RANKRIDGE IIT JEE/NEET JUNIOR COLLEGE (LONGTERM)

TELANGANA

STREAM: JR MPC
Time: 3:00 Hours

CUMULATIVE TEST-03

Date: 07-07-2025
Max Marks: 300

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. $\sin\alpha+\sin\beta=a,\ \cos\alpha+\cos\beta=b$
$\Rightarrow \sin(\alpha+\beta)=$
(A) ab (B) $a+b$
(C) $\frac{2ab}{a^2-b^2}$ (D) $\frac{2ab}{a^2+b^2}$

2. $\frac{1-\cos A+\cos B-\cos(A+B)}{1+\cos A-\cos B-\cos(A+B)}=$
(A) $\sin\frac{A}{2}.\cos\frac{B}{2}$ (B) $\sec\frac{A}{2}\cos ec\frac{B}{2}$
(C) $\tan\frac{A}{2}.\cot\frac{B}{2}$ (D) $2\sin\frac{A}{2}.\cos\frac{B}{2}$

3. $\cos^2(45^0-\alpha)+\cos^2(15^0+\alpha)$
$-\cos^2(15^0-\alpha)=$
(A) 0 (B) 1
(C) ½ (D) 2

4. $\frac{\cos^2 33^0-\cos^2 57^0}{\sin 21^0-\cos 21^0}=$
(A) $-1/\sqrt{2}$ (B) $1/2$
(C) $1/\sqrt{2}$ (D) $-1/2$

5. $\frac{\cos 6\theta+6\cos 3\theta+15\cos 2\theta+10}{\cos 5\theta+5\cos 3\theta+10}=$
(A) $\sin\theta$ (B) $\cos\theta$
(C) $2\sin\theta$ (D) $2\cos\theta$

6. $\sin^4\theta+\cos^4\theta=1-\frac{1}{2}f(\theta)$ then
$f\left(\frac{\pi}{4}\right)=$
(A) 1 (B) 0
(C) 1/2 (D) 1/4

7. $32\sin^6 15^0-48\sin^4 15^0+18\sin^2 15^0=$
(A) 1 (B) 2
(C) 3 (D) –1

8. If $f\left(\frac{2\tan x}{1+\tan^2 x}\right)=\frac{(\cos 2x+1)(\sec^2 x+2\tan x)}{2}$ then
$f(4)=$
(A) 1 (B) 3
(C) 0 (D) 5

9. If $n\in N$, and the period of $\frac{\cos nx}{\sin\left(\frac{x}{n}\right)}$ is 4π
,then $n=$
(A) 4 (B) 3
(C) 2 (D) 1

10. If $5\cos x+12\cos y=13$, then the maximum value of $5\sin x+12\sin y$ is
(A) 12 (B) $\sqrt{120}$
(C) $\sqrt{20}$ (D) 13

11. $5\cos\theta+3\cos\left(\theta-\frac{\pi}{3}\right)+8\in$
(A) $[-7,1]$ (B) $[1,8]$
(C) $[1,15]$ (D) $[2,15]$

12. $\sqrt{2+\sqrt{2+2\cos 4\theta}}=\left[where\ \theta\in(0,\pi/4)\right]$
(A) $\cos\theta$ (B) $\sin\theta$
(C) $2\cos\theta$ (D) $2\sin\theta$

13. If $3\sin\alpha=5\sin\beta$, then $\frac{\tan\frac{\alpha+\beta}{2}}{\tan\frac{\alpha-\beta}{2}}$ is equal to
(A) 1 (B) 2
(C) 3 (D) 4

