JEE MAIN 2026

Sample Paper - 11

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.

1. The area of smaller region bounded by the curve $9x^2 + 4y^2 - 36x + 16y + 16 = 0$ and the line $3x + 2y = 8$ is

   1) $\frac{3}{2}(\pi + 2)$ **2)** $3(\pi - 2)$ **3)** $\frac{3}{4}(\pi - 2)$ **4)** $\frac{3}{2}(\pi - 2)$

2. Let $A = \{z \in C : 1 \le |z - (1+i)| \le 2\}$ and $B = \{z \in A : |z - (1-i)| = 1\}$. Then B:

   1) is an empty set
   2) contains exactly two elements
   3) contains exactly three elements
   4) is an infinite set

3. Let $S = \left\{ x \in [-6, 3] - \{-2, 2\} : \frac{|x+3| - 1}{|x| - 2} \ge 0 \right\}$ and $T = \left\{ x \in Z : x^2 - 7|x| + 9 \le 0 \right\}$. Then the

   number of elements in $S \cap T$ is

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

4. $\displaystyle\int \frac{6x^{10} + 4}{x^3 \sqrt{x^{10} - 3x^4 - 1}} dx, x > 0 = $ _____ (c is constant of integration)

   1) $\dfrac{\sqrt{x^{10} - 3x^4 - 1}}{x^2} + c$ **2)** $\dfrac{2\sqrt{x^{10} - 3x^4 - 1}}{x^2} + c$

   3) $2\sqrt{x^{10} - 3x^4 - 1} + c$ **4)** $\sqrt{x^{10} - 3x^4} + C$

5. The value of the definite integral $\displaystyle\int_{-2}^{2} x^3 \ln\left(1^x + 3^x + 5^x + 15^x\right) dx = $

   1) $\dfrac{\ln 15}{4}$ **2)** $\dfrac{64}{5} \ln 15$ **3)** $\dfrac{32}{5} \ln 15$ **4)** $\dfrac{64}{5} \ln 30$

6. Let $x^2 + y^2 + Ax + By + C = 0$ be a circle passing through (0, 6) and touching the parabola $y = x^2$ at (2, 4). Then A + C is equal to

1) 16   **2)** 88/5   **3)** 72   **4)** -8

7. Match the following List – I with List II (for $z = x + iy$, $x, y \in R$)

		List I			**List II**	
P)		Area of the triangle formed by the complex numbers z, $\omega z, z + \omega z$ is $16\sqrt{3}$ then |z| is (where ω is a non real cube root of unity)		**1)**	4	
Q)		Area of the locus of z, if $\left\|\operatorname{Re} z\right\| + \left\|\operatorname{Im} z\right\| = 3$		**2)**	8	
R)		If $\left\| z + \dfrac{6}{z} \right\| = 5$ then the maximum of |z| is		**3)**	6	
S)		Number of complex numbers 'z' which satisfy $z^2 = \overline{z}$ is (are)		**4)**	18	

1) P – 1, Q – 4, R – 2, S – 3   **2)** P – 2, Q – 4, R – 3, S – 1

3) P – 2, Q – 3, R – 2, S – 1   **4)** P – 4, Q – 3, R – 1, S – 2

8. For $x \in R, x \neq -1$ if $(1+x)^{2016} + x(1+x)^{2015} + x^2(1+x)^{2014} + \ldots + x^{2016} = \displaystyle\sum_{i=0}^{2016} a_i x^i$ then $a_{17} =$

1) $\dfrac{\lfloor 2017}{\lfloor 17 \lfloor 2000}$ **2)** $\dfrac{\lfloor 2016}{\lfloor 16}$ **3)** $\dfrac{\lfloor 2016}{\lfloor 17 \lfloor 1999}$ **4)** $\dfrac{\lfloor 2017}{\lfloor 2000}$

9. The co-ordinate of the focus of the parabola described parametrically by $x = 5t^2 + 2$, $y = 10t + 4$ is

1) (3, 4)   **2)** (7, 4)   **3)** (4, 2)   **4)** (2, 9)

10. If coefficient of $x^2 y^3 z^4$ in $\left(x+y+z\right)^n$ is A, (where $A \neq 0$, $n \in N$) then coefficient of $x^4 y^4 z$ is

    1) 2A   **2)** $\dfrac{nA}{2}$ **3)** $\dfrac{A}{2}$ **4)** nA

11. Statement 1: $\displaystyle\sum_{k=1}^{\infty} \dfrac{6^k}{\left(3^k - 2^k\right)\left(3^{k+1} - 2^{k+1}\right)} = 2$

    Statement 2: $\displaystyle\sum_{k=1}^{n} \left(k^3 - \left(k-1\right)^3\right) = n^3$ for any natural number n

    1) Both statement 1 and statement 2 are true

    2) Both statement 1 and statement 2 are false

    3) Statement 1 is true, Statement 2 is false

    4) Statement 1 is false, Statement 2 is true

12. Let R_1 and R_2 be two relations defined on $\mathbb{R}$ by $aR_1b \Leftrightarrow ab \geq 0$ and $aR_2b \Leftrightarrow a \geq b$. Then

    1) R_1 is an equivalence relation but not R_2

    2) R_2 is an equivalence relation but not R_1

    3) Both R_1 and R_2 are equivalence relations

    4) Neither R_1 nor R_2 is an equivalence relation

13. Let (2, 3) be the focus of a parabola and $x + y = 0$ and $x - y = 0$ be its two tangents, then equation of its directrix will be

    1) $2x - 3y = 0$ **2)** $3x + 4y = 0$ **3)** $x + y = 5$ **4)** $12x - 5y + 1 = 0$

14. The solution of the differential equation $\left(1 - xy - x^5 y^5\right)dx - x^2\left(x^4 y^4 + 1\right)dy = 0$ given by (c is arbitary constant)

    1) $x = ce^{xy + \frac{1}{5}x^5 y^5}$ **2)** $x = ce^{xy - \frac{1}{5}x^5 y^5}$ **3)** $x = ce^{x^2 y^2 + \frac{1}{5}x^5 y^5}$ **4)** $x = ce^{x^2 y^2 - \frac{1}{5}x^5 y^5}$

15. Let $I_1 = \int_0^x e^{tx} \cdot e^{-t^2} dt$ and $I_2 = \int_0^x e^{-t^2/4} dt$ where x > 0 then the value of $\dfrac{I_1}{I_2}$ is

1) $e^{-x^2/2}$ 2) $e^{x^2/4}$ 3) $e^{-x^2/4}$ 4) $e^{x^2/2}$

16. Let the foci of the Ellipse $\dfrac{x^2}{16} + \dfrac{y^2}{7} = 1$ and Hyperbola $\dfrac{x^2}{144} - \dfrac{y^2}{\alpha} = \dfrac{1}{25}$ coincide. then the length

of the latus rectum of the Hyperbola is:-

1) $\dfrac{32}{9}$ 2) $\dfrac{27}{10}$ 3) $\dfrac{18}{5}$ 4) $\dfrac{27}{4}$

17. An ellipse $E : \dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} = 1, (a < b)$ passes through the vertices of the hyperbola

$H : \dfrac{x^2}{49} - \dfrac{y^2}{64} = -1$. Let the major and minor axes of the ellipse E coincide with the transverse

and conjugate axes of the hyperbola H. Let the product of the eccentricities of E and H be $\dfrac{1}{2}$.

