MELUHA INTERNATIONAL SCHOOL

HYDERABAD

UT1+UT2+UT3+UT4 **Date: 06-05-2020**	**JEE MAINS MODEL CT-3**	**Time: 3:00 Hrs.** **Max. Marks: 300 M**

MATHEMATICS
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 if not correct

SYLLABUS: Algebra, Trigonometry, Co-ordinate Geometry & Calculus

1. **Let a function** $f:(0,\infty)\to[0,\infty)$ **be defined by** $f(x)=\left|1-\frac{1}{x}\right|$, **then** f **is**

1) injective only
2) both injective as well as surjective
3) not injective but it is surjective
4) neither injective nor surjective

2. **If** $z=x+iy$ **lies in III quadrant, Then** $\frac{\bar{z}}{z}$ **also lies in III quadrant if**

1) $x>y>o$ 2) $x<y<o$ 3) $y<x<o$ 4) $y>x>o$

3. **If** $2\cos\frac{A}{2}=\sqrt{1+\sin A}+\sqrt{1-\sin A}$ **then** $\frac{A}{2}\in$

1) $2n\pi-\frac{\pi}{4}<\frac{A}{2}<2n\pi+\frac{\pi}{4}$ 2) $2n\pi+\frac{\pi}{4}<\frac{A}{2}<2n\pi+\frac{3\pi}{4}$

3) $2n\pi+\frac{3\pi}{4}<\frac{A}{2}<2n\pi+\frac{5\pi}{4}$ 4) $2n\pi-\frac{3\pi}{4}<\frac{A}{2}<2n\pi-\frac{\pi}{4}$

4. **The value of** x **for which** $\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)=2Tan^{-1}x$ **satisfied is**

1) $[0,1]only$ 2) $[0,\infty)$ 3) $(-\infty,0)$ 4) $(-\infty,\infty)$

5. **In** ΔABC, **the median AD is perpendicular to AC and if** $b=5,\ c=11$ **then a =**

1) 10 2) 12 3) 14 4) $\sqrt{146}$

6. $\left(2n_{C_0}\right)^2-\left(2n_{C_1}\right)^2+\left(2n_{C_2}\right)^2-\ldots+(-1)^{2n}\left(2n_{C_{2n}}\right)^2$ **equal to**

1) $\left(2n_{C_{2n}}\right)^2$ 2) $(-1)^{2n}\left(2n_{C_n}\right)$ 3) $(-1)^n\ 2n_{C_n}$ 4) $n_{C_n}+2n_{C_n}$

7. **If** $A=\begin{bmatrix}1 & 1\\ 0 & 1\end{bmatrix}$ **and** $B=\begin{bmatrix}\sqrt{3}/2 & \frac{1}{2}\\ \frac{-1}{2} & \sqrt{3}/2\end{bmatrix}$. **Then** $\left(BB^TA\right)^5$ **is equal to**

1) $\begin{bmatrix}2+\sqrt{3} & 1\\ -1 & 2-\sqrt{3}\end{bmatrix}$ 2) $\frac{1}{2}\begin{bmatrix}1 & 5\\ 0 & 1\end{bmatrix}$

3) $\begin{bmatrix}1 & 5\\ 0 & 1\end{bmatrix}$ 4) $\begin{bmatrix}5 & 1\\ 0 & 1\end{bmatrix}$

8. **If all the digits in the number 54326 are permuted in all possible ways and are arranged in decreasing order. Then the number having rank 89 is**

1) 34265 2) 34256 3) 43526 4) 43265

9. **If a** $\sin x + b\cos(x+\theta) + b\cos(x-\theta) = d$ **for same real** x, **then the minimum value of** $|\cos\theta|$ **is equal to**

1) $\frac{1}{2|b|}\sqrt{d^2-a^2}$ 2) $\frac{1}{2|a|}\sqrt{d^2-a^2}$ 3) $\frac{1}{|d|}\sqrt{d^2-a^2}$ 4) none of these

10. **The number of values of** x **in** $[0,2\pi]$ **satisfying the equation** $|\cos x - \sin x| \geq \sqrt{2}$ **is**

1) 0 2) 1 3) 2 4) 4

11. **If the line** $3x+4y-24=0$ **intersects the x-axis at the point A and the y-axis at the point B, then the incentre of the triangle OAB where O is the origin is**

1) (3,4) 2) (2,2) 3) (4,4) 4) (4,3)

12. **The lengths of tangents from (1,0), (2,0), (3,2) to a circular are** $1,\sqrt{7},\sqrt{2}$. **Then the equation of the circle is**

1) $x^2+y^2+6x+17y+6=0$ 2) $2x^2+2y^2-6x-17y-6=0$

3) $2x^2+2y^2-6x+17y-6=0$ 4) $2x^2+2y^2+6x-17y-6=0$

13. **The value of** λ **for which** $(10x-5)^2+(10y-7)^2=\lambda^2(5x+12y+7)^2$ **represents a parabola is**

1) $\frac{10}{26}$ 2) $\frac{13}{10}$ 3) $\frac{10}{13}$ 4) $\frac{26}{11}$

14. **A hyperbola has its centre at the origin passes through the point (4,2) has transverse axis of length 4 along the x-axis. The eccentricity of the hyperbola is**

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

15. **A function** $f: R \to R$ **satisfies the equation** $f(x+y)=f(x)f(y)$ **for all** $x, y \in R$, $f(x)\neq 0$ **and** $f(5)=2$. **Suppose that the function in differentiable at** $x=0$ **and** $f^1(0)=3$, **then** $f^1(5)=$

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

16. **Tangents are drawn to the curve** $y=\sin x$ **from the origin. The points of contact lie on**