14. The value of $\cos\frac{\pi}{10}\cos\frac{2\pi}{10}\cos\frac{4\pi}{10}\cos\frac{8\pi}{10}\cos\frac{16\pi}{10}$ is :

(A) $\frac{\sqrt{10+2\sqrt{5}}}{64}$ (B) $\frac{\cos(\pi/10)}{16}$

(C) $\frac{\cos(\pi/10)}{16}$ (D) $-\frac{\sqrt{10+2\sqrt{5}}}{64}$

15. The value of $\cos^2 10^0 - \cos 10^0 \cos 50^0 + \cos^2 50^0$ is

(A) $\frac{3}{2}(1+\cos 20^0)$ (B) $\frac{3}{4}$

(C) $\frac{3}{4}+\cos 20^0$ (D) $\frac{3}{2}$

16. The maximum value of $3\cos\theta + 5\sin\left(\theta - \frac{\pi}{6}\right)$ for any real value of θ is :

(A) $\sqrt{19}$ (B) $\frac{\sqrt{79}}{2}$

(C) $\sqrt{34}$ (D) $\sqrt{31}$

17. If m and M are minimum and the maximum values of $4+\frac{1}{2}\sin^2 2x - 2\cos^4 X, X \in R$, then M-m is equal to

(A) 9/4 (B) 15/4

(C) 7/4 (D) 1/4

18. Statement I : If $A+B+C=180^0$ then $\cos 2A+\cos 2B+\cos 2C = 1-4\cos A\cos B\cos C$

Statement II : If $A+B+C=0^0$ then $\cos A+\cos B+\cos C = -1+4\cos\frac{A}{2}\cos\frac{B}{2}\cos\frac{C}{2}$

(A) only I is true (B) only II is true

(C) Both I and II are true

(D) Neither I nor II are true

19. The value of $\cot 70^0 + 4\cos 70^0$ is

(A) 3 (B) $\frac{\sqrt{3}}{2}$

(C) $\sqrt{3}$ (D) 4

20. If the value of $\frac{3\cos 36^0 + 5\sin 18^0}{5\cos 36^0 - 3\sin 18^0}$ is $\frac{a\sqrt{5}-b}{c}$, where a,b,c are natural numbers and $\gcd(a,c)=1$ then $a+b+c$ is equal to :

(A) 50 (B) 40

(C) 52 (D) 54

(NUMERICAL VALUE TYPE)

Section-II contains 5 **Numerical Value Type** questions.

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21. The value of $\frac{(\sin 72^0 - \cos 54^0)(\sin 144^0 + \cos 54^0)}{(1-\cos 72^0)(\cos 72^0 - \cos 108^0)}$

22. The value of the expression $\frac{\cot 13^0 + \cot 26^0 + \cot 51^0}{\cot 13^0 \cot 26^0 \cot 51^0}$ is equal to

23. If $4\sin(60^0+\theta)\sin(60^0-\theta)-1 = k\cos\theta$ then $k=$

24. The maximum value of $y = \frac{1}{\sin^6 x + \cos^6 x}$ is _____

25. If $\sin^3 x\cos 3x + \cos^3 x\sin 3x = 3/8$, then the value of $8\sin 4x$ is _____

PHYSICS

(SINGLE CORRECT ANSWER TYPE)

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26. A rocket is fired and ascends with constant vertical acceleration of $10m/s^2$ for 1 minute. Its fuel is exhausted and it continues as a free particle. The maximum altitude reached is ($g=10m/s^2$)

(A) 18 km (B) 36 km

(C) 72 km (D) 108km

27. A boy throws n balls per second at regular time intervals. When the first ball reaches the maximum height he throws the second

one vertically up. The maximum height reached by each ball is

(A) $\frac{g}{2(n-1)^2}$ (B) $\frac{g}{2n^2}$

(C) $\frac{g}{n^2}$ (D) $\frac{g}{n}$

28. A stone projected vertically up from the ground reaches a height y in its path at t_1 seconds and after further t_2 seconds reaches the ground. The height y is equal to

(A) $\frac{1}{2}g(t_1+t_2)$ (B) $\frac{1}{2}g(t_1+t_2)^2$

(C) $\frac{1}{2}gt_1t_2$ (D) gt_1t_2

29. Two cars are travelling in the same direction with a velocity of 60 kmph. They are separated by a distance of 5 km. A truck moving in opposite direction meets the two cars in a time interval of 3 minute. The velocity of the truck is (in kmph)

(A) 20 (B) 30

(C) 40 (D) 60

30. Two trains A and B, 100m and 60m long, are moving in opposite directions on parallel tracks. The velocity of the shorter train is 3 times that of the longer one. If the trains take 4s to cross each other, the velocities of the trains are

(A) $V_A=10ms^{-1}, V_B=30ms^{-1}$

(B) $V_A=2.5ms^{-1}, V_B=7.5ms^{-1}$

(C) $V_A=20ms^{-1}, V_B=60ms^{-1}$

(D) $V_A=5ms^{-1}, V_B=15ms^{-1}$

31. The coordinates of a moving particle at any time 't' are given by $x=\alpha t^3$ and $y=\beta t^3$. The speed of the particle at time 't' is given by

(A) $\sqrt{\alpha^2+\beta^2}$ (B) $3t\sqrt{\alpha^2+\beta^2}$

(C) $3t^2\sqrt{\alpha^2+\beta^2}$ (D) $t^2\sqrt{\alpha^2+\beta^2}$

32. For motion of an object along the x-axis, the velocity v depends on the displacement x as $v=3x^2-2x$, then what is the acceleration at $x=2m$.

