MELUHA INTERNATIONAL SCHOOL

HYDERABAD

SR JEE MAINS MODEL | **CUM.TEST-2 (UT1+UT2+UT3)** | **Date: 30-04-2020**

Time: 3 Hours | **Max. Marks: 300 M**

JEE MAIN MODEL

MATHEMATICS

Section	Question type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 01 – 20)	Questions with Single Answer Type	4	-1	20	80
Sec – II(Q.N : 21 – 25)	Questions with Numerical Answer Type (+/ - Decimal Numbers)	4	0	5	20
Total				25	100

PHYSICS

Section	Question type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 26 – 45)	Questions with Single Answer Type	4	-1	20	80
Sec – II(Q.N : 46 – 50)	Questions with Numerical Answer Type (+/ - Decimal Numbers)	4	0	5	20
Total				25	100

CHEMISTRY

Section	Question type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 51 – 70)	Questions with Single Answer Type	4	-1	20	80
Sec – II(Q.N : 71 – 75)	Questions with Numerical Answer Type (+/ - Decimal Numbers)	4	0	5	20
Total				25	100

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (A), (B), (C) and (B) 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.

MATHEMATICS

SYLLABUS: CO-OORDINATE GEOMETRY

1. **If** $f(x+2y, x-2y) = xy$ **then** $f(x,y)$ **equals**

1) $\frac{x^2-y^2}{8}$ 2) $\frac{x^2-y^2}{4}$ 3) $\frac{x^2+y^2}{4}$ 4) $\frac{x^2+y^2}{2}$

2. **Let** $P = \{(x,y)/\ x^2+y^2=1, x, y \in R\}$ **then P is**

1) Reflexive 2) Symmetric 3) Transitive 4) Anti-symmetric

3. **Let** λ **and** α **be real let S denotes the set of all values of** λ **for which the system of linear equations**

$\lambda x + (\sin y)y + (\cos\alpha)z = 0$

$x + (\cos\alpha)y + (\sin\alpha)z = 0$

$-x + (\sin\alpha)y - (\cos\alpha)z = 0$ **has a non-trivial solution then S does not contain**

1) $(-1,1)$ 2) $[-\sqrt{2}, -1]$ 3) $[1, \sqrt{2}]$ 4) $(-\sqrt{2}, \sqrt{2})$

4. **The number of shortest ways in which can we reach from** $(0,0,0)$ **to point** $(3,7,11)$ **in space where the the movement is possible only along the** $x-$**axis,** $y-$**axis, and** $z-$**axis, or parallel to them and change of axes is permitted only at integral point is**

1) ${}^{21}C_3 \times {}^{18}C_7$ 2) ${}^{21}C_3 \times {}^{18}C_3$ 3) ${}^{21}C_7 \times {}^{18}C_7$ 4) ${}^{21}C_7 \times {}^{18}C_7$

5. **Value of** $\sum_{i=1}^{n}\sum_{j=1}^{n} i$

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

6. **If** $0 \le x \le 1000$ **and** $\left[\frac{x}{2}\right]+\left[\frac{x}{3}\right]+\left[\frac{x}{5}\right]=\frac{31}{30}x$ **where** $[x]$ **denotes greatest integer function, then possible number of value of** x **is**

1) 31 2) 32 3) 33 4) 34

7. **The number of roots of the equation** $2^x + 2^{x-1} + 2^{x-2} = 7^x + 7^{x-1} + 7^{x-2}$ **is**

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

8. **If** $Z_n = \cos\left(\frac{\pi}{(2n+1)(2n+3)}\right) + i\sin\left(\frac{\pi}{(2n+1)(2n+3)}\right)$ **then evaluate** $\lim_{n\to\infty} z_1 z_2 z_3 ......z_n$

1) $\frac{\sqrt{3}}{2}+\frac{i}{4}$ 2) $\frac{\sqrt{3}}{2}-\frac{i}{2}$ 3) $\frac{\sqrt{3}}{2}+\frac{i}{2}$ 4) $\frac{-\sqrt{3}}{2}-\frac{i}{2}$

9. **Let** $(1+\sqrt{1+x})\tan y = 1+\sqrt{1-x}$ **then** $\sin 4y$ **is equal to**

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

10. **Find the number of solutions to** $\sin x = \frac{x}{10}$

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

11. **The range of** $\tan^{-1}\left(\frac{2x}{1+x^2}\right)$ **is**

1) $\left[-\frac{\pi}{4},\frac{\pi}{4}\right]$ 2) $\left(-\frac{\pi}{4},\frac{\pi}{2}\right)$ 3) $\left(-\frac{\pi}{2},\frac{\pi}{4}\right]$ 4) $\left[\frac{\pi}{4},\frac{\pi}{2}\right]$

12. **A circular ring of radius 3 cm hangs horizontally from a point 4 cm vertically above the centre by 4 strings attached at equal intervals to its circumference. If the angle between two consecutive strings is** θ **then** $\cos\theta$ **is**

1) $\frac{4}{5}$ 2) $\frac{4}{25}$ 3) $\frac{16}{25}$ 4) $\frac{32}{25}$

13. **In a** ΔABC $a^2+c^2=2002b^2$ **then** $\frac{\cot A+\cot C}{\cot B}$ **is equal to**

1) $\frac{1}{2001}$ 2) $\frac{2}{2001}$ 3) $\frac{3}{2001}$ 4) $\frac{4}{2001}$

14. **The vertices of a triangle are** $\left(pq,\frac{1}{pq}\right)\left(qr,\frac{1}{qr}\right)\left(rp,\frac{1}{rp}\right)$ **where** p,q,r **are the roots of the equation** $y^3-3y^2+6y+1=0$ **the coordinates of its centroid are**

1) $(1,2)$ 2) $(2,-1)$ 3) $(1,-1)$ 4) $(2,3)$

15. **The point** $A(2,1)$ **is translated parallel to the line** $x-y=3$ **by a distance of 4 units. If the new position** A' **is in third quadrant then the coordinates of** A' **are**

1) $\left(2+2\sqrt{2},1+2\sqrt{2}\right)$ 2) $\left(-2+\sqrt{2},-1-2\sqrt{2}\right)$

3) $\left(2-2\sqrt{2},1-2\sqrt{2}\right)$ 4) $(0,0)$

16. **The straight lines represented by** $(y-mx)^2=a^2(1+m^2)$ **and** $(y-nx)^2=a^2(1+n^2)$ **form a**

1) rectangle 2) rhombus 3) trapezium 4) square

17. **The equation of the circle which is touched by** $y=x$ **has its centre on the positive direction of the** $x-$ **axis and cuts off as chord of length 2 units along the line** $\sqrt{3}y-x=0$

1) $x^2+y^2-4x+2=0$ 2) $x^2+y^2-4x+1=0$ 3) $x^2+y^2-8x+8=0$ 4) $x^2+y^2-4y+2=0$

18. **Consider four circles** $(x\pm1)^2+(y\pm1)^2=1$ **equation of smaller circle touching these four circles is**

1) $x^2+y^2=3-\sqrt{2}$ 2) $x^2+y^2=6-3\sqrt{2}$ 3) $x^2+y^2=5-2\sqrt{2}$ 4) $x^2+y^2=3-2\sqrt{2}$

19. **If M is the foot of the perpendicular from a point P on a parabola to its directrix and SPM is an equilateral triangle where S is the focus then SP is equal to**

1) a 2) 2a 3) 3a 4) 4a

20. **The eccentricity of the hyperbola with asymptotes** $3x+4y=2$ **and** $4x-3y=2$ **is**

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

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. 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 in all other cases.

