JEE MAIN 2026

Sample Paper - 20

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. Each student in a class of 40, studies at least one of the subjects English, Mathematics and Economics. 16 study English, 22 Economics and 26 Mathematics, 5 study English and Economic, 14 Mathematics and Economics and 2 study all the three subjects. Then the number of students who study English and Mathematics but not Economics is

1) 7 **2)** 5 **3)** 10 **4)** 4

2. The maximum value of the function

$f(x)=\frac{\sin x}{\sqrt{1-\cos^2 x}}+\frac{\cos x}{\sqrt{1-\sin^2 x}}+\frac{\tan x}{\sqrt{\sec^2 x-1}}+\frac{\cot x}{\sqrt{\operatorname{cosec}^2 x-1}}$ wherever it is defined is k.

Then $|k|$ is

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

3. Let a complex number $z, |z|\neq 1$, satisfy $\log_{\sqrt{2}}\left(\frac{|z|+11}{(|z|-1)^2}\right)\geq 0$. Then, the largest value of $|z|$ is equal to

1) 5 **2)** 2 **3)** 0 **4)** 1

4. **Statement I**: If $a_1x^2+b_1x+c_1=0$ and $a_2x^2+b_2x+c_2=0$ $(a_1\neq 0, a_2\neq 0)$ have a common root. Then $(c_1a_2-c_2a_1)^2=(b_1c_2-b_2c_1)(a_1b_2-a_2b_1)$

Statement II: The quadratic equations $x^2-6x+a=0$ and $x^2-cx+6=0$ have one root in common. The other roots of the first and second equations are integers in the ratio 4:3, if the common root is α then α^3 is 8

1) Statement I is true and Statement II is true

2) Statement I is false and Statement II is true

3) Statement I is true and Statement II is false

4) Statement I is false and Statement II is false

5. If $A(-2,-1), B(-2,1), C(2,1)$ are the vertices of a triangle ABC, then the perpendicular distance from its circumcenter to the side BC is

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

6. If R is a relation defined by aRb *iff* $a \le b$ on $N \times N$, then which of the following is correct?

1) R is not a symmetric relation **2)** R is a symmetric relation

3) R is not a reflexive relation **4)** R is a equivalence relation

7. The letters of the word OUGHT are written in all possible ways and these words are arranged as in a dictionary, in a series. Then, the serial number of the word TOUGH is

1) 89 **2)** 100 **3)** 258 **4)** 237

8. If $\frac{dy}{dx} = \frac{2^{x+y} - 2^x}{2^y}, y(0) = 1$, then $y(1) =$

1) $\log_2(2+e)$ **2)** $\log_2(1+e)$ **3)** $\log_2(2e^3)$ **4)** $\log_2(1+e^2)$

9. If one of the diameters of the circle $x^2 + y^2 - 10x + 4y + 13 = 0$ is a chord of another circle C, whose center is (3,2), then the diameter of the circle C is:

1) $\sqrt{20}$ **2)** 4 **3)** 12 **4)** $6\sqrt{2}$

10. If the standard deviation of $a_1, a_2, a_3, \ldots a_{2025}$ is λ, then the value of standard deviation of $2a_1 - 1, 2a_2 - 1, 2a_3 - 1, \ldots 2a_{2025} - 1$ is

1) 3λ **2)** 2λ **3)** $\lambda - 1$ **4)** $2\lambda + 1$

11. If the lines $\frac{x-1}{2}=\frac{y-2}{3}=\frac{z-3}{\alpha}$ and $\frac{x-4}{5}=\frac{y-1}{2}=\frac{z}{\beta}$ intersect, then the absolute value of $(\beta-\alpha)$ is _____

1) 3 **2)** -3 **3)** 13 **4)** -13

12. If the ratio of the sum to n terms of two A.P.'s is $(5n+3):(3n+4)$ then the ratio of their 4^{th} terms is

1) $\frac{16}{23}$ **2)** $\frac{23}{16}$ **3)** $\frac{38}{25}$ **4)** $\frac{25}{38}$

13. If the vertex of a parabola is $(4,3)$ and its directrix is Y-axis, then the equation of latus rectum of the parabola is

1) $x=3$ **2)** $y=8$ **3)** $y=3$ **4)** $x=8$

14. Let $a_1=1,a_2,a_3,a_4.....$ be consecutive natural numbers. Then

$\tan^{-1}\left(\frac{1}{1+a_1a_2}\right)+\tan^{-1}\left(\frac{1}{1+a_2a_3}\right)+.....+\tan^{-1}\left(\frac{1}{1+a_{2024}a_{2025}}\right)$ is equal to

1) $\frac{\pi}{4}+\cot^{-1}(2025)$ **2)** $\tan^{-1}(2025)-\frac{\pi}{4}$

3) $\tan^{-1}(2024)-\frac{\pi}{4}$ **4)** $\frac{\pi}{4}-\tan^{-1}(2024)$

15. If $y=\frac{2}{\sqrt{a^2-b^2}}Tan^{-1}\left[\sqrt{\frac{a-b}{a+b}}\tan\frac{x}{2}\right],a,b>0,\ \left.\frac{dy}{dx}\right|_{x=\frac{\pi}{2}}=$

1) $\frac{1}{b}$ **2)** $\frac{1}{a}$ **3)** $\frac{2}{a}$ **4)** $\frac{2}{b}$

16. For $\lambda > 0$, let θ be the angle between the vectors $\mathbf{a} = \hat{i} + \lambda\hat{j} - 3\hat{k}$ and $\mathbf{b} = 3\hat{i} - \hat{j} + 2\hat{k}$. If the vectors $\mathbf{a}+\mathbf{b}$ and $\mathbf{a}-\mathbf{b}$ are mutually perpendicular, then the value of $(14\cos\theta)^2$ is equal to

1) 40 **2)** 100 **3)** 25 **4)** 20

17. Let two fair six-faced dice A and B be thrown simultaneously. If E_1 is the event that die A shows up four, E_2 is the event that die B shows up two, then which of the following statements is true?

1) E_1 and E_2 are exclusive **2)** E_2 and E_1 are exhaustive

3) E_1 and E_2 are dependent **4)** E_1, E_2 are independent

18. If $\int \frac{2x^{12}+5x^9}{\left(1+x^3+x^5\right)^3}dx = \frac{x^m}{\ell\left(1+x^3+x^5\right)^r} + C$ then $\frac{m+\ell}{r} =$

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

19. Let $f(x) = x^2+9, g(x) = \frac{x}{x-9}$ and $a^2 = fog(10), b^2 = gof(3)$. If e and l denote the eccentricity and the length of the latus rectum of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, then $8e^2+l^2$ is equal to

1) 16 **2)** 12 **3)** 6 **4)** 8

20. Match the following columns:

	Column I (A, B, C are matrices)		**Column - II**
a.	If $\lvert A_{3\times3}\rvert = 2$, then $\lvert 2A^{-1}\rvert =$	p.	1
b.	If $\lvert A_{3\times3}\rvert = 1/8$, then $\lvert adj(adj(2A))\rvert =$	q.	4
c.	If $(A+B)^2 = A^2+B^2$, and $\lvert A_{2\times2}\rvert = 2$, then $\lvert B_{2\times2}\rvert =$	r.	8
d.	$\lvert A_{2\times2}\rvert = 2, \lvert B_{3\times3}\rvert = 3$ and $\lvert C_{4\times4}\rvert = 4$, then $\lvert ABC\rvert$ is equal to	s.	0
		t.	Does not exist

1) a-q; b-p; c-s; d-t **2)** a-p; b-r; c-q; d-s

3) a-p; b-q; c-r; d-s **4)** a-s; b-q; c-r; d-p

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.