If l is the length of the latus rectum of the ellipse E, then the value of 113l is equal to

1) 1556   2) 1552   3) 1662   4) 776

18. The mean and standard deviation of the marks of 200 candidates were found to be 40 and 15 respectively. Later, it was discovered that one of student marks 40 was wrongly read as 50. The correct mean and standard deviation, respectively are

1) 14.98, 39.95   2) 39.95, 14.98   3) 39.95, 224.5   4) 39.00, 14.00

19. If $\{a_i\}_{i=1}^n$ where n is an even integer is an arithmetic progression with common difference 1,

and $\sum_{i=1}^n a_i = 192$, $\sum_{i=1}^{n/2} a_{2i} = 120$ then n is equal to

1) 48   2) 96   3) 92   4) 104

20. If the circle $C_1 = x^2 + y^2 = 16$ intersects another circle C_2 of radius 5, in such a manner that the common chord is of maximum length and has a slope equal to 3/4 then one of the co-ordinates of the centre of C_2 are

1) $\left(\dfrac{9}{5}, \dfrac{12}{5}\right)$ 2) $\left(\dfrac{9}{5}, \dfrac{-12}{5}\right)$ 3) $\left(\dfrac{12}{5}, \dfrac{9}{5}\right)$ 4) $\left(\dfrac{12}{5}, \dfrac{-9}{5}\right)$

SECTION-II (NUMERICAL VALUE TYPE)

21. Two cards are drawn at random from a pack of 52 playing cards. If the odds against of the event that one card is heart and other is an ace are n:1 then n =

22. Let S be the region bounded by the curves $y = x^3$ and $y^2 = x$. The curve $y = 2|x|$ divides S into two regions of areas R_1 and R_2. If $\max\{R_1, R_2\} = R_2$, then $\dfrac{R_2}{R_1} =$

23. If the sum of the squares of the reciprocals of the roots α and β of the equation $3x^2 + \lambda x - 1 = 0$ is 15, then $6\left(\alpha^3 + \beta^3\right)^2 =$

24. If $I = \int (x^2 + 1)\left((x+1)e^x\right)^2 dx = A\left(f(x)\right)^2 + C$, where C is constant of integration and $f(-1) = \dfrac{2}{e}$, then $2A + f(0)$ is

25. The number of ways of arrangement of 5 letters of the word "IITJEE" 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. **Assertion (A):** A non-polar material do not have any permanent electric dipole moment, but when placed in external electric field it develops electric dipole moment.

    Reason (R): when a non-polar material is placed in an electric field, the centre of the positive charge distribution of its individual atom or molecule does not coincide with the centre of the negative charge distribution.

    In the light of above statements, choose the most appropriate 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 and R is not the correct explanation of A

    3) A is correct but R is not correct.

    4) A is not correct but R is correct

27. In a cuboid of dimensions $2L \times 2L \times L$, a tiny ball having charge q is placed at the centre of the face having area $4L^2$. The flux through a face having area $2L^2$ is

    1) $\dfrac{q}{12\varepsilon_0}$ **2)** $\dfrac{q}{3\varepsilon_0}$ **3)** $\dfrac{q}{2\varepsilon_0}$ **4)** $\dfrac{q}{6\varepsilon_0}$

28. An insulating solid sphere of radius R has a uniform positive charge density ρ. As a result of this uniform charge distribution there is a finite value of electric potential at the centre of the sphere, at the surface of the sphere and also at a point outside the sphere. The electric potential at infinity is zero

    Statement 1: Potential decreases uniformly from the centre to the surface of the sphere

   **Statement 2:** The magnitude of electric field at a distance r (r < R) from the centre of the sphere is $\dfrac{\rho r}{3 \in_0}$.

1) Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation of Statement 1

2) Statement 1 is true, Statement 2 is true, Statement 2 is not the correct explanation of statement 1

3) Statement 1 is true Statement 2 is false

4) Statement 1 is false Statement 2 is true

29. A 6 volt battery is connected to the terminals of a three metre long wire of uniform thickness and resistance of 100 ohm. The difference of potential between two points on the wire separated by a distance of 50 cm will be

1) 2 volt   **2)** 3 volt   **3)** 1 volt   **4)** 1.5 volt

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

Assertion (A): In a static magnetic field, the velocity of a charged particle changes only in direction.

Reason (R): Moving charged particle experiences magnetic force which is perpendicular to its direction of velocity

1) Both A and R are true and R is the correct explanation of A

2) Both A and R are true 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

31. A proton, a deuteron and an α particle with the same KE enter in a region of uniform magnetic field, moving at right angles to magnetic field. What is the ratio of the radii of their circular paths?

1) $1: \sqrt{2} :1$ **2)** $1: \sqrt{2} : \sqrt{2}$ **3)** $\sqrt{2} :1:1$ **4)** $\sqrt{2} : \sqrt{2} :1$

32. A bar magnet of dipole moment 10^4 JT^{-1} is free to rotate in a horizontal plane. A horizontal magnetic field 4×10^{-5} T exists in the space. Find the work done in rotating the magnet slowly from a direction parallel to the field to a direction 60^0 from the field

1) 0.1J   **2)** 0.2J   **3)** 0.4J   **4)** 0.5J

33. A conducting rod of resistance r moves uniformly with a constant speed v. If the rod keeps moving uniformly, then the amount of force required is ___
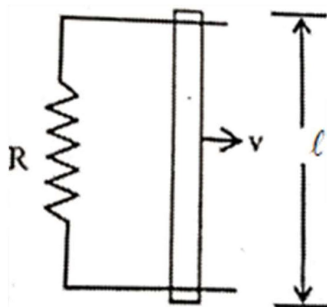
1) $\dfrac{vB^2 \ell^2}{R}$ **2)** $\dfrac{2vB^2 \ell^2}{(R+r)}$ **3)** $\dfrac{vB^2 \ell^2}{(R+r)}$ **4)** zero

34. Given below are two statements:

Statement I: An AC circuit undergoes electrical resonance if it contains both capacitor as well as inductor.

Statement II: If a pure inductor is connected across alternating voltage source then instantaneous voltage (v), instantaneous current (i) and inductive reactance $\left(x_L \right)$ are related

as $i = \dfrac{v}{X_L}$

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

1) Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation of Statement 1

2) Statement 1 is true, Statement 2 is true, Statement 2 is not the correct explanation of statement 1

3) Statement 1 is true Statement 2 is false

4) Statement 1 is false Statement 2 is true

35. Match List – I with List – II

	List I		List II
A)	AC generator	I)	Detects the presence of current in the circuit
B)	Galvanometer	II)	Converts mechanical energy into electrical energy
C)	Transformer	III)	Works on the principle of mutual induction in AC circuits
D)	Zener Diode	IV)	Voltage regulator

Choose the correct answer from the options given below

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

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

36. Identify the correct statement(s) from the following descriptions of various properties of electromagnetic waves.

A. In a plane electromagnetic wave electric field and magnetic field must be perpendicular to each other and direction of propagation of wave should be along electric field or magnetic field

B. The energy in electromagnetic wave is divided equally between electric and magnetic fields

C. Both electric field and magnetic field are parallel to each other and perpendicular to the direction of propagation of wave

D. The electric field, magnetic field and direction of propagation of wave must be perpendicular to each other

E. The ratio of amplitude of electric field to the amplitude of magnetic field is equal to speed of light

Choose the most appropriate answer from the options given below

1) D only **2)** B, D and E only

3) B, C and E only **4)** A, B and E only

37. A virtual erect image by a diverging lens is represented by (u,v,f are object distance, image distance and focal length respectively)


1)

2)

3)