21. **Number of solutions of the equation** $\left(\sqrt{3}+1\right)^{2x}+\left(\sqrt{3}-1\right)^{2x}=2^{3x}$ **is**

22. **If** $\left|\log_3^x\right|-\log_3^x-3<0$ **the value of** x **lies** $\left(\frac{1}{\sqrt{k}},\infty\right)$ **find value of** $(k)^{1/3}$

23. **If** $f(\theta)=\frac{1-\sin 2\theta+\cos 2\theta}{2\cos 2\theta}$ **then find value of** $8f\left(11^0\right)f\left(34^0\right)$

24. **If** $f(x)=\sin\left(\frac{\pi}{3}[x]-x^2\right)$ **to here** $[x]$ **denotes greatest integer function then** $f\left(\frac{\pi}{\sqrt{3}}\right)=$

25. **A tangent having slope** $-\frac{4}{3}$ **to the ellipse** $\frac{x^2}{18}+\frac{y^2}{32}=1,$ **intersects the major and minor axes at points A and B respectively. If C is centre of ellipse then area of** ΔABC

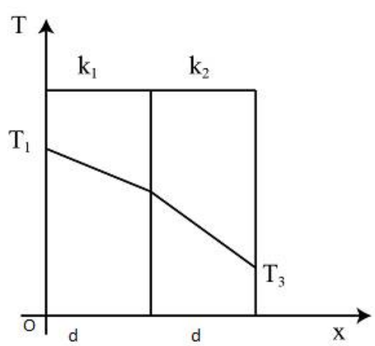
SECTION – I
(SINGLE CORRECT ANSWER TYPE)

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 if not correct.

PHYSICS

SYLLABUS: HEAT, HYDROSTATICS AND UNITS & MEASUREMENTS

26. **The temperature drops through each layer of a two layered furnace wall is shown in figure. Assume that the external temperature T_1 and T_3 are maintained constant and $T_1>T_3$. If the thickness of the layers are the same equal to d, choose correct statement from below:**



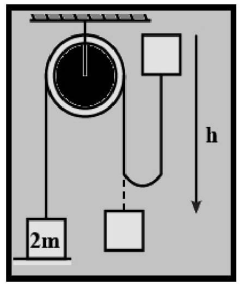
1) $k_1>k_2$

2) $k_1<k_2$

3) $k_1=k_2$ but heat flow through material (1) is larger than through (2)

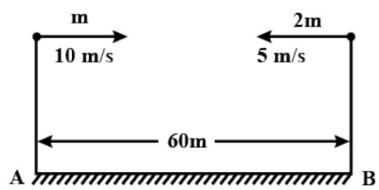
4) $k_1=k_2$ but heat flow through material (1) is less than through (2)

27. A mass 2m rests on a horizontal table. It is attached to a light inextensible string which passes over a smooth pulley and carries a mass m at the other end. If the mass m is raised vertically to a height h and is then dropped, what is the speed with which the mass 2m begins to rise?



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

28. Two particles, one of mass m and the other of mass 2 m, are projected horizontally towards each other from the same level above the ground with velocities 10 m/s and 5 m/s, respectively. They collide in air and stick to each other. The distance of the combined mass from point A is...m

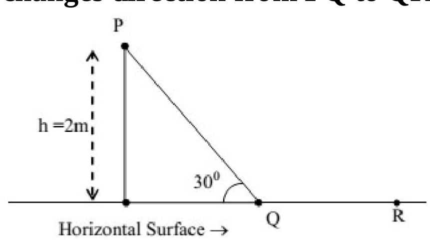


1) 20 2) 40 3) 25 4) 15

29. The density of a material in the shape of a cube is determined by measuring three sides of the cube and its mass. If the relative errors in measuring the mass and length are respectively 1.5% and 1%, the maximum error in determining the density is....%

1) 2.5 2) 0.5 3) 4.5 4) 3.5

30. A point particle of mass m, moves along the uniformly rough track PQR as shown in the figure. The coefficient of friction, between the particle and the rough track equals μ. The particle is released, from rest, from the point P and it comes to rest at a point R. The energies, lost by the ball, over the parts, PQ and QR, of the track, are equal to each other, and no energy is lost when particle changes direction from PQ to QR.



The values of the coefficient of friction μ and the distance x(=QR), are, respectively close to:

1) 0.5 and 3.5 m 2) 0.29 and 3.5 m 3) 0.29 and 6.5 m 4) 0.5 and 6.5 m

31. The position x of a particle varies with time (t) as $x = at^2 - bt^3$. The acceleration at time t of the particle will be equal to zero, where t is equal to

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

32. An escalator moves downward at constant speed. You walk up the escalator at this same speed, so that you remain at rest with respect to the earth. Are you doing any work?

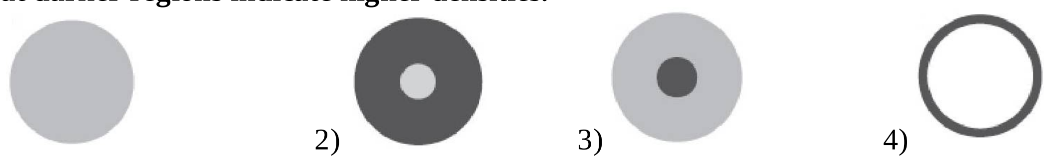
1) positive work 2) negative work

3) zero work 4)we cannot say anything with given information

33. A block with mass m starts from rest and slides down a plane inclined at an angle θ. The coefficient of kinetic friction is μ. Which expression correctly yields the block's speed v after it has travelled a distance d down along the plane, assuming that it does indeed start sliding down? (d is a distance here, so it is a positive quantity.)

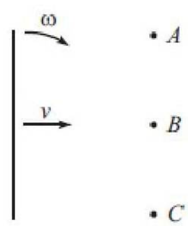
1) $mgd\sin\theta + \mu mgd\cos\theta = \frac{mv^2}{2}$
2) $mgd\sin\theta - \mu mgd\cos\theta = \frac{mv^2}{2}$
3) $-mgd\sin\theta + \mu mgd\cos\theta = \frac{mv^2}{2}$
4) None of the above is correct

34. If all of the following wheels are simultaneously released from rest at the same height on an inclined plane, and if none of the wheels slip, which one will reach the bottom first? Assume that darker regions indicate higher densities.



1) 2) 3) 4)

35. The CM of a uniform stick moves to the right, while the stick rotates clockwise with a nonzero positive angular velocity, as shown in Fig. Assuming that the relative size of v and ω has been chosen properly, which of the three points shown can have zero total angular momentum around it?



1) A
2) B
3) C
4) It is impossible for any of the points

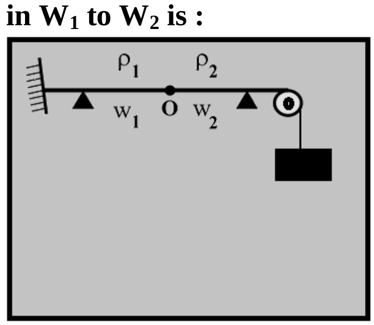
36. A satellite is revolving round the earth with orbital speed v_0. If it stops suddenly, find the speed with which it will strike surface of earth ($v_e =$ escape velocity of a particle on earth's surface).

1) $\frac{v_e^2}{v_0}$
2) v_0
3) $\sqrt{v_e^2 - v_0^2}$
4) $\sqrt{v_e^2 - 2v_0^2}$

37. The amplitude of a damped oscillator decreases to 0.5 times its original magnitude in 2s. In another 2s it will decrease to α times its original magnitude, where α equals

1) 0.125
2) 0.25
3) 0.75
4) none of these

38. Two wires W_1 and W_2 have the same radius r and respective densities $\rho_2 = 4\rho_1$. They are joined together at the point O, shown in the figure. The combination is used as a sonometer wire and kept under tension T. The point O is midway between the two bridges. When a stationary wave is set up in the composite wire, the joint is found to be a node. The ratio of the number of anti-nodes formed in W_1 to W_2 is :



1) 1 : 4
2) 4 : 1
3) 1 : 2
4) 2 : 1

39. **The ratio of specific heats $\frac{C_P}{C_V}=\gamma$, in terms of degrees of freedom is given by:**

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

40. **A mixture of 2 moles of helium gas (atomic mass = 4 u), and 1 mole of argon gas (atomic mass=40u) is kept at 300 K in a container. The ratio of their rms speeds $\frac{v_{rms}(Helium)}{v_{rms}(Argon)}$, is close to:**

