JEE-MAIN 2025

Session - 2

Mock Practice Test - 1

PHYSICS **Max Marks: 100**

(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.

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1. Which of the following is a constant for all temperature scales?

   1) UFP 2) LFP

   3) UFP–LFP 4) $\frac{X - LFP}{UFP - LFP}$ where X = measured value

2. If there are no heat losses, the heat released by the condensation of $X\ gm$ of steam at $100°C$ into water at $100°C$ can be used to convert $Y\ gm$ of ice at $0°C$ into water at $100°C$. Then the ratio $Y:X$ is nearly

   1) $1:1$ 2) $2.5:1$ 3) $2:1$ 4) $3:1$

3. A solid whose volume does not change with temperature floats in a liquid. For two different temperatures t_1 and t_2 of the liquid, fractions f_1 and f_2 of the volume of the solid remain submerged in the liquid. The coefficient of volume expansion of the liquid is equal to

   1) $\frac{f_1 - f_2}{f_2 t_1 - f_1 t_2}$ 2) $\frac{f_1 - f_2}{f_1 t_1 - f_2 t_2}$ 3) $\frac{f_1 + f_2}{f_2 t_1 + f_1 t_2}$ 4) $\frac{f_1 + f_2}{f_1 t_1 + f_2 t_2}$

4. An aluminium measuring rod which is correct at $5°C$ measures the length of a line as 80 cm at $45°C$. If thermal coefficient of linear expansion of aluminium is $2.50 \times 10^{-5} / °C$, the correct length of the line is

   1) $80.08cm$ 2) $79.92cm$ 3) $81.12cm$ 4) $79.62cm$

5. The root mean square speed of the molecules of a diatomic gas is V. When the temperature is doubled, the molecules dissociate into two atoms. The new root mean square speed of the atom is

   1) $\sqrt{2}V$ 2) V 3) $2V$ 4) $4V$

6. A faulty thermometer has its fixed points marked as $-5°$ and $95°$. If the temperature of a body as shown on Celsius scale is $55°$, then its temperature shown on this faulty thermometer is

1) 50 2) 55 3) 60 4) 65

7. A clock with a metal pendulum beating seconds keeps correct time at $0°C$. If it losses 12.5 seconds a day at $25°C$, the coefficient of linear expansion of metal of pendulum is

1) $\frac{1}{86400}/°C$ 2) $\frac{1}{43200}/°C$ 3) $\frac{1}{14400}/°C$ 4) $\frac{1}{28800}/°C$

8. The coefficients of apparent expansion of a liquid when determined using two different vessels A and B are γ_1 and γ_2 respectively. If the coefficient of linear expansion of the vessel A is α, The coefficient of linear expansion of the vessel
B is

1) $\alpha\frac{\gamma_1\gamma_2}{\gamma_1+\gamma_2}$ 2) $\frac{\gamma_1-\gamma_2}{2\alpha}$ 3) $\frac{\gamma_1-\gamma_2+\alpha}{3}$ 4) $\frac{\gamma_1-\gamma_2}{3}+\alpha$

9. Given that the specific heat in cal/g is $C=0.6t^2$, where t is the temperature on the Celsius scale. If the temperature of $10g$ of water is raised through $15°C$, what is the amount of heat required?

1) $60cal$ 2) $6750cal$ 3) $0.6cal$ 4) $200cal$

10. $10g$ of ice at $-20°C$ is added to $10g$ of water at $30°C$. The amount of ice in the mixture at resulting temperature is (Specific heat of ice $=0.5cal\,g^{-1}°c^{-1}$ and latent heat of ice $=80cal\,g^{-1}$)

1) 10g 2) 7.5g 3) 0g 4) 20g

11. During an experiment an ideal gas is found to obey an additional law VP^2 = constant. The gas is initially at a temperature 'T' and volume 'V'. When it expands to a volume $2V$, the temperature becomes,

1) T 2) $2T$ 3) $\sqrt{2}T$ 4) $\frac{T}{\sqrt{2}}$

12. Assertion(A): The total translational kinetic energy of all the molecules of a given mass of an ideal diatomic gas is 2.5 times the product of its pressure and its volume

Reason (R): The molecules of a gas collide with each other and velocities of the molecules change due to the collision

1) Both A and R are true and R is 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

13. Statement–I When a metallic sphere is heated, percentage increase in volume is less than the percentage increase in surface area

Statement–II Coefficient of superficial expansion is $\frac{2}{3}rd$ of coefficient of volumetric expansion

1) Both statement–I and statement–II are correct
2) Both statement–I and statement–II are wrong
3) Statement–I is correct, statement–II is wrong
4) Statement–II is correct, statement–I is wrong

14. Increase in moment of inertia of a uniform rod of length $l\left(\alpha = \text{coefficient of linear expansion}\right)$ about its perpendicular bisector when its temperature is slightly increased by ΔT is

1) $l\alpha\Delta T$ 2) $\frac{2}{3}l\alpha\Delta T$ 3) $2l\alpha\Delta T$ 4) $\frac{1}{2}l\alpha\Delta T$

15. A metal block floats in mercury at $0°C$ with k_1 fraction of its total volume submerged. When temperature is raised to $60°C$, a fraction k_2 of total volume is found submerged. If the coefficient of volumetric expansion of metal is γ_1 and coefficient of volumetric expansion of mercury is γ_2, then ratio of $\frac{k_1}{k_2}$ is

1) $\frac{1+60\gamma_1}{1+60\gamma_2}$ 2) $\frac{1-60\gamma_1}{1+60\gamma_2}$ 3) $\frac{1+60\gamma_1}{1-60\gamma_2}$ 4) $\frac{1+60\gamma_2}{1+60\gamma_1}$

16. A bimetallic strip having each strip of thickness 2cm consists of zinc and silver rivetted together. The approximate radius of curvature of the strip when heated through $50°C$ will be

$\left(\alpha_{zinc} = 32\times10^{-6}/°C \qquad \alpha_{silver} = 19\times10^{-6}/°C\right)$

1) $42.14m$ 2) $30.77m$ 3) $28.53m$ 4) $19.58m$

17. At what temperature is the *rms* speed of gaseous nitrogen molecules equal to that of oxygen molecules at $127°C$

1) $77°C$ 2) $350°C$ 3) $273°C$ 4) $457°C$

18. A rod of length 2m is at a temperature of $20°C$. If the temperature is increased to $50°C$ then find stress produced when the rod is fully prevented to expand.

$\left(Y = 2\times10^{11}\ N/m^2, \alpha = 15\times10^{-6}/°C\right)$

1) $11\times10^{6}\ N/m^2$ 2) $4\times10^{7}\ N/m^2$

3) $9\times10^{7}\ N/m^2$ 4) $8\times10^{6}\ N/m^2$

19. Assertion(A): Melting of solid no change in internal energy

Reason(R): Latent heat is the heat required to melt a unit mass of solid

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

2) Both A and R are true But R is not correct explanation of A

3) A is true but R is not true

4) A is false but R is true

20. A certain ideal gas has a temperature 300K and a pressure $5.0\times10^{4}\,Pa$. The molecules have a mean free path $4.0\times10^{-7}\,m$. If the temperature is increased to 350K and pressure is reduced to $1.0\times10^{4}\,Pa$, the mean free path is

1) $6.9\times10^{-8}m$ 2) $9.3\times10^{-8}m$ 3) $3.4\times10^{-7}m$ 4) $2.3\times10^{-6}m$

(NUMERICAL VALUE TYPE)

Section-II contains 10 **Numerical Value Type** questions. Attempt any 5 questions only. First 5 attempted questions will be considered if more than 5 questions attempted. The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**
Marking scheme: +4 for correct answer, 0 if **not attempt** and **-1** in all other cases.

21. The temperature of a body raises by $44°C$ when a certain amount of heat is given to it. The same heat when supplied to $22g$ of ice at $-8°C$, raises its temperature by $16°C$. The water equivalent of the body in grams is_____

(Given data $S_{water}=1cal/g°C$ and $L_f=80cal/g$ $S_{ice}=0.5cal/g°C$)

22. A non-isotropic solid metal cube has coefficient of linear expansion as; $5\times10^{-5}/°C$ along $x-$ axis and $5\times10^{-6}/°C$ along the Y and the $z-$axis. If the coefficient of volume expansion of the solid is $C\times10^{-6}/°C$ then the value of C is _____

23. A iron tyre is to be fitted into a wooden 1.0m in diameter. The diameter of the tyre is 6mm smaller than that of the wheel. The tyre is to heated so that its temperature increases by a minimum of (coefficient of volume expansion is $3.6\times10^{-5}/°C$) in $(°C)$_____

24. Equal masses of a gas are sealed in two vessels, one of volume V_0 and other of volume $2V_0$. If the first vessel is at temperature $300K$ and other is at 600K. The ratio of pressures in the two vessels is_____

25. By what percentage should the pressure of a given mass of a gas be increased so as to decreases its volume by 10% at a constant temperature?

