3 \rightarrow s, 4 \rightarrow p$ 4) $1 \rightarrow q, 2 \rightarrow r, 3 \rightarrow p, 4 \rightarrow s$

58. The number of unpaired electrons present in the complex species $[Ni(NH_3)_6]^{2+}$ _____

- 1) 0 2) 1 3) 2 4) 3

59. **Statement – I:** All elements of group 15 form hydrides of type EH_3 where $E = N, P, AS, Sb \text{ or } Bi$

Statement – II: All elements of group 15 form halides of type EX_3 where $E = N, P, AS, Sb \text{ or } Bi$

Statement – III: Incase of halides of nitrogen only NF_3 Is known to be stable

Statement – IV: The oxides of type E_2O_3 of arsenic and antimony are amphoteric and those of bismuth are predominantly basic

Select the correct combination

- 1) I, II, III only 2) I, II, III, IV 3) I, III, IV only 4) I, IV only

60. **Statement – I:** Mischmetall contains 5% lanthanide & 95% Fe

Statement – II: Electronic configuration Ce is $[Xe] 4f^2 6s^2$

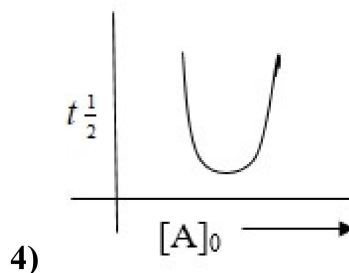
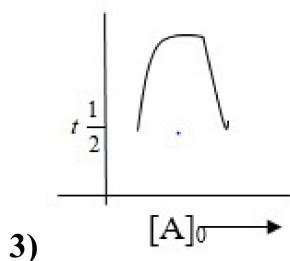
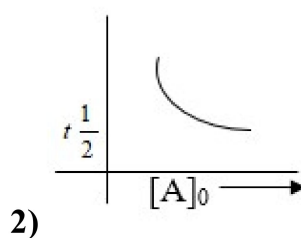
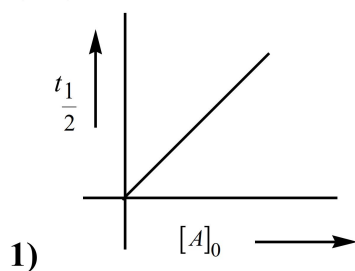
Statement – III: Eu^{2+} is a strong reducing agent

Statement – IV: Ce^{4+} is a strong oxidizing agent

Correct statements are

- 1) I, II only 2) I, II, III only 3) I, II, III, IV 4) III, IV only

61. **Assertion:** CH_3OH and $\text{CH}_3\text{CH}_2\text{OH}$ can be distinguished by using I_2 / NaOH
Reason: Ethanol gives yellow precipitate in Iodoform reaction but methanol will not
 1) Both Assertion (A) and Reason (R) are the true and Reason (R) is a correct explanation of Assertion (A).
 2) Both Assertion (A) and Reason (R) are the true but Reason (R) is not a correct explanation of Assertion (A).
 3) Assertion (A) is true and Reason (R) is false.
 4) Assertion (A) is false and Reason (R) is true.
62. **Assertion:** H_2O and HCl Form solution which shows negative deviation from Raoult's law
Reason: If interactions become stronger on mixing, then solutions show negative deviation from Raoult's Law
 1) Both Assertion (A) and Reason (R) are the true and Reason (R) is a correct explanation of Assertion (A).
 2) Both Assertion (A) and Reason (R) are the true but Reason (R) is not a correct explanation of Assertion (A).
 3) Assertion (A) is true and Reason (R) is false.
 4) Assertion (A) is false and Reason (R) is true.
63. Which of the following is correct relation between half-life $\left(t_{\frac{1}{2}}\right)$ and initial concentration (A_0) for zeroth order reaction ?