1) 3.16 2) 0.32 3) 0.45 4) 2.24

41. **A 15 g mass of nitrogen gas is enclosed in a vessel at a temperature 27^0C. Amount of heat transferred to the gas, so that rms velocity of molecules is doubled, is about:**
[Take R = 8.3 J/ K mole]

1) 10 kJ 2) 0.9 kJ 3) 6 kJ 4) 14 k

42. **Two Carnot engines A and B are operated in series. The first one, A, receives heat at T_1(=600 K) and rejects to a reservoir at temperature T_2. The second engine B receives heat rejected by the first engine and, in turn, rejects to a heat reservoir at T_3(=400 K). Calculate the temperature T_2 if the work outputs of the two engines are equal :**

1) 400 K 2) 600 K 3) 500 K 4) 300 K

43. **A cylindrical wooden buoy of height 3 m and mass 80 kg floats vertically in water. If the specific gravity is 0.80, how much will it be depressed when a body of mass 10 kg is placed on its upper surface?**

1) 0.1 m 2) 0.2 m 3) 0.3 m 4) 0.4 m

44. **The terminal velocity of a copper ball of radius 2.0 mm falling through a tank of oil at 20^0C is 6.5 $cm\,s^{-1}$. Compute the viscosity of the oil at 20^0C. Density of oil is $1.5\times10^3\,kg\,m^{-3}$, density of copper is $8.9\times10^3\,kg\,m^{-3}$. (express is kg $m^{-1}s^{-1}$)**

1) 0.11 2) 0.66 3) 0.99 4) 0.33

45. **A student measured the diameter of a small steel ball using a screw gauge of least count 0.001 cm. The main scale reading is 5 mm and zero of circular scale division coincides with 25 divisions above the reference level. If screw gauge has a zero error of -0.004 cm, the correct diameter of the ball is**

1) 0.521 cm 2) 0.529 cm 3) 0.053 cm 4) 0.525 cm

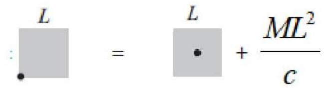
SECTION- II

(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. 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 in all other cases.

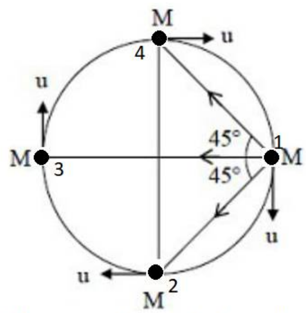
46. **A man weighing 80 kg is standing in a trolley weighing 320 kg. The trolley is resting on frictionless horizontal rails. If the man starts walking on the trolley with a speed of 1ms^{-1}, then after 4 seconds his displacement relative to the ground will be ... (in meters)**

47. **You will need to find the quantity c in the following picture equation that is Moment of inertia of a solid square of mass M and side L on L.H.S. = Moment of inertia of a solid square of mass M and side L on R.H.S.+** $\frac{ML^2}{c}$



(Note: Take Moment of inertia of solid square (mass M, side L) around the axis through the given dot and perpendicular to the plane of the square)

48. **Four particles, each of mass M and equidistant from each other (1 to 2, 2 to 3, 3 to 4 and 4 to 1), move along a circle of radius R under the action of their mutual gravitational attraction. If the speed of each particle is** $\frac{1}{2}\sqrt{\frac{GM}{R}\left(2\sqrt{X}+1\right)}$ **then X is.**



M: mass and u: speed of particles

49. **A toy-car, blowing its horn, is moving with a steady speed of 5 m/s, away from a wall. An observer, towards whom the toy car is moving, is able to hear 5 beats per second. If the velocity of sound in air is 340 m/s and the frequency in Hz of the horn of the toy car is …**

50. **A thermally insulated vessel contains 150g of water at 0^0C. Then the air from the vessel is pumped out adiabatically. A fraction of water turns into ice and the rest evaporates at 0^0C itself. The mass of evaporated water (in grams) will be …(Latent heat of vaporization of water** $= 2.10\times10^6\, J\, kg^{-1}$ **and Latent heat of Fusion of water = 3.36 x 10^5 J kg^{-1})**

SECTION – I
(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 if not correct.

CHEMISTRY

SYLLABUS: FIRST YEAR PHYSICAL CHEMISTRY

51. **Which of the following is not permissible arrangement of electrons in an atom?**
1) $n=5, l=3, m=0, s=+1/2$
2) $n=3, l=2, m=-3, s=-1/2$
3) $n=3, l=2, m=-2, s=-1/2$
4) $n=4, l=0, m=0, s=-1/2$

52. **The stability of + 1 oxidation state increases in the sequence:**
1) $Tl < In < Ga < Al$
2) $In < Tl < Ga < Al$
3) $Ga < In < Al < Tl$
4) $Al < Ga < In < Tl$

53. **Geometrical shapes of the complexes formed by the reaction of** Ni^{2+} **with** Cl^-, CN^- **and** H_2O, **respectively, are**
1) octahedral, tetrahedral and square planar
2) tetrahedral, square planar and octahedral
3) square planar, tetrahedral and octahedral
4) octahedral, square planar and octahedral

54. **The products obtained on heating $LiNO_2$ will be :**
1) $Li_2O + NO_2 + O_2$
2) $Li_3N + O_2$
3) $Li_2O + NO + O_2$
4) $LiNO_3 + O_2$

55. Aluminium chloride exists as dimer, Al_2Cl_6 in solid state as well as in solution of non-polar solvents such as benzene. When dissolved in water, it gives

1) $\left[Al(OH)_6\right]^{3-} + 3HCl$ 2) $\left[Al(H_2O)_6\right]^{3+} + 3Cl^-$

3) $Al^{3+} + 3Cl^-$ 4) $Al_2O_3 + 6HCl$

56. The stability of dihalides of Si, Ge, Sn and Pb increases steadily in the sequence

1) $PbX_2 << SnX_2 << GeX_2 << SiX_2$ 2) $GeX_2 << SiX_2 << SnX_2 << PbX_1$

3) $SiX_2 << GeX_2 << PbX_2 << SnX_2$ 4) $SiX_2 << GeX_2 << SnX_2 << PbX_2$

57. Which one of the following statement is not true ?

1) pH of drinking water should be between 5.5 – 9.5.

2) Concentration of DO below 6 ppm is good for the growth of fish.

3) Clean water would have a BOD value of less than 5 ppm.

4) Oxides of sulphur, nitrogen and carbon are the most widespread air pollutant.

58. Which of the following species is diamagnetic in nature?

1) H_2^- 2) H_2^+ 3) H_2 4) He_2^+

59. Which of the following oxy-acids has the maximum number of hydrogens directly attached to phosphorus?

1) $H_4P_2O_7$ 2) H_3PO_2 3) H_3PO_3 4) H_3PO_4

60. Match List - I (substances) with List - II (processes) employed in the manufacture of the substances and select the correct option.

List - I	**List - II**
Substances	**Processes**
(A) Sulphuric acid	**(i) Haber's process**
(B) Steel	**(ii) Bessemer's process**
(C) Sodium hydroxide	**(iii) Leblanc process**
(D) Ammonia	**(iv) Contact process**

Options:

(A) (B) (C) (D)

1) (iv) (ii) (iii) (i)

2) (i) (iv) (ii) (iii)

3) (i) (ii) (iii) (iv)

4) (iv) (iii) (ii) (i)

61. Which among the following is paramagnetic ?

1) Cl_2O 2) ClO_2 3) Cl_2O_7 4) Cl_2O_6

62. Which one of the following reactions of xenon compounds is not feasible?

1) $3XeF_4 + 6H_2O \rightarrow 2Xe + XeO_3 + 12HF + 1.5O_2$ 2) $2XeF_2 + 2H_2O \rightarrow 2Xe + 4HF + O_2$

3) $XeF_6 + RbF \rightarrow Rb\left[XeF_7\right]$ 4) $XeO_3 + 6HF \rightarrow XeF_6 + 3H_2O$

63. Which of the following ions will exhibit colour in aqueous solutions?

1) $La^{3+}(Z=57)$ 2) $Ti^{3+}(Z=22)$ 3) $Lu^{3+}(Z=71)$ 4) $Sc^{3+}(Z=21)$

64. The catalytic activity of transition metals and their compounds is mainly due to :

1) their magnetic behaviour 2) their unfilled *d*-orbitals

3) their ability to adopt variable oxidation state 4) their chemical reactivity

65. For gaseous state, if most probable speed is denoted by C*, average speed by $\overline{C}$ and mean square speed by C, then for a large number of molecules the ratios of these speeds are :

1) $C^*: \overline{C} : C = 1.225 : 1.128 : 1$ 2) $C^*: \overline{C} : C = 1.128 : 1.225 : 1$

3) $C^*: \overline{C} : C = 1:1.128 : 1.225$ 4) $C^*: \overline{C} : C = 1:1.225 : 1.128$

66. For the gas phase reaction, $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

which of the following conditions are correct ?