26. A steel tape measures the length of a copper rod as 90.0cm when both are at $10°C$, the calibration temperature for the tape. If the change in the tape read for the length of the rod when both are at $30°C$ is $x \times 10^{-3}$ cm. Find the value of 'x'

$\left(Given\ \alpha_{steel} = 1.2 \times 10^{-5} / °C, \alpha_{cu} = 1.7 \times 10^{-5} / °C\right)$

27. $100g$ of ice is mixed with $100g$ of water at $100°C$. What will be the final temperature of this mixture $(in\ °C)$_____

28. Two closed containers of equal volume of air are initially at $1.05 \times 10^5 Pa$ pressure and 300K temperature. IF the containers are connected by a narrow tube and one container is maintained at 300K temperature and other at 400K temperature. The final pressure (in kP1) in the containers is _____

29. The absolute coefficient of expansion of a liquid is 7 times, that the volume coefficient of expansion of the vessel. Then the ratio of absolute and apparent expansion of the liquid is $\frac{n}{6}$, the value of n_____

30. At STP, speed of sound in a gas sample is found exactly 330m/s. Density of gas is $1.3kg\ m^{-3}$. Number of degrees of freedom for a gas molecule will be _____

CHEMISTRY

Max Marks: 100

(SINGLE CORRECT ANSWER TYPE)

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31. The decreasing order of energy for the electrons represented by the following sets of quantum numbers is

$I.n=4,l=0,m=0,s=\pm 1/2$ $\quad$ $II.n=3,l=1,m=1,s=-1/2$

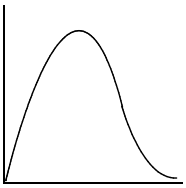
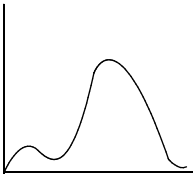
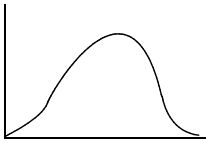
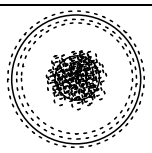
$III.n=3,l=2,m=0,s=+1/2$ $\quad$ $IV.n=3,l=0,m=0,s=-1/2$

1) $1>2>3>4$ $\quad$ 2) $2>1>3>4$ $\quad$ 3) $3>1>2>4$ $\quad$ 4) $4>3>2>1$

32. Potential energy of the electron in the Bohr's n^{th} orbit is

1) $\alpha - n^{-2}$ $\quad$ 2) $\alpha - n^{-1}$ $\quad$ 3) $\alpha - n^{1}$ $\quad$ 4) $\alpha - n^{2}$

33.

	Column–I		Column–II
1	Radial probability distribution graphs for $1s$ orbital	p	
2	Radial probability distribution graphs for $2s$ orbital	q	
3	Radial probability distribution graphs for $2p$ orbital	r	
4	Electron cloud picture of $2s$ orbital	s	

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

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

34. The wavelength of H_α line of Balmer series is X $\overset{o}{A}$. What is the wave length of H_β line of Balmer series in terms of 'X'

1) $X\frac{108}{80}\overset{o}{A}$ 2) $X\frac{80}{108}\overset{o}{A}$ 3) $\frac{1}{X}\frac{80}{108}\overset{o}{A}$ 4) $\frac{1}{X}\frac{108}{80}\overset{o}{A}$

35. Statement I :It is not possible to predict position and the velocity of an electron exactly and simultaneously

Statement II : Microscopic particles possesses both the particle nature and the wave nature

1) Both statement I and II are correct

2) Statement I is correct and statement II is incorrect

3) Statement I is incorrect and statement II is correct

4) Both statement I and II are incorrect

36. Select the incorrect statement

1) K.E. of photo-electron does not depend upon the wavelength of incident radiation

2) photoelectric current depends on intensity of incident radiation and not on frequency

3) Stopping potential depends on frequency of radiation and not on intensity

4) K.E. of photo-electron does not depends upon the intensity of incident radiation

37. Consider the following statements

I. $|\psi|^2$ is a measure of electron density at a point in an atom

II. Radial probability function $\left(=4\pi r^2R^2\psi^2\right)$ gives the probability of finding the electron at a distance r (atomic radius) from the nucleus regardless of direction

III. The shape of an orbital is defined as a surface of constant probability density that encloses some large fractions of the probability of finding the electron

Select the correct statements

1) Both *i* & *ii* **2)** Both *ii* & *iii* **3)** Both *i* & *iii* **4)** All of these

38. Assuming each of the following is moving with same velocity minimum de-Broglie wavelength is associated with

1) electron 2) Proton 3) CO_2 molecule 4) SO_2 molecule

39. If λ_0 and λ be threshold wavelength and wavelength of incident light, the velocity of photoelectron ejected from the metal surface is

1) $\sqrt{\frac{2h}{m}(\lambda_0 - \lambda)}$ **2)** $\sqrt{\frac{2hc}{m}(\lambda_0 - \lambda)}$ **3)** $\sqrt{\frac{2hc}{m}\left(\frac{\lambda_0 - \lambda}{\lambda\lambda_0}\right)}$ **4)** $\sqrt{\frac{2h}{m}\left(\frac{1}{\lambda_0} - \frac{1}{\lambda}\right)}$

40. Statement – I: Wavelength of limiting line of Lyman series is less than wavelength of limiting line of Balmer series

Statement – II: Rydberg constant value is same for all elements

1) Statement – I is true, Statement – II is also true; Statement – II is the correct explanation of Statement – I

2) Statement – I is true, Statement – II is also true; Statement – II is not the correct explanation of Statement – I

3) Statement – I is true, Statement – II is false

4) Statement – I is false, Statement – II is true

41. Write the molecular formula of $2,3-$dibromo$-1-$phenyl pentane.

1) $C_{10}H_{14}Br_2$ **2)** $C_{11}H_{13}Br_2$ **3)** $C_{11}H_{14}Br_2$ **4)** $C_{11}H_{15}Br_2$

42. The bond–line structural representation of organic compounds, carbon–carbon bonds are drawn in _____

1) Parallel **2)** Horizontal **3)** Vertical **4)** Zig–Zag

43. In molecular models, bonds are not shown

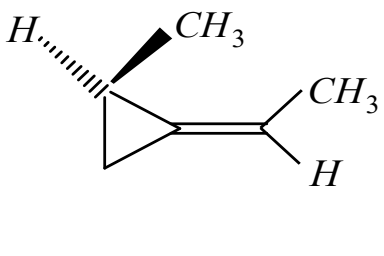
1) Frame work model **2)** Ball–and–stick model

3) Space filling model **4)** Wedge and dash

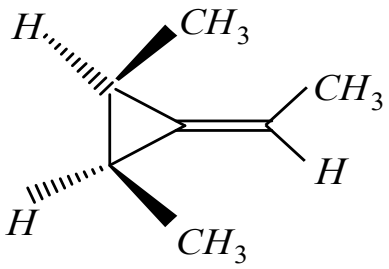
44. In homolytic cleavage, the single electron movement is shown by

1) Arrow **2)** half–headed **3)** Fish hook **4)** both B and C

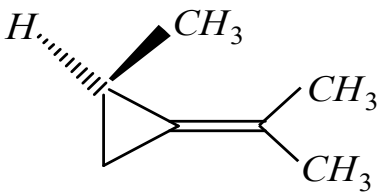
45. Find the sum of all the stereocentres that are present in below compounds



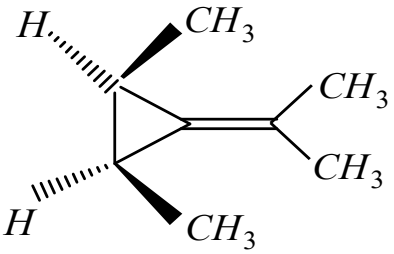
(I)



(II)



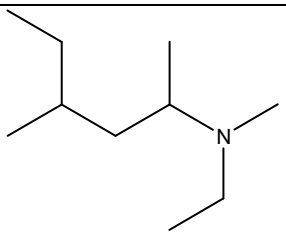
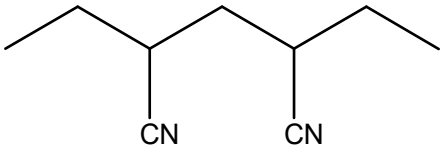
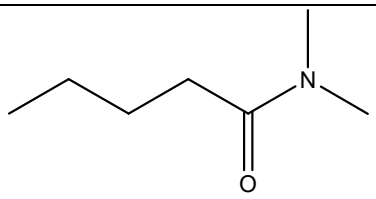
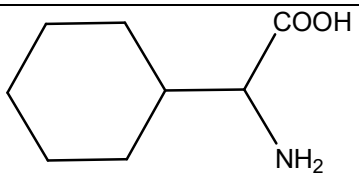
(III)



(IV)

1) 8 **2)** 9 **3)** 10 **4)** 11

46. Match the general formula from Column I with the class they belong to in column II

Column–I		Column–II	
i		p	Has tertiary N–atom
ii		q	Has tertiary carbon atom
iii		r	Has five carbons in the parent chain
iv		s	Has two carbons in the parent chain