4)
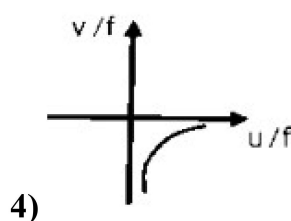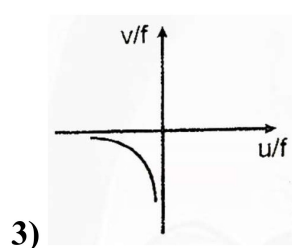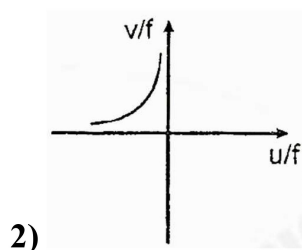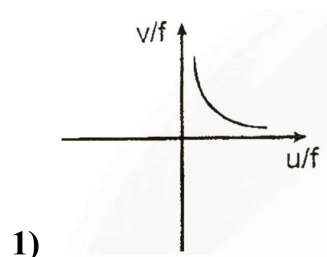
38. An air bubble in a glass slab of refractive index $\mu = 1.5$ when viewed from one side appears to be at 6cm and from opposite side at 4cm. Then the width of glass slab is

1) 10 cm   2) 15 cm   3) 18 cm   4) 20 cm

39. In a double-slit experiment, at a certain point on the screen the path difference between the two interfering waves having same intensity is $\frac{1}{4}th$ of their wavelength. The ratio of the intensity of light at that point to that at the centre of a bright fringe is

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

40. A metal plate of area $2 \times 10^{-4} m^2$ is illuminated by a radiation of intensity 8mW/m². The work function of the metal is 5eV. The energy of the incident photons is 10 eV and only 1% of it produces photo electrons. The number of emitted photo electrons per second and their maximum energy, respectively, will be [$1eV = 1.6 \times 10^{-19} J$]

1) 10^{14} and 10 eV   2) 10^{12} and 5 eV   3) 10^{11} and 5 eV   4) 10^{10} and 5 eV

41. According to Bohr model, magnetic field at centre (at the nucleus) of a hydrogen atom due to motion of electron in the nth orbit is proportional to

1) $1/n^3$ **2)** $1/n^5$ **3)** n^5 **4)** n^3

42. A heavy nucleus having mass number 200 gets disintegrated into two small fragments of mass number 80 and 120. If binding energy per nucleon for parent nucleus is 6.5 M eV and for daughter nuclei is 7 MeV and 8 MeV respectively, then the energy released in the decay will be

1) 200 MeV **2)** 240 MeV **3)** 220 MeV **4)** 180 MeV

43. Following circuit is equivalent to
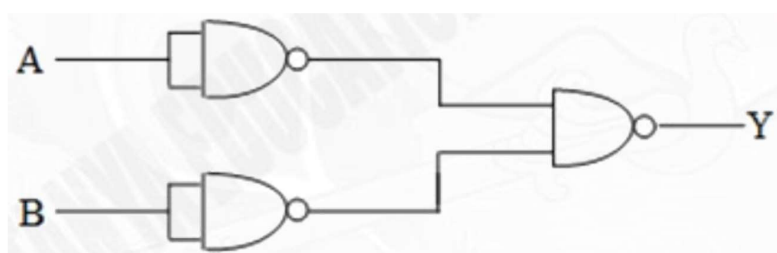
1) AND gate **2)** OR gate **3)** NOT gate **4)** X-OR gate

44. A dipole P is released from rest from point O as shown in figure.
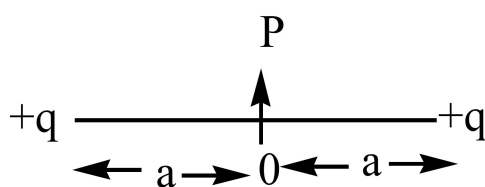
Then,

1) it will make SHM

2) it will move linearly along +ve y-direction

3) it will be in rotational and translational motion

4) it will be stationary

45. In the figure four identical plates 1, 2, 3 and 4 are placed at x = 0, d , 2d and 3d respectively. Graph shows variation of potential with position of plates. Capacitance of any one capacitor is C. Then equivalent capacitance between plates 1 and 3 is
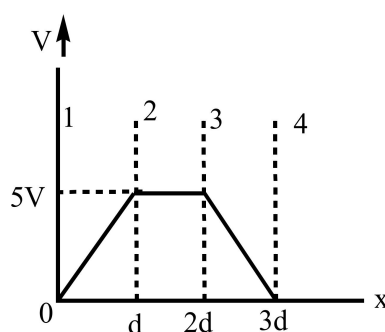
1) C/2   **2)** 3C   **3)** 3C/2   **4)** 2C

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 parallel plate capacitor with plate area A and plate separation d is filled with a dielectric material of dielectric constant K = 4. The thickness of the dielectric material is x, where

x < d

Let C_1 and C_2 be the capacitance of the system for $x = \dfrac{d}{4}$ and $x = \dfrac{d}{2}$, respectively. If $C_1 = 10\mu F$ the value of C_2 is _____ μF .

47. Resistances are connected in a meter bridge circuit as shown in the figure. The balancing length l_1 is 40 cm. Now an unknown resistance x is connected in series with Q and new balancing length is found to be 25 cm measured from the same end. Then the value of x will be _____ Ω
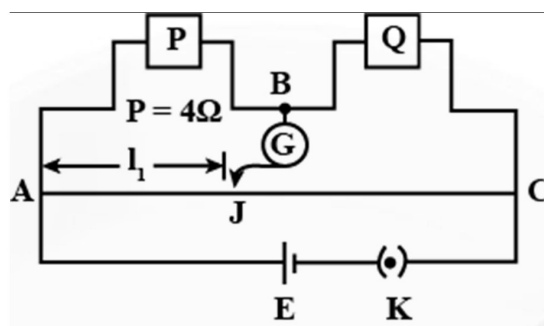
48. Amplitude of the electric field produced by the radiation coming from a 100W bulb at a distance of 3m is E. The amplitude of electric field produced by the radiation coming from 60 W at the same distance is $\sqrt{\dfrac{x}{5}}E$. Where the value of x = _____

49. A narrow beam of light is incident normally on a $30^o - 60^o - 90^o$ prism (near vertex A) whose one side is reflecting as shown in the figure. Refractive index of material of prism is $\mu = 2.2$. The total deviation of the beam when it comes out of the prism is $n \times 36^o$. Find n

Incident
beam direction
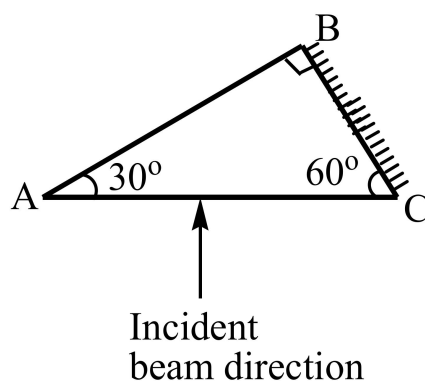
50. There are 16 nodes on a circle. Each node is connected with every other node by a resistance R. Equivalent resistance between any two consecutive nodes is $\dfrac{R}{n}$. Find n

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. Incorrect statement is

1) In carboxylic acids, the bonds to the carboxyl carbon lie in one plane and are separated by about 120°.

2) The carboxylic carbon is less electrophilic than carbonyl carbon because of the resonance in carboxylic acid.

3) Aliphatic carboxylic acids upto nine carbon atoms are colorless liquids at room temperature with pleasant odours.

