RANKRIDGE IIT JEE/NEET JUNIOR COLLEGE (LONGTERM)

TELANGANA

STREAM: JR MPC
Time: 3:00 Hours

WEEKEND TEST-20

Date: 08-12-2025
Max Marks: 300

SYLLABUS

MATHEMATICS : Hyperbolic functions and properties of vectors
PHYSICS : Mechanical Properties of Solids (complete chapter)
CHEMISTRY : Organic IUPAC nomenclature and isomerism

MATHEMATICS

(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) 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. If $\bar{a},\bar{b},\bar{c}$ are unit vectors such that $(\bar{a},\bar{b})=\frac{\pi}{6},(\bar{b},\bar{c})=\frac{\pi}{3}$ and $(\bar{c},\bar{a})=\frac{\pi}{4}$, then $|\bar{a}+\bar{b}+\bar{c}|=$

(A) 3 (B) $4+\sqrt{3}+\sqrt{2}$
(C) $\sqrt{4+\sqrt{3}+\sqrt{2}}$ (D) 2

2. If $\bar{a},\bar{b},\bar{c}$ are three vectors of equal magnitude and angle between each pair of vectors is $\pi/3$ such that $|\bar{a}+\bar{b}+\bar{c}|=\sqrt{6}$, then $|\bar{a}|=$

(A) 2 (B) -1
(C) 1 (D) $\frac{\sqrt{6}}{3}$

3. If $\overline{AB}=3\bar{i}-4\bar{j}-\bar{k},\ \overline{BC}=4\bar{i}-\bar{j}+3\bar{k}$ are two sides of a ΔABC, then $\angle C=$

(A) 45^0 (B) 90^0
(C) 75^0 (D) 30^0

4. The angle between the vectors $\bar{a}$ and $\bar{b}$ is 60^0. Then the angle between $-2\bar{a}$ and $3\bar{b}$ is

(A) 120^0 (B) 150^0
(C) 30^0 (D) 90^0

5. The vectors $2\bar{i}-m\bar{j}+3m\bar{k}$ and $(1+m)\bar{i}-2m\bar{j}+\bar{k}$ include an acute angle for

(A) all values of m
(B) $m>-2, m<-1/2$
(C) $m<-2$ or $m>-1/2$
(D) $m>2, m<1/2$

6. $\bar{a}=\bar{i}-\bar{j}+3\bar{k};\bar{b}=3\bar{i}-5\bar{j}+6\bar{k}$. The magnitude of the projection of $2\bar{a}-\bar{b}$ on $\bar{a}+\bar{b}$ is

(A) $\frac{22}{\sqrt{10}}$ (B) $\frac{22}{\sqrt{133}}$
(C) $\frac{11\sqrt{2}}{\sqrt{10}}$ (D) $\frac{22}{\sqrt{5}}$

7. Let $\bar{a}=2\bar{i}+3\bar{j}+\bar{k},\bar{b}=4\bar{i}+\bar{j}$ and $\bar{c}=\bar{i}-3\bar{j}-7\bar{k}$. A vector $\bar{r}$ is such that $\bar{r}.\bar{a}=9,\ \bar{r}.\bar{b}=7;\ \bar{r}.\bar{c}=6$, then $\bar{r}$ is

(A) $\bar{i}+3\bar{j}+2\bar{k}$ (B) $\bar{i}+3\bar{j}-2\bar{k}$
(C) $\bar{i}-2\bar{j}+3\bar{k}$ (D) $\bar{i}+2\bar{j}+5\bar{k}$

8. The angle between the diagonals of a parallelogram with the vectors $2\bar{i}+\bar{j}$ and $\bar{k}-2\bar{j}$ as adjacent sides is

(A) $\pi/2$ (B) $\pi/6$
(C) $\pi/3$ (D) $\pi/4$

9. Let $\bar{a},\bar{b},\bar{c}$ be unit vectors and $\bar{x}=\bar{a}+\bar{b}+\bar{c}$. If $\bar{a}.\bar{x}=1,\ \bar{b}.\bar{x}=\frac{3}{2}$ and $|\bar{x}|=2$, then the angle between $\bar{c}$ and $\bar{x}$ is