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21. Let L be a common tangent line to the curves $\frac{x^2}{9}+\frac{y^2}{4}=1$ and $x^2+y^2=\frac{31}{4}$. Then, the square of the slope of the line L is _____

22. If A and B are the two real values of k for which the system of equations $x+2y+z=1, x+3y+4z=k, x+5y+10z=k^2$ is consistent, then A^2+B^2 is_____

23. Let $f:(0,\pi)\to R$ be a function given by $f(x)=\begin{cases}\sin^2 x, & 0<x<\frac{\pi}{2}\\ a-8, & x=\frac{\pi}{2}\\ \left(1+|\cot x|\right)^{\frac{b}{a}|\tan x|}, & \frac{\pi}{2}<x<\pi\end{cases}$ where $a,b\in Z$. If f is continuous at $x=\pi/2$, then a^2+b^2 is equal to ____

24. If $\alpha=\lim\limits_{x\to 0^+}\left(\frac{e^{\sqrt{\tan x}}-e^{\sqrt{x}}}{\sqrt{\tan x}-\sqrt{x}}\right)$ and $\beta=\lim\limits_{x\to 0^+}(1+\sin x)^{\frac{1}{2}\cot x}$ are the roots of the quadratic equation $ax^2+bx-\sqrt{e}=0$, then $24\log_e(a+b)$ is equal to ____

25. If getting a head on a fair coin when it is tossed is considered as success, then the probability of having more number of failures when ten fair coins are tossed simultaneously is k, then $512k$ is _____

PHYSICS **Max Marks: 100**

SECTION-I (SINGLE CORRECT ANSWER TYPE)

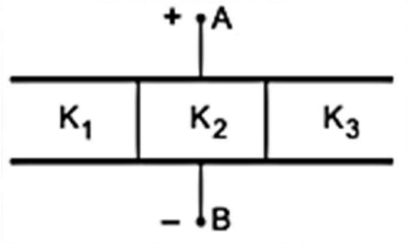
This section contains **20 Multiple Choice Questions.** Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

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

26. Two charged conducting spheres of radii a and b are connected to each other by a conducting wire. The ratio of charges of the two spheres respectively is:

1) $\frac{a}{b}$ **2)** $\frac{b}{a}$ **3) 1** **4)** ab

27. The space between the plates of a parallel plate capacitor of capacitance C is filled with three dielectric slabs of identical sizes as shown in figure. If the dielectric constants of the three slabs are K_1, K_2 *and* K_3 . Find the new capacitance.



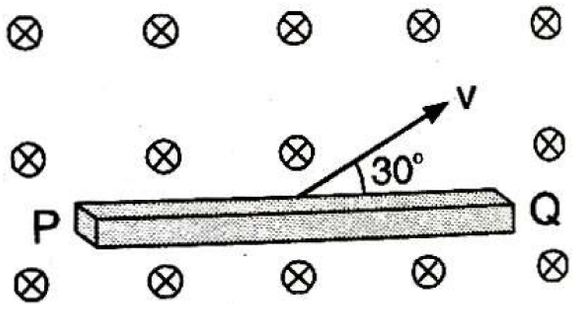
1) $\frac{C}{3}\left(K_1K_2 + K_2K_3 + K_3K_1\right)$ **2)** $\frac{C}{3}\left(\frac{1}{K_1} + \frac{1}{K_2} + \frac{1}{K_3}\right)$

3) $\frac{C}{3}\left(K_1K_2K_3\right)$ **4)** $\frac{C}{3}\left(K_1 + K_2 + K_3\right)$

28. In a meter bridge, a standard resistor of $R\Omega$ is connected in the left gap and the two wires A and B are connected one after the other in the right gap. The balancing length measured from the left is 50 cm for either of them. If the two wires are connected in series and put in the right gap, balancing length measured from left would be (in cm)

1) 1 **2)** 33.3 **3)** 55.7 **4)** 100

29. A conducting rod PQ of length $l = 2\,m$ is moving at a velocity $\upsilon = 8\ ms^{-1}$ making an angle 30^0 with its length. A uniform magnetic field $B = 3\ T$ exists in a direction perpendicular to the plane of motion. Then,



1) $V_P - V_Q = 49V$ **2)** $V_P - V_Q = 24V$

3) $V_Q - V_P = 49V$ **4)** $V_Q - V_P = 48V$

30. Assertion A : In series LCR circuit, resonance can take place.
Reason R : Resonance takes place if inductive and capacitive reactances are not equal.

1) A is false but R is true

2) A is true but R is false

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

4) Both A and R are true but R is NOT the correct explanation of A

31. Statement – I: Work done by friction on a body sliding down an inclined plane is always positive.
Statement – II: Work done is greater than zero, if angle between force and displacement is acute.

1) Both statement I and statement II are correct

2) Statement I is incorrect and statement II is correct

3) Statement I is correct and statement II is incorrect

4) Both statement I and statement II are incorrect

32. Assertion A: In case of bullet fired from a free gun, the ratio of kinetic energy of gun and bullet is equal to ratio of mass of bullet and gun

Reason R: In the above firing, total momentum of gun+bullet system remains conserved.

1) A is false but R is true

2) A is true but R is false

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

4) Both A and R are true but R is NOT the correct explanation of A

33. Two particles of mass M and 5M are released in free space with initial separation distance d between them. If they attract each other due to gravitational force only, then the ratio of distances covered by small mass to higher mass just before collision is

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

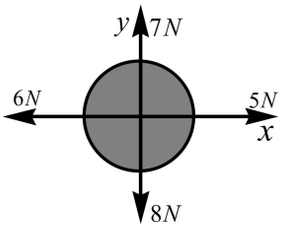
34. If F is force, V is velocity H is latent heat, and s is specific heat, then match the quantity given in Column I with the dimensions given in Column II.

Column – I		**Column – II**	
i.	F	**a.**	L^2T^{-2}
ii.	V	**b.**	$L^2T^{-2}K^{-1}$
iii.	H	**c.**	MLT^{-2}
iv.	s	**d.**	$L\,T^{-1}$

1) $i \to c, ii \to d, iii \to a, iv \to b$ **2)** $i \to a, ii \to b, iii \to c, iv \to d$

3) $i \to d, ii \to a, iii \to b, iv \to c$ **4)** $i \to c, ii \to a, iii \to b, iv \to d$

35. For a free body diagram shown in the figure, the four forces are applied in the 'x' and 'y' directions. What additional force must be applied and at what angle with positive $x-axis$ so that the net acceleration of body is zero?



1) $\frac{2}{\sqrt{3}}N, 30^0$ **2)** $\sqrt{2}N, 135^0$ **3)** $\sqrt{2}N, 45^0$ **4)** $2N, 45^0$

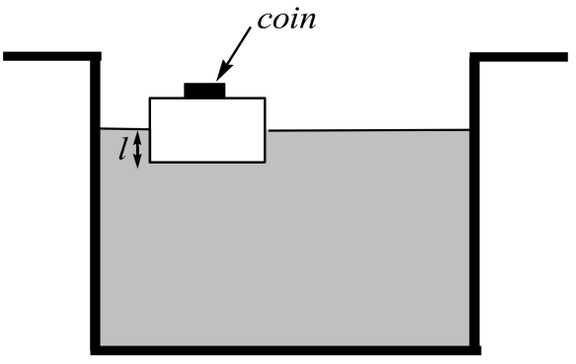
36. The kinetic energy needed to project a body of mass m from the earth's surface to infinity is (R is the radius of the earth)

1) $\frac{1}{4}mgR$ **2)** $\frac{1}{2}mgR$ **3)** mgR **4)** $2mgR$

37. Pressure inside a soap bubble is greater than the pressure outside by an amount:
(given : R= Radius of bubble, S= Surface tension of bubble)

1) $\frac{S}{R}$ **2)** $\frac{4S}{R}$ **3)** $\frac{3R}{S}$ **4)** $\frac{6R}{S}$

38. A wooden block, with a coin placed on its top, floats in water as shown in the figure. The distance l is shown here. After some time, the coin falls into the water. Then