4) Most carboxylic acids exist as dimer in the vapour phase.

52. Match List I and List II

	List I		List II
A)	Glucose $+Br_2 / H_2O$	**P)**	Addition product forms
B)	Glucose + HCN	**Q)**	No reaction
C)	Glucose + $NaHSO_3$	**R)**	White PPt forms
D)	Glucose + $conHNO_3$	**S)**	Gluconic Acid
		T)	Product is optically active

1) $A \rightarrow S; B \rightarrow Q; C \rightarrow R; D \rightarrow T$

2) $A \rightarrow S,T; B \rightarrow P,T; C \rightarrow Q; D \rightarrow T$

3) $A \rightarrow T; B \rightarrow P,T; C \rightarrow Q; D \rightarrow S,T$

4) $A \rightarrow P,S,T; B \rightarrow P,T; C \rightarrow Q; D \rightarrow T$

53. Incorrect statements from following are?

A) Crystal field theory failed to explain strength of ligands

B) Valence bond theory fails to explain colour and kinetic stability of complexes

C) Both $\left[Ni(CN)_4 \right]^{-2}$ and $\left[Ni(CO)_4 \right]$ are square planar complexes and diamagnetic

D) Both $\left[PtCl_2Br_2 \right]^{-2}$ and $\left[NiCl_2Br_2 \right]^{-2}$ show geometrical isomerism

1) A & B only   **2)** C & D Only   **3)** C Only   **4)** A, C & D

54. Correct electron gain enthalpy order is
   1) Ne > S > F > Cl   2) He > Ne > Ar = Kr > Xe
   3) O > S > Ne > He   4) Ne > S > Cl > F

55. Lead sulphate is soluble in ammonium acetate solution due to the formation of
   1) Ammonium tetraacetoplumbate (II)
   2) Ammonium hexaacetoplumbate (II)
   3) Ammonium tetrahydroxyplumbate (II)
   4) Ammonium hexahydroxyplumbate (II)

56. **Assertion (A):** HF has lower boiling point than HCl.
   Reason (R): In liquid state HF is associated through hydrogen bonding, but HCl molecules are associated through vander wall's forces
   1) Both A & R are correct and reason R is not correct explanation of A
   2) Both A & R are correct and reason R is correct explanation of A
   3) A is correct and R is not correct
   4) A is not correct and R is correct

57. Assertion (A): Alcohols react as both electrophiles and nucleophiles.
   Reason (R): Alcohol (R – OH) reacts with $R'MgX$ to produce $R - R'$.
   1) Both A & R are correct and reason R is not correct explanation of A
   2) Both A & R are correct and reason R is correct explanation of A
   3) A is correct and R is not correct
   4) A is not correct and R is correct

58.

$$\text{(ketone)} \xrightarrow[NaCN]{HCN} A \xrightarrow{H_3O^+} B \xrightarrow[then\,H_2O]{LAH} C$$
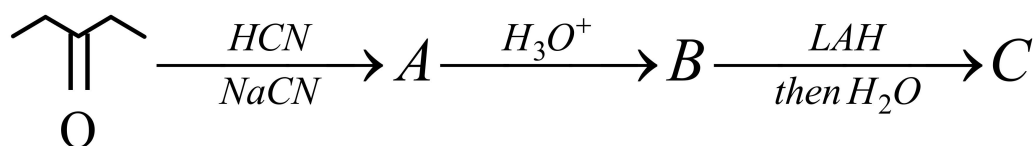
Correct statement(s) about C is/are
A) dihydric alcohol   B) $\alpha-$hydroxy acid
C) Vicinal diol   D) Optically active

1) C only   2) A & C only   3) A, C & D   4) B & D

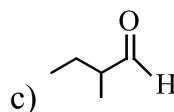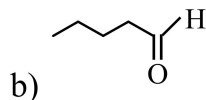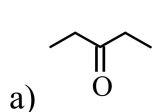**59.** Decreasing order of reactivity of the following compounds for SN^1 Substitution is?

a) (benzyl chloride, Cl)   b) (isopropyl chloride, Cl)   c) (4-tert-butyl chlorobenzene, Cl)   d) (4-methyl benzyl chloride, Cl, CH_3)

1) c > d > a > b   **2)** d > a > b > c   **3)** c > b > a > d   **4)** d > c > a > b
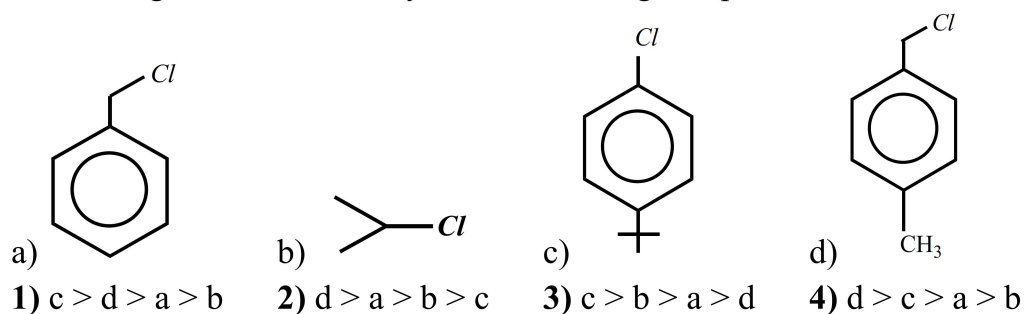
60. Incorrect reaction is?

1) (chloro-nitrobenzene) $\xrightarrow[\Delta]{NH_3}$ (amino-nitrobenzene)

2) (phenol, OH) $\xrightarrow{Br_2 / H_2O}$ (2,4,6-tribromophenol, OH, Br, Br, Br)

3) (aniline, NH_2) $\xrightarrow[AlCl_3]{CH_3 - I}$ (4-methyl aniline, NH_2, CH_3)

4) (aniline, NH_2) $\xrightarrow[Py]{2CH_3 - I}$ (N,N-dimethyl aniline, $H_3C-N-CH_3$)
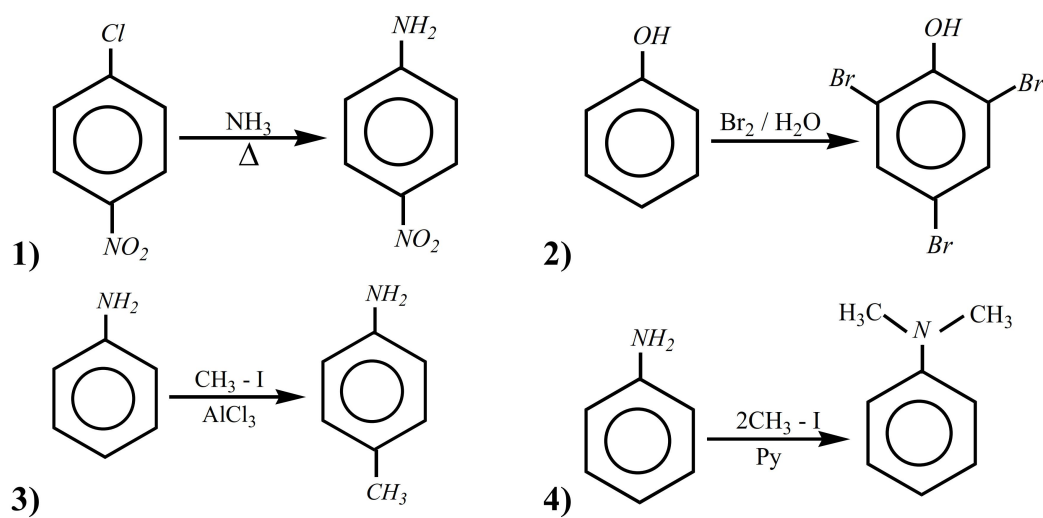
61. Incorrect boiling point order is?