64 For multi electron system the decreasing order of energy of a given orbitals $5d, 4f, 5p, 5s$ is _____

- 1) $5d > 4f > 5p > 5s$ 2) $4f > 5d > 5p > 5s$
3) $5s > 5d > 5p > 4f$ 4) $4f > 5s > 5d > 5p$

65 Number of molecules of H_2SO_4 present in 100 ml of 0.02M H_2SO_4 (assume no dissociation) solution is _____

- 1) 12.044×10^{20} molecules 2) 6.022×10^{23} molecules
3) 1×10^{23} molecules 4) 12.044×10^{23} molecules

66. Identify disproportionation reaction

- 1) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
2) $CH_4 + 4Cl_2 \rightarrow CCl_4 + 4HCl$
3) $2F_2 + 2OH^- \rightarrow 2F^- + OF_2 + H_2O$
4) $2NO_2 + 2OH^- \rightarrow NO_2^- + NO_3^- + H_2O$

67. In order to oxidize a mixture containing one mole each of $FeC_2O_4, Fe_2(C_2O_4)_3, FeSO_4$, and $Fe_2(SO_4)_3$ in acidic medium, the total number of moles of $KMnO_4$ required is _____

- 1) 3 2) 2 3) 1 4) 1.5

68. The wavelength of first Lyman lines of Hydrogen (H), He^+ and Li^{2+} ions are λ_1, λ_2 & λ_3 respectively. The ratio $\lambda_1 : \lambda_2 : \lambda_3$ is _____

- 1) 1 : 4 : 9 2) 9 : 4 : 1 3) 36 : 9 : 4 4) 6 : 3 : 2

69. Molar solubility of $Ni(OH)_2$ in 0.5 M $Ca(OH)_2$ is _____

$(K_{sp} \text{ of } Ni(OH)_2 = 2 \times 10^{-15} M)$

- 1) $2 \times 10^{-13} M$ 2) $2 \times 10^{-14} M$ 3) $2 \times 10^{-15} M$ 4) $2 \times 10^{-16} M$

70. Which of the following molecule contains more number of nitrogen atoms

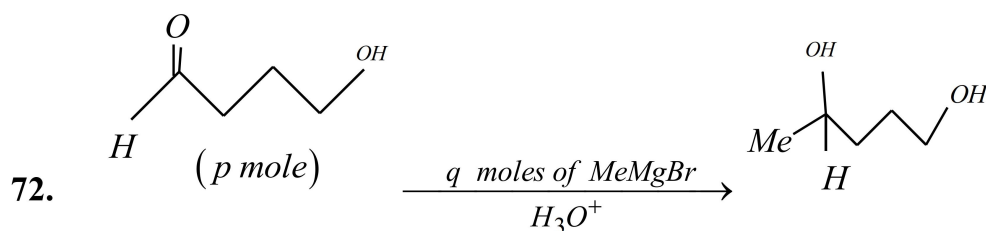
- 1) Cytosine 2) Thymine 3) Adenine 4) Uracil

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

71. $t_{99.9}$ is the time required for the reaction to undergo 99.9% completion and t_{50} is the time required for the reaction to undergo 50% completion. The relation between $t_{99.9}$ and t_{50} for a first order reaction is $t_{99.9} = xt_{50}$ the value of 'x' is _____ (nearest integer)

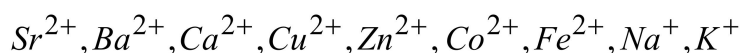


The value of $\frac{q+p}{q-p}$ on completion of above reaction is _____

73. At 27°C dinitrogen tetroxide is 50% dissociated into NO_2 through the following reaction $\text{N}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2$. The standard free energy change (in J) for the reaction at this temperature and a total pressure of one atmosphere is _____

$$\left(\ln^x = 2.3 \log x, R = 8.3 \text{ JK}^{-1} \text{ mol}^{-1} \right) (\log^4 = 0.6, \log^3 = 0.48)$$

74. Number of metal ions characterized by flame test among the following is _____



75. Number of reducing sugars among the following is _____

Glucose, fructose, maltose, sucrose, lactose, cellobiose, mannose

ANSWER KEY

MATHEMATICS

1	3	2	2	3	2	4	1	5	2
6	1	7	1	8	4	9	3	10	2
11	3	12	4	13	2	14	2	15	3
16	1	17	2	18	1	19	3	20	4
21	7	22	6	23	3	24	7	25	3

PHYSICS

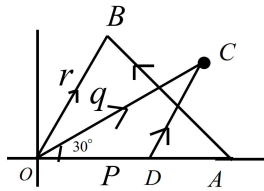
26	2	27	2	28	2	29	2	30	3
31	2	32	3	33	4	34	4	35	4
36	1	37	2	38	1	39	4	40	3
41	4	42	4	43	4	44	2	45	3
46	67	47	208	48	8	49	1	50	1