1) l decreases **2)** l increases

3) l remains constant **4)** can not be said

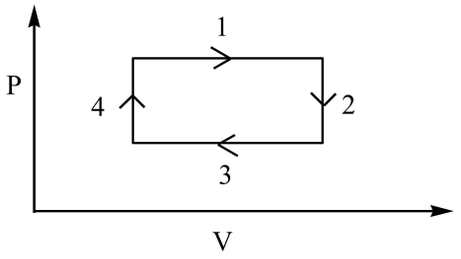
39. The Thermodynamic process, in which internal energy of the system remains constant is

1) Isothermal **2)** Adiabatic **3)** Isobaric **4)** Isochoric

40. The volume of an ideal gas $(\gamma = 1.5)$ is changed adiabatically from 5 litres to 4 litres. The ratio of initial pressure to final pressure is:

1) $\frac{4}{5}$ **2)** $\frac{8}{5\sqrt{5}}$ **3)** $\frac{2}{\sqrt{5}}$ **4)** $\frac{16}{25}$

41. An ideal gas undergoes a four step cycle as shown in the P-V diagram below. During this cycle, positive work is done by the gas in



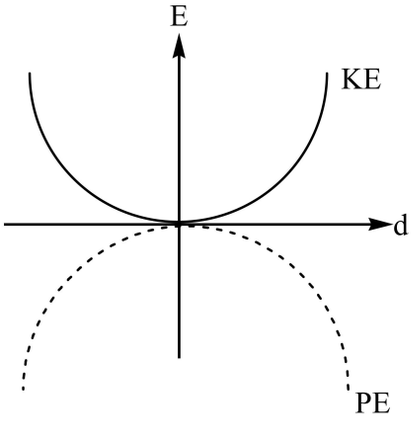
1) step 1 **2)** step 2 **3)** step 3 **4)** step 4

42. Statement – I : The formula connecting u, v and f for a spherical mirror is valid for mirrors whose sizes are very small compared to their radii of curvature.
Statement – II : Laws of reflection are strictly valid for plane surfaces, but not for large spherical surfaces.

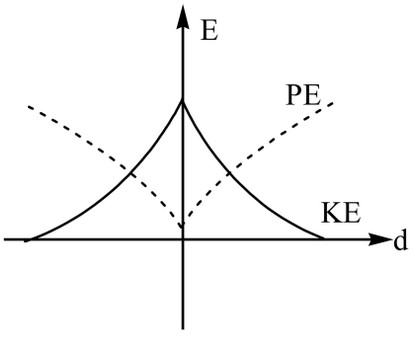
1) Statement I is correct and statement II are correct
2) Statement I is incorrect and statement II is correct
3) Statement I is correct and statement II is incorrect
4) Both statement I and statement II are incorrect

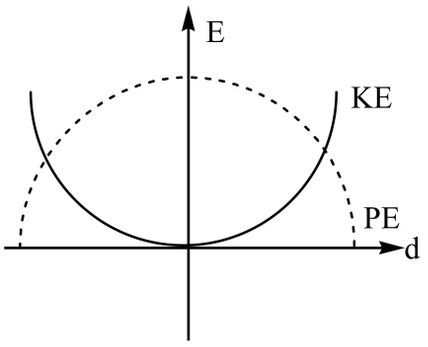
43. For a simple pendulum, a graph is plotted between its kinetic energy (KE) and potential energy (PE) against its displacement d. Which one of the following represents these correctly? (graphs are schematic and not drawn to scale)

1)

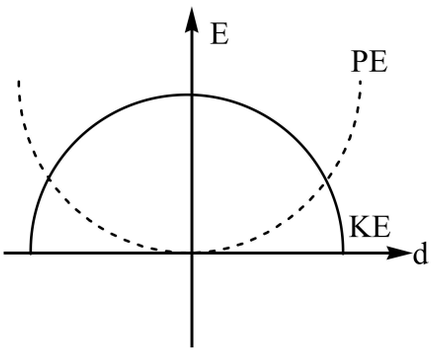


2)





3)



4)

44. A tuning fork A of unknown frequency produces 5 beats/s with a fork of known frequency 340 Hz. If frequency of fork A is lower than that of the other, what is the original frequency of fork A?

1) 335 Hz **2)** 338 Hz **3)** 345 Hz **4)** 342 Hz

45. A particle is travelling 4 times as fast as an electron. Assuming the ratio of de-Broglie wavelength of a particle to that of electron is 2:1, the mass of the particle is

1) 16 times the mass of e^- **2)** 8 times the mass of e^-

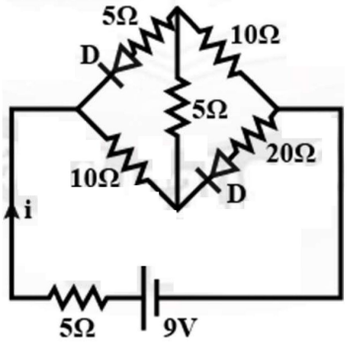
3) $\frac{1}{16}$ times the mass of e^- **4)** $\frac{1}{8}$ times the mass of e^-

SECTION-II (NUMERICAL VALUE TYPE)

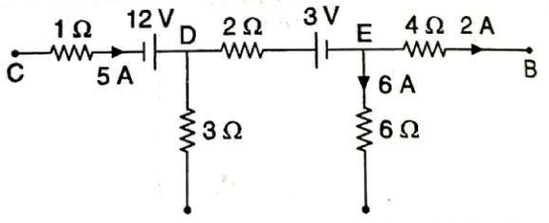
This section contains **5 Numerical Value Type Questions.** The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **Nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and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

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

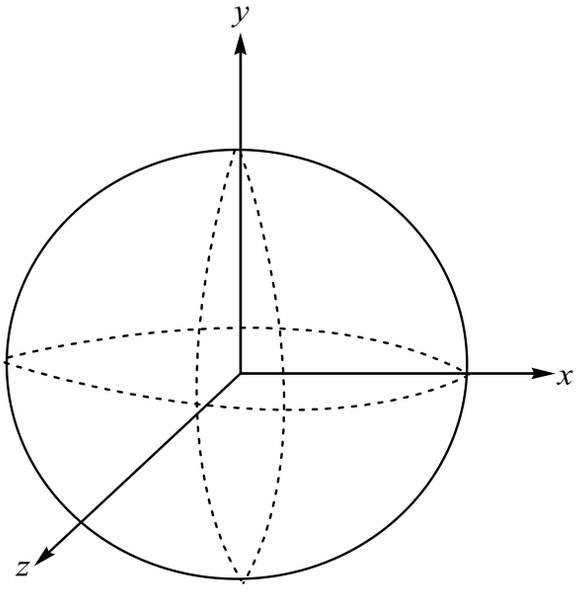
46. The current i in the network is_____$\times 10^{-1} A$



47. Figure shows part of a circuit. What is the potential difference $V_C - V_B =$ _____ V



48. Three rings, each having equal radius R and carrying a current I are placed mutually perpendicular to each other such that each has its centre at the origin of coordinate system. The magnitude of the magnetic field at the common centre is $\sqrt{k}\left(\frac{\mu_0 I}{2R}\right)$. Then the value of k is



49. A solid spherical body of density ρ is floating half-immersed in a liquid of density d. Neglect the effects of surface tension. Then $\frac{d}{\rho}$ is _____

50. Two coherent sources of light interfere. The intensity ratio of two sources is 1:4. For this interference pattern , the value of $\frac{I_{max}}{I_{min}}$ 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.