1) $xy=x+y$ 2) $x^2y^2=x^2-y^2$ 3) $xy=x-y$ 4) $x^2y^2=x^2+y^2$

17. **The integral** $\int \frac{3x^{13}+2x^{11}}{(2x^4+3x^2+1)^4}dx$ **is equal to**

1) $\frac{x^4}{(2x^4+3x^2+1)^3}+c$ 2) $\frac{x^{12}}{6(2x^4+3x^2+1)^3}+c$

3) $\frac{x^4}{6(2x^4+3x^2+1)^3}+c$ 4) $\frac{x^{12}}{(2x^4+3x^2+1)^3}+c$

18. **Find the value of** $\int_0^{2\pi} \frac{x\sin^8 x}{\sin^8 x+\cos^8 x}dx$

1) π^2 2) $2\pi^2$ 3) $3\pi^2$ 4) $4\pi^2$

19. **The solution of the differential equation** $\frac{dy}{dx}=1+x+y^2+xy^2$, **when** $y=0$ *and* $x=0$

1) $y=\tan\left(x+\frac{x^2}{2}\right)+2$ 2) $y=x+\frac{x^2}{2}+2$

3) $y=\tan\left(x+\frac{x^2}{2}\right)$ 4) $y=x+\frac{x^2}{2}$

20. **The area of the greater region bounded by** $y=\cos x,\ y=x+1$ *and* $y=0$ **is**

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

SECTION-II
(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers.

Marking Scheme: +4 for correct answer, 0 in all other cases.

21. **A quadratic equation with integral coefficients has two prime numbers as its roots. If the sum of the coefficients of the equation is prime then the sum of the roots is _____**

22. **The relation on the set** $A=\{x:|x|<3,\ x\in z\}$ **is defined by** $R=\{(x,y):y=|x|, x\neq -1\}$. **Then the number of elements in the power set of R is_____**

23. **Let** $x^2+y^2-4x-2y-11=0$ **be a circle. A pair of from the point (4,5) with the pair of radii form a quadrilateral of area in sq. units is_____**

24. **Evaluate** $\lim\limits_{x\to 2}\dfrac{3^x+3^{x-1}-12}{3^{\frac{-x}{2}}-3^{1-x}}$

25. S **and** S^1 **are foci of the ellipse** $25x^2+16y^2=1600$. **Then the sum of the distances from** S **and** S^1 **to the point** $\left(4\sqrt{3},5\right)$ **is ____**

PHYSICS
(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 if not correct

SYLLABUS: Mechanics, Heat, Hydrostatics and Units & Measurements, Magnetism and Optics

26. **A particle moves from the point** $\left(2.0\hat{i}+4.0\hat{j}\right)m$ **at t = 0 with an initial velocity** $\left(5.0\hat{i}+4.0\hat{j}\right)m/s$ **.It is acted upon by a constant force which produces constant acceleration** $\left(4.0\hat{i}+4.0\hat{j}\right)m/s^2$ **. What the distance of the particle from the origin at time 2s ?**

1) $20\sqrt{2}m$ 2) 15m 3) $10\sqrt{2}m$ 4) 5m

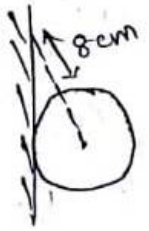
27. **A man running at a speed of 5kmph finds that the rain is falls vertically. When the stops running, he finds that the rain is falling at an angle of 60^0 with the horizontal. The velocity of rain with respect to running man is**

1) $\frac{5}{\sqrt{3}}kmph$ 2) $\frac{5\sqrt{3}}{2}kmph$ 3) $\frac{4\sqrt{3}}{5}kmph$ 4) $5\sqrt{3}\,kmph$

28. **A body is projected at an angle of 45^0 from a point on the ground at a distance of 30m from the foot of a vertical pole of height 20m. The body just crosses the top of the pole and strikes the ground at a distance s from the foot of the pole on the other side of the pole . Then s =**

1) 20m 2) 30m 3) 50m 4) 60m

29. A uniform sphere of weight W and radius 5cm is being held by a string as shown in the figure. The tension in the string will be



1) $\frac{13W}{12}$ 2) $\frac{12W}{5}$ 3) $\frac{5W}{12}$ 4) $\frac{13W}{5}$

30. A mass of 10kg is suspended vertically by a rope from the roof. When a horizontal force is applied on the rope at some point, the rope deviated at an angle of 45^0 at the point. If the suspended mass is at equilibrium. The magnitude of the force applied is $\left(g = 10\,m/s^2\right)$

1) 200 N 2) 100 N 3) 140 N 4) 70 N

31. A bullet hits a block at rest on a frictionless horizontal surface and gets embedded into it. The physical quantity associated with the block that remains unchanged is

1) linear momentum 2) kinetic energy
3) temperature 4) gravitational potential energy

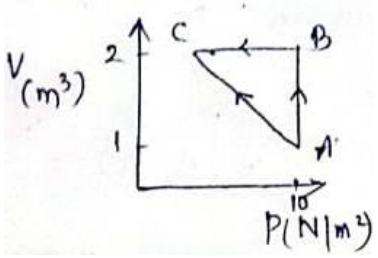
32. A particle of mass m moving with certain velocity collides elastically head on with a particle of mass 4m at rest. The percentage of KE transferred is

1) 75% 2) 25% 3) 64% 4) 32%

33. The ratio of the coefficient of volume expansion of a glass container to that of a viscous liquid kept inside the container is 1:4 what fraction of the inner volume of the container should the liquid occupy .So that the volume of the remaining vacant space will be same at all temperature ?