(A) $\cos^{-1}\left(\frac{1}{4}\right)$ (B) $\cos^{-1}\left(\frac{3}{4}\right)$

(C) $\cos^{-1}\left(\frac{3}{8}\right)$ (D) $\cos^{-1}\left(\frac{5}{8}\right)$

10. Let $\bar{a}$ and $\bar{b}$ be two unit vectors. If the vectors $\bar{c} = a + 2\hat{b}$ and $\bar{d} = 5a - 4\hat{b}$ are perpendicular to each other, then the angle between $\bar{a}$ and $\bar{b}$ is

(A) $\frac{\pi}{6}$ (B) $\frac{\pi}{2}$

(C) $\frac{\pi}{3}$ (D) $\frac{\pi}{4}$

11. If the vector $\bar{a} = 3\bar{j} + 4\bar{k}$ is the sum of two vectors $\bar{a_1}$ and $\bar{a_2}$, vector $\bar{a_1}$ is parallel to $\bar{b} = \bar{i} + \bar{j}$ and vector $\bar{a_2}$ is perpendicular to $\bar{b}$, then $\bar{a_1} =$

(A) $\frac{1}{2}\left(\bar{i} + \bar{j}\right)$ (B) $\frac{1}{3}\left(\bar{i} + \bar{j}\right)$

(C) $\frac{2}{3}\left(\bar{i} + \bar{j}\right)$ (D) $\frac{3}{2}\left(\bar{i} + \bar{j}\right)$

12. If $\bar{a} = 2\bar{i} + \bar{j} - 3\bar{k}, \bar{b} = \bar{i} - 2\bar{j} + \bar{k}$, then a vector of length 5 and perpendicular to both $\bar{a}$ and $\bar{b}$ is

(A) $\pm\frac{5}{\sqrt{3}}\left(\bar{i} + \bar{j} + \bar{k}\right)$ (B) $\pm\left(\bar{i} + \bar{j} + \bar{k}\right)$

(C) $\pm\left(\bar{i} - \bar{j} + \bar{k}\right)$ (D) $\pm\frac{3}{\sqrt{5}}\left(\bar{i} + \bar{j} + \bar{k}\right)$

13. If $\bar{a} + 2\bar{b} + 4\bar{c} = \bar{0}$, then $\bar{a}\times\bar{b} + \bar{b}\times\bar{c} + \bar{c}\times\bar{a} -$

(A) $4\left(\bar{b}\times\bar{c}\right)$ (B) $5\left(\bar{b}\times\bar{c}\right)$

(C) $6\left(\bar{b}\times\bar{c}\right)$ (D) $7\left(\bar{b}\times\bar{c}\right)$

14. Let $\bar{a} = 2\bar{i} + 3\bar{j} - \bar{k}, \bar{b} = 3\bar{i} - \bar{j} + \bar{k}$ and $\bar{c} = \bar{i} + \bar{j} + 3\bar{k}$. If $\bar{r}\times\bar{b} = \bar{c}\times\bar{b}, \bar{r}.\bar{a} = 0$, then $\bar{r} =$

(A) $-\bar{i} + \bar{j} + \bar{k}$ (B) $2\left(-\bar{i} + \bar{j} + \bar{k}\right)$

(C) $-5\bar{i} + \bar{j} + \bar{k}$ (D) $-\bar{i} + 5\bar{j} + \bar{k}$

15. If $\bar{a}, \bar{b}, \bar{c}$ are three vectors such that $|\bar{a}| = |\bar{c}| = 1, |\bar{b}| = 4, |\bar{b}\times\bar{c}| = 2$ and $2\bar{b} = \bar{c} + \lambda\bar{a}$ then $\lambda =$

(A) $\sqrt{65 - 8\sqrt{3}}$ (B) $\sqrt{17}$

(C) $\sqrt{3}$ (D) $\sqrt{\frac{17}{2}\left(2 + \sqrt{3}\right)}$

16. The vector $\bar{c}$ is perpendicular to both $\bar{a} = (1, -2, -1), \bar{b} = (2, 1, -1)$ and $\bar{c}$ also satisfies $\left|\bar{c}\times\left(\bar{i} - \bar{j} + \bar{k}\right)\right| = 2\sqrt{6}$, then $\bar{c} =$