1) $i-prs, ii-pr, iii-q, iv-s$

2) $i-q, ii-prs, iii-ps, iv-qs$

3) $i-pqs, ii-qr, iii-pr, iv-q$

4) $i-qs, ii-pr, iii-s, iv-p$

47. Consider the molecules in Column I and match then with their stereochemical properties from Column II

	Column–I		Column–II
i	$CH_3-CH=CH-\underset{\displaystyle OH}{\underset{\vert}{CH}}-CH=CH-CH_3$	p	Have only three stereoisomers
ii	$CH_3-\underset{\displaystyle OH}{\underset{\vert}{CH}}-\underset{\displaystyle OH}{\underset{\vert}{CH}}-CH_3$	q	Have four stereoisomers
iii	$CH_3-CH_2-\underset{\displaystyle OH}{\underset{\vert}{CH}}-\underset{\displaystyle OH}{\underset{\vert}{CH}}-CH_3$	r	Have only two optically active isomers
iv	$CH_3-\underset{\displaystyle Cl}{\underset{\vert}{CH}}-CH=CH-Cl$	s	Have more than two pairs of diastereomers

1) $i-qrs, ii-pr, iii-qs, iv-qs$ **2)** $i-p, ii-q, iii-r, iv-s$

3) $i-pq, ii-qs, iii-r, iv-q$ **4)** $i-pqr, ii-rs, iii-qr, iv-pq$

48. Assertion (A): Singlet carbene have opposite spin (anti parallel)

Reason(R): Singlet carbene has bent structure

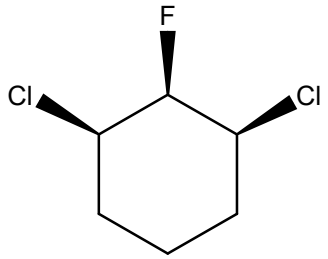
1) If both A and R are correct and R is the correct explanation of A

2) If the both A and R are correct but R is not the correct explanation of A

3) If R is correct but R is incorrect

4) If both A and R is incorrect

49. Statement–I the following compound is optically inactive



Statement–II It has two chiral carbons

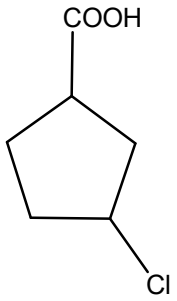
1) Both Statement I and Statement II are correct and statement II is the correct explanation of Statement I

2) Both Statement I and Statement II are correct and statement II is not the correct explanation of Statement I

3) Statement–I is correct but Statement–II is incorrect

4) Statement–II is correct but Statement–I is incorrect

50. Statement–I Following compound has its IUPAC name 3-chlorocyclopentanoic acid



Statement–II –COOH is the principal functional group of compound which determines the suffix name

1) Both Statement I and Statement II are correct and statement II is the correct explanation of Statement I

2) Both Statement I and Statement II are correct but statement II is not the correct explanation of Statement I

3) Statement–I is correct but Statement–II is incorrect

4) Statement–II is correct but Statement–I is incorrect

(NUMERICAL VALUE TYPE)

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51. The magnitude of an orbital angular momentum vector of an electron is $\sqrt{6}\frac{h}{2\pi}$. Into how many components will the vector split if an external field is applied to it?

52. The work function (ϕ) of some metals is listed below. The number of metals which will show photoelectric effect when light of 300 nm, wavelength falls on the metal is

Metal	Li	Na	K	Mg	Cu	Ag	Fe	Pt	W
$\Phi(eV)$	2.4	2.3	2.2	3.7	4.8	4.3	4.7	6.3	4.75

53. The velocity of an electron in a certain Bohr's orbit of H-atom bears the ratio $1:550$ to the velocity of light. The quantum number n of the orbit is

54. The uncertainty in the position of an electron is equal to its de-Broglie wavelength. The minimum percent error in its measurement of velocity under these circumstances will be approximately_____

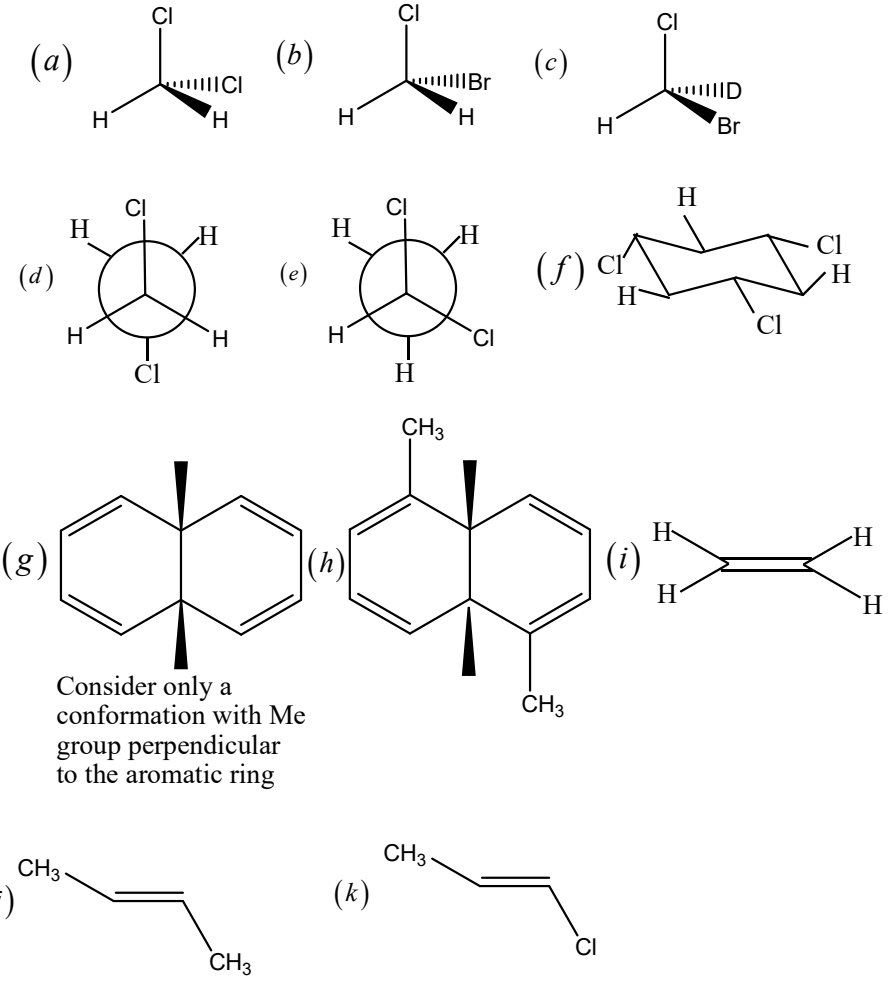
55. How many of the following ions have the same magnetic moments?

Fe^{2+} Mn^{2+} Cr^{2+} Ni^{2+}

56. How many different IUPAC names can be assigned (excluding stereoisomers) to organic compound with molecular formula $C_4H_{10}O$?

57. In the compound $7-ethyl\ 3-nonene-2,5,8-$tricarboxylic acid, how many atoms are in sp^2-hybridization state?

58. Number of chiral isomers are



59. How many $C-C$ single bonds are present in the compound. $1-ethoxy-3-(2-$ methoxy ethoxy) propane

60. When name of hydrocarbon $3-(1-butenyl)-1,5$ hexadiene is rewritten correctly according to IUPAC conversion, what would be the number of carbon atoms in the parent chain

MATHEMATICS

Max Marks: 100

(SINGLE CORRECT ANSWER TYPE)

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

61. Suppose that $A_1, A_2, A_3 \ldots\ldots A_{50}$ are fifty sets, each containing 6 elements and $B_1, B_2, B_3 \ldots B_n$ are n sets, each containing 3 elements. If $\underset{i=1}{\overset{50}{U}} A_i = S = \underset{j=1}{\overset{n}{U}} B_i$ and each element of S belongs to exactly 10 *of the* A_i's and exactly 9 of the B_j's then $n =$

1) 45 **2)** 54 **3)** 90 **4)** 18

62. Let S be the set of all real numbers for $a, b \in S$,

Statement–I: Relation R is defined by aRb iff $1 + ab > 0$ then R is reflexive and symmetric

Statement–II: Relation R is defined by aRb iff $|a - b| < 1$ then R is an equivalence relation

1) Both S-I & S–II are true and S–II is correct explanation of S-I

2) Both S-I & S–II are true and S–II is NOT correct explanation of S-I

3) S–I is true and S–II is false

4) S–I is false and S–II is true

63. If k be the minimum number of elements that must be added to the relation $R = \{(1,2),(2,3)\}$ on the set $\{1,2,3\}$ so that it is an equivalence relation then the number of positive divisors of $2k + 2$ is_____

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

64. In a certain town 25% families own a cellphone, 15% families own a television and 65% families own neither a cellphone nor a television. If 1500 families own both a cellphone and a television. Then the total number of families in the town is