1) 2:5 2) 1:4 3) 1:64 4) 1:8

34. An ideal gas is taken through the cycle $A \to B \to C \to A$ as shown in figure. If the net heat supplied to the gas in the cycle is 5J, the work done by the gas in the process $C \to A$ is

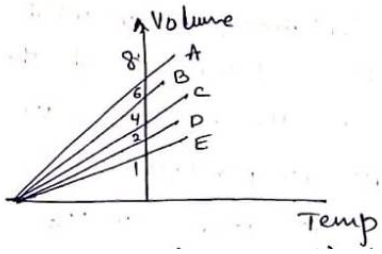


1) -5J 2) -10 J 3) 15 J 4) -20 J

35. The specific heat capacities of an ideal gas at constant pressure and at constant volume are $620 Jkg^{-1}k^{-1}$ and $420 Jkg^{-1}k^{-1}$ respectively. The density of the gas at STP is approximately.

1) 2.88 kg/m^3 2) 4.86 kg/m^3 3) 3.88 kg/m^3 4) 1.86 kg/m^3

36. The expansion of an ideal gas of mass m at a constant pressure P is given by the straight line D. Then the expansion of the same ideal gas of mass 2m at a pressure P/2 is given by the straight line.

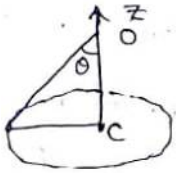


1) E 2) C 3) B 4) A

37. A uniform square sheet a side length of 2R. A circular sheet of maximum possible area is removed from one of the quadrants of the square sheet. The distance of centre of mass of the remaining portion from the centre of the original sheet is

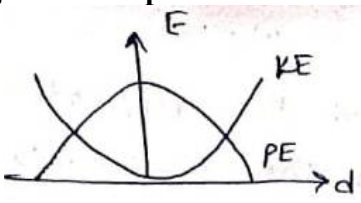
1) $\frac{\pi R}{\sqrt{2}(16-\pi)}$ 2) $\frac{R}{(16-\pi)}$ 3) $\frac{R}{\pi(16-\pi)}$ 4) $\frac{R\pi}{(16-\pi)}$

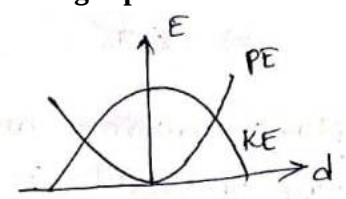
38. A conical pendulum of length 1m makes an angle $\theta = 45^0$ wrt z-axis and moves in a circle in the XY plane. The radius of the circle is 0.4 m and its centre is vertically below O. The speed of the pendulum in its circular path will be

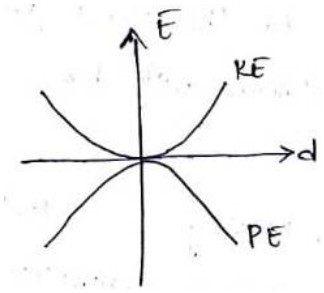


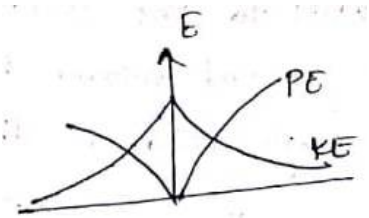
1) 0.4 m/s 2) 4 m/s 3) 2 m/s 4) 0.2 m/s

39. For a simple pendulum, a graph is plotted between its kinetic energy and potential energy against its displacement d. Which one of the following represents these correctly ?

1) 

2) 

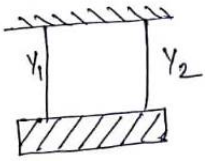
3) 

4) 

40. A point particle is held on the axis of a ring of mass 'm' and radius 'r' at a distance 'r' from its centre C, when released, it reaches C under the gravitational attraction of the ring. Its speed at C will be.

1) $\sqrt{\frac{Gm}{r}}$ 2) $\sqrt{\frac{2Gm}{r}}$ 3) $\sqrt{\frac{2Gm}{r}\left(1-\frac{1}{\sqrt{2}}\right)}$ 4) $\sqrt{\frac{2Gm}{r}\left(\sqrt{2}-1\right)}$

41. Two wires of equal length and equal cross sectional areas as suspended as shown in figure. Their young's modulii are Y_1 and Y_2 respectively. The equivalent young's modulus is



1) Y_1+Y_2 2) $\frac{Y_1+Y_2}{2}$ 3) $\frac{Y_1Y_2}{Y_1+Y_2}$ 4) $\sqrt{Y_1Y_2}$

42. A hydrophilic surface is characterized by contact angle at the water-solid interface. The value of contact angle should be.

1) $>90^0$ 2) $<90^0$ 3) $=90^0$ 4) $=180^0$

43. Two plane mirrors are inclined to each other such that a ray of light incident on the first mirror M_1 and parallel to the second mirror M_2 is finally reflected from the second mirror M_2 parallel to the first mirror M_1. The angle between the two mirrors will be

1) 75^0 2) 90^0 3) 45^0 4) 60^0

44. n identical waves each of intensity I_0 interfere with each other. The ratio of maximum intensities if the interference is (1) coherent and ii) in coherent is

1) n^2 2) $\frac{1}{n}$ 3) $\frac{1}{n^2}$ 4) n

45. A magnetic dipole in a constant magnetic field has

1) zero potential energy when the torque is maximum
2) minimum potential energy when the torque is maximum
3) maximum potential energy when the torque is maximum
4) zero potential energy when the torque is minimum

SECTION-II
(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers.

Marking Scheme: +4 for correct answer, 0 in all other cases.