(A) $\pm\left(3\bar{i} - \bar{j} + 5\bar{k}\right)$ (B) $\pm\left(3\bar{i} + \bar{j} + 5\bar{k}\right)$

(C) $\pm\left(5\bar{i} + \bar{j} + 3\bar{k}\right)$ (D) $\pm\left(3\bar{i} - \bar{j} - 5\bar{k}\right)$

17. If $\bar{a}$ and $\bar{b}$ are any two vectors of magnitudes 2 and 3 respectively, such that $\left|2\left(\bar{a}\times\bar{b}\right)\right| + \left|3\left(\bar{a}.\bar{b}\right)\right| = k$, then the maximum value of k is

(A) $\sqrt{13}$ (B) $2\sqrt{13}$

(C) $6\sqrt{13}$ (D) $10\sqrt{13}$

18. Let $\bar{a} = 2\hat{i} + 7j - k, \bar{b} = 3\hat{i} + 5k$ and $\bar{c} = \hat{i} - j + 2k$. Let $\bar{d}$ be a vector which is perpendicular to both $\bar{a}$ and $\bar{b}$, and $\bar{c}.\bar{d} = 12$. Then $\left(-\hat{i} + j - k\right).\left(\bar{c}\times\bar{d}\right)$ is equal to

(A) 24 (B) 42

(C) 48 (D) 44

19. Let $\bar{a} = \hat{i} - j, \bar{b} = \hat{i} + j + k$ and $\bar{c}$ be a vector such that $\bar{a}\times\bar{c} + \bar{b} = \bar{0}$ and $\bar{a}.\bar{c} = 4$, then $|\bar{c}|^2$ is equal to

(A) $\frac{19}{2}$ (B) 9

(C) 8 (D) $\frac{17}{2}$

20. $\bar{r}$ is a vector perpendicular to the plane determined by the vectors $2\bar{i} - \bar{j}$ and $\bar{j} + 2\bar{k}$. If the magnitude of the projection of $\bar{r}$ on the vector $2\bar{i} + \bar{j} + 2\bar{k}$ is 1, then $|\bar{r}| =$

(A) $\sqrt{6}$ (B) $3\sqrt{6}$

(C) $\frac{2\sqrt{6}}{3}$ (D) $\frac{3\sqrt{6}}{2}$

(NUMERICAL VALUE TYPE)

Section-II contains 5 Numerical Value Type questions.
Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases

21. If $\bar{a},\bar{b}$ are noncollinear unit vectors, $|\bar{a}+\bar{b}|=\sqrt{3}$, then $(2\bar{a}+5\bar{b}).(3\bar{a}-\bar{b})=$

22. Let $\bar{a},\bar{b},\bar{c}$ be three mutually perpendicular vectors of the same magnitude and equally inclined at an angle θ with the vector $\bar{a}+\bar{b}+\bar{c}$ then $36\cos^2 2\theta$ is equal to ____.

23. $(\bar{a}\times\bar{b})^2+(\bar{a}.\bar{b})^2=144$ and $|\bar{a}|=4$, then $|\bar{b}|=$ ____.

24. Let $\bar{a}=\hat{i}+\alpha j+3k$ and $\bar{b}=3\hat{i}-\alpha j+k$. If the area of the parallelogram whose adjacent sides are represented by the vectors $\bar{a}$ and $\bar{b}$ is $8\sqrt{3}$ square units, then $\bar{a}.\bar{b}$ is equal to ____.

25. Let $\bar{a}=\hat{i}-3j+7k$, $\bar{b}=2\hat{i}-j+k$ and $\bar{c}$ be a vector such that $(\bar{a}+2\bar{b})\times\bar{c}=3(\bar{c}\times\bar{a})$. If $\bar{a}.\bar{c}=130$, then $\bar{b}.\bar{c}$ is equal to ____.