(A) $48ms^{-2}$ (B) $80ms^{-2}$

(C) $18ms^{-2}$ (D) $10ms^{-2}$

33. A body is projected vertically up with velocity $98ms^{-1}$. After 2 s if the acceleration due to gravity of earth disappears, the velocity of the body at the end of next 3 s is

(A) $49ms^{-1}$ (B) $49.6ms^{-1}$

(C) $78.4ms^{-1}$ (D) $94.7ms^{-1}$

34. An object falls from a bridge that is 45m above the water. It falls directly into a small row-boat moving with constant velocity that was 12m from the point of impact when the object was released. What was the speed of the boat? $(g=10ms^{-2})$

(A) 1.2m/s (B) 2.3m/s

(C) 3.5m/s (D) 4.4m/s

35. Two particles start simultaneously from the same point and move along two straight lines. One with uniform velocity v and other with a uniform acceleration a. If α is the angle between the lines of motion of two particles then the least value of relative velocity will be at time given by

(A) $\frac{v}{a}\sin\alpha$ (B) $\frac{v}{a}\cos\alpha$

(C) $\frac{v}{a}\tan\alpha$ (D) $\frac{v}{a}\cot\alpha$

36. A train starting from rest first accelerates uniformly up to a speed of 80 km/h for time t, then it moves with a constant speed for time 3t. The average speed of the train for this duration of journey will be (in km / h)

(A) 80 (B) 70

(C) 30 (D) 40

37. A particle is moving with constant in a circular path. When the particle turns by an angle 90^0 the ratio of instantaneous velocity to its average velocity is $\pi : x\sqrt{2}$ The value of x will be

(A) 2 (B) 5

(C) 1 (D) 7

38. A particle is moving with speed $v=b\sqrt{x}$ along positive x-axis. Calculate the speed of the particle at time $t=\tau$ (assume that the particle is at origin at t = 0).

(A) $\frac{b^2\tau}{4}$ (B) $\frac{b^2\tau}{2}$

(C) $b^2\tau$ (D) $\frac{b^2\tau}{\sqrt{2}}$

39. A particle located at x = 0 at time t = 0 starts moving along with the positive x-direction with a velocity 'v' that varies as $v=\alpha\sqrt{x}$. The displacement of the particle varies with time as

(A) t^2 (B) t

(C) $t^{1/2}$ (D) t^3

40. A body starts moving from rest with constant acceleration covers displacement S_1 in first $(p-1)$ seconds and S_2 in first p seconds. The displacement S_1+S_2 will be made in time:

(A) $\sqrt{(2p^2-2p+1)}s$

(B) $(2p^2-2p+1)s$

(C) $(2p+1)s$

(D) $(2p-1)s$

41. Given below are two statementa

Statement 1: Area under velocity- time graph gives the distance travelled by the body in a given time

Statement II: Area under acceleration-time graph is equal to the change in velocity in the given time.

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

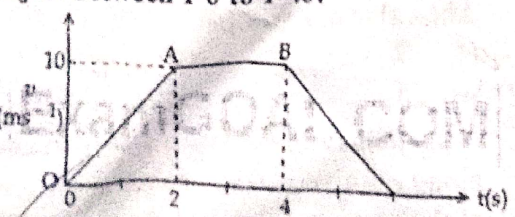
(A) Both Statement I and Statement II are true

(B) Statement I is correct but Statement II is false.

(C) Statement is incorrect but Statement 11 is true.

(D) Both Statement I and Statement II are false.

42. The velocity-time graph of an object moving along a straight line is shown in figure. What is the distance covered by the object between 1-0 to 1-4s?