46. The tension in massless cable connected to an iron ball of 100kg when it is submerged in sea water is $\left(\rho_{iron} = 8\times10^3 kg/m^3 \text{ and } \rho_{water} = 1000\,kg/m^3 \text{ and } g = 10\,m/s^2\right)$ Newtons.

47. A man grows into a giant such that his linear dimensions increase by a factor of 9. Assuming that his density remains same, the stress in the leg will change by a factor of _____

48. The eye can be regarded as a single refracting surface. The radius of curvature of this surface is equal to that of cornea (7.8 mm). This surface separates two media of refractive indices 1 and 1.34. Calculate the distance from the refracting surface at which a parallel beam of light will come to focus _____in cm.

49. In a Young's double slit experiment the distance between the two identical slits is 6.1 times larger than the slit width. Then the number of intensity maxima observed within the central maximum of the single slit diffraction pattern. is:_____

50. At a location the horizontal component of the earth's magnetic field is 0.3G in the magnetic meridian and the dip angle is 60^0. The earth's magnetic field at this location in G is____

CHEMISTRY
(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 if not correct

SYLLABUS: First Year Inorganic Chemistry, Second Year Inorganic Chemistry, First Year Physical Chemistry & Second Year Physical Chemistry

51. The de-Broglie's wavelength of electron present in first Bohr orbit of "H" atom is

1) $2\pi\times0.529\,A^0$ 2) $\frac{0.529}{2\pi}A^0$ 3) $4\times0.529\,A^0$ 4) $0.529\,A^0$

52. A certain quantity of a gas occupies 100ml when collected over water at 15^0C and 750 mm pressure. If it occupies 91.9 ml in dry state at STP , the vapour pressure of water at 15^0C is ?

1) 12.8 mm 2) 14.8 mm 3) 13.2 mm 4) 13.7 mm

53. 1gram of carbonate (M_2CO_3) on treatment with excess HCl produces 0.01186 mole CO_2. The molar mass M_2CO_3 in gram mol^{-1} is

1) 11.86 2) 1186 3) 84.3 4) 118.6

54. In a 500ml flask the degree of dissociation PCl_5 at equilibrium is 40% and the intial amount is 5 moles. The value of equilibrium of PCl_5 is

1) 2.33 2) 2.66 3) 5.32 4) 4.66

55. When a certain amount of ethylene was burnt 6226 kJ heat was evolved . If heat of combustion of ethylene is 1411 kJ, the volume of O_2 (ml NTP) that entered into the reaction is

1) 296.5 ml 2) 29.62 lit 3) 6226×22.4 *lit* 4) 22.4 lit

56. If value of chlorine is 12ev and electron affinity of chlorine is 3.61 ev. Number of chlorine atoms in the gaseous state that can be ionized by utilizing the energy that is liberated in the Process $\underset{(g)}{Cl} + \bar{e} \longrightarrow \underset{(g)}{Cl^-}$ involving one mole of chlorine atoms is

1) 1.8×10^{23} 2) 3 3) 3×10^{23} 4) 1.8×10^{22}

57. Which of the following conversions involves change in both shape and hybridization

1) $H_2O \rightarrow H_3O^+$ 2) $BF_3 \rightarrow BF_4^-$ 3) $CH_4 \rightarrow C_2H_6$ 4) $NH_3 \rightarrow NH_4^+$

58. Electronegativity of group 13 elements follow the order.

1) $B > Ga > Al > Tl > In$ 2) $B > Tl > Ga > Al > In$

3) $B > Tl > In > Ga > Al$ 4) $B > Al > Tl > In > Ga$

59. Example of three dimensional silicate is

1) Zeolites 2) Ultra mines 3) Feldspars 4) Beryl's

60. Biochemical oxygen demand (BOD) value can be measure of water pollution caused by the organic matter. Which of the following statements is correct.

1) polluted water has BOD value higher than 10 ppm
2) clean water has BOD value higher than 10 ppm
3) Anaerobic bacteria increase the BOD value
4) Aerobic bacteria decreases the BOD value.

61. The volume strength of solution formed by mixing 1 lit 0.5 m H_2O_2 with 2 lit 0.5 M H_2O_2.

1) 11.2 2) 5.6 3) 22.4 4) 2.8

62. The pair that contains two P-H bonds in each of the oxo acid is

1) $H_4P_2O_5$ and H_3PO_3 2) $H_4P_2O_5$ and $H_4P_2O_6$ 3) H_3PO_2 and $H_4P_2O_5$ 4) H_3PO_2 and $H_4P_2O_7$

63. The correct sequence of decreasing number of π – bonds in the structure of $H_2SO_3, H_2SO_4, H_2S_2O_7$

1) $H_2SO_4 > H_2S_2O_7 > H_2SO_3$ 2) $H_2SO_3 > H_2SO_4 > H_2S_2O_7$

3) $H_2S_2O_7 > H_2SO_4 > H_2SO_3$ 4) $H_2S_2O_7 > H_2SO_3 > H_2SO_4$

64. Give the no. of lone pair in the central atoms of the following inter halogen compounds $XX^1, XX_3^1, XX_5^1, XX_7^1$

1) 3,2,1,1 2) 3,2,1,0 3) 3,1,2,0 4) 3,2,2,0

65. XeF_2 is hydrolyzed in the presence of small amount of water. What are the gaseous products formed.

1) Xe, O_2 2) F_2, O_2 3) Xe, O_3 4) O_2F_2, Xe

66. The degenerate orbitals of $\left[Cr\left(H_2O\right)_6\right]^{3+}$ are

1) d_{xy} and d_{yz} 2) d_{yz} and d_z^2 3) $d_{x^2-y^2}$ and d_{xy} 4) d_z^2 and d_{xz}

67. A solution containing 62 gram ethylene glycol in 250 gm water is cooled to -10^{0}C . If k_f for Water is 1.86 K kg mol^{-1}, the amount of water (in gm) separated as ice is.