1) $OH > CH_3 - O - CH_3 > CH_3 - CH_2 - CH_3$

2) $NH_2 > \text{NH-CH}_3 > N$

3) $OH > \overset{O}{\underset{\|}{C}} > O > O$

4) $OH < \underset{OH}{} > OH$
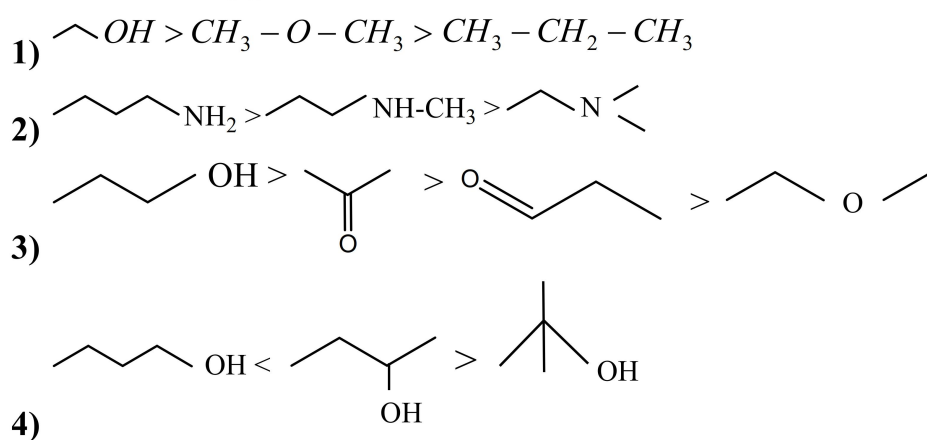
62. Correct reactivity order towards RMgCl is ?

a) (structure: CH₃-CO-CH₂CH₃ ketone with O)   b) (structure: CH₃CH₂CH₂-CHO aldehyde with O, H)   c) (structure: aldehyde CH₃CH₂-CH(CH₃)-CHO with O, H)

1) a > b > c   **2)** c > b > a   **3)** b > a > c   **4)** b > c > a

63. The maximum number of possible oxidation states of actinoides are shown by?

1) Bk and Cf   **2)** No and Lr   **3)** Ac and Th   **4)** Np and Pu

64. $MnO_2 \xrightarrow[KNO_3 \,/\, air]{fused \; KOH} x \xrightarrow{H^+} y + z + H_2O$
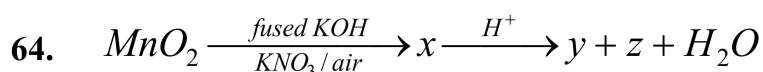
If x, y and z are Mn containing compounds and oxidation state of Mn in y is more than O.St. of Mn in Z then incorrect statements about x, y and z is/are

i) Both x & y are colourd due to d-d transition

ii) When y is heated at 513K then x and z are formed

iii) y is not very soluble in H_2O

iv) Both x & y are tetrahedral

1) i & iii   **2)** i & ii   **3)** i only   **4)** ii & iv

65.

$\text{(benzene)} \xrightarrow[con\,H_2SO_4]{con\,HNO_3} X \xrightarrow{Fe-HCl} Y \xrightarrow{NaNO_2-dil\,HCl,0^oC} Z \xrightarrow[\Delta]{H_2O} P \xrightarrow{aq\,NaOH} Q \xrightarrow{CH_3-I} R$
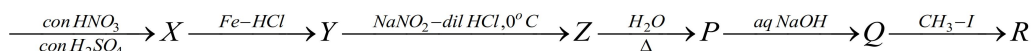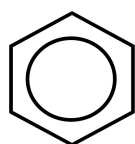
R is

1) Anisole   **2)** Phenol   **3)** Alcohol   **4)** Toludine

66. Incorrect combination is?

α-Amino acid	One letter symbol
A) Histidine	H
B) Phenylalanine	F
C) Lysine	K
D) Tyrosine	W

1) A   **2)** B   **3)** C   **4)** D

67. $x\left(C_7H_{12}\right) \xrightarrow{O_3} \xrightarrow{Zn-H_2O} A$

$A \xrightarrow[\Delta]{aq\ NaOH}$

Then x is?

1)   2)   3)   4)
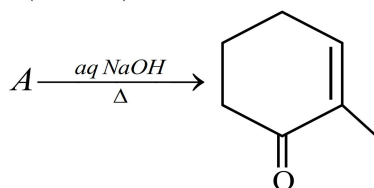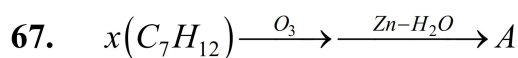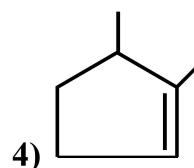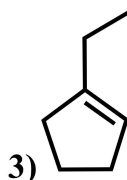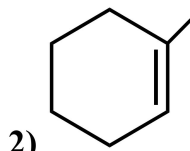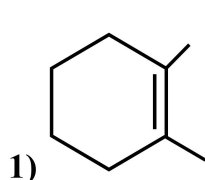
68. Gabriel phthalimide synthesis is not applicable for?

1)

2)

3)

4) $CH_3 - NH_2$
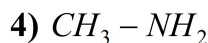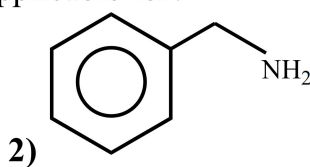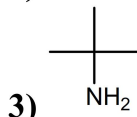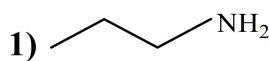
69. A sample of sea water was found to contain 9.5% w/w of $MgCl_2$ and 5.85 % w/w of NaCl (Assuming complete ionization of salts) What will be the boiling point of sample? (K_b for water = 0.52 k-Kg/mol, At. Wt of Mg = 24, Na = 23, Cl = 35.5)

1) $102.6^{o}C$ 2) $103.07^{o}C$ 3) $101.04^{o}C$ 4) $100.52^{o}C$

70. Electrolysis of aqueous $CuSO_4$ (0.1 M) was carried out is two cells I and II. In I, the electrodes are of Cu and is II they were of Pt. As the electrolysis proceeds pH of the electrolyte solution will
1) decrease is II and remain the same in I
2) remain the same in both I and II
3) increase in both I and II
4) increase in I and decrease is II

<div align="center">

SECTION-II (NUMERICAL VALUE TYPE)

</div>

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. How many ketones with molecular formula $C_5H_{10}O$ give racemic mixture with $LiAlH_4 / H_2O$

72. The rate constant value for the decay of radioactive isotopes X and Y, used in radio-medicine are $0.05 hr^{-1}$ and $0.025 hr^{-1}$ respectively. In a hospital at a time 't_0' the activity of sample X was found to be twice that of Y. (Activity = no. of disintegrations / sec). The activities of the two radioisotopes will be approximately equal when the time elapsed is _____ hour (Round off to nearest integer). (use ln 2=0.7)

73. Concentration of K^+ ions inside a biological cell was found to be 25 times higher than that outside. The magnitude of the potential difference between the two sides of the cell in close to ___mV (nearest integer) ($2.303 \dfrac{RT}{F} = 59 mV$, log5=0.7) (difference in concentration of other ions can be taken as negligible).