1) 10,000 **2)** 20,000 **3)** 30,000 **4)** 40,000

65. If the difference between the number of subsets of the sets A and B is 120, then choose the incorrect option

1) maximum value of $n(A \cap B) = 3$ **2)** minimum value of $n(A \cap B) = 0$

3) maximum value of $n(A \cup B) = 21$ **4)** minimum value of $n(A \cup B) = 7$

66. Assertion (A): Consider the non-empty set consists of children in a house, consider a relation $R: xRy$ iff x is sister of y then R is an equivalence relation

Reason (R): A relation R on a set A is said to be an equivalence on A iff it is reflexive, symmetric and transitive

1) Both A and R are true and R is 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

67. A survey shows that 53% of the people in a city read a magazine A whereas 69% read a magazine B. If $x\%$ of the people read both the magazine then a possible value of x can be

1) 76 **2)** 55 **3)** 45 **4)** 65

68. If $n(A)=50, n(B)=20$ and $n(A\cap B)=10$ then $n(A\Delta B)=k^2+1$ then $k=$ _____

1) ± 5 **2)** ± 7 **3)** ± 6 **4)** ± 8

69. Which of the following is an equivalence relation on z.

1) $xRy \Leftrightarrow x<y$ **2)** $xRy \Leftrightarrow x>y$

3) $xRy \Leftrightarrow x-y$ is divisible by 5 **4)** $xRy \Leftrightarrow x$ divides y

70. A relation R is defined from $\{2,3,4,5\}$ to $\{3,6,7,10\}$ by $x\,Ry \Leftrightarrow x$ is relatively prime to y, then number of ordered pairs in R is

1) 3 **2)** 5 **3)** 9 **4)** 7

71. Assertion (A): $f(x)=\dfrac{x^2-16}{x-4}$ & $g(x)=x+4$ are equal

Reason (R): Two functions f and g are said to be equal if their domains and ranges are equal and $f(x)=g(x), \forall x \in$ domain

1) Both A and R are true and R is 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

72. Let $f:R\to R$ be a periodic function such that $f(T+x)=1+\left[1-3f(x)+3(f(x))^2-(f(x))^3\right]^{1/3}$, where T is a fixed $+ve$ number then period of $f(x)$ is

1) T **2)** $2T$ **3)** $3T$ **4)** $4T$

73. The range of the function $f(x)=\dfrac{x^2+x+2}{x^2+x+1}, x\in R$ is

1) $(1,\infty)$ **2)** $\left(1,\dfrac{11}{7}\right)$ **3)** $\left(1,\dfrac{7}{3}\right]$ **4)** $\left(1,\dfrac{7}{5}\right]$

74. If $af(x+1)+bf\left(\dfrac{1}{x+1}\right)=x, x\neq -1, a\neq b$ then $f(2)=$

1) $\dfrac{2a+b}{2(a^2-b^2)}$ **2)** $\dfrac{a}{a^2-b^2}$ **3)** $\dfrac{a+2b}{a^2-b^2}$ **4)** $\dfrac{2ab}{a+b}$

75. Assertion (A): If $f:N\to N$ where $f(x)=x-(-1)^x$ then f is bijection

Reason (R): A function f is bijection if f is one–one and onto

1) Both A and R are true and R is 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

76. Let $f:\left[\dfrac{-\pi}{3},\dfrac{\pi}{6}\right]\to B$ be defined by $f(x)=2\cos^2 x+\sqrt{3}\sin 2x+1$, where $B=[a,b]$ such that $f^{-1}(x)$ exists, then the quadratic equation having the roots a,b is

1) $x^2+4x=0$ **2)** $x^2+4x+2=0$

3) $x^2-4x-2=0$ **4)** $x^2-4x=0$

77. If $f(x)=(x+1)^2-1, x\geq -1$ and α,β are the solutions of the equation $f(x)=f^{-1}(x)$ then $\alpha^3+\beta^3=$

1) 1 **2)** 0 **3)** –1 **4)** 2

78. Statement–I: The range of function $f(x)=\operatorname{sgn}\left(x^2-2x+3\right)$ is $\{1\}$

Statement–II: The range of function $f(x)=\left[\sin\{x\}\right]$ is $\{0\}$ where $\{.\}$ represents the fractional part of function and $[.]$represents the greatest integer function

1) Both S-I & S–II are true and S–II is correct explanation of S-I

2) Both S-I & S–II are true and S–II is NOT correct explanation of S-I

3) S–I is true and S–II is false

4) S–I is false and S–II is true

79. If $f(x)$ is a polynomial function such that $f(x)f\left(\frac{1}{x}\right)=f(x)+f\left(\frac{1}{x}\right)$ and $f(3)=-80$ then $f(2)=$

1) 17 **2)** –15 **3)** 16 **4)** –17

80. The function $f:R\to\left[\frac{-1}{2},\frac{1}{2}\right]$ defined as $f(x)=\frac{x}{1+x^2}$ is

1) neither injective nor surjective **2)** invertible

3) injective but not surjective **4)** surjective but not injective

(NUMERICAL VALUE TYPE)

Section-II contains 10 **Numerical Value Type** questions. Attempt any 5 questions only. First 5 attempted questions will be considered if more than 5 questions attempted. 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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81. The number of equivalence relations defined on set $A=\{a,e,i,o,u\}$ is xy then $x+y=$

82. Let $A=\{1,2,3,4,5,6,\}$ and $B=\{3,4,6,7\}$ then the number of elements in set, $\{C\subseteq A:C\cap B\neq\phi\}$ is

83. Let $f:R\to[2,\infty]$ be a function defined as $f(x)=x^2-12ax+15-2a+36a^2$. If $f(x)$ is surjective on R, then the value of $2a$ is_____

84. If $P=\{1,2,3,4,5\},Q=\{a,b,c\}$ then the number of onto functions from $P$to Q is _____

85. If $f(x)=\frac{5^{2x}}{5^{2x}+5}, x\in R$ then $f\left(\frac{1}{2025}\right)+f\left(\frac{2}{2025}\right)+.....+f\left(\frac{2024}{2025}\right)$ is

86. Let $f:N\to R$ be a function such that $f(x+y)=f(x)f(y)$,for natural numbers x and y. If $f(1)=2$ then the value of α for which $\sum_{k=1}^{10} f(\alpha+k)=512\left(2^{10}-1\right)$ holds, is_____

87. The domain of the function $f(x)=\log_4\left\{\log_5\left(\log_3\left(18x-x^2-77\right)\right)\right\}$ is (α,β) then $\alpha\beta=$_____

88. Let α denote the total number of one-one functions from a set A with 3 elements to a set B with 4 elements and β denote the total number of one-one functions from the set A to the set $A\times B$ and $2\beta=k\alpha$ then $k=$

89. The range of $f(x)=\left[\sin x+\left[\cos x+\left[\tan x+\left[\sec x\right]\right]\right]\right], \quad x\in,\left(0,\frac{\pi}{4}\right),[\ ]$ denotes greatest integer function is $\{\lambda\}$ then $\lambda=$_____

90. If $f:\{1,2,3.....\}\to\{0,\pm1,\pm2....\}$ is defined by $f(n)=\begin{cases} n/2, & \text{if } n \text{ is even} \\ -\left(\frac{n-1}{2}\right), & \text{if } n \text{ is odd} \end{cases}$ then $f^{-1}(-50)$ is

KEY SHEET

PHYSICS

1)	**D**	2)	**D**	3)	**A**	4)	**A**	5)	**C**
6)	**A**	7)	**A**	8)	**D**	9)	**B**	10)	**B**
11)	**C**	12)	**D**	13)	**A**	14)	**C**	15)	**A**
16)	**B**	17)	**A**	18)	**C**	19)	**D**	20)	**D**
21)	**50**	22)	**60**	23)	**500**	24)	**1**	25)	**11**
26)	**9**	27)	**10**	28)	**120**	29)	**7**	30)	**5**

CHEMISTRY

31)	**C**	32)	**A**	33)	**B**	34)	**B**	35)	**A**
36)	**A**	37)	**D**	38)	**D**	39)	**C**	40)	**C**
41)	**C**	42)	**D**	43)	**C**	44)	**D**	45)	**C**
46)	**C**	47)	**A**	48)	**A**	49)	**B**	50)	**D**
51)	**5**	52)	**4**	53)	**4**	54)	**8**	55)	**2**
56)	**7**	57)	**8**	58)	**3**	59)	**4**	60)	**8**

MATHEMATICS

61)	**C**	62)	**C**	63)	**B**	64)	**C**	65)	**C**
66)	**D**	67)	**C**	68)	**B**	69)	**C**	70)	**C**
71)	**D**	72)	**B**	73)	**C**	74)	**A**	75)	**A**
76)	**D**	77)	**C**	78)	**B**	79)	**B**	80)	**D**
81)	**7**	82)	**56**	83)	**13**	84)	**150**	85)	**1012**
86)	**8**	87)	**80**	88)	**110**	89)	**1**	90)	**101**