CHEMISTRY

51	3	52	4	53	4	54	4	55	2
56	1	57	3	58	3	59	2	60	4
61	1	62	1	63	1	64	1	65	1
66	4	67	2	68	3	69	3	70	3
71	10	72	3	73	687	74	6	75	6



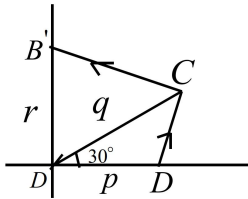
SOLUTION MATHEMATICS



1.

$$\overrightarrow{DC} = \overrightarrow{a}, \overrightarrow{AB} = \overrightarrow{b}, \overrightarrow{OA} = q \hat{i}$$

Rotate $\triangle OAB$ by 30° then A reaches C. B reaches B' Where $|\overrightarrow{AB}| = |\overrightarrow{CB}'|$



$|\overrightarrow{DC}| + |\overrightarrow{CB}'|$ is min if they are collinear

$$\begin{aligned} & (2, 0, -3) \\ & \frac{x}{1} = \frac{y-2}{1} = \frac{z+4}{-1} \end{aligned}$$

2.

3.

$\alpha - \beta$	5	4	3	2	1	0	-1	-2	-3	-4	-5
Prob	$\frac{1}{36}$	$\frac{2}{36}$	$\frac{3}{36}$	$\frac{4}{36}$	$\frac{5}{36}$	$\frac{1}{6}$	$\frac{5}{36}$	$\frac{4}{36}$	$\frac{1}{12}$	$\frac{1}{18}$	$\frac{1}{36}$

4. R be $(2\cos\theta, 3\sin\theta)$, OP perpendicular to OR

$$\therefore \frac{3}{2} \tan \theta \times \frac{3}{\sqrt{3}} = -1 \Rightarrow \tan \theta = \frac{-2\sqrt{3}}{9}, \text{ Required} = \frac{1}{4} \left(\frac{1}{OP^2} + \frac{1}{OR^2} \right) = \frac{13}{144}$$

5. Given $\int \tan^{-1} x \cdot \frac{1}{x(\ln x)} + \frac{1}{1+x^2} \cdot \ln(\ln x) \therefore f(x) = \left(\tan^{-1} x \right) \ln(\ln x)$

6. By differentiating wrt x, we get $(1+x^2)f'(x) = x \rightarrow f(x)$ is odd

$$\text{Required integral} = \int_{-\pi/4}^{\pi/4} \sec^2 x \, dx = 2$$

7. $D = p^2 - 5p$. If $p=9$, then D is perfect square

$$\text{Area} = \int_0^9 (x-9)^2 \, dx = 243$$

8. $m = {}^6C_2 \times {}^5C_4 \times 2! \times 4! \times 5!$

$$n = 5! \times 6!$$

9. Required = coefficient of x^{99} in $x^{100} \left(1 + 2 \left(\frac{1+x}{x} \right) + \dots + 101 \left(\frac{1+x}{x} \right)^{100} \right)$

10. $x^2 - 16 \geq 0$, $x \neq 2, -2$, $(x+5)(x-2) \geq 0$

$$x \in (-\infty, -5) \cup (2, \infty)$$

$$11. \quad \cos\left(2\sin^{-1}\frac{1}{\sqrt{5}}\right) = \frac{3}{5}, \quad \sin^{-1}\left(\sin\frac{2\pi}{3}\right) = \frac{\pi}{3} \qquad \cos^{-1}\left(\cos\frac{7\pi}{6}\right) = 2\pi - \frac{7\pi}{6}$$

$$12. \quad ABA^T = I \Rightarrow AB^T A^T = I$$

$$13. \quad a_1 + a_2 + a_3 = 2, \quad b_1 + b_2 + b_3 = 2, \quad c_1 + c_2 + c_3 = 2$$

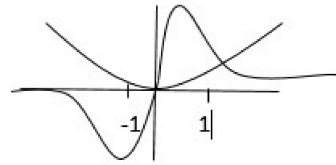
(det A) max when $a_1 = 2, b_2 = 2, c_3 = 2$ & else are '0'.