(A) 30m (B) 10m

(C) 13m (D) 11m

43. A particle initially at rest starts moving from reference point $x=0$ along x-axis, with velocity v that varies as $v=4\sqrt{x}m/s$. The acceleration of the particle is_____ ms^{-2}

(A) 8 (B) 12

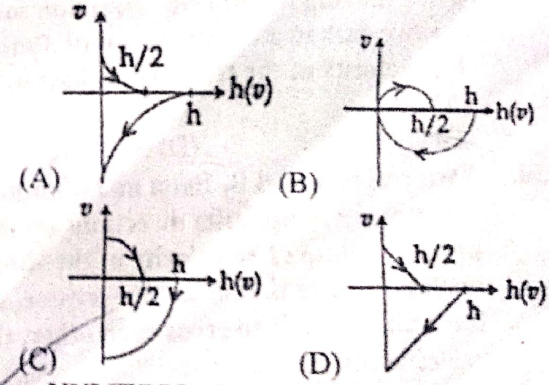
(C) 16 (D) 32m

44. The distance travelled by a particle is related to time t as $x=4t^2$. The velocity of the particle at $t=5s$ is.

(A) $40ms^{-1}$ (B) $25ms^{-1}$

(C) $20ms^{-1}$ (D) $8ms^{-1}$

45. A Tennis ball is released from a height h and after freely falling on a wooden floor it rebounds and reaches height $\frac{h}{2}$. The velocity versus height of the ball during its motion may be represented graphically by : (graph are drawn schematically and on not to scale)



NUMERICAL VALUE TYPE)

Section-II contains 5 Numerical Value Type questions.

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46. From the top of a tower, a ball is thrown vertically upward which reaches the ground in 6s. A second ball thrown vertically downward from the same postion with the same speed reaches the ground in 1.5s. A third ball released, from the rest from the same location, will reach the ground in_____s.

47. A cat, on seeing a rat at a distance $d=5m$, starts with velocity $U=5ms^{-1}$ and moves with acceleration $\alpha=2.5ms^{-2}$ in order to catch it, while the rate with acceleration β

starts from rest. For what value of β will be cat overtake the rate_____$(in\ ms^{-2})$

48. A particle moves in a straight line so that its displacement x at any time t is given by $x^2 = 1 + t^2$. Its acceleration at any time t is x^{-n} wheren_____

49. A balloon was moving upwards with a uniform velocity of 10 m/s. An object of finite mass is dropped from the balloon when it was at a height of 75 m from the ground level. The height of the balloon from the ground when object strikes the ground was around: (takes the value of gas 10 m/s²

50. A particle moving in a straight line covers half the distance with speed of 3 m/s. The other half of the distance is covered in two equal time intervals with speed of 4.5m/s and 7.5m/s respectively. The average speed of the particle during this motion is_____ ms^{-1}

CHEMISTRY

(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.

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51. Which of the following sets of quantum numbers represents the highest energy of an atom
A) n = 3 l = 1 m = 1 s = 1/2
B) n = 3 l = 2 m = 1 , s = 1/2
C) n = 4 l = 0 m = 0 s = 1/2
D) n = 3 l = 0, m = 0 s = 1/2

52. Sum of electronic spins of all electrons with the configuration $3d^7$ is
A) + 3/2 B) + 5/2
C) + 7/2 D) 9/2

53. The values of four quantum numbers of valence electron of an element X is n = 4 , l = 0 m = 0, s = 1/2 The element is
A) K B) Ti
C) Na D) Sc

54. The spin magnetic momentum of electrons in an ion is 4.84 BM. Its total spin will be
(A) ±1 (B) ±2
(C) $\geq \sqrt{\frac{h}{4\pi}}$ (D) ±2.5

55. An element has 2 electrons in K shell, 8 electrons in L shell, 13 electrons in M shell and one electron in N shell. The element is
A) Cr B) Fe
C) V D) Ti

56. Which has the same number of s-electrons as the d-electrons in Fe^{2+}?
A) Li B) Na
C) N D) P

57. During ionisation of copper atom, the quantum numbers of electron removed may be
A) n = 4, l = 1, s = +1/2
B) n = 3, l = 0, s = -1/2
C) n = 4, l = 0, s = +1/2
D) n = 4, l = 2, s = -1/2

58. Which one of the following set of quantum numbers is not possible for a 4p electron?
A) n = 4 , l = 1 , m = 1 , m_s = +1/2
B) n = 4 , l = 1 , m = 0, m_s = +1/2
C) n = 4, l = 1 , m = 2, m_s = +1/2
D) n = 4, l = 1 , m = -1, m_s = +1/2

59. An orbital made of four lobes can have the following quantum numbers
A) n = 2, l = 2, m = 0
B) n = 3 , l = 1, m = -2
C) n = 3 , l = 2, m = 0
D) n = 3 , l = 3, m = -3