SOLUTIONS
PHYSICS

1. For all scales $\frac{X-LFP}{UFP-LFP}=a(\text{constant})$

2. According to method of mixture
Heat lost by the steam = Heat gained by the ice
$x\times 540=Y\times 80+Y\times 1\times 100$
$540x=180Y \qquad \therefore \frac{Y}{x}=\frac{540}{180}=\frac{3}{1}$

3. Fraction of solid submerged at $t_1°c$ = volume of displaced liquid
$f_1=V_0(1+\gamma t_1)$
Fraction of solid submerged at $t_2°c$ = volume of displaced liquid
$f_2=V_0(1+\gamma t_2)$
$\frac{f_1}{f_2}=\frac{1+\gamma t_1}{1+\gamma t_2}\Rightarrow r=\frac{f_1-f_2}{f_2t_1-f_1t_2}$

4. Increase in length $\Delta L=L\propto\Delta\theta=80\times 2.50\times 10^{-5}\times(45-5)\simeq 0.08cm$
$\therefore$ The correct length of the line $=80+.08=80.08cm$

5. $V_{rms}=\sqrt{\frac{3RT}{M}}$ T will become $T/2$ and M will become $\frac{M}{2}$
So that the value of V_{rms} will increase by $\sqrt{4}=2$ times
$\therefore$New root mean square will be $2V$

6. $\frac{C-0}{100}=\frac{X-(-5)}{95-(-5)}\Rightarrow\frac{55}{100}=\frac{X+5}{100} \qquad \therefore X=50$

7. Loss of time $\Delta t=\frac{1}{2}\propto\Delta\theta\times 86400$
$12.5=\frac{1}{2}\propto(25)\times 86400\Rightarrow\alpha=\frac{1}{86400}/°C$

8. $\gamma_R=\gamma_A+\gamma_g\Rightarrow\gamma_R=\gamma_A+3\alpha g$
For vessel $'A'$ $\gamma_R=\gamma_1+3\alpha$
For vessel $'B'$ $\gamma_R=\gamma_2+3\alpha B$
Hence $g_1+3\alpha=\gamma_2+3\alpha B\,(or)\,\alpha_B=\frac{\gamma_1-\gamma_2}{3}+\alpha$

9. Given that $C=0.6t^2$
We use $dQ=mcdt$

$$\int_0^Q dQ = \int_0^{15} 10 \times 0.6t^2 \Rightarrow Q = 6\left(\frac{t^3}{3}\right)_0^{15} \Rightarrow Q = 6750cal$$

10. Heat given out by water $H_1 = 10 \times 1 \times (30 - 0) = 300cal$

Hear required by $10g$ ice at $-20°C$ to reach $0°C$

$H_2 = 10 \times 0.5 \times 20 = 100cal$

Amount of heat remaining $= 200cal$

$mL_f = 200 \Rightarrow m \times 80 = 200$

$m = 2.5g$

Hence mass of ice left $= 10g - 2.5g = 7.5g$

11. $PV = nRT$ and $VP^2 = K, \Rightarrow P = \frac{K^1}{\sqrt{V}}$

$\therefore \frac{K^1}{\sqrt{V}}.V = nRT$

$\Rightarrow K^1\sqrt{V} = nRT \Rightarrow T = \frac{K^1}{nR} \Rightarrow T \propto \sqrt{V}$

$(or)\frac{T_1}{T_2} = \sqrt{\frac{V_1}{V_2}} \Rightarrow \frac{T_2}{T_1} = \sqrt{\frac{V}{2V}} = \frac{1}{\sqrt{2}} \Rightarrow T_2 = \sqrt{2}T$

12. Translational degree of freedom is three

$\therefore$ Translational $KE = \frac{3}{2}PV = 1.5PV$

13. Percentage of volume expansion $\frac{\Delta V}{V} \times 100 = 3\frac{\Delta r}{r} \times 100$

Percentage of areal expansion $\frac{\Delta A}{A} \times 100 = 2\frac{\Delta r}{r} \times 100$

Where $r =$ radius of sphere

$\therefore$ Percentage increase in volume of sphere is largest.

Coefficient of superficial expansion $\beta = \frac{\Delta A}{A \times 100} = 2 \times \frac{\Delta r}{r \times 100}$

Coefficient of volume expansion $r = \frac{\Delta V}{V \times 100} = 3 \times \frac{\Delta r}{r \times 100}$

$\therefore \frac{B}{r} = \frac{2}{3} \Rightarrow \beta = \frac{2}{3}r$

14. Moment of inertia $I = \frac{1}{12}ml^2 \quad I \propto l^2$

$$\frac{\Delta I}{I}=2\frac{\Delta l}{l}$$

But $\frac{\Delta l}{l}=\propto \Delta t$

$$\therefore \frac{\Delta T}{I}=2\times\Delta t(or)\Delta I=2\propto IAT$$

15. For equilibrium in case (1) at $0°C$ upthrust = weight of body $V_{in}d_2g=V\,d_1\,g$

$$\frac{V_{in}}{V}=\frac{d_1}{d_2}=K_1\rightarrow(1)$$

For equilibrium in case (2) at $60°C$, when the temperature is increased, the density will decreases

$d_1^1=d_1/(1+r_1 60)\quad d_2^1=d_2/(1+r_2 60)$

Again upthrust = weight of the body

$V_{in}^{'}d_2^{'}g=V'd_1^{'}g$

$$K_2=\frac{V_1^1 n}{V^1}=\frac{d_1^1}{d_2^1}=\frac{d_1}{1+r_1 60}\times\frac{1+r_2 60}{d_2}=\frac{d_1}{d_2}\left(\frac{1+r_2 60}{1+r_1 60}\right)$$

$$\therefore \frac{K_1}{K_2}=\frac{d_1}{d_2}\times\frac{d_2}{d_1}\left(\frac{1+r_1 60}{1+r_2 60}\right)=\frac{1+r_1 60}{1+r_2 60}$$

16. Radius of curvature $R=\frac{t}{(\alpha_1-\alpha_2)\Delta T}=\frac{2\times10^{-2}}{(32-19)\times10^{-6}\times50}=30.77m$

17. $V_{rms}=\sqrt{\frac{3RT}{M}}\Rightarrow V_{rms}\propto\sqrt{\frac{T}{M}}$

$$\frac{V_{N_2}}{V_{O_2}}=\sqrt{\frac{TN_2}{TO_2}\times\frac{M_{O_2}}{M_{N_2}}}$$

$$\therefore 1=\sqrt{\frac{T_{N_2}}{T_{O_2}}\times\frac{32}{28}}\qquad M_{N_2}=28\quad M_{H_2}=2$$

$$\frac{T_{N_2}}{T_{O_2}}=\frac{28}{14}\Rightarrow T_{N_2}=\frac{T_{O_2}}{T_{N_2}}=\frac{273+127}{16}=\frac{320}{14}=400$$

$$\frac{T_{N_2}}{T_{O_2}}=\frac{28}{32}$$

$$T_{N_2}=\frac{28}{32}\times T_{O_2}=\frac{\cancel{28}^{7}}{\cancel{32}_{8}}\times\cancel{400}^{50}=350K=77°C$$

18. Thermal stress $=Y\propto\Delta\theta=2\times10^{11}\times15\times10^{-6}\times(50-20)=9\times10^{7}\ N/m^2$

19. Melting of solid causes change in its internal energy

20. Mean free path $\lambda = \frac{KT}{\sqrt{2}d^2 p} \Rightarrow \lambda \propto \frac{T}{P}$

$$\therefore \lambda_2 = \left(\frac{T_2}{T_1}\right)\left(\frac{P_1}{P_2}\right)\lambda_1 = \left(\frac{350}{300}\right)\left(\frac{5\times10^4}{10^4}\right)\left(4\times10^{-7}\right) = 2.3\times10^{-8}m$$

21. $Q = m_I S_I \Delta\theta + m_I L_f + m_W s_W \Delta\theta$

$Q = 22\times0.5\times(8) + 22\times80 + 22\times1\times16$

$Q = 2200cal \rightarrow (1)$

Heat required to raise the temperature of the body by $44°C$

$Q = ms\Delta\theta = ms(44) \rightarrow (2)$

From $(1)\&(2)$ $ms(44) = 2200$

$\therefore$ Water equivalent of the body $(ms) = \frac{2200}{44} = 50g$

22. Given $\alpha_x = 5\times10^{-5}/°C$ $\alpha_f = \alpha_z = 5\times10^{-6}/°C = 50\times10^{-6}/°C$

$\therefore r = \alpha_x + \alpha_y + \alpha_z = 60\times10^{-8}/°C$

23. $\Delta d = d\alpha\Delta\theta$

$6 = 1\times1.2\times10^{-5}\times\Delta\theta$

$\Delta\theta = \frac{6\times10^{-3}}{1.2\times10^{-5}} = 5\times10^2 = 500°C$

24. As number of moles in the two vessels are equal

We have $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

If is given that $V_1 = V_0$ $V_2 = 2V_0$

And $T_1 = 300K$ $T_2 = 600K$

Thus we have $\frac{P_1V_0}{300} = \frac{P_2(2V_0)}{600}(or)$ $P_1 = P_2(or)\frac{P_1}{P_2} = 1$