1) $\Delta H = 0$ and $\Delta S < 0$
2) $\Delta H > 0$ and $\Delta S > 0$
3) $\Delta H < 0$ and $\Delta S < 0$
4) $\Delta H > 0$ and $\Delta S < 0$

67. The following equilibrium constants are given:

$N_2 + 3H_2 \rightleftharpoons 2NH_3; K_1$

$N_2 + O_2 \rightleftharpoons 2NO; K_2$

$H_2 + \frac{1}{2}O_2 \rightleftharpoons H_2O; K_2$

The equilibrium constant for the oxidation of NH_3 **by oxygen to give** NO **is**

1) $\frac{K_2K_3^2}{K_1}$
2) $\frac{K_2^2K_3}{K_1}$
3) $\frac{K_1K_2}{K_3}$
4) $\frac{K_2K_3^3}{K_1}$

68. The dissociation constants for acetic acid and HCN at 25^0C are 1.5 × 10–5 and 4.5 × 10^{-10} **respectively. The equilibrium constant for the equilibrium**

$CN^- + CH_3COOH \rightleftharpoons HCN + CH_3COO^-$ **would be:**

1) 3.0×10^{-5}
2) 3.0×10^{-4}
3) 3.0×10^{4}
4) 3.0×10^{5}

69. A reduction in atomic size with increase in atomic number is a characteristic of elements of

1) d-block
2) f-block
3) radioactive series
4) high atomic masses

70. According to the Periodic Law of elements, the variation in properties of elements is related to their

1) nuclear masses
2) atomic numbers
3) nuclear neutron-proton number ratios
4) atomic masses

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. 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 in all other cases.

71. K_c for $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ is 0.04 at 25^0C. How many moles of PCl_5 must be added to a 3 litre flask to obtain a Cl_2 of concentration 0.15 M.

72. A certain photochemical reaction is found to acquire $8.1\times10^{-19}J$ energy per water molecule. Calculate the number of photons per water molecule of light with wavelength of 2.21×10^{-6} m that is required to initiate the reaction.

73. Calculate the molecular mass of a gas if its specific heat at constant pressure is 0.125 and at constant volume is 0.075

74. A certain volume of dry air at NTP is expanded reversibly to three times its volume (a) isothermally (b) adiabatically. Calculate the final pressure and temperature in each case, assuming ideal behavior. (C_p/C_v for air is 1.4)

75. 1g of KCl solution gives 1.925g of AgCl when heated with excess of $AgNO_3$ solution. Taking equivalent wt ot Ag as 108 and that of Cl as 35.5 calculate the equivalent wt of potassium

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MELUHA INTERNATIONAL SCHOOL

HYDERABAD

SR JEE MAINS MODEL | **CUM.TEST-2 (UT1+UT2+UT3)** | **Date: 30-04-2020**

Time: 3 Hours | **Max. Marks: 300 M**

KEY SHEET

MATHEMATICS

1) **1**	2) **2**	3) **4**	4) **1**	5) **2**	6) **4**	7) **1**	8) **3**	9) **3**	10) **4**
11) **1**	12) **3**	13) **2**	14) **2**	15) **3**	16) **2**	17) **1**	18) **1**	19) **4**	20) **3**
21) **1**	22) **3**	23) **4**	24) **0**	25) **24**					

PHYSICS

26) **1**	27) **1**	28) **2**	29) **3**	30) **2**	31) **3**	32) **1**	33) **2**	34) **3**	35) **1**
36) **4**	37) **2**	38) **3**	39) **1**	40) **1**	41) **1**	42) **3**	43) **3**	44) **3**	45) **2**
46) **3.2**	47) **2**	48) **2**	49) **292.87**	50) **20.67**					

CHEMISTRY

51) **2**	52) **4**	53) **2**	54) **1**	55) **2**	56) **4**	57) **2**	58) **3**	59) **2**	60) **1**
61) **2**	62) **4**	63) **2**	64) **3**	65) **3**	66) **2**	67) **4**	68) **3**	69) **2**	70) **2**
71) **2.1**	72) **9**	73) **40**	74) **0.217**	75) **39.05**					

Paper Setters:

SNO	Subject	Name of the Paper Setter	Phone No	Branch
2	MATHS-B	ZABEER SIR	8019470690	CO ICC
3	PHYSICS	BHARGAV SHARMA SIR	9618550817	CO ICC
4	CHEMISTRY	KATAMAIAH SIR	9948729934	CO ICC

Paper Verifiers:

SNO	Subject	Name of the Paper Verifier	Phone No	Branch
1				
2				
3				
4				

HINTS & SOLUTIONS

MATHS

1. Let $x+2y=u, x-2y=v$

$x=\frac{u+v}{2}, y=\frac{u-v}{4}$

$f(u,v)=\left(\frac{u+v}{2}\right)\left(\frac{u-v}{4}\right)=\frac{u^2-v^2}{8}$

$f(x,y)=\frac{x^2-y^2}{8}$

2. Obviously the relation is not reflexive and transitive but it is symmetric

$x^2+y^2=1, \Rightarrow y^2+x^2=1$

3. $\begin{vmatrix} \lambda & \sin\alpha & \cos\alpha \\ 1 & \cos\alpha & \sin\alpha \\ -1 & \sin\alpha & -\cos\alpha \end{vmatrix}=0$

$\lambda=\sin 2\alpha+\cos 2\alpha$

$\Rightarrow -\sqrt{2}<\lambda<\sqrt{2}$

4. Total number of units to be covered

$=3+7+11=21$

3 units can be chose in ${}^{21}C_3$ ways

7 units can be chose in ${}^{18}C_7$ ways

Rest units in ${}^{11}C_{11}$ ways

${}^{21}C_3 \times {}^{18}C_7$

5. $\sum_{i=1}^{n}\sum_{j=1}^{n} i=\sum_{i=1}^{n} n_i$

$=n\sum_{i=1}^{n} i=\frac{n(n(n+1))}{2}$

6. $\left[\frac{x}{2}\right]+\left[\frac{x}{3}\right]+\left[\frac{x}{5}\right]=\frac{31x}{30}$

LHS is integer, $\Rightarrow$ RHS must be integer

$\frac{31}{30}x=K$

x should be multiple of 30 so possible values can be $0,30,60....990 \Rightarrow 34$

7. $2^x\left(1+\frac{1}{2}+\frac{1}{4}\right)=7^x\left(1+\frac{1}{7}+\frac{1}{7^2}\right)$

$\left(\frac{7}{2}\right)^{x-2}=\frac{7}{57}$

$x=2+\frac{\log\left(\frac{7}{57}\right)}{\log\left(\frac{7}{2}\right)}$

No of roots $=1$ or drawn graph of

$\left(\frac{7}{2}\right)^{x-2}=\frac{7}{57}$

8. $Z_n=e^{i\frac{\pi}{(2n+1)(2n+3)}}$

$=e^{i\frac{\pi}{2}\left(\frac{1}{2n+1}-\frac{1}{2n+3}\right)}$

$\pi z_n=e^{i\left(\frac{\pi}{2}\left(\frac{1}{3}-\frac{1}{5}+\frac{1}{5}+\frac{1}{7}+....+\frac{1}{2n+1}-\frac{1}{2n+3}\right)\right)}$