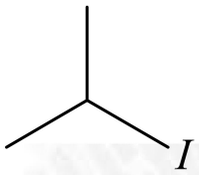
51. Match the terms given in column I with the units given in column II

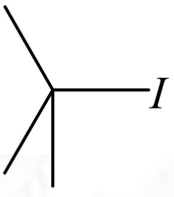
	Column I		Column II
a)	Molar conductance $(\wedge_m)$	P)	$S\ cm^{-1}$
b)	Emf of cell (E_{cell})	q)	m^{-1}
c)	Specific conductance (K)	r)	$S\ cm^2 mol^{-1}$
d)	Cell const (G^*)	s)	Volt (V)

1) a-r; b-s; c-p; d-q **2)** a-s; b-r; c-q; d-p

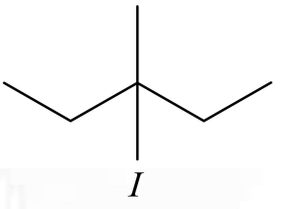
3) a-r; b-s; c-q; d-p **4)** a-s; b-r; c-p; d-q

52. Which among the following compounds will undergo fastest SN^2 reaction

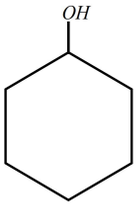
1) 

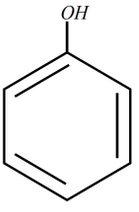
2) 

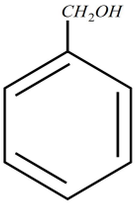
3) $CH_3 - I$

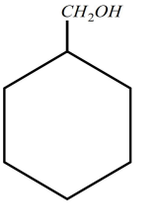
4) 

53. A compound 'X' is acidic and it is soluble in $NaOH$ solutions, but insoluble in $NaHCO_3$ solution. Compound 'X' also gives violet colour with neutral $FeCl_3$ solutions. The compound 'X'is :

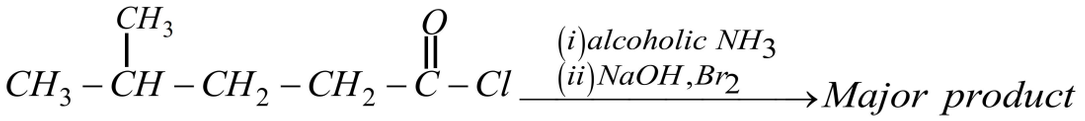
1) 

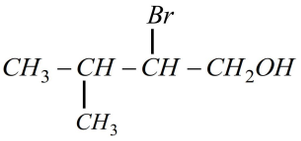
2) 

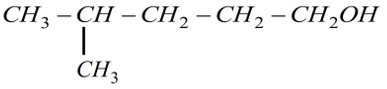
3) 

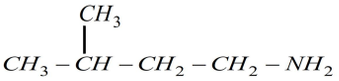
4) 

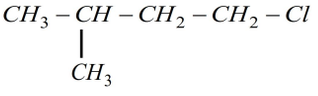
54. The major product of the following reaction is:



1) 

2) 

3) 

4) 

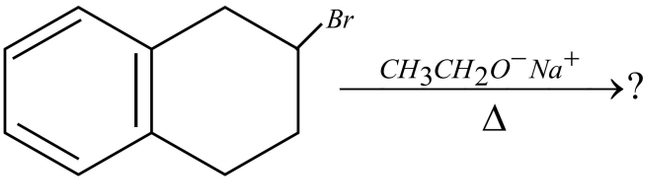
55. For electrode reaction

$Al^{3+} + 3e^- \rightarrow Al(s)$

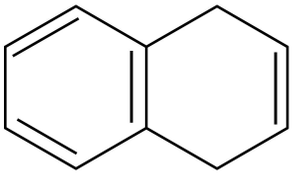
How many moles of electrons are required by 1 mole of Al^{3+} ions for complete reduction.

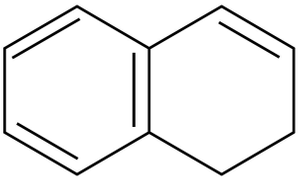
1) 1 **2)** 2 **3)** 3 **4)** 4

56. The reaction,



Gives as the major elimination product

1) 

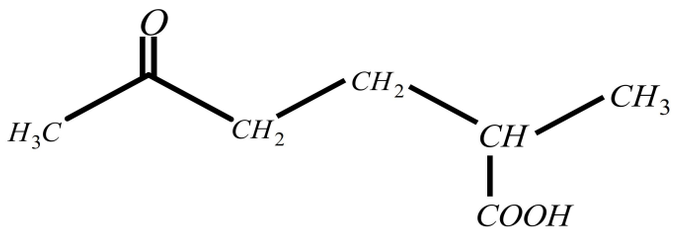
2) 

3) equal amounts of (1) and (2) **4)** Neither (1) nor (2)

57. Calculate the mass of lime (CaO) obtained by heating 200 kg of 95% lime stone $(CaCO_3)$:

1) 104.4 kg **2)** 105.4 kg **3)** 212.8 kg **4)** 112 kg

58. The correct IUPAC nomenclature for the following compound is



1) 2-methyl-5-oxo hexanoic acid
2) 5-formyl-2-methyl hexanoic acid
3) 2-Formyl-5-methyl hexan-6-oic acid
4) 5-methyl-2-oxo hexan-6-oic acid

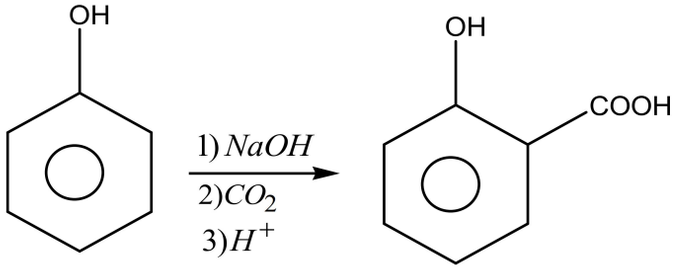
59. Assertion: Addition of $HCl(aq.)$ to $HCOOH(aq.)$ decrease the dissociation of $HCOOH(aq.)$.

Reason: Due to common ion effect of H^+, dissociation of $HCOOH$ decrease.
1) If both Assertion and Reason are true Reason is the correct explanation of Assertion
2) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion
3) If Assertion is true and Reason is false
4) If Assertion is false and Reason is true

60. The conjugate base for bicarbonate ion$\left(HCO_3^-\right)$ is

1) CO_3^{2-} **2)** HCO_3^- **3)** CO_2 **4)** H_2CO_3

61.



, then the name of this reaction is

1) Stephen reaction **2)** Etard reaction
3) Reimer-tieman reaction **4)** Kolbe's reaction

62. The freezing point of equimolal aqeous solutions will be highest for:

1) $NaCl$ **2)** $Ca(NO_3)_2$ **3)** $AlCl_3$ **4)** $C_6H_{12}O_6$

63. What is the total energy of the electron in first orbit of H-atom?

1) -13.6eV **2)** -27.2eV **3)** -1.51eV **4)** 13.6eV

64. Which of the following statements is incorrect?

1) In $[SiF_6]^{2-}$, $[GeCl_6]^{2-}$ and $[Sn(OH)_6]^{2-}$; the central atoms are in sp^3d^2 hybridized state

2) Both Carbon and Silicon cannot exceed their covalence more than four

3) Lead is more stable in +2 oxidation state due to inert pair effect

4) In group-14 carbon has unique ability of forming $p\pi - p\pi$ multiple bonds with itself and also with small sized atom like O, N etc.