74. How many of the following statements are incorrect?
    I) Sea water freezes at a lower temperature than pure water
    II) Boiling point of sea water increases as it evaporates
    III) Sea water boils at a lower temperature than fresh water
    IV) Density of sea water at STP is same as that of fresh water
    V) Half life is 50% of the total time taken for the completion of a reaction.
    VI) Collision frequency (Z), which is the number of collisions per second per unit volume, is same as the rate constant of the reaction
    VII) A change in the activation energy of a reaction at a particular temperature will result in a proportional change in the rate and rate constant of the reaction at the same temperature.
    VIII) All first order reactions are not unimolecular
    IX) For a zero order reaction, slope of a plot of $t_{1/2}$ vs initial concentration will be zero.

75. In a saturated solution of AgBr($K_{sp} = 2 \times 10^{-13}$), If 10^{-7} moles of $AgNO_3$ are added to 1litre of this solution, find specific conductance of this solution in terms of $10^{-7} S - m^{-1}$ units.

    Given: $\lambda^o_{(Ag^+)} = 6 \times 10^{-3} S - m^2 / mol$

    $\lambda^o_{(NO_3^-)} = 7 \times 10^- S - m^2 / mol$

    $\lambda^o_{(Br^-)} = 8 \times 10^{-3} S - m^2 / mol$

ANSWER KEY

MATHEMATICS

1	**4**	2	**4**	3	**4**	4	**2**	5	**3**
6	**1**	7	**2**	8	**1**	9	**2**	10	**3**
11	**1**	12	**4**	13	**1**	14	**1**	15	**2**
16	**2**	17	**2**	18	**2**	19	**2**	20	**2**
21	**25**	22	**19**	23	**24**	24	**2**	25	**180**

PHYSICS

26	**1**	27	**1**	28	**4**	29	**3**	30	**1**
31	**1**	32	**2**	33	**3**	34	**3**	35	**2**
36	**2**	37	**1**	38	**2**	39	**2**	40	**4**
41	**2**	42	**3**	43	**2**	44	**2**	45	**4**
49	**13**	47	**6**	48	**3**	49	**5**	50	**8**

CHEMISTRY

51	**3**	52	**2**	53	**2**	54	**1**	55	**1**
56	**4**	57	**3**	58	**2**	59	**2**	60	**3**
61	**4**	62	**4**	63	**4**	64	**3**	65	**1**
66	**4**	67	**3**	68	**3**	69	**2**	70	**1**
71	**2**	72	**28**	73	**83**	74	**6**	75	**69**

1. $\dfrac{\pi}{4}ab - \dfrac{1}{2}ab$

   where a, b are length of semi minor and major axis.

2. $A = \left\{ z \in C : 1 \le \left| z - (1+i) \right| \le 2 \right\}$
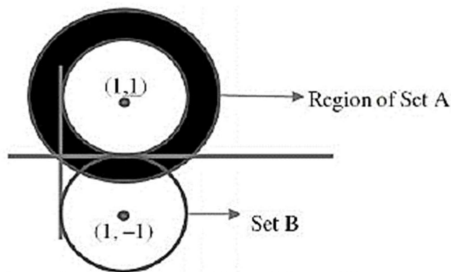
   $B = \left\{ z \in A : \left| z - (1-i) \right| = 1 \right\}$ $A \cap B$ has infinite set.

3. $-6 \le x \le -4$, $x = 3$ & $|x| \le \dfrac{7+\sqrt{13}}{2} \Rightarrow x = -5, -4, 3$

4. $\displaystyle \int \dfrac{6x^{10}+4}{x^5\sqrt{x^6-3-x^{-4}}}\,dx = \int \dfrac{6x^5+4x^{-5}}{\sqrt{x^6-3-x^{-4}}}\,dx$

   $x^6 - 3 - x^{-4} = t$ $\left(6x^5 + 4x^{-5}\right)dx = dt$

5. $I = \displaystyle\int_{-2}^{2}(-x)^3 \ln\left(\dfrac{15^x + 5^x + 3^x + 1^x}{15^x}\right)dx$ $2I = \displaystyle\int_{-2}^{2} x^4 \ln 15\, dx$

6. $x^2 + y^2 + Ax + By + C = 0$

   is passing through (0, 6) $\Rightarrow 6B + C = -36$

   The tangent of the parabola $y = x^2$ at (2, 4) is

   $4x - y - 4 = 0$ ……. (1)

   The tangent of circle $x^2 + y^2 + Ax + By + C = 0$ at (2, 4) is

   $(4+A)x + (8+B)y + 2A + 4B + 2C = 0$ … (2)

   From Equation (1) and (2)

   $\dfrac{4+A}{4} = \dfrac{8+B}{-1} = \dfrac{2A+4B+2C}{-4}$

   $A + 4B = -36$ …..(3)

   $3A + 4B + 2C = -4$ …… (4)

   From equation (3) and (4) $A + C = 16$

7. A) Area of triangle $= \dfrac{\sqrt{3}}{4}|z|^2 = 16\sqrt{3}$ $|z| = 8$

   B) Required area $4 \times \dfrac{1}{2} \times 3^2$

C) $\left|z\right|-\dfrac{6}{\left|z\right|}\le 5$ $\left|z^2\right|-5\left|z\right|-6\le 0$ $\left|z\right|\le 6$

D) Conceptual

8. $\displaystyle\sum_{i=0}^{2016} a_i x^i = (1+x)^{2017} - x^{2017}$ $a_{17}=$coefficient of x^{17} in $(1+x)^{2017}$

9.   Equation of parabola $x = 5t^2 + 2$, $y = 10t + 4$

   $t^2 = \dfrac{x-2}{5}, t = \dfrac{y-4}{10}$ $\Rightarrow \dfrac{x-2}{5} = \left(\dfrac{y-4}{10}\right)^2$ $\Rightarrow (y-4)^2 = 20(x-2)$

   focus (7, 4)

10.   Since $x^2 y^3 z^4$ is occurring in the expansion of $(x+y+z)n$, so n should be 9 only.

   Now $A = \dfrac{9!}{2!\times 3!\times 4!} = 1260$

   Coefficient of $x^4 y^4 z = \dfrac{9!}{4!\times 4!} = 630 = \dfrac{A}{2}$

11. $\displaystyle\sum_{k=1}^{\infty} \dfrac{6^k}{\left(3^k - 2^k\right)\left(3^{k+1} - 2^{k+1}\right)} = \dfrac{1}{3}\sum_{k=1}^{\infty} \dfrac{\left(\dfrac{2}{3}\right)^k}{\left(1-\left(\dfrac{2}{3}\right)^k\right)\left(1-\left(\dfrac{2}{3}\right)^{k+1}\right)} = 2$

12.   a= 1, b = 0, c = -2 then transitive fails for R_1

13.   Mirror image of focus in the tangent of parabola lie on its directrix.

14.   The given equation is $dx - x(ydx + xdy) = x^5 y^4 (ydx + xdy)$

   $\Rightarrow \dfrac{dx}{x} = \left(1 + x^4 y^4\right)d(xy) \Rightarrow \ln x = xy + \dfrac{1}{5}x^5 y^5 + \ln c \Rightarrow x = ce^{xy+\frac{1}{5}x^5 y^5}$

15. $I_1 = \displaystyle\int_0^x e^{\frac{x^2}{4} - \left(t - \frac{x}{2}\right)^2} dt = e^{\frac{x^2}{4}} \int_{\frac{-x}{2}}^{x/2} e^{-z^2} dz$ $t - \dfrac{x}{2} = z$