$\lim_{x\to\infty}\pi z_n=\lim_{n\to\infty} e^{i\left(\frac{\pi}{2}\right)\left(\frac{2n}{3(2n+3)}\right)}$

$=e^{i\frac{\pi}{6}} \quad =\frac{\sqrt{3}}{2}+\frac{i}{2}$

9. $\tan y=\frac{1+\sqrt{1-x}}{1+\sqrt{1+x}}$

$x=\cos\theta$ then

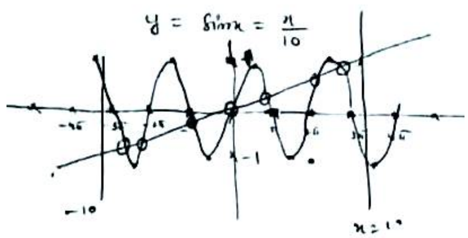
$\sqrt{1-x}=\sqrt{2}\sin\theta/2, \sqrt{1+x}=\sqrt{2}\cos\theta/2$

$$\tan y=\frac{\sin\frac{\pi}{4}+\sin\frac{\theta}{2}}{\cos\frac{\pi}{4}+\cos\frac{\theta}{2}}=\tan\left(\frac{\pi}{8}+\frac{\theta}{4}\right)$$

$$y=\frac{\pi}{8}+\frac{\theta}{4}$$

$$\sin(4y)=\sin\left(\frac{\pi}{2}+\theta\right)=\cos\theta=x$$

10. $y=\sin x=\dfrac{x}{10}$



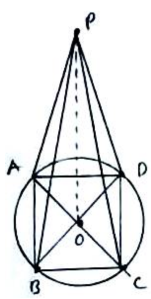
No of solution =7

11. $1+x^2\ge 2|x| \Rightarrow \dfrac{2|x|}{1+x^2}\le 1$

$$-1\le\frac{2x}{1+x^2}\le 1 \Rightarrow \tan^{-1}\left(\frac{2x}{1+x^2}\right)\in\left[-\frac{\pi}{4},\frac{\pi}{4}\right]$$

12. $OP=4cm$

$OA=OB=OC=OD=3cm$



$AP=BP=CP=OP$

$=5CM$

ABCD is a square of length $=3\sqrt{2}$ cm

$$\sin\theta/2=\frac{\frac{1}{2}BC}{BP}=\frac{3}{5\sqrt{2}}$$

$$\cos\theta=\frac{16}{25}$$

13. $\dfrac{\cot A+\cot C}{\cot B}=\dfrac{\sin(A+C)\sin B}{\sin A\sin C\cos B}$

$$=\frac{\sin^2 B}{\sin A\cos B\sin C}$$

$$=\frac{4R^2b^2}{4R^2ac\cos B}$$

$$=\frac{2b^2}{a^2+c^2-b^2}$$

$$=\frac{2b^2}{2002b^2-b^2}=\frac{2}{2001}$$

14. p,q,r are roots

$p+q+r=3, pq+qr+rp=0$

$pqr=-1$

$$\text{Centroid}=\left(\frac{pr+qr+rp}{3},\frac{\frac{1}{pq}+\frac{1}{qr}+\frac{1}{rp}}{3}\right)$$

$=(2,-1)$

15. AA' is parallel to $x-y=3$

is passing through $(2,1)$

$\tan\theta=1$

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

$AA'=4$

$$x-2=-4\left(\frac{1}{\sqrt{2}}\right)=-2\sqrt{2}$$

$x=2-2\sqrt{2}$

$y-1=-2\sqrt{2}$

$y=1-2\sqrt{2}$

16. $y-mx=\pm a\sqrt{1+m^2}\Rightarrow$ parallel line

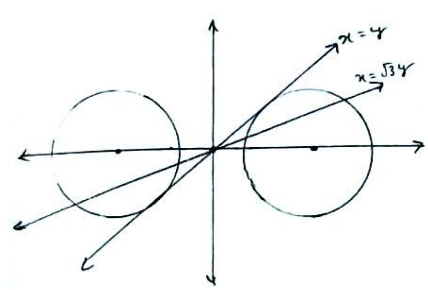
$y-nx=\pm a\sqrt{1+n^2}\Rightarrow$ parallel line

$\Rightarrow$ distance between parallel lines is 2a

Rhombus

17. Let centre $=(a,0)\Rightarrow r=d$

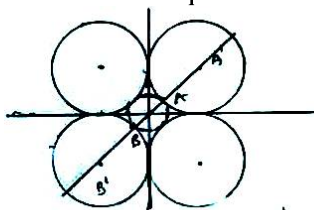
$$x-y=\frac{a}{\sqrt{2}}$$



$x-\sqrt{3}y=0$ cuts circle of length 2 units chord

$$\left(\frac{a}{\sqrt{2}}\right)^2=1^2+\left(\frac{a-\sqrt{3}\times 0}{\sqrt{1+3}}\right)^2 \Rightarrow a=2$$

18. Diameter of required circle



$= A'B' - A'A' - B'B'$

$= \left(\sqrt{2} - 1\right)$

19. $p = \left(at^2, 2at\right)$

$SP = PM = a + at^2$

$m = \left(0, 2at\right)$

Δspm is equilateral

$SP = PM = SM$

$SP^2 = PM^2$

$\Rightarrow t^2 = 3, t = \sqrt{3}$

$sp = a + 3a = 4a$

20. Asymptotes are perpendicular hyperbola is rectangular $e = \sqrt{2}$

21. $\left(\frac{\sqrt{3}+1}{2\sqrt{2}}\right)^{2x} + \left(\frac{\sqrt{3}-1}{2\sqrt{2}}\right)^{2x} = 1$

$\left(\sin 75^0\right)^{2x} + \left(\cos 75^0\right)^{2x} = 1$

$x = 1$

22. $\left|\log_3^x\right| = \log_3^x \; x \geq 1$

$-\log_3^x \quad x \in \left(0,1\right)$

$\Rightarrow x \geq 1 \Rightarrow -3 < 0$

$x \in \left[1, \infty\right]$

If $x \in \left(0,1\right)$

$-\log_3^x - \log_3^x - 3 < 0$

$\log_3^{\frac{1}{x^2}} < 3$

$\frac{1}{x^2} < 3^3$

$x \in \left(\frac{1}{\sqrt{27}}, 1\right)$

$k = 27 \qquad k^{1/3} = 3$

23. $f\left(\theta\right) = \frac{1 - \sin 2\theta + \cos 2\theta}{2\cos 2\theta}$

$f\left(\theta\right) = \frac{1}{1 + \tan\theta}$

$8f\left(11^0\right).f\left(34^0\right) = 8.\frac{1}{\left(1 + \tan 11^0\right)\left(1 + \tan 34^0\right)}$

$= \frac{8}{2} = 4$

24. $\left[\sqrt{\frac{\pi}{3}}\right] = 1$

$f\left(\sqrt{\frac{\pi}{3}}\right) = 0$

25. $y = mx + \sqrt{18m^2 + 32}$

$m = -\frac{4}{3}$

$4x + 3y = 24$

$A\left(6,0\right), B\left(0,8\right)$

Area $= \frac{1}{2}\left(6\right)\left(8\right) = 24$

PHYSICS

26. Both the blocks are in series and the heat flow is in steady state:

$Q = KA\frac{dT}{dx}$

$K_1 A\left(\frac{dT}{dx}\right) = K_2 A\left(\frac{dT}{dx}\right)_2$

The slope for the second graph is much larger (in magnitude). i.e. The value of K is much larger in case 1 to compensate.

i.e. $K_1 > K_2$

27. Velocity of the mass m just before string becomes tight.

$v = \sqrt{2gh} \qquad (i)$

Using impulse = change in momentum

For mass 2m

$J = 2m_1/v_1 \qquad (ii)$

For mass m (iii)