PHYSICS

(SINGLE CORRECT ANSWER TYPE)

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26. A particle moves according to the equation $x=a\cos\left(\frac{\pi t}{2}\right)$. The distance covered by it in the time interval between t = 0 to t = 3 s is
(A) 2a (B) 3a
(C) 4a (D) a

27. A particle is subjected to two SHMS $x_1=A_1\sin\omega t$ and $x_2=A_2\sin\left(\omega t+\frac{\pi}{4}\right)$. The resultant SHM will have an amplitude of
(A) $\frac{A_1+A_2}{2}$ (B) $\sqrt{A_1^2+A_2^2}$
(C) $\sqrt{A_1^2+A_2^2+\sqrt{2}A_1A_2}$
(D) A_1A_2

28. The displacement of a particle executing SHM at any time t (seconds) is $x=0.01\sin 100\pi(t+0.05)$ then its time period will be
(A) 0.2 s (B) 0.1 s
(C) 0.06 s (D) 0.02 s

29. A 20 g particle is executing SHM between the limits (5, 0, 0)cm and (15, 0, 0)cm. The total distance covered during one oscillation is
(A) 10 cm (B) 15 cm
(C) 20 cm (D) 25 cm

30. A body executing SHM has a maximum velocity of $1ms^{-1}$ and a maximum acceleration of $4ms^{-2}$. Its amplitude in metres is
(A) 1 (B) 0.75
(C) 0.5 (D) 0.25

31. The velocity of a particle in SHM at the instant when it is 0.6 cm away from the mean position is 4 cm/s. If the amplitude of vibration is 1 cm then its velocity at the instant when it is 0.8 cm away from the mean position is (in cm/s)
(A) 2.25 (B) 2.5
(C) 3.0 (D) 3.5

32. An object is attached to the bottom of a light vertical spring and set vibrating. The maximum speed of the object is 15 cm/s and the period is 628 milli seconds. The amplitude of the motion in centimetres is
(A) 3.0 (B) 2.0
(C) 1.5 (D) 1.0

33. The ratio of velocities of particle in SHM at displacements A/3 and 2A/3 is
(A) 1:2 (B) 2:1
(C) $\sqrt{8}:\sqrt{5}$ (D) $\sqrt{5}:\sqrt{8}$

34. The average kinetic energy of a simple harmonic oscillator is 2 joule and its total energy is 5 joule. Its minimum potential energy is
(A) 1J (B) 1.5 J
(C) 2J (D) 3J

35. The acceleration due to gravity on a planet is 3/2 times that on the earth. If length of a seconds pendulum on earth is 1m, length

of seconds pendulum on surface of planet is

(A) 0.7m (B) 1m
(C) 1.7m (D) 1.5 m

36. The length of a pendulum changes from 1 m to 1.21m. The percentage change in its period is

(A) 20% (B) 21%
(C) 10% (D) 11%

37. A body of mass 1/4 kg is in SHM and its displacement is given by the relation $x = 0.05Sin\left(20t + \frac{\pi}{2}\right)m$. If this in seconds, the maximum force acting on the particle is

(A) 5N (B) 2.5N
(C) 10N (D) 0.25N

38. A simple pendulum has a time period T_1 on the earth's surface and T_2 when taken to height R above the earth's surface, where R is the radius of the earth. The value of $\frac{T_2}{T_1}$ is

(A) 2 (B) 1
(C) $\sqrt{2}$ (D) 4

39. Displacement time equation of a particle executing SHM is, $x = 10\sin\left(\frac{\pi}{3}t + \frac{\pi}{6}\right)cm$. The distance covered by particle in 3s is

(A) 5 cm (B) 20 cm
(C) 10 cm (D) 15 cm

40. A particle executes SHM with a time period of 16 s. At time t = 2s the particle crosses the mean position while at t = 4s its velocity is $4ms^{-1}$. The amplitude of motion in metre is

(A) $\sqrt{2}\pi$ (B) $16\sqrt{2}\pi$
(C) $32\sqrt{2}/\pi$ (D) $4/\pi$

41. Four simple harmonic vibrations $x_1 = 8\sin(\omega t)$, $x_2 = 6\sin\left(\omega t + \frac{\pi}{2}\right)$, $x_3 = 4\sin(\omega t + \pi)$ and $x_4 = 2\sin\left(\omega t + \frac{3\pi}{2}\right)$ are superimposed on each other. The resulting amplitude is.... units,