1) 16 2) 32 3) 48 4) 64

68. The radius of Na^+ is 95 pm and that of Cl^- is 181 pm. The edge length of unit cell in NaCl would be (pm).

1) 181 2) 95 3) 276 4) 552

69. $Zn / Zn^{+2}\left(C_1\right) // Zn^{+2}\left(C_2\right) / Zn$ for this cell ΔG is negative is

1) $C_1 = C_2$ 2) $C_1 > C_2$ 3) $C_2 < C_1$ 4) both 1 & 2 correct

70. Which represents the time to complete 90% of first order reaction

1) $\frac{k}{2.303}\log\frac{4}{3}$ 2) $\frac{2.303}{k}\log\frac{3}{4}$ 3) $\frac{2.303}{k}$ 4) $\frac{2.303}{k}\log 3$

SECTION-II

(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers.

Marking Scheme: +4 for correct answer, 0 in all other cases.

71. 50ml of 0.1 M Acetic acid is shaken with 0.5 grams of activated charcoal. The concentration of solution has fallen to 0.05 M. The x/m value in freundlish equation could be_____

72. 20% decomposition of H_2O_2 in presence of an acid requires 5 mints. The time required for 50% decomposition in _____mints.

73. The copper crystallizes in FCC with a unit cell length of 361 pm. What is the radius of copper atom_____

74. A solution of $CaCl_2$ is 0.5 mol/lit, then the moles of chlorides ion in 500ml. Will be _____

75. The weight of H_2O_2 present in 1 lit of 5.6 vol H_2O_2 is _____

MELUHA INTERNATIONAL SCHOOL

HYDERABAD

UT1+UT2+UT3+UT4
Date: 06-05-2020

JEE MAINS MODEL CT-3

Time: 3:00 Hrs.
Max. Marks: 300 M

KEY SHEET

MATHS

1) **3**	2) **3**	3) **1**	4) **2**	5) **3**	6) **2**	7) **3**	8) **1**	9) **1**	10) **3**
11) **2**	12) **4**	13) **3**	14) **1**	15) **4**	16) **2**	17) **2**	18) **1**	19) **3**	20) **1**
21) **5**	22) **16**	23) **8**	24) **72**	25) **20**					

PHYSICS

1) **1**	2) **4**	3) **4**	4) **1**	5) **2**	6) **1**	7) **3**	8) **2**	9) **1**	10) **4**
11) **4**	12) **1**	13) **3**	14) **2**	15) **3**	16) **2**	17) **2**	18) **4**	19) **4**	20) **1**
21) **875**	22) **9**	23) **3.1**	24) **12**	25) **0.6**					

CHEMISTRY

1) **1**	2) **3**	3) **3**	4) **2**	5) **2**	6) **1**	7) **2**	8) **3**	9) **3**	10) **1**
11) **2**	12) **3**	13) **3**	14) **2**	15) **1**	16) **1**	17) **4**	18) **4**	19) **3**	20) **3**
21) **0.3**	22) **15.52**	23) **128**	24) **0.50**	25) **17**					

HINTS & SOLUTIONS

MATHS

1. For $x \in (1, \infty)$

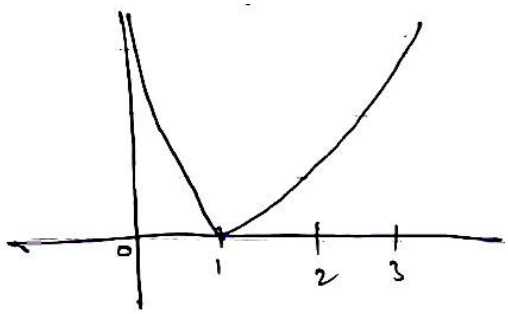
$\frac{1}{x} < 1$

$\Rightarrow 1 - \frac{1}{x} > 0$

For $x \in (0,1)$

$\frac{1}{x} > \phi \Rightarrow 1 - \frac{1}{x} < 0$

$\therefore \left|1 - \frac{1}{x}\right|$ *graph is*



Surjective

2. $z \in IIIQ \Rightarrow x < 0, y < 0$

$\frac{\bar{z}}{z}=\frac{x-iy}{x+iy}=\frac{x^2-y^2=zixy}{x^2+y^2}\in IIIQ$

$x^2-y^2<0,\ -2xy<0$

$\Rightarrow x^2<y^2,\ xy>0$

$\Rightarrow y<x<0$

3. $2\cos A/2=\left|\cos A/2+\sin A/2\right|+\left|\cos A/2-\sin A/2\right|$

$\Rightarrow c+s>0,\ c-s>0$

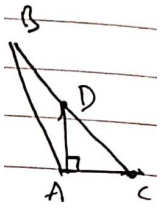
$\Rightarrow A/c\in\left(\frac{-\pi}{4},\frac{\pi}{4}\right)$

4. $2\tan^{-1}x\in(0,\pi)$

$\Rightarrow \tan^{-1}x\in\left(0,\frac{\pi}{2}\right)$

$\Rightarrow x\in(0,\infty)$

5. $\cos C=\frac{a^2+b^2-c^2}{2ab}=\frac{b}{a/2}$



$\Rightarrow a^2+b^2-c^2=4b^2$

$\Rightarrow a^2=3b^2+c^2$

$\Rightarrow a=14$

6. Formula

7. $BB^T=I$

$\Rightarrow\left(BB^TA\right)^5=A^5$

8. Numbers starting with $6\rightarrow 4!=24$
Numbers starting with 5,4 also 24 each
Numbers starting with $36\rightarrow 3!=6$
Numbers starting with $35\rightarrow 3!=6$
Numbers starting with $346\rightarrow 2!=2$
Numbers starting with $345\rightarrow 2!$
Next number 34265