$mv - J = mv_1$

Solving Eqs. (i), (ii) and (iii), we get

$v = \frac{\sqrt{2gh}}{3}$

28. Given, Velocity A & B, $V_A = 10\,m/s$

& $V_B = -5\,m/s$

Distance A to B, $AB = 60m$

Relative velocity of A with respect to

$B \;\; V_{AB} = V_A - V_B = 10 - \left(-5\right) = 15\; m/s$

Time required to cover distance A to B,

$t = \frac{AB}{V_{AB}} = \frac{60}{15} = 4$ sec

Hence, at 4 sec they both collide and stick together in 4 sec, distance cover by

$A = V_A t = 10 \times 4 = 40\,m$

They both collide at 40m from A

29. Density = Mass / Volume
$1\Delta d/d = 1\Delta M/M + 3\Delta L/L = 1.5 + 3x\ 1 = 4.5\%$

30. Work done by friction at QR= μmgx
In triangle, sin $30^0 = 1/2 = 2/PQ$
PQ = 4m
Work done by friction at PQ = μmg
x cos 30^0 x 4 = μmg x $\sqrt{3}/2 \times 4 = 2\sqrt{3}\ \mu mg$
Since work done by friction on parts PQ and QR are equal, $\mu mgx = 2\sqrt{3}\mu mgx$
$= 2\sqrt{3} \cong 3.5m$
Applying work energy theorem from P to R
$mg \times \sin 30^0 \times 4 = 2\sqrt{3}\ \ \mu mg + \mu mgx$
$2 = 4\sqrt{3}\mu \quad \mu = 0.29$

31. $x = at^2 - bt^3$
$\frac{dx}{dt} = v = 2at - 3bt^2$
$\frac{dv}{dt} = a = 2a - 6bt = 0$
$2a = 6bt \ \therefore t = \frac{a}{3b}$

32. Your feet apply a normal force on the steps, and your feet are moving.
So, there is a nonzero force-times-distance product. The work that you do on the escalator is positive; your feet move downward as they apply a downward force on the escalator. Conversely, the escalator does negative work on you; it moves downward as it applies an upward force on your feet. Since negative work is done on you, the general work-energy theorem says that your total energy decreases. Your kinetic energy doesn't change (it is always zero; or essentially constant, if we include the roughly constant motion of your legs), nor does your gravitational
potential energy change (because you remain at the same height). But your internal chemical potential energy decreases as you use up the dinner you ate the night before.

33. The component of the gravitational force pointing down along the plane has magnitude mg $\sin\theta$. The block is moving down the plane, so gravity does positive work; this work is (mg $\sin\theta$)d. The kinetic friction force points up along the plane with magnitude μN =μ(mg $\cos\theta$). The associated work is negative and equals - (μ mg $\cos\theta$)d. The total work is therefore (mgd $\sin\theta$ - μmgd $\cos\theta$). Since the block starts at rest, the change in kinetic energy is $\frac{mv^2}{2} - 0$. The work-energy theorem therefore gives choice (b)..
Alternatively: If you want to think in terms of energy instead of work, then the mgd $\sin\theta$ loss in potential energy shows up as $mv^2/2$ kinetic energy plus μmgd $\cos\theta$ heat (which is the magnitude of the work done by friction). This yields the same equation, just rearranged.

34. The mass is more concentrated in the center in choice (c). So, when moment of inertial is written in the form of βmr^2, where β is a numerical coefficient, the β for choice (c) is the smallest. This means that when potential energy is converted into kinetic energy as the wheel rolls down the plane, less energy goes into rotational energy and more energy goes into translational energy. The CM speed for (c) is therefore largest, so it reaches the bottom first.

35. The total L is the sum of the L around the CM, plus the L of the object treated like a point mass at the CM. The former of these has a clockwise sense relative to A (and any other point, for that matter). The latter has a counterclockwise sense relative to A (but zero relative to B, and clockwise relative to C). So, it is possible for these two contributions to cancel around point A if v and w are related properly (ω = 6v/1, as you can show).

36. Let r=radius of satellite.
$v_0 =$ the orbital speed of a satellite.
$v_e =$ escape velocity of a particle on earth's surface
$v =$ velocity of satellite at which it strike the surface of the earth
M= mass of earth

M=mass of satellite
The orbital speed of a satellite is given by
$v_0^2 = \frac{GM}{r}$.....(1)
Escape velocity of a particle on the earth surface $v_0^2 = \frac{2GM}{R}$........(2)
$v_e^2 = \frac{2GM}{R}$.....(2)

Applying law of conservation of energy at point A and B,

$K.E =$ change in potential energy

$$\frac{1}{2}mv^2 = -\frac{GMm}{r} - \left(\frac{GMm}{R}\right)$$

$$v^2 = \frac{2GM}{R} - \frac{2GM}{r}$$

$v^2 = v_e^2 - 2v_0^2$ (from equation 1 and 2)

$$v = \sqrt{v_e^2 - 2v_0^2}$$

37. $A = A_0 e^{-kt}$

In 2 seconds 0.5 $A_0 = A_0 e^{-k2}$

In next 2 seconds that is total 4 seconds from start new amplitude $A_f = A_0 e^{-4}$

By using eq 1 we will get

$$A_f = A_0\left(e^{\ln(0.5)}\right)^2 = A_0(0.5)^2 = 0.25A_0$$

38. $n_1 = n_2 \quad n = \frac{p}{2i}\sqrt{\frac{T}{\pi r^2 d}}$

$T \to$ same $n_1 = n_2$

$r \to$ same $\frac{p_1}{\sqrt{d_1}} = \frac{p_2}{\sqrt{d_2}}$

$$\frac{p_1}{p_2} = \frac{1}{2}$$

39. Take $C_V = \frac{nR}{2}$ and Mayor's relation

$C_P - C_V = R$

On solving we will get $\gamma = \frac{C_p}{C_v} = 1 + \frac{2}{n}$

40. $n_{He} = 2 \quad n_{Ar} = 1$

$m_{He} = 4u \quad m_{Ar} = 40u$

$T = 300K$

$$\frac{v_{rms}(Helium)}{v_{rms}(Argon)} = ? \; v_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3k_BT}{m}}$$

$$\frac{v_{rms}(Helium)}{v_{rms}(Argon)} = \sqrt{\frac{m_{Ar}}{m_{He}}} = \sqrt{\frac{40}{4}} = 3.16$$

41. $Q_v = nC_V\Delta T$

$m = 15\ g$ in closed vessel

$M = 28\,g\,mol^{-1}$; Nitrogen gas;

Diatomic $T = 300\ K$

$Q = ?$

$$v'_{rms} = 2v_{rms}$$

$$\Rightarrow T' = 4(300) = 1200K$$

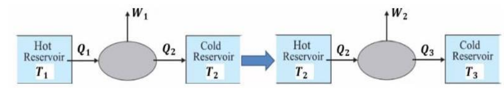
$$v_{rms} = \sqrt{\frac{3RT}{M}}$$

$$\Rightarrow T' = 4T$$

$$Q = \left(\frac{15}{28}\right)\left(\frac{5R}{2}\right)(1200 - 300)$$

$$\Rightarrow Q = 10{,}021.4J \approx 10kJ$$

42. $T_2 = 600K; T_3 = 400K$



$T_2 = ?$ for $W_1 = W_2 = W$

For Engine 1: $Q_1 - Q_2 = W$

For Engine 2: $Q_2 - Q_3 = W$

$\Rightarrow Q_1 - Q_2 = Q_2 - Q_3$

$$\Rightarrow 2 = \frac{T_1 + T_3}{T_2} \Rightarrow T_2 = \frac{600 + 400}{2} = 500K$$

On solving

43. By Archimedes' principle, the summeged height, h, of the unloaded buoy is given by

$\rho_{water} gAh = \rho_{water} gA(3)$

or $h = \frac{\rho_{wood}}{\rho_{water}}\ 3 = (0.80)(3) = 2.40m$

$$\frac{h + \Delta h}{h} = \frac{80 + 10}{80}$$

or $\Delta h = \frac{10}{80}h = \frac{10}{80}2.40 = 0.30m$

44. $v_t = 2a^2(\rho - \sigma)g/(9\eta)$

We have $v_1 = 6.5 \times 10^{-2} ms^{-1}, a = 2 \times 10^{-3} m.$

$g = 9.8 ms^{-2}, \rho = 8.9 \times 10^3 kg\,m^{-3},$

$\sigma = 1.5 \times 10^3 kg\,m^{-3}.$ From Eq. (10.20)

$$\eta = \frac{2}{9} \times \frac{(2 \times 10^{-3})m^2 \times 9.8 ms^{-2}}{6.5 \times 10^{-2} ms^{-1}} \times 7.4 \times 10^3\,kg\,m^{-3}$$

$$= 9.9 \times 10^{-1} kg\,m^{-1}s^{-1}$$

45. L.C. of screw gauge =0.001 cm

M.S.R. =5 mm =0.5 cm

C.S.R.=25 Circular Scale Divisions

Zero error $= -0.004$ cm

Correct diameter=?