25. $\frac{PV}{T} = \frac{P^1\frac{90}{100}V}{T} \Rightarrow \frac{P^1}{P} = 1 + \frac{0}{90} \Rightarrow \frac{P^1 - P}{P} = \frac{10}{90}$

$\therefore \frac{P^1 - P}{P}\times100 = \frac{10}{90}\times100 \approx 11$

26. $\frac{L_0(1+\alpha_c\Delta\theta)}{1(1+\alpha_s\Delta\theta)} = \frac{90\left(1+1.7\times10^{-5}\times20\right)}{1\left(1+1.2\times10^{-5}\times20\right)} \approx 90.0089$

27. Let the final temperature of mixture be θ . Then

$$100\times 80+100(\theta-0)=100\times(100-\theta)\Rightarrow\theta=10^{\circ}C$$

28. $$\frac{P_0V_0}{T_0}+\frac{P_0V_0}{T_0}=PV_0\left(\frac{1}{300}+\frac{1}{400}\right)$$

$$2\frac{P_0V_0}{T_0}=PV_0\left(\frac{1}{300}+\frac{1}{400}\right)\Rightarrow p=\frac{2P_0}{T_0}\left(\frac{300\times 400}{700}\right)$$

$$p=\frac{2\times 1.05\times 10^5}{300}\times\frac{300\times 400}{700}=120kP_a$$

29. $$r_R=\gamma_A+\gamma_B\Rightarrow 7\gamma_g=\gamma_A+\gamma_g\Rightarrow\gamma_A=6\gamma g$$

$$\therefore \gamma_R/\gamma_A=\frac{7\gamma_g}{6\gamma_g}=\frac{7}{6}$$

30. Speed of sound $V=\sqrt{\frac{\gamma.p}{\rho}}$

$$330=\sqrt{\frac{\gamma\times 1.01\times 10^5}{1.3}}$$

$$r=1.4$$

$\therefore$ degrees of freedom $f=\frac{2}{r-1}=\frac{2}{1.4-1}=5$

CHEMISTRY

31. Smaller the value of $(n+l)$, smaller the energy. If two or more sub-orbits have same values of $(n+l)$, sub-orbits with lower values of n has lower energy. The $(n+l)$ values of the given options are as follows

$I.n = 4, l = 0, n + l = 4$

$II.n = 3, l = 1, n + l = 4$

$III.n = 3, l = 2, n + l = 5$

$IV.n = 3, l = 0, n + l = 3$

Among I & II two II is having least 'n' value

Correct order is $3 > 1 > 2 > 4$

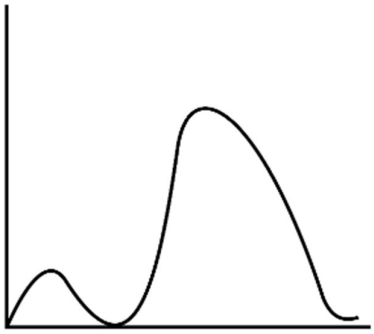
32. Potential energy of the electron in the n^{th} orbit,

$$P.E. = -2 \times 13.6 \times \frac{Z^2}{n^2}$$

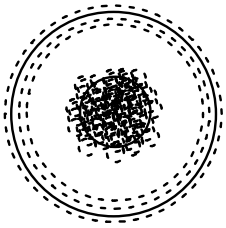
$$P.E. \propto -\frac{1}{n^2}$$

$$P.E. \propto -n^{-2}$$

33. Radial probability distribution graph for $2s$ orbital



Electron cloud picture of $2s$ orbital



34. For Balmer series, $\frac{1}{\lambda} = R\left[\frac{1}{2^2} - \frac{1}{n_2^2}\right]$

For alpha line, $\frac{1}{\lambda_\alpha} = R\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = \frac{1}{X}$

$$\frac{1}{\lambda_\alpha} = R \times \frac{5}{36} = \frac{1}{X}$$

$$R = \frac{36}{5} \times \frac{1}{X} ....(1)$$

For beta line, $\frac{1}{\lambda_\beta} = R\left[\frac{1}{2^2} - \frac{1}{4^2}\right] = \frac{3}{16}R.....(2)$

Substitute eq (1) into (2)

$$\frac{1}{\lambda_\beta} = \frac{3}{16}R = \frac{3}{16} \times \frac{36}{5} \times \frac{1}{X} = \frac{108}{80} \times \frac{1}{X}$$

$$\lambda_\beta = X\frac{80}{108}A^o.$$

35. Conceptual

36. Conceptual

37. *I*. $|\psi|^2$ is a measure of electron density at a point in an atom. Thus, the statement is correct

II.Radial probability function $4\pi^2R^2\psi^2$ gives the probability of finding the electron at a distance r from the nucleus regardless of direction. Thus, the statement is correct

III. The shape of an orbital is defined as a surface of constant probability density that encloses some large fractions of the probability of finding the electron. Thus, the statement is correct.

38. $\lambda = \frac{h}{mv}$. For same velocity $\lambda \propto \frac{1}{m}$.

SO_2 molecule has least wavelength because their molecular mass is high

39. The kinetic energy of the ejected electron is given by the equation

$$hv = hv_0 + \frac{1}{2}mv^2 \quad \because v = \frac{c}{\lambda}$$

Or $\frac{hc}{\lambda} = \frac{hc}{\lambda_0} + \frac{1}{2}mv^2$

$$\frac{1}{2}mv^2 = \frac{hc}{\lambda} - \frac{hc}{\lambda_0} = hc\left(\frac{\lambda_0 - \lambda}{\lambda\lambda_0}\right)$$

$$\therefore v^2 = \frac{2hc}{m}\left(\frac{\lambda_0 - \lambda}{\lambda\lambda_0}\right)$$

Or $v = \sqrt{\frac{2hc}{m}\left(\frac{\lambda_0 - \lambda}{\lambda\lambda_0}\right)}$

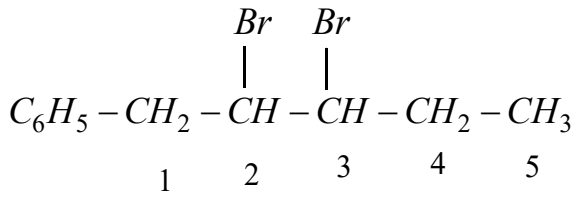
40.

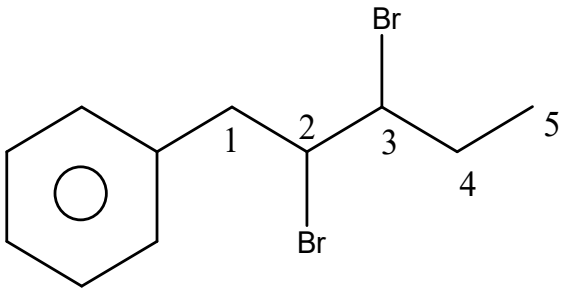
	Lyman series	Balmer series
Limiting line:	$n=\infty \, to \, n=1$	$n=\infty \, to \, n=2$
	$E_L > E_B$	[Limiting case]
	$\lambda_L < \lambda_B$	

Rydberg constant represents the limiting value of the highest wavenumber of any photon that can be emitted from an atom

$$\frac{1}{\lambda_L} = Z^2 R[\lambda_L = \text{limiting case}]$$

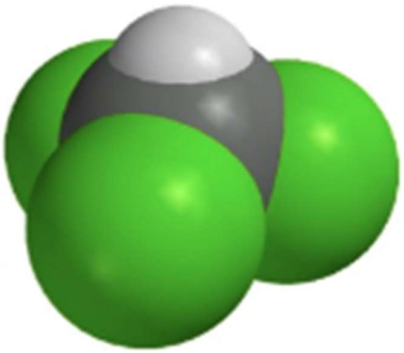
41. $C_{11}H_{14}Br_2$





42. Carbon Carbon bonds are bond line structural representation is zig zag manner

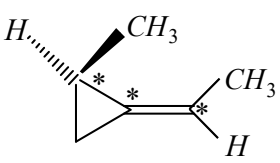
43.



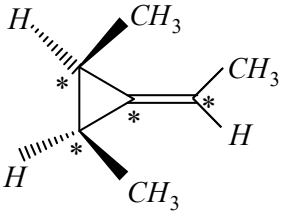
Space filling model

44.  half–headed or Fish hook

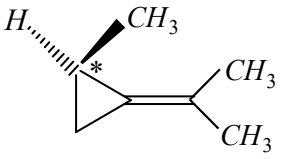
45.