(A) 20 (B) $8\sqrt{2}$
(C) $4\sqrt{2}$ (D) 4

42. The metallic bob of a simple pendulum has the relative density ρ. The time period of this pendulum is T. If the metallic bob is immersed in water, then the new time period is

(A) $T\left(\frac{\rho-1}{\rho}\right)$ (B) $T\left(\frac{\rho}{\rho-1}\right)$
(C) $T\sqrt{\frac{\rho-1}{\rho}}$ (D) $T\sqrt{\frac{\rho}{\rho-1}}$

43. A simple pendulum with a brass bob has a period T. The bob is now immersed in a non-viscous liquid and oscillated. If the density of the liquid is 1/8th of brass, the time period of the same pendulum will be

(A) $\sqrt{\frac{8}{7}}T$ (B) $\frac{8}{7}T$
(C) $\frac{64}{49}T$ (D) T

44. A Seconds pendulum is suspended from roof of a vehicle that is moving along a circular track of radius $\frac{10}{\sqrt{3}}m$ with speed 10m/s. Its period of oscillation will be ($g = 10m/s^2$)

(A) $\sqrt{2}s$ (B) 2s
(C) 1s (D) 0.5s

45. Amplitude of oscillation of a particle that executes SHM is 2 cm. Its displacement from its mean position in a time equal to 1/6th of its time period is

(A) $\sqrt{2}cm$ (B) $\sqrt{3}cm$
(C) $\frac{1}{\sqrt{2}}cm$ (D) $\frac{1}{\sqrt{3}}cm$

NUMERICAL VALUE TYPE)

Section-II contains 5 Numerical Value Type questions.

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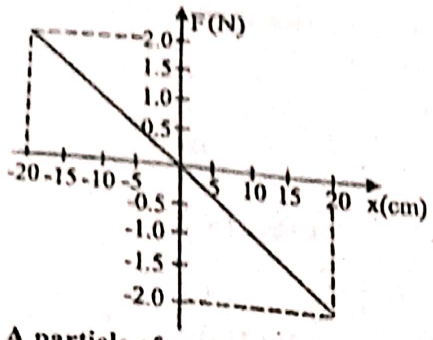
46. Figure shows the variation of force acting on a particle of mass 400 g executing simple harmonic motion. The frequency of oscillation of the particle is $f = \frac{x}{2\pi}s^{-1}$ where $x =$ _____.



47. A particle of mass 1 kg is executing SHM with an amplitude of 1m and time period π sec, kinetic energy of the particle at the moment when the dis-placement is 0.8m is 72×10^{-x} J, where x = _____.

48. A particle of mass 0.1kg executes SHM under a force F = -10x(N). Speed of particle at mean position is 6 m/s. Its amplitude of oscillation $x\times10^{-1}m^2$, where x = _____.

49. A simple pendulum 4 m long swing with an amplitude of 0.2 m. Its acceleration at the ends of its path is $a=x\times10^{-1}m/s^2$, where x = _____.

50. The displacement of two identical particles executing SHM are represented by equations $x_1=4\sin\left(10t+\frac{\pi}{6}\right)$ & $x_2=5\cos(\omega t)$ For what value of ω, energy of both the particles is same.

CHEMISTRY

(SINGLE CORRECT ANSWER TYPE)

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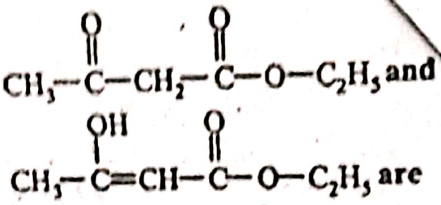
51. n- Butane and isobutane are a pair of
(1) chain isomers
(2) position isomers
(3) metamers
(4) functional isomers

52. The compound which is not isomeric with diethyl ether is
(1) n-propyl methyl ether
(2) Butan-1-ol
(3) 2- Methylpropan-2-ol
(4) Butanone

53. The molecules



are
(1) Geometrical isomers
(2) Tautomers
(3) Diastereomers
(4) Metamers

54. Carboxylic acids and esters are
(1) Functional isomers
(2) Keto-enol tautomers
(3) Geometrical isomers
(4) Not isomers at all