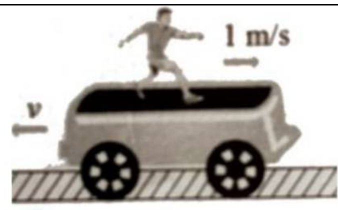
Final reading =M.S.R+(C.S.R ×LC) –zero error

Final reading $= 0.5 + (25 \times 0.001) - (-0.004)$

$\Rightarrow$ Final reading $= 0.5 + 0.025 + 0.004$

$\Rightarrow$ Final reading $= 0.529$ cm

46. According to LOCOLH, |Forward momentum of mass| = |opposite momentum of totally along with mass|



$$m_{mass}(v_{mass}) = (m_{trally} + m_{mass})\left(\frac{x_{trolly}}{t}\right)$$

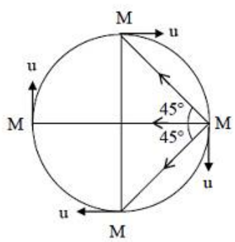
$$80(1) = (320+80)\left(\frac{x_{Trolly}}{4}\right)$$

$$\therefore x_{Trolly} = \frac{320}{400} = \frac{4}{5} = 0.8\,ms$$

Step-2:
Net displacement of mass release to ground $= x_{mass} - x_{trally} = (1)(4) - 0.8 = 3.2\,m$

47. To find c, we can use the parallel-axis theorem. The axes (the dots) are $\frac{L}{\sqrt{2}}$ away from each other, therefore $c = 2$.

48. Net force on any one particle



$$\frac{GM^2}{(2R)^2} + \frac{GM^2}{(R\sqrt{2})^2}\cos 45^0 + \frac{GM^2}{(2\sqrt{2})^2}\cos 45^0$$

$$= \frac{GM^2}{R^2}\left[\frac{1}{4} + \frac{1}{\sqrt{2}}\right]$$

This force will be equal to centripetal force so $\frac{Mu^2}{R} = \frac{GM^2}{R^2}\left[\frac{1+2\sqrt{2}}{4}\right]$

$$u = \sqrt{\frac{GM}{4R}\left[1+2\sqrt{2}\right]} = \frac{1}{2}\sqrt{\frac{GM}{R}\left(2\sqrt{2}+1\right)}$$

49. From Doppler's effect

$$\text{f(direct)} = \text{f}\left(\frac{340}{340-5}\right) = \text{f}_1$$

$$\text{f(by wall)} = \text{f}\left(\frac{340}{340-5}\right) = \text{f}_2$$

Beats = $(\text{f}_1 - \text{f}_2)$

$$5 = \text{f}\left(\frac{340}{340-5} - \frac{340}{340+5}\right)$$

$\Rightarrow$ f = 172.41Hz

50. Suppose 'm' gram of water evaporates then, heat required

$$\Delta Q_{req} = mL_v$$

Mass that converts into ice $= (150 - m)$

So, heat released in this process

$$\Delta Q_{rel} = (150-m)L_f$$

Now, $\Delta Q_{rel} = \Delta Q_{req}$

$$(150-m)L_f = mLv$$

$$m = (L_f + L_v) = 150L_f$$

$$m = \frac{150L_f}{L_f + L_v}$$

$$m = 20.67\,g$$

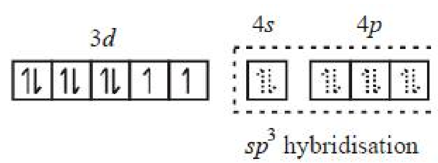
CHEMISTRY

51. $m = -l$ to $+l$, through zero thus for $l = 2$, values of m will be – 2, –1, 0, + 1, + 2.
Therefore for $l = 2$, m
cannot have the value -3.

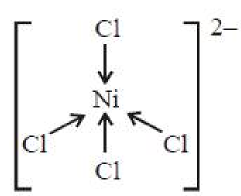
52. The stability of +1 oxidation state increases from aluminium to thallium i.e.
Al < Ga < In < Tl

53. $Ni^{+2} + 4Cl^- \rightarrow \underset{sp^3}{[NiCl_4]^{2-}}$

$[NiCl_4]^{2-}. = 3d^8$ configuration with nickel in + 2
oxidation state, Cl– being weak field ligand does not compel for pairing of electrons.
So, $[NiCl_4]^{2-}$



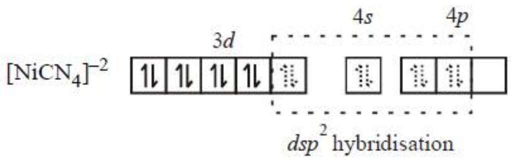
Hence, complex has tetrahedral geometry



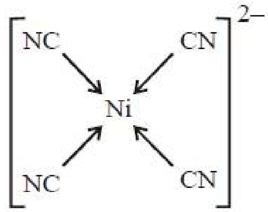
$Ni^{+2} + 4CN^- \longrightarrow [Ni(CN)_4]^{2-}$

$[Ni(CN)_4]^{2-} = 3d^8$

configuration with nickel in + 2
oxidation state, CN– being strong field ligand compels for pairing of electrons.
So,

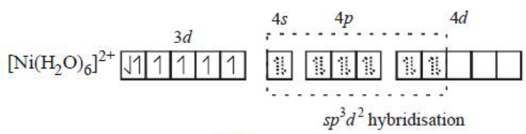


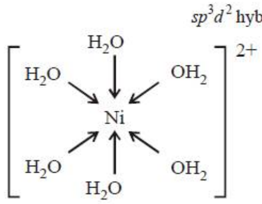
Hence, complex has square planar geometry.



$Ni^{+2} + 6H_2O \longrightarrow [Ni(H_2O)_6]^{2+}$

$\left[Ni^{+2} + (H_2O)_6\right]^{2+} = 3d^8$ configuration with nickel in + 2 oxidation state. As with $3d^8$ configuration two *d*-orbitals are not available for d^2sp^3 hybridisation. So, hybridisation of Ni (II) is sp^3d^2 and Ni (II) with six co-ordination will have octahedral geometry.





54. $4LiNO_3 \rightarrow 2Li_2O + 4NO_2 + O_2$

55. $AlCl_6 + 12H_2O \rightleftharpoons 2\left[Al(H_2O)_6\right]^{3+} + 6C\bar{l}$

56. Reluctance of valence shell electrons to participate in bonding is called inert pair effect. The stability of lower oxidation state (+2 for group 14 element) increases on going down the group. So the correct order is
$SiX_2 < GeX_2 < SnX_2 < PbX_2$

57. The ideal value of D.O for growth of fishes is $8\,mg/l$. $7\,mg/l$ is desirable range, below this value fishes get susceptible to disease. A value of $2\,mg/l$ or below is lethal for fishes.