$$14. \quad f''(1) = 3 - 2a + b = a, \quad f''(2) = 12 - 2a = b, \quad f'''(3) = 6 \quad \therefore a = 3, b = 6 \text{ s}$$

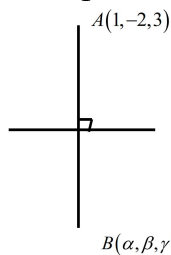
15. Conceptual

$$16. \quad \int e^y dy = \int 2x dx = f(x) = \ln(x^2 + c)$$

$$f'(1) = 1 \Rightarrow C = 1$$

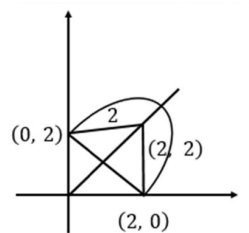


17. conceptual



$$18. \quad AB \perp \text{line}, (\alpha - 1)2 + 4(\beta + 2) + 3(\gamma - 3) = 0 \therefore 2\alpha + 4\beta + 3\gamma = 3$$

19.

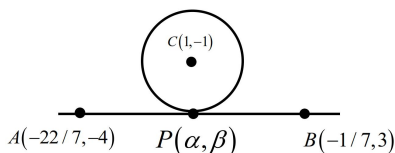


$$20. \quad B = (1, 2) \text{ \& Let } C \equiv (\alpha, 4 - 2\alpha) \therefore AB = \sqrt{2^2 + 1^2} = \sqrt{(2\alpha - 3)^2 + (3 - \alpha)^2}, 5\alpha^2 - 18\alpha + 13 = 0$$

$$21. \quad \text{Equation of AB is } 7X - 3Y + 10 = 0 \dots (I)$$

$$\text{Equation of CP is } 3x + 7y - 4 = 0 \dots (ii)$$

$$\alpha = \frac{-41}{29} \qquad \beta = \frac{1}{29}$$



$$22. \quad |kz_1 + (1 - k)z_2 - z_3| = \text{height from vertex C.}$$

$$\therefore \text{Area} = \frac{1}{2}(AB)(\text{height}) = \frac{1}{2}|z_1 - z_3||z_2 - z_3|\sin C$$

$$\alpha = \frac{\sin c}{AB} = \frac{1}{2R} = \frac{1}{6}$$

$$23. \quad (\sin x + 3)(\sin x - (x - 1)^2) = 0$$

$$24. \text{ Required} = \lim_{n \rightarrow \infty} \frac{3 \left(\sum_{r=1}^{n-1} (-r^3 + r^2(n+1) - nr) \right)}{n(n+1)(3n^2 - n - 2)} = \frac{1}{6}$$

$$25. \mu = \frac{40 \times 12.5 - 10 \times 15}{25} = 14 \quad \sigma^2 = 2 + \frac{15 \times 25}{40 \times 40} (4)^2 = 5.75$$

PHYSICS

26. Gases have less viscosity.

Due to insoluble impurities like detergent surface tension decreases

$$27. \omega = \frac{2\pi}{T} \Rightarrow \omega \propto \frac{1}{T} \quad T_{\text{moon}} = 27 \text{ days}$$

$$T_{\text{earth}} = 365 \text{ days } 4 \text{ hour} \Rightarrow \omega_{\text{moon}} > \omega_{\text{earth}}$$

28. Co-efficient of depends on surface in contact So, depends on material of object.

29.: Measuring instruments Theory

30. Ampere- Maxwell law

$$\rightarrow \oint \vec{B} \cdot d\vec{l} = \mu_0 i_c + \mu_0 \epsilon_0 \frac{d\phi_E}{dt}$$

$$\text{Faraday law} \rightarrow \oint \vec{E} \cdot d\vec{l} = \frac{d\phi_B}{dt}$$

$$\text{Gauss' law for electricity} \rightarrow \oint \vec{E} \cdot d\vec{A} = \frac{Q}{\epsilon_0}$$

$$\text{Gauss 'law for magnetism} \rightarrow \oint \vec{B} \cdot d\vec{A} = 0$$

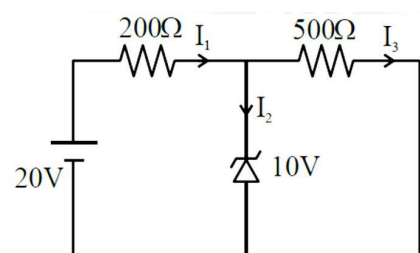
$$31. Y = AB + \bar{A}.B$$

$$= (A + \bar{A}).B$$

$$Y = 1.B$$

$$Y = B$$

32.