9. $a\sin x+b\left[\cos(x-\theta)+\cos(x+\theta)\right]=d$

$\Rightarrow a\sin x+2b\cos x\cos\theta=d$

$d^2\le a^2+4b^2\cos^2\theta$

$\Rightarrow\frac{d^2-a^2}{4b^2}\le\cos^2\theta$

10. Given $\left|\cos x-\sin x\right|\ge\sqrt{2}$

But $\left|\cos x-\sin x\right|\le\sqrt{2}$

$\Rightarrow\left|\cos x-\sin x\right|=\sqrt{2}$

$\Rightarrow\cos\left(x+\frac{\pi}{4}\right)=1\ or\ -1$

$x+\frac{\pi}{4}=0,\pi\ or\ 2\pi$

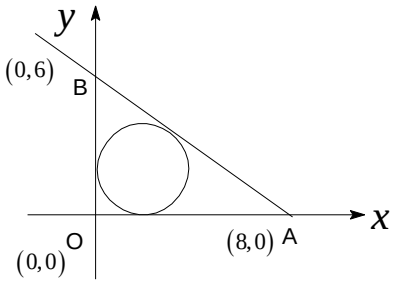
$\Rightarrow x=\frac{3\pi}{4}\ or\ \frac{7\pi}{4}\ \left(x\in(0,2\pi)\right)$

11. $\left|\frac{3x+4y-24}{5}\right| = r$

$7r - 24 = \pm 5r$

$r = 12 \text{ or } 2$

$\text{if } r = 2 \text{ incentre} = (2,2)$



12. $2g + c = 0,\ 4g + c = 3,\ 6g + 4f + c = -11$

Solving , $g = \frac{3}{2},\ f = \frac{-17}{4}, c = -3$

13. $100\left[\left(x - \frac{1}{2}\right)^2 + \left(y - \frac{7}{10}\right)^2\right]$

$= 169\lambda^2 \left(\frac{5x + 12y + 7}{\sqrt{169}}\right)^2$

$= \frac{169\lambda^2}{100} = 1 \Rightarrow \lambda = \frac{10}{13}$

14. $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

$2a = 4 \Rightarrow a = 2$

$\frac{x^2}{4} - \frac{y^2}{b^2} = 1$

If it passes through (4, 2), then $b^2 = \frac{4}{3}$

$e = \sqrt{\frac{a^2 + b^2}{a^2}} = \sqrt{1 + \frac{1}{3}} = \frac{2}{\sqrt{3}}$

15.

	OR
$f^1(x) = 3f(x)$	$f^1(x) = f(x)\, f^1(0)$
$f^1(5) = 3f(5)$	$f^1(5) = f(5)\, f^1(0)$
$= 3 \times 2 = 6$	$= 2 \times 3 = 6$

16. Eqn .of tangent at (x_1, y_1) is

$y - y_1 = \cos x_1 (x - x_1)$

If it passes through (0,0)

$y_1 = x_1 \cos x_1$

$y_1^2 = x_1^2 (1 - y_1^2) \Rightarrow x^2 y^2 = x^2 - y^2$

17. $I = \int \frac{3x^{13} + 2x^{11}}{x^{16}\left(2 + \frac{3}{x^2} + \frac{1}{x^4}\right)^4}\, dx$

$$I=\int \frac{\frac{3}{x^3}+\frac{2}{x^5}}{\left(2+\frac{3}{x^2}+\frac{1}{x^4}\right)^4}\,dx$$

$$put\ t=2+\frac{3}{x^2}+\frac{1}{x^4}$$

$$=\frac{-1}{2}\int\frac{dt}{t^4}=\frac{1}{6t^3}+c=\frac{1}{6\left(2+\frac{3}{x^2}+\frac{1}{x^4}\right)^3}+c$$

$$=\frac{x^{12}}{6\left(2x^4+3x^2+1\right)^3}+c$$

18. $$\int_0^{2x} f(x)\,dx=\int_0^a\left[f(x)+f(2a-x)\right]dx$$

$$I=\int_0^{\pi}\left[\frac{x\sin^8 x}{\sin^8 x+\cos^8 x}+\frac{(2\pi-x)\sin^8 x}{\sin^8 x+\cos^8 x}\right]dx$$

$$=2\pi\int_0^{\pi}\frac{\sin^8 x}{\sin^8 x+\cos^8 x}dx=4\pi\int_0^{\pi/2}\frac{\sin^8 x}{\sin^8 x+\cos^8 x}\,dx$$

$$=4\pi\times\frac{\pi}{4}=\pi^2$$

19. $$\frac{dy}{dx}=(1+x)\left(1+y^2\right)$$

$$\int\frac{dy}{1+y^2}=\int(1+x)\,dx$$

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

$$x=0,y=0\Rightarrow c=0$$

$$y=\tan\left(x+\frac{x^2}{2}\right)$$

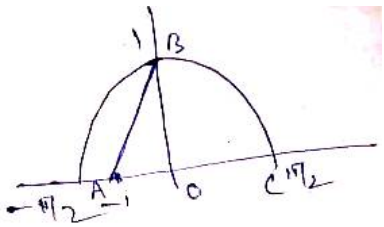
20. $y=\cos x$

$y=x+1$

$y=0$

Area = ΔOAB + *area of the curve OBC*

$$=\frac{1}{2}+1=\frac{3}{2}$$



Numerical Value Questions:-

21. α,β are prime

Let $x^2+ax+b=0$ is the quadratics

$\Rightarrow 1+a+b$ is prime

$\Rightarrow 1-(\alpha+\beta)+\alpha\beta$ is prime

$\Rightarrow(\alpha-1)(\beta-1)$ is prime

$\Rightarrow \alpha,\beta$ *are* $2,3$

$\therefore \alpha+\beta=5$

22.