60. The orbital having minimum 'm' value
A) Spherical in shape B) Dumbell in shape
C) Double dumbell in shape
D) Tetrahedral

61. For an electron in a hydrogen atom, the wave function Ψ is proportional to exp, where a_0 is the Bohr's radius. What is the ratio of the probability of finding the electron at the nucleus to the probability of finding it at a_0 ?
A) e B) e^2
C) $1/e^2$ D) zero

62. Consider the following statements :
a) Electron density in XY plane in $3d_{x^2-y^2}$ orbital is zero
b) Electron density in XY plane in $3d_z^2$ orbital is zero
c) 2s orbital has only one spherical node
d) For $2p_z$ orbital YZ is the nodal plane
The correct statements are:
A) b and c B) a, b, c, d
C) Only b D) a & c

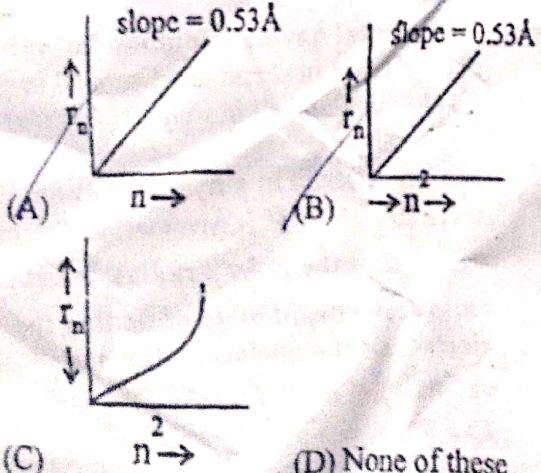
63. The successive elements belonging to the 3d-series have the same number of electrons in the d-sub-shell. The elements are
A) Ti & V B) V & C
C) Cr & Mn D) Mn & F

64. Which of the following quantum numbers is correct for an electron in 4f-orbital
A) $n = 4, l = 3, m = 1, s = +1/2$
B) $n = 4, l = 3, m = 4, s = +1/2$
C) $n = 4, l = 4, m = 1, s = +1/2$
D) $n = 4, l = 2, m = -2, s = +1/2$

65. The angular momentum of an electron due to its spin is given by
(A) $\sqrt{s(s+1)}\frac{h}{2\pi}$ (B) $s(s+1)\frac{h}{2\pi}$
(C) $\frac{h}{2\pi}$ (D) $s(s+1)\frac{2\pi}{h}$

66. The maximum probability of finding electron in the d_{xy} orbital is
A) Along with x - axis
B) Along the y - axis
C) At an angle of 45^0 from the X and Y axis
D) At an angle of 90^0 from the x and y axis

67. Which of the following curves may represent the radius of orbit (r_n) in a H-atoms as a function of principal quantum number (n)



(D) None of these

68. According to (n + l) rule after completing 'np' level the electron enters into
A) (n-1)d B) (n+1)s
C) nd D) (n+1)p

69. The electron density of 3dxy orbital in YZ plane is
A) 50% B) 95%
C) 33.33% D) Zero

70. Wave properties are only important for particles having
A) High mass and low velocities
B) Low mass and no velocity
C) High mass and high velocities
D) Low mass and high velocities

(NUMERICAL VALUE TYPE)

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71. The Schrodinger wave equation for hydrogen atom is

$$\Psi_{2s} = \frac{1}{4\sqrt{2\pi}}\left(\frac{1}{a_0}\right)^{3/2}\left(2 - \frac{r_0}{a_0}\right)e^{-r_0/a_0}$$

Where a_o is Bohr's radius. If the radial node is 2s be at r_0, then find $r_0 = x.a_0$.. Find 'x' value?

72. In Ψ_{321} the sum of angular momentum, spherical nodes and angular node $\frac{\sqrt{x}h + y\pi}{z\pi}$ is then $x + y + z$ is ____.

73. What is the maximum number of electrons in an atom that can have the following quantum numbers $n = 4, m_l = +1$ ____.

74. If highest magnetic quantum number of a given atom is represented by -3, what will be its principle quantum number?

75. Consider the following set of quantum numbers

	n	l	m_l
A.	3	3	-3
B.	3	2	-2
C.	2	1	+1
D.	2	2	+2

The number of correct sets of quantum numbers is ____.

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BEST OF LUCK