65. Which of the following exhibit only optical isomerism?

(Given that: en= $NH_2CH_2CH_2NH_2, gly = NH_2CH_2COO^-$)

1) $[Co(en)_3]^{+3}$ **2)** $[Co(NH_3)_4Cl_2]^+$

3) $[Cr(gly)_3]$ **4)** $[Co(NH_3)_3Cl_3]$

66. Which of the following is a square planar complex ?

1) $[Ni(CN)_4]^{2-}$ **2)** $[NiCl_4]^{2-}$ **3)** $[Ni(CO)_4]$ **4)** $[CoCl_4]^{2-}$

67. Which of the following is an example of double salt

1) $[Rh(PPh_3)_3Cl]$ (Wilkinson's catalyst)

2) $[Fe(H_2O)_5NO]SO_4$ (Brown ring complex)

3) $FeSO_4(NH_4)_2SO_4.6H_2O$ (Mohr's salt)

4) $NaOH$ (caustic soda)

68. The correct statements from the following are:
A) The increasing order of atomic radii of group 13 elements is $B < Al < Ga < In < Tl$.
B) Al dissolves in dil. HCl and liberate H_2 but conc. HNO_3 renders Al passive by forming a protective oxide layer on the surface.
C) All elements of group 13 exhibits highly stable + 1 oxidation state.
D) Hybridisation of Al in $\left[Al\left(H_2O\right)_6\right]^{3+}$ ion is sp^3d^2.
Choose the correct answer from the options given below:
1) (B) and (D) only **2)** (A) and (C) only
3) (A), (B) and (C) only **4)** (A) and (B) only

69. **Assertion (A):** The bond angles of the hydrides decreases in the order

$NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$.

Reason (R): The Lewis basic strength of the hydrides increases in the order

$NH_3 < PH_3 < AsH_3 < SbH_3$.

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 incorrect

4) A is incorrect but R is correct

70. Which of the following order is correct?

1) $E^\circ_{F_2/2F^-} < E^\circ_{Cl_2/2Cl^-} < E^\circ_{Br_2/2Br^-} < E^\circ_{I_2/2I^-} : E^\circ_{values}\left(SRP\ \ values\right)$

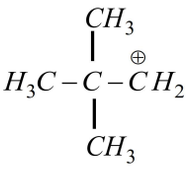
2) $I > Br > Cl > F$; Electron affinity

3) $F^- > Cl^- > Br^- > I^-$; $\left|Hydration\ enthalpy\right|$

4) $F_2 > Cl_2 > Br_2 > I_2$; Bond dissociation enthalpy

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. Number of H-atoms involved in hyper conjugation in the following is

72. Oxidation state of Sulphur in sulphuric acid (H_2SO_4) is x .Find $|x|$

73. Consider the following oxides; $N_2O, NO, CO, CO_2, N_2O_5, Al_2O_3, ZnO, V_2O_5$

If

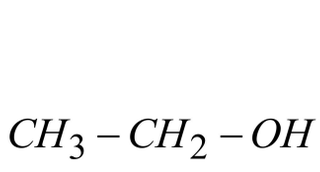
X = number of neutral oxides,

Y = number of acidic oxides

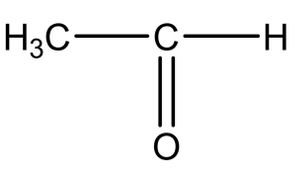
Z = number of an amphoteric oxides

Then [(X+Y)–(Z)] is_____.

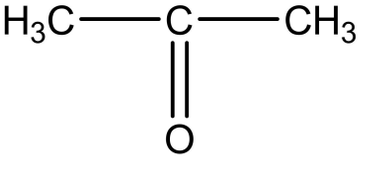
74. How many of the following compounds give iodoform test when reacted with $I_2 + NaOH$?



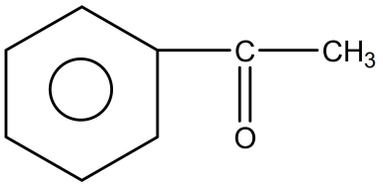
(I)



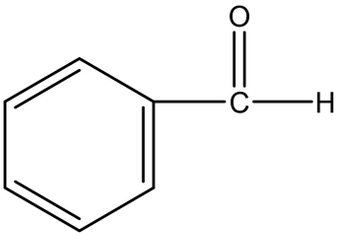
(II)



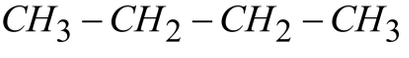
(III)



(IV)



(V)



(VI)

75. If enthalpy of neutralization of HCl by $NaOH$ is $-57kJmol^{-1}$ and with NH_4OH is $-50kJ\ mol^{-1}$ calculate enthalpy of Ionisation of $NH_4OH(aq)$.

ANSWER KEY

MATHEMATICS

1)	**2**	2)	**1**	3)	**1**	4)	**1**	5)	**1**
6)	**1**	7)	**1**	8)	**2**	9)	**3**	10)	**2**
11)	**1**	12)	**3**	13)	**4**	14)	**2**	15)	**2**
16)	**3**	17)	**4**	18)	**4**	19)	**4**	20)	**1**
21)	**3**	22)	**5**	23)	**81**	24)	**12**	25)	**193**

PHYSICS

26)	**1**	27)	**4**	28)	**2**	29)	**2**	30)	**2**
31)	**2**	32)	**3**	33)	**4**	34)	**1**	35)	**3**
36)	**3**	37)	**2**	38)	**1**	39)	**1**	40)	**2**
41)	**1**	42)	**3**	43)	**4**	44)	**1**	45)	**4**
46)	**3**	47)	**20**	48)	**3**	49)	**2**	50)	**9**

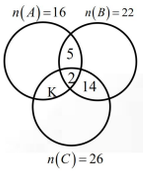
CHEMISTRY

51)	**1**	52)	**3**	53)	**2**	54)	**3**	55)	**3**
56)	**2**	57)	**4**	58)	**1**	59)	**1**	60)	**1**
61)	**4**	62)	**4**	63)	**1**	64)	**2**	65)	**1**
66)	**1**	67)	**3**	68)	**1**	69)	**3**	70)	**3**
71)	**0**	72)	**6**	73)	**2**	74)	**4**	75)	**7**

SOLUTIONS
MATHEMATICS

1. $n(A\cup B\cup C)=16+22+6-5-14-K+2 \Rightarrow 40=47-K\Rightarrow K=7$

$\Rightarrow$ Number of students who study English and Mathematics but not economics=5



2. $f(x)=\dfrac{\sin x}{\sqrt{1-\cos^2 x}}+\dfrac{\cos x}{\sqrt{1-\sin^2 x}}+\dfrac{\tan x}{\sqrt{\sec^2 x-1}}+\dfrac{\cot x}{\sqrt{\operatorname{cosec}^2 x-1}}$

$$=\frac{\sin x}{|\sin x|}+\frac{\cos x}{|\cos x|}+\frac{\tan x}{|\tan x|}+\frac{\cot x}{|\cot x|}=\begin{cases}4, & x\in 1^{st}\ quadrant\\ -2, & x\in 2^{nd}\ quadrant\\ 0, & x\in 3^{rd}\ quadrant\\ -2, & x\in 4^{th}\ quadrant\end{cases}\qquad f(x)_{\max}=4$$

3. $\log_{\sqrt{2}}\left(\dfrac{|z|+11}{|z|^2-2|z|+1}\right)\geq 0\Rightarrow \dfrac{|z|+11}{|z|^2-2|z|+1}\geq 1$

$\Rightarrow |z|^2-2|z|+1\leq |z|+11$

$\Rightarrow (|z|-5)(|z|+2)\leq 0\Rightarrow |z|\leq 5\left[\because |z|+2>0\right]$

4. Let root of $x^2-6x+a=0$ are $\alpha, 4\beta=4\alpha\beta=a$

$x^2-cx+6=0$ are $\alpha, 3\beta=3\alpha, \beta=6\Rightarrow a=8$

$\Rightarrow \quad x^2-6x+8=0\Rightarrow x^2-cx+6=0$

Has a root common $\Rightarrow c=5$ *or* $c=\dfrac{11}{2}$

Integral roots are 2, 4 and 2, 3. Common root is 2

5. ΔABC is a right angled triangle at B and midpoint of hypotenuse AC is the circumcentre

Circumcentre of ΔABC is $S(0,0)$

6. Now

$$\lim_{x\to\infty}\frac{a\left(1+x+\dfrac{x^2}{2!}+\dfrac{x^3}{3!}+.....\right)+\beta\left(1-x+\dfrac{x^2}{2!}-\dfrac{x^3}{3!}+.....\right)+\gamma\left(x-\dfrac{x^3}{3!}+.....\right)\left[\because \sin x\leq x\forall x\in R\right]}{x^3}$$