$A=\{-2,-1,0,1,2\}$

$\therefore R=\{(-2,2)(0,0)(1,1)(2,2)\}$

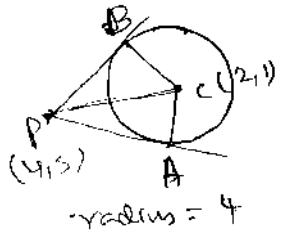
No. of elements in power set = 2^4

23. $PA=\sqrt{4}=2$

Area of quadrilateral PABC = 2 Area of ΔPAC

$=2\times\frac{1}{2}\times PA\times AC$

$=2\times4=8$ *sq.units*



24. $\lim\limits_{x\to2}\dfrac{3^x+\frac{3^x}{3}-12}{\frac{1}{3^{\frac{x}{2}}}-\frac{3}{3^x}}=\lim\limits_{x\to0}\dfrac{\frac{4}{3}3^x-12}{\frac{1}{3^{\frac{x}{2}}}+\frac{3}{3^x}}$

Put $t=3^{\frac{x}{2}}$

$=\lim\limits_{t\to3}\dfrac{\frac{4t^2}{3}-12}{\frac{1}{t}-\frac{3}{t^2}}=72$

25. $\frac{x^2}{64}+\frac{y^2}{100}=1$

$a<b$

$SP+S^1P=2b=20$

PHYSICS

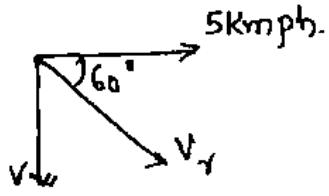
26. $\vec{s}=s_0+ut+\frac{1}{2}at^2$

$\vec{s}=(2i+4j)+(5i+4j)2+\frac{1}{2}(4i+4j)4$

$\vec{s}=20i+20j$

$|\vec{s}|=20\sqrt{2}m$

27.



The horizontal velocity of rain = Velocity of running man = 5 kmph

Vertical velocity of rain = V kmph

$\tan60^0=\frac{V}{5}$

$\Rightarrow V=5\sqrt{3}\,kmph$

Relative velocity of rain wrt man $=5\sqrt{3}\,kmph$

28. $x = 30m \;\; ; \;\; y = 20m \; ; \theta = 45^0$

$S = R - 30$

$y = x\tan\theta\left(1 - \frac{x}{R}\right)$

29.

$\sin\theta = \frac{5}{13}$

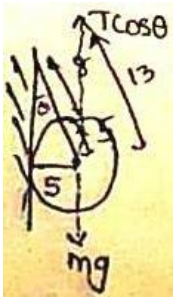
$\cos\theta = \frac{12}{13}$

$T = \cos\theta = mg$

$T = \frac{W}{\cos\theta}$

$T = \frac{W}{\frac{12}{13}}$

$T = \frac{13W}{12}$

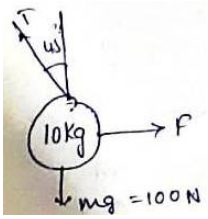


30.

$\frac{T}{\sqrt{2}} = 100$

$\frac{T}{\sqrt{2}} = F$

$F = 100\,N$



31. Conceptual

32. % KE transferred

$= \frac{4m_1m_2}{(m_1 + m_2)} \times 100$

$= \frac{4m(4m)}{(m + 4m)^2} \times 100 = 64\%$

33. $v_1r_1 = v_2r_2$

34. In cyclic process $du = 0$

$\therefore dQ = dW$

$5 = W_{AB} + W_{BC} + W_{CA}$

$W_{AB} = P(V_2 - V_1) = 10J$

$W_{BC} = 0(V - Const)$

$\therefore W_{CA} = -5J$

35. $\rho = \frac{P}{\delta T}; \delta = C_P - C_V = 200$

$\therefore \rho = \frac{1.013 \times 10^5}{200(273)} = 1.86\,Kg/m^3$

36. $PV \propto MT$

$V \propto \frac{MT}{P}$

$P \propto M$

37. $d = \frac{R}{\sqrt{2}}$

$A = 4R^2$

$a = \pi R^2$

$x = \frac{md}{M-m} = \frac{ad}{A-a}$

38. $T\sin\theta = \frac{mv^2}{r}$

$V = \sqrt{rq\tan\theta}$

$V = \sqrt{0.4(10)} = 2m/s$

39. Conceptual

40. $TE_1 = TE_2$

$\frac{-GMm}{\sqrt{r^2+r^2}} = \frac{-GMm}{r} + \frac{1}{2}mv^2$

After solving

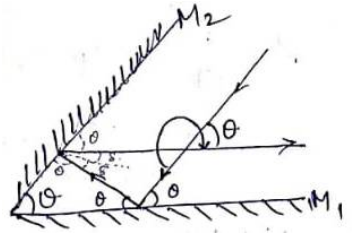
$\Rightarrow V = \sqrt{\frac{2Gm}{r}\left(1-\frac{1}{\sqrt{2}}\right)}$

41. Conceptual

42. Conceptual

43. $\delta_1 + \delta_2 = 360 - 2\theta = 180 + \theta$

$3\theta = 180^0 \Rightarrow \theta = 60^0$



44. Coherent $I = n^2 I_0$

Incoherent $I = nI_0$

45. $PE = -PE\cos\theta$

$T = PE\sin\theta$

T_{max} when $\theta = 90^0; PE = 0$

Numerical Value Questions:-

46. $T = mg\left(1-\frac{1}{RD}\right) = mg\left(1-\frac{pl}{pb}\right)$

$T = 100(10)\left(1-\frac{1000}{8\times10^3}\right)$

$T = 100\left(\frac{7}{8}\right) = 875\,N$

47. Stress in $leg = \frac{W}{2A}$

W=density $\times$volume

$V \propto L^3; A \propto L^2$

$Stress \propto L$

$\therefore$ Stress increases by a factor of 9.