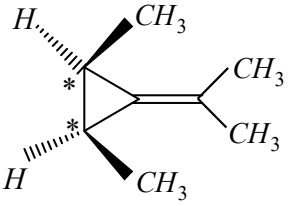
(I)



(II)



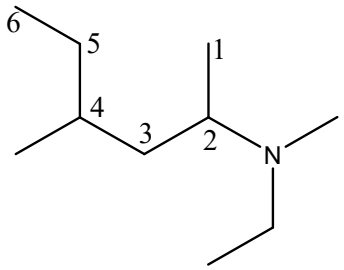
(III)



(IV)

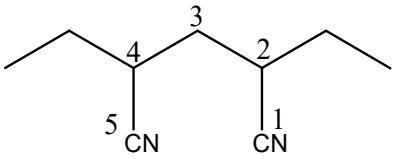
Stereocenters are marked with asterisck(*)

46. $(i) \rightarrow (p,q,s)$

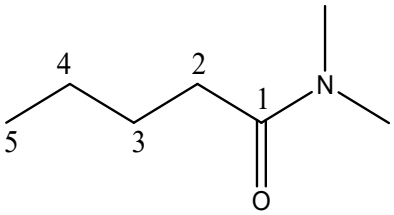


Is has $3°N-$ atom. Parent chain has six carbon. It has $C-4$ and $C-2$ tertiary carbon

$(ii) \rightarrow (q,r)$

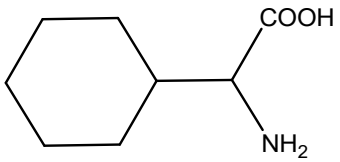


It has no tertiary N-atom. C-2 and C-4 are tertiary carbon. Parent chain has 5 carbon



Its nitrogen is tertiary. Parent chain has five carbon

$(iv) \rightarrow q$ it has two tertiary carbon. Parent chain has only two carbon



47. (i) $cis-cis$ and trans-trans are achiral while $cis-trans$ is chiral, giving total four stereoisomers

(ii) Has a meso form and a pair of enantiomers

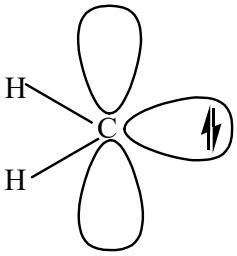
(iii) has two pair of enantiomers

(iv) has two pair of enantiomers

48.

$H-C-H$

sp^2- hybridise



Diamagnetic bent shaped (lp.bp) repulsion behave as cation

49. Compound has a plane of symmetry therefore, optically inactive. It has two carbons bonded to chlorine, chiral , Carbon bonded to fluorine is not chiral

50. –COOH is directly on cyclopentane ring. Its correct IUPAC name would be 3-chlorocyclopentane carboxylic acid

51. The orbital angular momentum is given by $\sqrt{l(l+1)}\times h/2\pi$

In the question, it is given to be $\sqrt{6}\times h/2\pi$

So, it means $\sqrt{l(l+1)}=\sqrt{6}$

$l=2$

The possible values of magnetic quantum numbers for $l=2$ will be

$m_l=-2,-1,0,1,2$

So, the vector can split into FIVE components in the presence of the external magnetic field

52. Energy of photon

$$=\frac{hc}{\lambda}J=\frac{hc}{e\lambda}eV=\frac{6.625\times10^{-34}\times3\times10^{8}}{300\times10^{-9}\times1.602\times10^{-19}}=4.14eV$$

For photoelectric effect to occur, energy of incident photons must be greater than work function of metal. Hence, only Li, Na, K and Mg have work functions less than $4.14V$.

53. Given that

Velocity of electron $= \frac{1}{550} \times$ velocity of light

But we know velocity of electron in Bohr orbit is

$V_n = \frac{2.19 \times 10^8 \times Z}{n} cm / \sec$

$\therefore \frac{2.19 \times 10^8 \times 1}{n} = \frac{1}{550} \times 3 \times 10^{10}$

$\therefore n = \frac{2.19 \times 10^8 \times 550}{3 \times 10^{10}} = 4$

Hence answer is 4.

54. According to the question, uncertainty in position is equal to de-Broglie wavelength

$\therefore \Delta x = \frac{h}{mv}$

Now, according to uncertainty principle, $\Delta x \times \Delta p = \frac{h}{4\pi}$

As mentioned in the question, minimum percent error is required

So, $m\Delta v \times \Delta x = \frac{h}{4\pi}$.

By putting the value of Δx from above, we get $\frac{\Delta v}{v} = \frac{1}{4\pi}$.

So, % error $= \frac{\Delta v}{v} \times 100 = \frac{100}{4\pi} = 8$

55. As we know,

$\mu = \sqrt{n(n+2)}$

$n =$ number of unpaired electrons

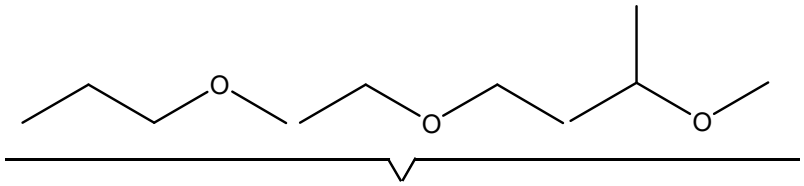
$Fe^{2+} = 4$ unpaired electrons

$Mn^{2+} = 5$ unpaired electrons

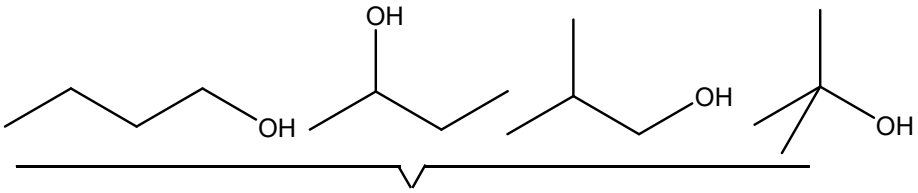
$Cr^{2+} = 4$ unpaired electrons

$Ni^{2+} = 2$ unpaired electrons

56. (7) compound $C_4H_{10}O$ is based on general formula $C_nH_{2n+2}O$, Hence, it can be an alcohol or ether



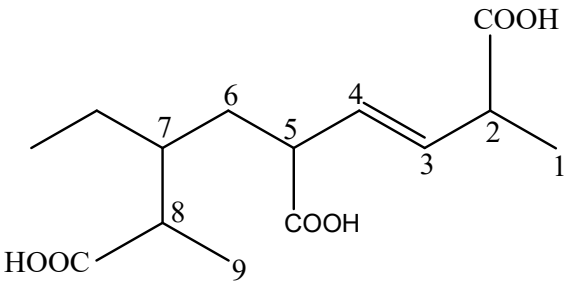
Ethers



Alcohols

57. All three carbon of three $-COOH$ are sp^2

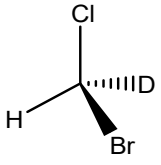
Three oxygen, one in each $-COOH$ are sp^2



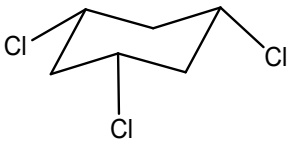
7-ethyl-3-nonene-2,5,8-tricarboxylic acid

Both C-3 and C-4 carbons are sp^2

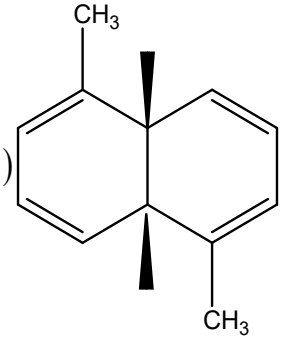
58.



(a) one chiral center is present so compound is chiral (P.O.S absent)

(f) 

P.O.S absent so compound is chiral

(h) 

No C.O.S.; no P.O.S

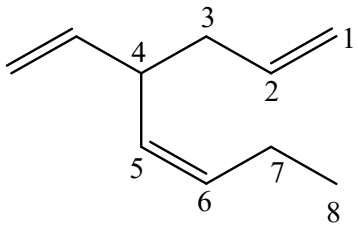
P.O.S: Plane of symmetry

C.O.S: Center of symmetry

59.

$$CH_3 - CH_2 - O - \overset{1}{CH_2} - \overset{2}{CH_2} - \overset{3}{CH_2} - O - CH_2 - CH_2 - O - CH_3$$

60.