Constant terms should be zero $\Rightarrow \quad \alpha+\beta=0$

Coefficient of x should be zero $\Rightarrow \alpha-\beta+\gamma=0$

Coefficient of x^2 should be zero $\lim_{x\to 0}\dfrac{x^3\left(\dfrac{\alpha}{3!}-\dfrac{\beta}{3!}-\dfrac{\gamma}{3!}\right)+x^4\left(\dfrac{\alpha}{3!}-\dfrac{\beta}{3!}-\dfrac{\gamma}{3!}\right)}{x^3}=\dfrac{2}{3}$

$\Rightarrow \quad \dfrac{\alpha}{2}+\dfrac{\beta}{2}=0, \quad$ Now $\Rightarrow \quad \dfrac{\alpha}{6}-\dfrac{\beta}{6}-\dfrac{\gamma}{6}=2/3 \quad \Rightarrow \quad \alpha=1,\beta=-1,\gamma=-2$

7. We arrange the letters of OUGHT in alphabetical order as G, H, O, T, U
In dictionary words starting with

$G \cdots\cdots\cdots\to 4!$
$H \cdots\cdots\cdots\to 4!$
$O \cdots\cdots\cdots\to 4!$
$TG \cdots\cdots\cdots\to 3!$
$TH \cdots\cdots\cdots\to 3!$
$TOG \cdots\cdots\cdots\to 2!$
$TOH \cdots\cdots\cdots\to 2!$
$TOUGH \to 1!$

Total = 89

8. $\dfrac{dy}{dx}=\dfrac{2^{x+y}-2^x}{2^y}\Rightarrow\dfrac{dy}{dx}=2^x\dfrac{\left(2^y-1\right)}{2^y}\Rightarrow\dfrac{2^y}{2^y-1}dy=2^x dx\Rightarrow\int\dfrac{2^y}{2^y-1}dy=\int 2^x dx$

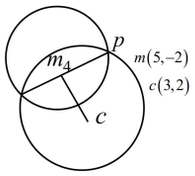
$\Rightarrow \quad \dfrac{\log\left(2^y-1\right)}{\log 2}=\dfrac{2^x}{\log 2}+c;\ y(0)=1\Rightarrow 0=\dfrac{1}{\log 2}+c\Rightarrow c=\dfrac{-1}{\log 2}$

$\therefore \quad \dfrac{\log\left(2^y-1\right)}{\log 2}=\dfrac{2^x}{\log 2}-\dfrac{1}{\log 2}\Rightarrow\log\left(2^y-1\right)=2^x-1$

If $x=1$ than $\log\left(2^y-1\right)=2-1=1\Rightarrow 2^y-1=e\Rightarrow 2^y=e+1\Rightarrow y=\log_2(e+1)$

$\Rightarrow \quad y(1)=\log_2(e+1)$

9.



$2x+3y=12, \quad 3x-2y=5, \qquad 13x=39 \quad \Rightarrow \quad x=3,y=2$

Centre $=C=(5,-2)$, radius $=r=\sqrt{25+4-13}=\sqrt{16}=4, CM=\sqrt{20}$, $CP=6$.

10. As standard deviation is independent of change of origin
$\therefore$ It remains same $\therefore$ $S.D=2\lambda$

11. Given the lines $\dfrac{x-1}{2}=\dfrac{2-y}{-3}=\dfrac{z-3}{\alpha}$ and $\dfrac{x-4}{5}=\dfrac{y-1}{2}=\dfrac{z}{\beta}$ intersect

So, point on first line $(1,2,3)$ and point on second line $(4,1,0)$

Vector joining both points is $-3\hat{i}+\hat{j}+3\hat{k}$

Now vector along first line is $2\hat{i}+3\hat{j}+\alpha\hat{k}$

Also vector along second line is $5\hat{i}+2\hat{j}+\beta\hat{k}$

Now these three vectors must be coplanar $\Rightarrow \begin{vmatrix} 2 & 3 & \alpha \\ 5 & 2 & \beta \\ -3 & 1 & 3 \end{vmatrix} = 0$

$\Rightarrow \quad 2(6-\beta)-3(15+3\beta)+\alpha(11)=0 \quad \Rightarrow \alpha-\beta=3$

12. Given $\dfrac{\frac{n}{2}\left[2a_1+(n-1)d_1\right]}{\frac{n}{2}\left[2a_2+(n-1)d_2\right]}=\dfrac{5n+3}{3n+4}$

For $n=7, \dfrac{a_1+3d_1}{a_2+3d_2}=\dfrac{38}{25}$

13. Equation of directrix is $x=0.....(1)$

Equation of the tangent at vertex is $x=4.....(2)$

(2) is equidistant from (1) and latus rectum

$\therefore$ equation of latusrectum is $x=8$

14. By given condition, $a_2-a_1=a_3-a_2=.....=a_{2025}-a_{2024}=1$

$\therefore \tan^{-1}\left(\dfrac{a_2-a_1}{1+a_1a_2}\right)+\tan^{-1}\left(\dfrac{a_3-a_2}{1+a_2a_3}\right)+.....+\tan^{-1}\left(\dfrac{a_{2025}-a_{2024}}{1+a_{2024}a_{2025}}\right)$

$\left[\tan^{-1}a_2-\tan^{-1}a_1\right]+\left[\tan^{-1}a_3-\tan^{-1}a_2\right]+.....+\left[\tan^{-1}a_{2025}-\tan^{-1}a_{2024}\right]$

$=\tan^{-1}a_{2025}-\tan^{-1}a_1=\tan^{-1}(2025)-\dfrac{\pi}{4}$

15. $y=\dfrac{2}{\sqrt{a^2-b^2}}Tan^{-1}\left(\sqrt{\dfrac{a-b}{a+b}}Tan\dfrac{x}{2}\right)$

$\dfrac{dy}{dx}=\dfrac{2}{\sqrt{a^2-b^2}}\dfrac{1}{\left(1+\dfrac{a-b}{a+b}Tan^2\dfrac{x}{2}\right)}\sec^2\dfrac{x}{2}.\dfrac{1}{2}\sqrt{\dfrac{a-b}{a+b}}$

$\left.\dfrac{dy}{dx}\right|_{x=\frac{\pi}{2}}=\dfrac{1}{a}$

16. $\mathbf{a}+\mathbf{b}, \mathbf{a}-\mathbf{b}$ are mutually perpendicular $\Rightarrow (\mathbf{a}+\mathbf{b}).(\mathbf{a}-\mathbf{b})=0 \Rightarrow \mathbf{a}^2-\mathbf{b}^2=0$

$\Rightarrow \left|\hat{i}+\lambda\hat{j}-3\hat{k}\right|^2-\left|3\hat{i}-\hat{j}+2\hat{k}\right|^2=0 \Rightarrow 1+\lambda^2+9=9+1+4 \Rightarrow \lambda^2=4 \Rightarrow \lambda=2\left[\because \lambda>0\right]$

$\cos\theta=\dfrac{\mathbf{a}.\mathbf{b}}{|\mathbf{a}||\mathbf{b}|}=\dfrac{\left(\hat{i}+2\hat{j}-3\hat{k}\right).\left(3\hat{i}-\hat{j}+2\hat{k}\right)}{\left|\hat{i}+2\hat{j}-3\hat{k}\right|\left|3\hat{i}-\hat{j}+2\hat{k}\right|}=\dfrac{3-2-6}{\sqrt{1+4+9}\sqrt{9+1+4}}=\dfrac{-5}{14}$

$\Rightarrow \quad 14\cos\theta=-5 \Rightarrow (14\cos\theta)^2=25.$

17. $E_1=\{(4,1),(4,2),(4,3),(4,4),(4,5),(4,6)\}$

$E_2=\{(1,2),(2,2),(3,2),(4,2),(5,2),(6,2)\}$

$E_3=\{(1,2),(1,4),(1,6),(2,1),(2,3),(2,5),(3,2),(3,4),(3,6),(4,1),(4,3),(4,5),(5,2),(5,4),(5,6),(6,1),(6,3),(6,5)\}$

$$P(E_1)=\frac{1}{6};P(E_2)=\frac{1}{6};P(E_3)=\frac{1}{2}$$

$$P(E_1\cap E_2)=\frac{1}{36},P(E_2\cap E_3)=\frac{1}{12},P(E_1\cap E_3)=\frac{1}{12}$$

And $P(E_1\cap E_2\cap E_3)=0\neq P(E_1).P(E_2).P(E_3)$

$\Rightarrow \quad 0\neq\frac{1}{6}.\frac{1}{6}.\frac{1}{2}\Rightarrow E_1,E_2,E_3$ are not independent.