   $= 2e^{x^2/4}\cdot \displaystyle\int_0^{x/2} e^{-z^2} dz$ $I_2 = \displaystyle\int_0^x e^{-\frac{t^2}{4}dt}$ Let $\dfrac{t}{2} = z$ $= \displaystyle\int_0^{x/2} e^{-z^2} \times 2dz$

16.   Foci of the Ellipse $= (\pm 3,0)$

   Foci of the Hyperbola $= \pm \dfrac{1}{5}\sqrt{144 + \alpha}$ $\therefore \alpha = 81$

   length of the latus rectum $= \dfrac{2b^2}{a} = \dfrac{27}{10}$

17.   Ellipse passes through $(0, \pm 8)$

   $b^2 = 64$ $e_E = \sqrt{1 - \dfrac{b^2}{a^2}}$, $e_H = \dfrac{\sqrt{113}}{8}$, $\lambda = \dfrac{2b^2}{a}$

18.   (2) Corrected $\displaystyle\sum x = 40 \times 200 - 50 + 40 = 7990$

$$\therefore \text{ Corrected } \bar{x} = 7990/200 = 39.95$$

$$\text{Incorrect } \sum x^2 = n\left[\sigma^2 + \bar{x}^2\right] = 200\left[15^2 + 40^2\right] = 365000$$

$$\text{Correct } \sum x^2 = 365000 - 2500 + 1600 = 364100$$

$$\therefore \text{ Corrected } \sigma = \sqrt{\frac{364100}{200} - (39.95)^2} = \sqrt{(1820.5 - 1596)} = \sqrt{224.5} = 14.98$$

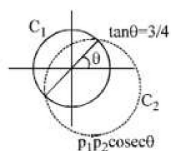19. $$\sum_{i=1}^{n} a_i = \frac{n}{2}\{2a_1 + (n+1)\} = 192 \quad \Rightarrow 2a_1 + (n-1) = \frac{384}{n} \ldots\ldots(1)$$

$$\sum_{i=1}^{n/2} a_{2i} = \frac{n}{4}\left[2a_1 + 2 + \left(\frac{n}{2} - 1\right)2\right] = 120$$

$$2a_1 + n = \frac{480}{n} \quad \ldots\ldots (2)$$

From equation (2) and (1)

$$1 = \frac{480}{n} - \frac{384}{n} \qquad n = 480 - 384 = 96$$

20. Equation of common chord is $y = \frac{3}{4}x \Rightarrow 3x - 4y = 0$

Family of circle $x^2 + y^2 - 4 + \lambda(3x - 4y) = 0$

Equate radius of this circle as 5

21. Heart and Not Ace = 12

Ace and Not Heart = 3

Ace and Heart = 1

$$P(E) = \frac{^{12}C_1 \cdot ^3C_1 + ^3C_1 \cdot ^1C_1 + ^{12}C_1 \cdot ^1C_1}{^{52}C_2} = \frac{1}{26}$$

22.
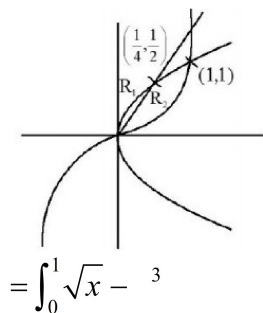
$$= \int_0^1 \sqrt{x} - \ ^3$$

$$= \left[\frac{2x^{3/2}}{3} - \frac{x^4}{4} \right]_1^0 \quad = \frac{5}{12}$$

$$R_1 = \int_0^{1/4} \left(\sqrt{x} - 2x \right) dx$$

$$= \left[\frac{2x^{3/2}}{3} - x^2 \right]_0^{1/4} = \frac{1}{48}$$

$$\therefore R_2 = \frac{19}{48}$$

So, $\dfrac{R_2}{R_1} = 19$

23. Here $\alpha + \beta$ roots of equation

$$3x^2 + \lambda x - 1 = 0$$

$$\alpha + \beta = \frac{-\lambda}{3}, \quad \alpha\beta = \frac{-1}{3}$$

$$\frac{1}{\alpha^2} + \frac{1}{\beta^2} = \frac{(\alpha + \beta)^2 - 2\alpha\beta}{\alpha^2 \beta^2} = 15$$

$$\lambda^2 = 9$$

Now

$$6\left(\alpha^3 + \beta^3 \right)^2 = 6\left((\alpha + \beta)\left((\alpha + \beta)^2 - 3\alpha\beta \right) \right)^2$$

$$= 6\left(\frac{\lambda^2}{9} \right) \left\{ \frac{\lambda^2}{9} + 1 \right\}^2 = 24$$

24. $I = \int \left(x^2 + 1 \right) \left((x+1) e^x \right)^2 dx$

$$\left(x^2 + 1 \right) e^x = t$$

$$\Rightarrow (x+1)^2 e^x dx = dx$$

$$I = \frac{1}{2} \left(\left(x^2 + 1 \right) e^x \right)^2 + c$$

$$= \frac{1}{2} \left(f(x) \right)^2 + c$$

$$2A + f(0) = 1 + 1 = 2$$

25. Coefficient of x^5 in $5!\left(1 + x + \frac{x^2}{2} \right)^2 (1+x)^2$

PHYSICS

26. Both correct and correct explanation also.

27. $\phi = \left(\dfrac{q}{2 \in_0} - \dfrac{q}{6 \in_0} \right) \times \dfrac{1}{4} \quad = \dfrac{q}{12 \in_0}$

28. Statement 1 is wrong and statement 2 is correct

29. $V_{AB} = E$
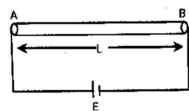
    $\therefore$ Potential gradient $K = \dfrac{V_{AB}}{L} = \dfrac{E}{L}$ $\quad \therefore$ Potential difference across length ℓ is $V = K\ell$

30. Both correct and correct explanation

31. $r_p = \dfrac{\sqrt{2m_p K}}{eB}$ $\qquad r_d = \dfrac{\sqrt{2(2m_p)K}}{eB}$ $\qquad r_a = \dfrac{\sqrt{2(4m_p)K}}{(2e)B}$

32. $W = MB(\cos 0^0 - \cos 60^0 = \dfrac{MB}{2}$

33. $F = l\,\ell\,B$ $\qquad\qquad = \dfrac{vB\ell}{(R+r)}\ell B \qquad\qquad = \dfrac{vB^2\ell^2}{(R+r)}$

34. Due to phase difference between voltage and current $i \neq \dfrac{\upsilon}{x_L}$

35. Zener diode is used as voltage regulator.

36. $\vec{E}, \vec{B}$ and $\vec{C}$ are mutually perpendicular.
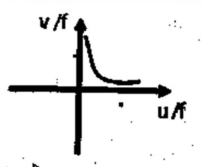
37.

38. $6 = \dfrac{x_1}{1.5}, 4 = \dfrac{x_2}{1.5} \qquad$ width $= x_1 + x_2$

39. $\Delta\phi = \dfrac{\pi}{2} \qquad \dfrac{I}{I_{max}} = \dfrac{I_0 + I_0}{4I_0} = \dfrac{1}{2}$

40. $P = IA = 8 \times 10^{-3} \times 2 \times 10^{-4} = 16 \times 10^{-7} W$

    Photons per sec $= \dfrac{P}{h\upsilon} = \dfrac{16 \times 10^{-7}}{10 \times 1.6 \times 10^{-19}} = 10^{12}$

    Photo electrons / sec $= 10^{12} \times \dfrac{1}{100} = 10^{10}$

41. $B = \dfrac{\mu_0 i}{2r}$; magnetic field at centre of hydrogen atom i.e. at nucleus.