Zener is in breakdown region.

$$I_3 = \frac{10}{500} = \frac{1}{50}$$

$$I_1 = \frac{10}{200} = \frac{1}{20}$$

$$I_2 = I_1 - I_3$$

$$I_2 = \left(\frac{1}{20} - \frac{1}{50} \right) = \left(\frac{3}{100} \right) = 30mA$$

$$33. \text{ K.E.} = hf - \phi$$

$$\tan \theta = h$$

$$34. \mu = \frac{\sin\left(\frac{A + \delta_m}{2}\right)}{\sin \frac{A}{2}}$$

$$\frac{\cos \frac{A}{2}}{\sin \frac{A}{2}} = \frac{\sin\left(\frac{A + \delta_m}{2}\right)}{\sin \frac{A}{2}}$$

$$\sin\left(\frac{\pi}{2} - \frac{A}{2}\right) = \sin\left(\frac{A + \delta_m}{2}\right)$$

$$\frac{\pi}{2} - \frac{A}{2} = \frac{A}{2} + \frac{\delta_m}{2}$$

$$\delta_m = \pi - 2A$$

$$35. \vec{F} = (6t\hat{i} + 6t^2\hat{j})N$$

$$\vec{F} = m\vec{a} = (6t\hat{i} + 6t^2\hat{j})$$

$$\vec{a} = \frac{\vec{F}}{m} = (3t\hat{i} + 3t^2\hat{j})$$

$$\vec{v} = \int_0^t \vec{a} dt = \frac{3t^2}{2}\hat{i} + t^3\hat{j}$$

$$P = \vec{F} \cdot \vec{v} = (9t^3 + 6t^5)W$$

$$36. \text{ Since, Intensity } \propto \text{ width of slit } (\omega)$$

$$_{\min} = \left(\sqrt{I_1} - \sqrt{I_2} \right)^2 =$$

$$\text{So, } I_1 = I, I_2 = 4I \quad _{\max} = \left(\sqrt{I_1} + \sqrt{I_2} \right)^2 = 9$$