55. $CH_3CH_2CH_2OH$ is a functional isomer of
(1) $C_2H_5OCH_3$
(2) $CH_3OC_3H_7$
(3) $CH_3CH_2CH_2OCH_2CH_3$
(4) $CH_3CHOHCH_3$

56. The number of structural alcoholic isomers for $C_4H_{10}O$ is
(1) 2 (2) 3
(3) 4 (4) 5

57. The number of aromatic isomers possible for C_7H_8O is
(1) 2 (2) 3
(3) 4 (4) 5

58. Primary, secondary and tertiary amines are
(1) Chain isomers (2) Position isomers
(3) Functional isomers (4) Tautomers

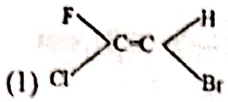
59. Which of the following compounds is isomeric with trimethyl amine?
(1) 1-Propanamine (2) 2-Propanamine
(3) Both 1 and 2 (4) 2-Butanamine

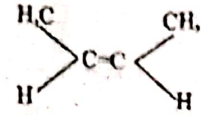
60. Among the following the pair that is not a pair of metamers
(1) $CH_3OCH_2CH_2CH_3$ & $CH_3CH_2OCH_2CH_3$
(2) $CH_3OCH_2CH_2CH_3$ & $CH_3OCH(CH_3)_2$
(3) $CH_3NHCH_2CH_2CH_3$ & $CH_3NHCH_2CH_3$
(4) $CH_3COCH_2CH_2CH_3$ & $CH_3CH_2COCH_2CH_3$

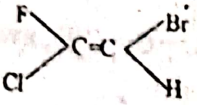
61. Which of the following exhibit cis-trans isomerism
(1) propene (2) 1 -butene
(3) 2-butene (4) benzene

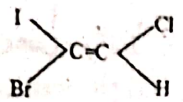
62. Which of the following compound has zero dipole moment?
(1) 1,1-Dichloro ethylene
(2) Cis-1,2-dichoroethylene
(3) Trans-1,2-dichoroethylene
(4) Both 2 & 3

63. The E – isomer is

(1) 

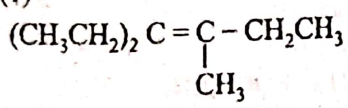
(2) 

(3) 

(4) 

64. 169. Which among the following compounds show geometrical isomerism
(I) 1 – butene (II) 2 – butene
(III) 2 – methyl - 2 – butene
(IV) 2 – pentene
(1) II, III (2) II, III, IV
(3) II, IV (4) I, II,IV

65. Geometrical isomerism is not shown by
(1)



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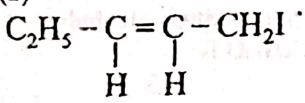

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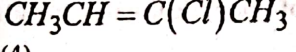
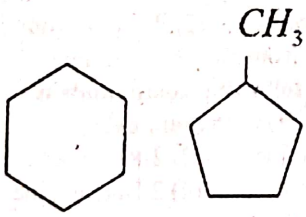


(4)

66. The relationship between given following pair of compounds



(I) (II)

(1) Chain isomer (2) Position isomer
(3) Metamer (4) Functional isomer

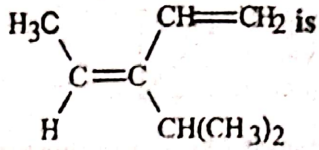
67. How many possible positional isomers for pentanone?
(1) 2 (2) 3
(3) 4 (4) 5

68. The type of isomerism found in urea molecule is
(1) Chain (2) Position
(3) Tautomerism (4) Geometrical

69. No.of geometrical isomers possible for the compound

(1) 2 (2) 3
(3) 4 (4) 5

70.



(1) E-isomer (2) Z-isomer
(3) Cis-isomer (4) Trans-isomer

(NUMERICAL VALUE TYPE)

Section-II contains 5 **Numerical Value Type** questions.
Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases

71. Number of possible position isomers for Dichlorobenzene is_____.
72. The number of isomeric amines possible for the formula C_3H_9N_____.
73. How many positional isomers exist for $C_3H_5Cl_3$_____.
74. Number of chain isomers in C_6H_{14} is_____.
75. The number of primary alcoholic isomers for $C_4H_{10}O$ is_____.

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BEST OF LUCK