    $i = \dfrac{e}{T} = ef = a\, z^2/n^3 \qquad r\, a\, n^2/Z, \qquad B\, a\, i/r\, a\, Z^3/n^5 \qquad B\, a\, 1/n^5$

42. Energy released $\qquad = (80 \times 7 + 120 \times 8 - 200 \times 6.5 = 220 MeV)$

43. $Y = \overline{\overline{A}.\overline{B}} = A + B$ i.e. OR gate

44. E will be maximum at $y = \pm \dfrac{a}{\sqrt{2}}$ $U = -\vec{P}.\vec{E}$ is min at this location.
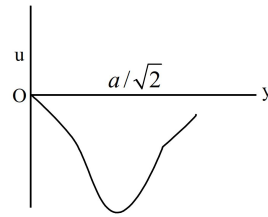
So, $y = +a/\sqrt{2}$ is stable equilibrium

Since dipole was released from O so it will continue upto ∞ (conservation of energy).

45.
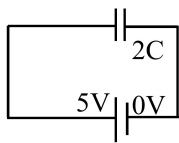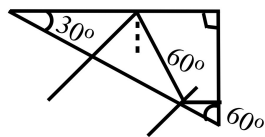

46. $C_1 = \dfrac{\in_0 A}{\dfrac{d}{4K} + \dfrac{3d}{4}} = \dfrac{\in_0 A}{\dfrac{13}{16}d}$ $C_2 = \dfrac{\in_0 A}{\dfrac{d}{2K} + \dfrac{d}{2}} = \dfrac{\in_0 A}{\dfrac{5d}{8}}$ $\Rightarrow \dfrac{C_2}{C_1} = \dfrac{13}{10}$

47. $\dfrac{4}{Q} = \dfrac{40}{60} \Rightarrow Q = 6$ $\dfrac{4}{6+x} = \dfrac{25}{75} \Rightarrow x = 6$

48. $I = \dfrac{P}{4\pi r^2} = \dfrac{1}{2} \in_0 CE_0^2$

49. Beam is incident normally on reflecting surface. So it will retrace the path.

$\theta_c = \sin^{-1}\dfrac{1}{2.2}$ $\Rightarrow \theta_c < 30^o$

$\therefore$ Deviation $= 180^o$ $= 5 \times 36^o$

50. All other 14 points are at same potential
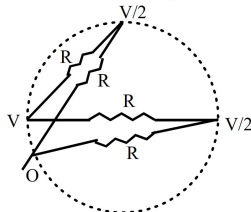
$\dfrac{1}{\text{Re}q} = \dfrac{1}{2R} + \dfrac{1}{2R} + ... + \dfrac{1}{R}$

$\underbrace{}_{14\ terms}$

$\Rightarrow R_{eq} = \dfrac{R}{8}$

CHEMISTRY

51. Aliphatic carboxylic acids upto nine carbon atoms are colorless liquids at room temperature with unpleasant odours.

52. $NaHSO_3$ does not react with glucose

53. $Ni(CO)_4$ - Tetrahedral

$[NiCl_2Br_2]^{-2}$ - Can't show G.I

54. $S = -200$
$F = -333$
$Cl = -349$
Ne = +ve value

55. $PbSO_4 \xrightarrow{4CH_3COONH_4} [Pb(CH_3COO)_4]^{-2}$

56. HF has H.B but not HCl.

57. $R-OH \xrightarrow{RMgX} R-H$

58.

A= HO CN

B= HO COOH

C= HO OH
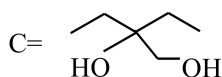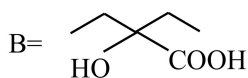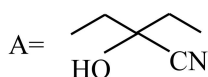
59. SN^1 rate $\propto C^+$ stability

60. 1) $ArSN^2$
3) Aniline does not undergo F.C alkylation

61. $1^o R-OH > 2^o R-OH > 3^o R-OH$
boiling point order

62. Aldehydes are more reactive than ketones

63. NP & PU Show +3 to +7

64. $x = K_2MnO_4$, $y = KMnO_4$, $z = MnO_2$

65.

X= NO₂   Y= NH₂   P= OH   R= OCH₃
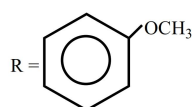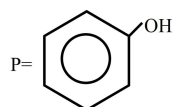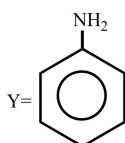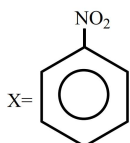
66. Tyrosine – Y

67.
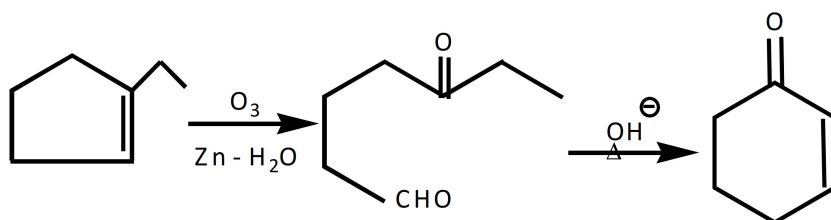
68. $3^o\, R-X$ Can't undergo G.T.S

69.   In 100gm solution

$n_{MgCl_2} = 0.1 \qquad n_{NaCl} = 0.1$
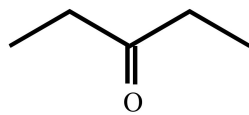
After dissociation total moles $= 0.1 \times 3 + 0.1 \times 2 \quad = 0.5$

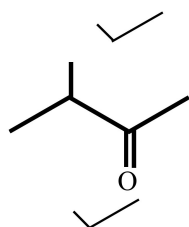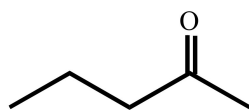$W_{water} = 100 - 9.5 - 5.85 \;\; = 84.65 \text{ gm}$

$\therefore \Delta T_b = 0.52 \times 0.5 \times \dfrac{1000}{84.65} \qquad = 3.07^o C \quad \therefore T_b = 103.07^o C$
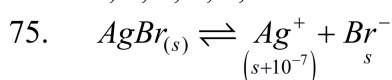
70.

71.

X

72.   28

73.   83

74.   3, 4, 5, 6, 7, 9

75. $AgBr_{(s)} \rightleftharpoons \underset{(s+10^{-7})}{Ag^+} + \underset{s}{Br^-}$

$s^2 + 10^{-7} s - 20 \times 10^{-14} = 0$

$s = \dfrac{-10^{-7} + \sqrt{10^{-14} + 80 \times 10^{-14}}}{2} = 4 \times 10^{-7}$

$\left[Ag^+ \right] = 5 \times 10^{-7} M$

$\left[Br^- \right] = 4 \times 10^{-7} M$

$\left[NO_3^- \right] = 1 \times 10^{-7} M$

$\wedge^o = \dfrac{K}{1000 C} \Rightarrow K^1_{Ag^+} = 6 \times 10^{-3} \times 1000 \times 5 \times 10^{-7}$

$= 30 \times 10^{-7} s - m^2 / mol$

$K^1_{NO_3^-} = 7 \times 1 \times 10^{-7} sm^2 / mol$

$K^1_{Br^-} = 8 \times 4 \times 15^7 sm^2 / mol \qquad = 32 \times 10^{-7}$

$K^1_{total} = 69 \times 10^{-7} sm^2 / mol$