$$\frac{I_{\max}}{I_{\min}} = \frac{9I}{I} = \frac{9}{1}$$

$$37. a \times 10^b$$

$$\text{If } a > 5 \text{ order is } b \quad a > 5 \text{ order is } b + 1$$

38. $f = \rho A v^2$
39. $n = 4$
40. NCERT Theory
41. A pressure node is a displacement anti-node and displacement node is a pressure anti node. $\Delta P = -B \frac{\partial y}{\partial x}$ At displacement nodes, $\frac{\partial y}{\partial x}$ is both maximum and minimum
42. $I_1 = 3A$, $I_2 = 4\sqrt{2} \sin wt$ $I_{\text{net}} = I_1 + I_2 = (3 + 4\sqrt{2} \sin wt)$
 $I_{\text{rms}} = \sqrt{3^2 + (4\sqrt{2})^2} \times \frac{1}{2} = 5A$
43. Rubber experiences larger lateral strain than steel
44. According to Gauss's theorem in electrostatics, $\oint E \cdot ds = \frac{q}{\epsilon_0}$. Here, E is due to all the charges q_1, q_2, q_3, q_4 and q_5 . As q is charge enclosed by the Gaussian surface, therefore, $q = q_2 + q_4$
45. Given, radius of earth $R = 6.37 \times 10^6 \text{ m}$
 Negative surface charge density $\sigma = 10^{-9} \text{ C/m}^2$
 Potential $V = 400 \text{ kV} = 400 \times 10^3 \text{ V}$ Current on the globe $I = 1800 \text{ A}$
 Surface area of earth $A = 4\pi R^2 = 4 \times 3.14 \times (6.37 \times 10^6)^2 = 509.64 \times 10^{12} \text{ m}^2$
 Charge on earth surface $Q = \text{Area of earth surface} \times \text{Surface charge}$
 $Q = A\sigma = 509.64 \times 10^{12} \times 10^{-9} = 509.64 \times 10^3 \text{ C}$
 We know that $Q = It$ \therefore Time required to neutralize earth's surface
 $t = \frac{Q}{I} = \frac{509.64 \times 10^3}{1800} t = 283.1 \text{ s}$ or $t = 4 \text{ min } 43 \text{ s}$
 Thus, the time required to neutralize the earth's surface is 283.1s.
46. $I_{\text{sphere}} = \frac{2}{3} MR^2 = Mk_1^2$
 $I_{\text{cylinder}} = \frac{1}{12} M(4R^2) + \frac{1}{4} MR^2 + M(2R)^2 = \frac{1}{12} MR^2 = Mk_2^2, \frac{k_1}{k_2} = \sqrt{\frac{2}{3} \cdot \frac{12}{67}} = \sqrt{\frac{8}{67}}$
47. $^{235}\text{U} \rightarrow ^{140}\text{Ce} + ^{94}\text{Zr} + n$
 Disintegration energy $Q = (m_R - m_P) \cdot c^2, m_R = 235.0439 \text{ u}$
 $m_P = 139.9054 \text{ u} + 93.9063 \text{ u} + 1.0086 \text{ u} = 234.8203 \text{ u}$
 $Q = (235.0439 \text{ u} - 234.8203 \text{ u}) c^2 = 0.2236 \text{ u} \cdot c^2 = 0.2236 \times 931, Q = 208.1716$
48. $dF = \frac{\mu_0}{2\pi a} \left(\frac{i}{2\pi R} dx \right)^2 l = \frac{\mu_0}{2\pi \times 2R} \cdot \frac{i^2}{4\pi^2 R^2} \cdot dx \cdot dx \cdot l$ Pressure on the element
 $= \frac{\mu_0}{2\pi \cdot 2R} \cdot \frac{i^2 dx}{4\pi^2 R^2} \cdot \frac{dx \cdot l}{dx \cdot l}$
49. Potential $V = xy$

50. Redraw the circuit in series and parallel combination

CHEMISTRY

51. $A = PhCH_2OH$, $B = HCOOH$

52. $A = PhOH$, $B = PhH$, $C = PhCH_3$

53. due to lanthanide contraction size of Mo=W

54. O_2 has 2 upe-

55. only I^- is oxidized by O_2 based on SRP values

56. $K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$ $i = 3$

57. Tollen's Test – Aldehydes

Barfoed Test – Monosaccharides

Molisch Test – Carbohydrates

Biuret Test – Proteins and peptides

58. $d^8 SFL \Rightarrow 2upe^-$

59. NCERT

60. III and IV are correct

61. Both correct & correct explanation

62. both correct and correct explanation

63. $\left(t^{\frac{1}{2}}\right)_o = \frac{[A]_o}{2K}$

64. Based on $n+1$ value

65. $0.02 \times 100 \times 10^{-23} \times 6.022 \times 10^{23} = 12.044 \times 10^{20}$

66. $2NO_2 + 2OH^- \rightarrow NO_2^- + NO_3^- + H_2O$

67. $\frac{3+6+1+0}{5} = \frac{10}{5} = 2$

68. $\frac{1}{\lambda} \propto R_n z^2 \Rightarrow \lambda_1 : \lambda_2 : \lambda_3 = \frac{1}{1^2} : \frac{1}{2^2} : \frac{1}{3^2}$ $1 : \frac{1}{4} : \frac{1}{9} = 36 : 9 : 4$

69. $Ni(OH)_2 \rightarrow Ni^{2+} + 2OH^-$ $2 \times 10^{-15} = x = 2 \times 10^{-15}$

71. $t_{99.9} = \frac{2.303}{K} \log \frac{100}{0.1} = \frac{6.909}{K} = \frac{0.69}{\frac{t_1}{2}} = 10 \frac{t_1}{2}$

72. if $P=1 \Rightarrow q=2$, $\frac{2+1}{2-1} = 3$

73. $N_2O_4(g) \rightarrow 2NO(g)$
 $\begin{array}{cc} | & | \\ 1-0.5 & 2 \times 0.5 \\ =0.5 & =1 \end{array}$

74. $Sr^{2+}, Ba^{2+}, Ca^{2+}, Cu^{2+}, Na^+, K^+$

75. Except sucrose remaining given sugars are reducing