48. $\frac{1.34}{V} - \frac{1}{-\infty} = \frac{1.34-1}{7.8}$

$\frac{1.34}{V} = \frac{34}{780} \Rightarrow V \approx 3.1cm$

49. $\beta = \frac{2\lambda D}{d}\ n = \frac{\beta}{\beta^1}$

$n = \frac{2\lambda D/d}{\frac{\lambda d}{6.1d}} = 12$

50. $B_H = 0.3G \ \ ;\theta = 60^0$

$\tan\theta = \frac{B_V}{B_H}$

$B_V = B_H \tan 60^0 = 0.3\sqrt{3}$

$B = \sqrt{B_H^2 + B_V^2} \approx 0.6G$

CHEMISTRY

51. $r_n = 0.529\ \overset{0}{\text{A}}$

$Mvr = \frac{h}{2\pi}$

$2\pi r = \frac{h}{mv} = \lambda$

$\lambda = 2\pi \times 0.529\ \overset{0}{\text{A}}$

52. $P_{dry} + P_{aq} = P_{real}$ Final conditions

$P_{dry} = 750 - P_{aq.vp}$ $P_2 = 760mm\ of\ Hg$

$v_1 = 100ml$ $V_2 = 91.9$

$T_1 = 288$ $T_2 = 273k$

According to ideal gas equation = $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{750 - P_1}{288} = \frac{760 \times 91.9}{273}$

$P_1 = 750 - 736.8$

$= 13.2\ mm\ of\ Hg.$

53. $M_2CO_3 + 2HCl \longrightarrow 2MCl + 2H_2O + CO_2$

1 gm

0.01186 moles

$\frac{1}{M} = 0.01186$

$M = \frac{1}{0.01186} = 83.4$

54. $PCl_5 \rightarrow PCl_3 + Cl_2$

$$K_C = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

$$K_C = \frac{[4M][4M]}{[6M]}$$

$$K_C = \frac{16}{6}$$

$$K_C = 2.67$$

55. $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O; \Delta H = -6226\,KJ$

Volume of O_2 entered in the reaction $= \frac{6226 \times 3 \times 22.4}{1411} = 296.5ml$

56. $n = \frac{3.61ev}{12ev} \times 6.023 \times 10^{23}$

$= 0.3 \times 6.023 \times 10^{23}$

$= 1.8 \times 10^{23}$

57. $BF_3 - sp^2 - Trigonal\ \ planar$

$BF_4^- - sp^3 - Tetrahedral$

58. $\underset{(2.0)}{B} > \underset{(1.8)}{Tl} > \underset{(1.7)}{In} > \underset{(1.6)}{Ga} > \underset{(1.5)}{Al}$

59. Conceptual

60. Conceptual

61. $2H_2O_2 \rightarrow 2H_2O + O_2$

Volume strength = 11.2 M

$M = \frac{11.2 \times N}{2} = 5.6$

62. Conceptual

63. Conceptual

64. Conceptual

65. Conceptual

66. Conceptual

67. $\Delta Tf = Kf\ M$

$10 = 1.86 \times \frac{62/62}{w.kgs}$

$w = 0.186$

$\Delta w = 250 - 186$

$= 64\,grams.$

68. $a = 2\left(r_{Na^+} + r_{Cl^-}\right)$

$= 2(295 + 181) = 2(276) = 552\,pm$

69. Conceptual

70. $K_1 = \frac{2.303}{t\frac{1}{2}}$

$t\frac{1}{2} = \frac{2.303}{K}$

Numerical Value Questions:-

71. Mass of acetic acid adsorbed by 0.5 grams of

$$= \frac{60(0.1-0.05)50}{1000}$$

$$mass(m) = 0.15\, grams$$

$$\therefore \frac{x}{m} = \frac{0.15}{0.5} = 0.3\, grams.$$

72. Ist order reaction $k = \frac{2.303}{t}\log\frac{a}{a-x}$

$$k = \frac{2.303}{5}\log\frac{100}{80}$$

$$k = 0.04463$$

But half life $t\frac{1}{2} = \frac{0.693}{k} = \frac{0.693}{0.04463} = 15.52$ mints

73. Face diagonal of cube $= \sqrt{2a}$

$$r + 2r + r = \sqrt{2a}$$

$$r = \frac{\sqrt{2a}}{4}$$

$$r = \frac{a}{2\sqrt{2}}$$

$$r = \frac{361}{2\sqrt{2}}$$

$$r = 128\, pm$$

74. For every 1 mol of $CaCl_2$, there are 2 mol of Cl^- In 500 ml of given solution , there will be 0.25 mol $CaCl_2$ (0.5×0.5)

So if we are looking at Cl^- ions, it will be twice of that

$$= 0.25\times 2$$
$$= 0.5\, moles$$

75. $2H_2O_2 \rightarrow 2H_2O + O_2$

$2\times 17 \rightarrow 34$

For 2 lit $\rightarrow 34$

For 1 lit $\rightarrow 17$