18. $$\int\frac{2x^{12}+5x^9}{\left(1+x+x^5\right)^3}dx=\int\frac{2x^{12}+5x^9}{x^{15}\left(\frac{1}{x^5}+\frac{1}{x^2}+1\right)^3}dx \quad =\int\frac{\frac{2}{x^3}+\frac{5}{x^6}}{\left(\frac{1}{x^5}+\frac{1}{x^2}+1\right)^3}dx$$

Put $\frac{1}{x^2}+\frac{1}{x^5}+1=t \;=\int-\frac{dt}{t^3}=\frac{1}{2t^2}+c \quad =\frac{1}{2\left(\frac{1}{x^5}+\frac{1}{x^2}+1\right)^2}+c \quad =\frac{x^{10}}{2\left(1+x^3+x^5\right)^2}+c$

$m=10;r=2;l=2;\ \frac{m+l}{r}=6$

19. Given $f(x)=x^2+9,g(x)=\frac{x}{x-9} \qquad a=f\left(g(10)\right)=f\left(\frac{10}{10-9}\right)=f(10)=109$

$$b=g\left(f(3)\right)=g(9+9)=g(18)=\frac{18}{9}=2$$

$$E:\frac{x^2}{109}+\frac{y^2}{2}=1;e^2=1-\frac{2}{109}=\frac{107}{109};\ell=\frac{2(2)}{\sqrt{109}}=\frac{4}{\sqrt{109}};8e^2+\ell^2=\frac{8(107)}{109}+\frac{16}{109}=8$$

20. a. $|A|=2\Rightarrow\left|2A^{-1}\right|=2^3/|A|=4$

b. $\left|adj\left(adj(2A)\right)\right|=|2A|^4=2^{12}|A|^4=2^{12}/2^{12}=1$

c. $(A+B)^2=A^2+B^2 \qquad \Rightarrow \qquad AB+BA=O$

$\Rightarrow \quad |AB|=|-BA|=-|BA|=-|AB| \qquad \Rightarrow \qquad |AB|=0 \qquad \Rightarrow \qquad |B|=0$

d. Product ABC is not defined.

21. Tangent to the curve $\frac{x^2}{9}+\frac{y^2}{4}=1$ is

$y^2=mx\pm\sqrt{a^2m^2+b^2},y=mx\pm\sqrt{9m^2+4}$

And equation of tangent to the curve $x^2+y^2=\frac{31}{4}$ is

$y=mx\pm a\sqrt{1+m^2},y=mx\pm\sqrt{\frac{31}{4}\left(1+m^2\right)}$

For common tangent $9m^2+4=\frac{31}{4}+\frac{31}{4}m^2 \Rightarrow \frac{5}{4}m^2=\frac{15}{4}\Rightarrow m^2=3$

22. Here $\Delta=0$ and $\Delta_1=\Delta_2=\Delta_3=0\Rightarrow k=1,2$ then $A^2+B^2=1+4=5$

23. f is continuous at $x=\frac{\pi}{2}\Rightarrow \lim\limits_{x\to\pi/2-} f(x)=\lim\limits_{x\to\pi/2+} f(x)=f\left(\frac{\pi}{2}\right)$

$$\Rightarrow \lim_{x\to\pi/2-}\left(\frac{8}{7}\right)^{\frac{\tan 8x}{\tan 7x}}=\lim_{x\to\pi/2+}\left(1+|\cot x|\right)^{\frac{b}{a}|\tan x|}=a-8$$

$$\Rightarrow \left(\frac{8}{7}\right)^0=e^{\lim\limits_{x\to\pi/2+}(1+\cot x)-1\frac{b}{a}\tan x}=a-8\Rightarrow 1=e^{\lim\limits_{x\to\pi/2+}\frac{b}{a}}=a-8\Rightarrow a-8=1, e^{b/a}=1$$

$$\Rightarrow a=9, b=0, \quad \therefore\ a^2+b^2=81+0=81$$

24. $\alpha=\lim\limits_{x\to0+}\frac{e^{\sqrt{\tan x}}-e^{\sqrt{x}}}{\sqrt{\tan x}-\sqrt{x}}=1, \beta=\lim\limits_{x\to0}(1+\sin x)^{\frac{1}{2}\cot x}=e^{1/2}$

The equation having roots 1, $\sqrt{e}$ is $x^2-\left(1+\sqrt{e}\right)x+\sqrt{e}=0$

It is given as $ax^2+bx-\sqrt{e}=0$

By comparing we get $\frac{a}{1}=\frac{b}{-\left(1+\sqrt{e}\right)}=\frac{-1}{1}a=-1, b=1+\sqrt{e}$

$$\therefore \quad 12\log_e(a+b)=12\log_e\left(-1+1+\sqrt{e}\right)=6.$$

25. $P(X=0)+P(X=1)+P(X=2)+P(X=3)+P(X=4)$

$$=\left(\frac{1}{2}\right)^{10}+{}^{10}C_1\left(\frac{1}{2}\right)^9\left(\frac{1}{2}\right)+{}^{10}C_2\left(\frac{1}{2}\right)^8\left(\frac{1}{2}\right)^2+{}^{10}C_3\left(\frac{1}{2}\right)^7\left(\frac{1}{2}\right)^3+{}^{10}C_4\left(\frac{1}{2}\right)^6\left(\frac{1}{2}\right)^4=\frac{193}{2^9}$$

26. $V = \dfrac{KQ}{R}$

27. $C = C_1 + C_2 + C_3$

28. Since the balancing length is at the midpoint, each wire has a resistance equal to the known resistance value R. When they are in series, if ℓ is the balancing length measured from the left, we have resistance R in the left gap and 2R in the right gap.

Thus $\dfrac{R}{2R} = \dfrac{\ell}{100-\ell}$

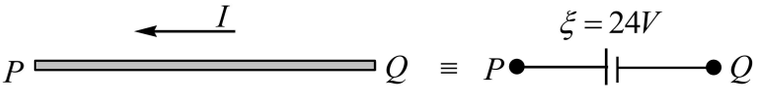
$\Rightarrow \quad \ell = 33.3\ cm$

29. $\xi = B\ell\upsilon_{\perp}$

$\Rightarrow \quad \xi = (3)(2)(8\sin 30)$

$\Rightarrow \quad \xi = 24\ V$

From Fleming's Right Hand Rule, the induced current in the rod PQ is directed from Q to B, thus giving an equivalent emf replacement of the motional emf as



So, P is at a higher potential.

30. At resonant frequency

$X_L = X_C$

$\therefore \quad Z = R$ (minimum)

31. Work done by friction on inclined plane will be negative

$W = Fs\cos\theta = +ve, if\ \theta < 90^0$.