Given: $3-(1-buteryl)-1,5-hexadine$

IUPAC: $4-\text{ethenyl}-1,5-\text{octadiene}$

MATHEMATICS

61. No.of elements in $S=\frac{5\not{0}\times 6}{1\not{0}}=\frac{n\times 3}{9}\Rightarrow n=90$

62. $S-I\rightarrow$ Let $a\in R\Rightarrow 1+a.a=1+a^2>0$

R is reflexive

Let $(a,b)\in R\Rightarrow 1+ab>0\Rightarrow 1+ba>0$

R is symmetric

Since $\left(1,\frac{1}{3}\right)\in R$ and $\left(\frac{1}{3},-1\right)\in R$ but $(1,-1)\notin R$

R is not transitive

$|a-a|=0<1$

$\therefore aRa;\forall a\in R\Rightarrow R$ is reflexive

$aRb\Rightarrow|a-b|<1\Rightarrow|b-a|<1\Rightarrow bRa\Rightarrow R$ is symmetric

aRb,bRc then $a\not{R}c\Rightarrow R$ is not transitive

63. $\{(1,1),(2,2),(3,3),(1,2),(2,3),(2,1),(3,2),(1,3),(3,1)\}$

$k=7$

The number of positive divisors of $2k+2=16=2^4$ is 5

64. Let the total population of town be 'x'

$\therefore\frac{25}{100}x+\frac{15x}{100}-1500+\frac{65x}{100}=x\Rightarrow\frac{105x}{100}-x=1500\Rightarrow x=30,000$

65. Let $n(A)=\alpha,n(B)=\beta,(\alpha>\beta)$

Given $2^\alpha-2^\beta=120\Rightarrow\alpha=7,\beta=3$

$\therefore n(A\cap B)\in[7,10]$

66. R is transitive but not reflexive and symmetric

67. $n(A)=53,n(B)=69,n(A\cap B)=x$

$n(A\cup B)=n(A)+n(B)-n(A\cap B)=122-x$

Since max of $n(A),n(B)\le n(A\cup B)$

$\Rightarrow 69\le n(A\cup B)\le 100\Rightarrow 69\le 122-x\le 100\Rightarrow 22\le x\le 53$

68. $n(A\Delta B)=n(A\cup B)-n(A\cap B)$

69. $x\not{R}y\Leftrightarrow x-y$ is divisible by 5

$xRx\Rightarrow 0$ is divisible by 5

$x\not{R}y\Rightarrow x-y$ is divisible by 5

$\Rightarrow y-x$ is also divisible by 5

xRy and $yRz \Rightarrow xRz$

70. $xRy \Rightarrow x$ is relatively prime to y

$R = \{(2,3),(2,7),(3,7),(3,10),(4,3),(4,7),(5,3),(5,6),(5,7)\}$

71. The domain of $f(x)$ is $R-\{4\}$ and domain of $g(x)$ is R

So assertion is false and R is true

72. $f(T+x) = 1+\left[(1-f(x))^3\right]^{1/3} = 1+(1-f(x))$

$\Rightarrow f(T+x)+f(x) = 2 \rightarrow (1) \Rightarrow f(2T+x)+f(T+x) = 2 \rightarrow (2)$

$(2)-(1) \Rightarrow f(2T+x)-f(x) = 0 \Rightarrow f(x+2T) = f(x)$

$\therefore$ Period of $f(x)$ is $2T$

73. $f(x) = \dfrac{(x^2+x+1)+1}{x^2+x+1} = 1+\dfrac{1}{\left(x+\frac{1}{2}\right)^2+\frac{3}{4}}$

$\therefore f(x) > 1$

$f(x)$ is max when $\left(x+\dfrac{1}{2}\right)^2+\dfrac{3}{4}$ is minimum

$\therefore f_{\max} = 1+\dfrac{1}{\frac{3}{4}} = \dfrac{7}{3}$

when $x = \dfrac{-1}{2}$

Range $= \left(1, \dfrac{7}{3}\right]$

74. $af(x+1)+bf\left(\dfrac{1}{x+1}\right) = (x+1)-1 \rightarrow (1)$

Replacing $x+1$ by $\dfrac{1}{x+1}$, we get

$af\left(\dfrac{1}{x+1}\right)+bf(x+1) = \dfrac{1}{x+1}-1 \rightarrow (2)$

$(1)\times a-(2)\times b \Rightarrow$

$\left(a^2-b^2\right)f(x+1) = a(x+1)-a-\dfrac{b}{x+1}+b$

Put $x=1$

$$f(2)=\frac{2a+b}{2\left(a^2-b^2\right)}$$

75. Assertion (A): $f(x)=\begin{cases}x-1; x \text{ is even}\\ x+1; x \text{ is odd}\end{cases}$

So f is clearly one-one and onto

A is true, R is true and R is correct explanation of A

76. $f(x)=1+\cos 2x+\sqrt{3}\sin 2x+1=2+2\sin\left(2x+\frac{\pi}{6}\right)$

Since $-\frac{\pi}{3}\le x\le\frac{\pi}{6}\Rightarrow\frac{-\pi}{2}\le\left(2x+\frac{\pi}{6}\right)\le\frac{\pi}{2}$

Range $[0,4]=B$

The quadratic equation having roots $0,4$ is $x^2-4x=0$

77. $f^{-1}(x)=f(x)\Rightarrow f(x)=x$

78. $I\rightarrow f(x)=\operatorname{sgn}\left((x-1)^2+1\right)=1 \quad \left\{\because (x-1)^2+1>0,\forall x\in R\right\}$

$II\rightarrow f(x)=\left[\sin\{x\}\right]$

Since $0\le\{x\}<1\Rightarrow 0\le\sin\{x\}<\sin 1\Rightarrow\left[\sin\{x\}\right]=0$

Range is $\{0\}$

79. $f(x)=1-x^n$

$f(3)=-80\Rightarrow 1-3^n=-80\Rightarrow 3^n=81\Rightarrow n=4\Rightarrow f(x)=1-x^4$

$\therefore f(2)=1-16=-15$

80. $f(2)=f\left(\frac{1}{2}\right)=\frac{2}{5}$

$\therefore f$ is not injective

Here range of $f(x)is$ $\left[-\frac{1}{2},\frac{1}{2}\right]=$ co-domain

$\therefore f$ is surjective

81. no.of equivalence relations $= 52$

$\therefore x+y=7$

82. $A=\{1,2,3,4,5,6\}$

The number of subsets of A is $2^6=64$

$C\cap B=\phi\Rightarrow C\subseteq\{1,2,5\}\Rightarrow$ The number of subsets of such $C's\ is\ 2^3=8$

$\therefore$ The number of elements in $\{C\subseteq A: C\cap B\neq 0\}=64-8=56$

83. $f(x)=(x-6a)^2+15-2a$

Since $f(x)$ is surjection on R

$\therefore 15-2a=2\Rightarrow 2a=13$

84. no.of onto functions $=n^m-n_{C_1}(n-1)^m+n_{C_2}(n-2)^m+.....$

85. $f(x)=\dfrac{25^x}{25^x+5}$

$$f(x)+f(1-x)=\frac{25^x}{25^x+5}+\frac{25^{1-x}}{25^{1-x}+5}=\frac{25^x}{25^x+5}+\frac{25}{25+5\left(25^x\right)}=\frac{25^x+5}{25^x+5}=1$$

$$\therefore f\left(\frac{1}{2025}\right)+f\left(\frac{2}{2025}\right)+----f\left(1-\frac{2}{2025}\right)+f\left(1-\frac{1}{2025}\right)$$

$=1+1+-----1012\ times=1012$

86. $f(x+y)=f(x)f(y)\Rightarrow f(x)=a^x$

$f(1)=2\Rightarrow a=2$

$\therefore f(x)=2^x$

$$\therefore 512\left(2^{10}-1\right)=\sum_{k=1}^{10}f(\alpha+k)=\sum_{k=1}^{10}f(\alpha)f(k)=f(\alpha)\left(f(1)+f(2)+....+f(10)\right)$$

$= f(\alpha)\left(2+2^2+2^3+------+2^{10}\right) \Rightarrow 512\left(2^{10}-1\right) = 2^{\alpha}.2\dfrac{\left(2^{10}-1\right)}{2-1} \Rightarrow 512 = 2^{\alpha+1}$

$\Rightarrow \alpha+1=9 \Rightarrow \alpha=8$

87. $f(x) = \log_4\left\{\log_5\left(\log_3\left(18x-x^2-77\right)\right)\right\}$ is defined

When $\log_5\left\{\log_3\left(18x-x^2-77\right)\right\} > 0$ and $18x-x^2-77>0$

$\Rightarrow \log_3\left(18x-x^2-77\right) > 5^{\circ}$ and $x^2-18x+77<0$

$\Rightarrow 18x-x^2-77>3$ and $(x-7)(x-11)<0$

$\Rightarrow x^2-18x+80<0$ and $7<x<11 \Rightarrow 8<x<10$ and $7<x<11 \Rightarrow 8<x<10 \Rightarrow x \in (8,10)$

88. $\alpha = n(B)_{P_{n(A)}} = 4_{P_3} = 24$

$\beta = n(A\times B)_{P_{n(A)}} = 12_{P_3} = 1320$

$2\beta = 110\times 24 = 110\times\alpha$

$\therefore K = 110$

89. $x \in \left(0,\dfrac{\pi}{4}\right) \Rightarrow 0<\sin x<\dfrac{1}{\sqrt{2}}; \dfrac{1}{\sqrt{2}}<\cos x<1, 0<\tan x<1, 1<\sec x<\sqrt{2}$

$f(x) = \left[\sin x+\left[\cos x+\left[\tan x+1\right]\right]\right] = \left[\sin x+\left[\cos x+\left[\tan x\right]+1\right]\right]$

$= \left[\sin x+\left[\cos x+1\right]\right] = \left[\sin x+\left[\cos x\right]+1\right] = \left[\sin x+1\right] = \left[\sin x\right]+1 = 1$

$\therefore$ Range $= \{1\}$

90. $f^{-1}(-50) = n \Rightarrow f(n) = -50 \Rightarrow -\dfrac{(n-1)}{2} = -50 \Rightarrow n = 101$