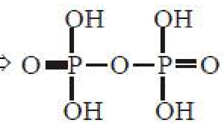
58. A diamagnetic substance contains no unpaired
electron. H2 is diamagnetic as it contains all paired electrons

$H_2 = \sigma_b^2$ (diamagnetic), $H_2^+ = \sigma_b^1$ (paramagnetic), $H_2^- = \sigma_b^2, \sigma_a^{*1}$ (paramagnetic)

He_2^+ (paramagnetic) $= \sigma_b^2, \sigma_a^{*1}$ (paramagnetic)

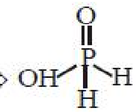
59.

1) $H_4P_2O_7 \Rightarrow$



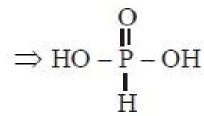
Pyrophosphoric acid

2) $H_3PO_2 \Rightarrow$



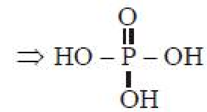
Hypophosphorous acid

3) $H_3PO_3 \Rightarrow$



Phosphorous acid

4) $H_3PO_4 \Rightarrow$



orthophosphoric acid

60. (A) Sulphuric acid — (iv) Contact process
(B) Steel — (ii) Bessemer's process
(C) Sodium hydroxide — (iii) Leblanc process
(D) Ammonia — (i) Haber's process

61. ClO_2 contains 7 + 12 i.e. 19 electrons (valence) which is an odd number, i.e. there is (are) free electron(s). Hence it is paramagnetic in nature.

62. The products of the concerned reaction react each other forming back the reactants.
$XeF_6 + 3H_3O \rightarrow XeO_3 + 6HF.$

63. $La^{3+} : 54e^- = [Xe]$
$Ti^{3+} : 19e^- = [Ar]3d^1$ (Coloured)
$Lu^{3+} : 68e^- = [Xe]4f^{14}$
$Sc^{3+} : 18e^- = [Ar]$

64. The transition metals and their compounds are used as catalysts. Because of the variable oxidation states they may form intermediate compound with one of the readtants. These intermediate provides a new path with
lowe activation energy.
$V_2O_5 + SO_2 \rightarrow V_2O_4 + SO_3$
$2V_2O_4 + O_2 \rightarrow 2V_2O_5$

65. Most probable speed $(C^*) = \sqrt{\dfrac{2RT}{M}}$

Average Speed $\left(\bar{C}\right) = \sqrt{\dfrac{8RT}{\pi M}}$

Root mean square velocity (C) $=\sqrt{\frac{3RT}{M}}$

$$C^* = \bar{C} : C = \sqrt{\frac{2RT}{M}} : \sqrt{\frac{8RT}{\pi M}} : \sqrt{\frac{3RT}{M}}$$

$$= 1 : \sqrt{\frac{4}{\pi}} : \sqrt{\frac{3}{2}} = 1:1.128:1.225$$

66. For the reaction

$$PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$$

The reaction given is an example of decomposition reaction and we know that decomposition reactions are endothermic in nature, i.e., $\Delta S > 0$

(Δ S is positive)

67. Given,

$$N_2 + 3H_2 \rightleftharpoons 2NH_3; K_1 \quad ....(i)$$

$$N_2 + O_2 \rightleftharpoons 2NO; \quad K_2 \quad ....(ii)$$

$$H_2 + \frac{1}{2}O_2 \rightleftharpoons H_2O; \quad K_3 \quad ....(iii)$$

We have to calculate

$$4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O;\ K = ?$$

or $2NH_3 + \frac{5}{2}O_2 \longrightarrow 2NO + 3H_2O$

For this equation, $K = \frac{[NO]^2\,[H_2O]^3}{[NH_3]^2\,[O_2]^{5/2}}$

but $K_1 = \frac{[NH_3]^2}{[N_2][H_2]^3},\ K_2 = \frac{[NO]^2}{[N_2][O_2]}$

& $K_3 = \frac{[H_2O]}{[H_2][O_2]^{1/2}}$ or $K_3^3 = \frac{[H_2O]^3}{[H_2]^3\,[O_2]^{3/2}}$

Now operate, $\frac{K_2 . K_3^3}{K_1}$

$$= \frac{[NO]^2}{[N_2][O_2]} \times \frac{[H_2O]^3}{[H_2]^3\,[O_2]^{3/2}} \cdot \frac{[N_2][H_2]^3}{[NH_3]^2}$$

$$= \frac{[NO]^2\,[H_2O]^3}{[NH_3]^2\,[O_2]^{5/2}} = K$$

$$\boxed{\therefore\ K = \frac{K_2 . K_3^3}{K_1}}$$

68. Given, $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$;

$K_{a_1} = 1.5 \times 10^{-5}$ ....(i)

$HCN \rightleftharpoons H^+ + CN^-;\ K_{a_2} = 4.5 \times 10^{-10}$

or $H^+ + CN^- \rightleftharpoons HCN$;

$$K'_{a_2} = \frac{1}{K_{a_2}} = \frac{1}{4.5 \times 10^{-10}} \quad ...(ii)$$

$\therefore$ From (i) and (ii), we find that the equilibrium constant (K_a) for the reaction ,

$CN^- + CH_3COOH \rightleftharpoons CH_3COO^- + HCN$, is

$$K_a = K_{a_1} \times K'_{a_2} = \frac{1.5 \times 10^{-5}}{4.5 \times 10^{-10}} = \frac{1}{3} \times 10^5 = 3.33 \times 10^4$$

69. f-block elements show a regular decrease in atomic size due to lanthanide/actinide contraction.

70. The properties of elements change with a change in atomic number.

71. At equil. No. Of mole of Cl_2 in $3L = 0.15 \times 3 = 0.45$

PCl_5	$\rightleftharpoons$ PCl_3	+ Cl_2	
x	0	0	Initial moles
x − 0.45	0.45	0.45	Moles at eqb.
$\frac{(x-0.45)}{3}$	$\frac{(0.45)}{3}$	$\frac{(0.45)}{3}$	Molar conc. at eqb.

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]} = \frac{(0.15)(0.15)}{\frac{(x-0.45)}{3}}$$

$\therefore$ x = 2.1 mole

72. $N = \frac{E\lambda}{hc} = \frac{8.1 \times 10^{-19} \times 2.21 \times 10^{-6}}{6.62 \times 10^{-34} \times 3 \times 10^8} = 9$ photons

73. $\gamma = \frac{C_p}{C_v} = \frac{0.125}{0.075} = 5/3 = 1.66$ hence gas is monoatomic

Molar heat at constant volume $C_v = 3/2\,R = 3/2 \times 2 = 3\,cal.$

Also, specific heat $\times$ molar mass $= C_V$

$$0.075 \times M = 3 \therefore M = \frac{3}{0.075} = 40\ g/mol$$

74. Let V_1 be the initial volume of dry air at NTP

(a) Isothermal expansion, Since $\Delta T = 0$ hence $P_1V_1 = P_2V_2$

$$\therefore P_2 = \frac{P_1V_1}{V_2} = \frac{1 \times V_1}{3V_1} = 0.333 \text{ atm}$$

(b) Adiabatic expansion we have

$$\frac{T_1}{T_2} = \left[\frac{V_2}{V_1}\right]^{\gamma-1} \quad \text{or} \quad \frac{273}{T_2} = \left[\frac{3V_1}{V_1}\right]^{1.4-1}$$

$$T_2 = 176\,K = -97^0 C$$

Final pressure under adiabatic conditions

$$\frac{P_1}{P_2} = \left[\frac{V_2}{V_1}\right]^{\gamma} \quad \frac{1}{P_2} = \left[\frac{3V_1}{V_1}\right]^{1.4} \quad P = 0.217\,atm$$

75. $\frac{\text{wt of KCl}}{\text{wt of AgCl}} = \frac{\text{eq.wt.of K+eq.wt.of Cl}}{\text{eq.wt.of Ag+eq.wt.of Cl}}$

$$\frac{1}{1.925} = \frac{\text{Eq.wt of K+35.5}}{108+35.5}$$

$\therefore$ Eq.wt.of K = 39.05