32. $0 = \vec{P}_{gun} + \vec{P}_{bullet}$

Or $P_{gun} = P_{bullet}$

$$\frac{K_{gun}}{K_{bullet}} = \frac{P_{gun}^2 / 2m_{gun}}{P_{bullet}^2 / 2m_{bullet}} = \frac{m_{bullet}}{m_{gun}}.$$

33. Total distance moved by the bodies,

$x_1 + x_2 = 12R - 3R = 9R$ ..... (i)

Also, $Mx_1 = 5Mx_2$ ..... (ii)

After solving above equations, we get

$x_1 = 7.5R$

$x_2 = 1.5R$

34. iii. $[H] = \left[\dfrac{Heat}{Mass}\right] = \dfrac{ML^2T^{-2}}{M} = L^2T^{-2}$

iv. $[s] = \left[\dfrac{Heat}{Mass \times Temperature}\right] = \dfrac{ML^2T^{-2}}{MK} = L^2T^{-2}K^{-1}$

35. Resultant force

36. $\frac{1}{2}MV_e^2$

37. EXCESS PRESSURE $=\frac{4S}{R}$

38. l decreases as the block moves up.

39. Isothermal process

40. Adiabatic process

41. Heat and work depends on the path taken to reach a specific value. Hence, heat and work are path functions.

42. The formula connecting u, v and f for a spherical mirror $\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$ is valid only for mirrors of small apertures where the size of aperture is very small as compared to the radius of curvature of the mirror. Laws of mirror are valid for plane as well as large spherical surfaces. The laws of reflection are valid when ever the light is reflected.

43. $K.E=\frac{1}{2}k\left(A^2-d^2\right)$ *and* $P.E=\frac{1}{2}kd^2$

At mean position $d=0$. At extreme position $d=A$.

44. Let f_1 be the frequency heard by wall, $f_1=\left(\frac{v}{v-v_c}\right)f_0$

Here, $v=$ Velocity of sound,
$v_c=$ Velocity of Car,
$f_0=$ actual frequency of car horn
Let f_2 be the frequency heard by driver after reflection from wall.

$$f_2=\left(\frac{v+v_c}{v}\right)f_1=\left(\frac{v+v_c}{v-v_c}\right)f_0$$

$$\Rightarrow \quad 480=\left[\frac{345+v_c}{345-v_c}\right]440 \Rightarrow \frac{12}{11}=\frac{345+v_c}{345-v_c}$$

$$\Rightarrow \quad v_c=54\ km/hr$$

45. Given : $v_{paritcle}=4v_{electron}$ and $\lambda_{particle}\times 2\lambda_{electron}$

Using $\lambda=\frac{h}{p}$

$\lambda P=$ constant

$$\therefore \quad \lambda_{particle}\times p_{particle}=\lambda_{electron}\times p_{electron}$$

$$\Rightarrow \quad \lambda_{particle}\times m_{particle}\times v_{particle}$$

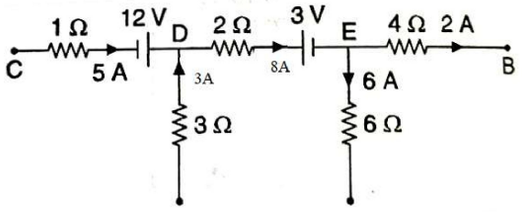
$$=\lambda_{electron}\times m_{electron}\times v_{electron}$$

$$\therefore \quad m_{particle}v_{particle}=\frac{m_{electron}v_{electron}}{2}$$

$$\Rightarrow \quad m_{particle}=\frac{m_{electron}}{8}$$

46. Both the diodes are reverse biased, so, there is no flow of current through 5Ω and 20Ω resistances. Now, two resistors of 10Ω and two resistors of 5Ω are in series.
Hence, current I through the network $= 0.3A$.

47. Applying Kirchhoff's Junction Law at E current in wire DE is 8 A from D to E. Now further applying Junction Law at D. The current in 3Ω resistance will be 3A towards D.



48. $\vec{B} = \frac{\mu_0 I}{2R}\left(\pm\hat{i}\right) + \frac{\mu_0 I}{2R}\left(\pm\hat{j}\right) + \frac{\mu_0 I}{2R}\left(\pm\hat{k}\right)$

$\Rightarrow \quad \left|\vec{B}\right| = \frac{\mu_0 I}{2R}\sqrt{3}$

49. weight = buoyant force

50. We have given, $\frac{I_1}{I_2} = \frac{1}{4} \Rightarrow I_2 = 4I_1$

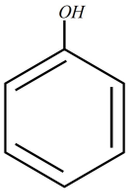
$I_{\max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2 = 9I_1$

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

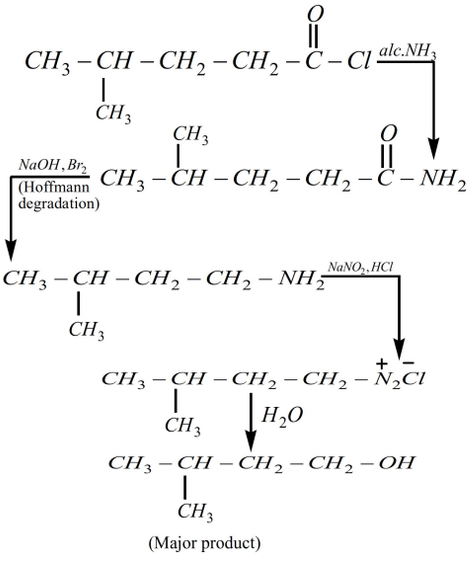
CHEMISTRY

51. Theory based

52. 1^0 alkyl halides more reactive towards S_N2 reaction.

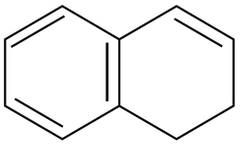
53. 

54.



(Major product)

55. Check balanced reaction given

56. 

57. Mass of pure $CaCO_3 = 200 \times \frac{95}{100} = 190kg$

$$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$$

100g 56

$1g$ $\frac{56}{100}$

190 kg $\frac{56}{100} \times 190kg = 106.4\ kg$

58. 2-methyl-5-oxo hexanoic acid

59. If both Assertion and Reason are true Reason is the correct explanation of Assertion

60. Conceptual

61. Kolbe's reaction

62. Depression in freezing point, $\Delta T_f = iK_f m$. The value of van't Hoff factor (i) is minimum for the glucose, which is a non-electrolyte. Hence, aqueous solution of glucose has highest freezing point.

63. $E_{n,z} = -13.6 \times \frac{z^2}{n^2} eV$

64. C=4, Si=6

65. *i*) $\left[Co(en)_3\right]^{3+}$; O. I (only)

ii) $\left[Co(NH_3)_4 Cl_2\right]^{+}$; G. I (only)

iii) $\left[Cr(gly)_3\right]$; both O. I and G. I

iv) $\left[Co(NH_3)Cl_3\right]$; G. I (fac and mer)

66. *i*) $Ni^{+2}; d^8; SFL; C.No = 4; square\ planar$

ii) $Ni^{+2}; d^8; WFL; C.No = 4; Tetrahedral$

iii) $Ni^0; 4s^2 3d^8; SFL; C.No = 4; Tetrahedral$

iv) $Co^{+2}; 3d^7; WFL; C.No = 4; Tetrahedral$

67. $FeSO_4(NH_4)_2 SO_4.6H_2O$ (Mohr's salt)

68. $(i)\ B < Ga < Al < In < Tl$: *Atomic radius*

$(ii)\ Tl$: *more stable in* $+1$ due to I.P.E

69. $NH_3 > PH_3 > AsH_3 > SbH_3$: Lemis basic structure

70. *i*) F_2 *to* I_2; SRP values decreases

ii) $Cl > F > Br > I$; electron affinity

iii) $Cl_2 > Br_2 > F_2 > I_2$; BDE

71. 0

72. $2 \times (+1) + 1 \times x + 4 \times (-2) = 0$

$x = \pm 6$

73. X = 3, Y = 2, Z = 3

74. I, II, III, IV compounds gives iodoform text.

75. $-50 = (\Delta H) NH_4OH - 57$