MELUHA INTERNATIONAL SCHOOL

HYDERABAD

SR MPC	**JEE ADVANCE**	**Date: 30-04-2020**
Time: 3 Hours	**(IIT 2016 PAPER-2 MODEL – 60 BITS)**	**Max. Marks: 240 M**

PHYSICS

SYLLABUS: ***Kinematics(1D & 2D), Laws of Motion, Work, Energy and Power and Rotational Motion Gravitation, Oscillations and Waves, Thermal Properties, Thermodynamics, Kinetic Theory of Gases, Elasticity, Hydrostatics and Dynamics, Units, Measurements and Errors***

Section 1 (Maximum Marks : (32)

- This section contains **EIGHT** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive
- For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS
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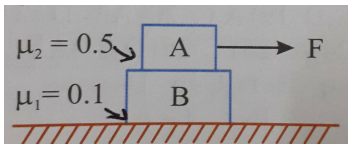
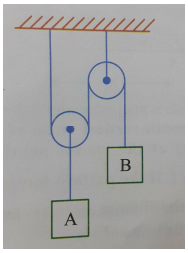
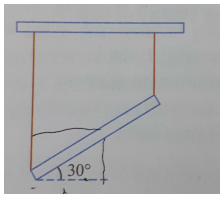
1. A block A of mass 10Kg rests on a second block of mass 8 Kg. The coefficients of friction at various surfaces are shown in figure . A horizontal force of 100N is applied on upper block A relative to block B after 0.01S of application of force. The system is initially at rest (Express your answer in cm/s and take $g = 10 m/s^2$



2. Block A has a weight of 30N and block B has weight 50N. Calculate the distance A must desend from rest before it obtains a speed of 4m/s (neglect mass of cord and pulleys) (take $g = 10 m/s^2$ **)**



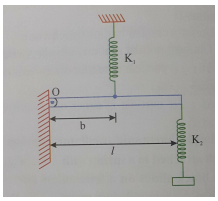
3. A thin uniform rod of mass m and length 2L is held at an angle of 30^0 **with the horizontal by means of two vertical inextensible strings, at each end as shown in figure. If the string at the right end breaks, leaving the bar to swing, the tension in the stringat the left end of the bar immediately after string breaks is** $T = \frac{n}{13} mg$ **. Then n=**



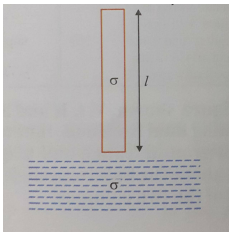
4. A chord of length 64m is used to connect a 100Kg astronant to a spaceship whose mass is much larger than that of the astronant. Estimate the value of the tension (in $10^{-2} N$ **) in the**

chord. Assume that the spaceship and the astronant fall on a straight line from the earth's centre (Take radius of earth 6400Km)

5. **A rod of mass m and length ℓ hinged at one end is connected by two springs of spring constants k_1 and k_2 so that it is horizontal at equilibrium. What is the angular frequency of the system (in rad/sec (Take $\ell = 1m,\ b = \frac{1}{4}m,\ k_1 = 16N/m,\ k_2 = 63N/m, m = 3Kg$)**



6. **A uniform vertical cylinder is released from rest with its lower end just touching the liquid surface of a deep lake. Calculate the maximum displacement of the cylinder in meters (Take $\ell = 4m$ and $\frac{\sigma}{\rho} = \frac{1}{2}$)**



7. **A 50gm lead bullet (specific heat 0.020 cal/g) is initially at 30^0C. It is fired vertically upward with a speed of 84 m/sec. On returning to the starting level, it strikes a slab of ice at 0^0C. $(x \times 100)mg$ of ice is melted. Find the value of 'm'**

8. **A diatomic ideal gas is compressed adiabatically to $\frac{1}{32}$ of its initial volume. In the initial temperature of the gas is $'T_i'$ (in kelvin) and the final temperature is $'xT_i'$, the value of 'x' is**

Section 2 (Maximum Marks : (32)

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9. **A particle is projected from ground with velocity $40\sqrt{2}m/s$ at 45^0. At time t=2sec**
A) displacement of particle is 100m
B) vertical component of velocity is 20 m/s
C) velocity makes an angle of $Tan^{-1}(2)$ with vertical
D) particle is at height of 60m from ground

10. **The force F_1 that is necessary to move a body up an inclined plane is double the force F_2 that is necessary to just prevent it from sliding down then (where ϕ = angle of friction, θ = inclined plane angle, w = weight of the body)**

A) $F_2 = w\sin(\theta-\phi)\sec\phi$ B) $F_1 = w\sin(\theta-\phi)\sec\phi$

C) $\tan\phi = 3\tan\theta$ D) $3\tan\phi = \tan\theta$

11. The potential energy 'U' in joule of a particle of mass 1kg moving in X-Y plane obeys the law U=3x+4y, where (x, y) are the co-ordinates of the particle in meters. If the particle is at rest at (6, 4) at time t = 0 then

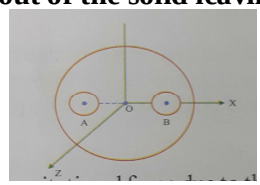
A) the particle has constant acceleration

B) the particle has zero acceleration

C) the speed of the particle when it crosses the y-axis is 10 m/s

D) co-ordinates of particle at t = 1 s are (4, 5, 2)

12. A solid sphere of uniform density and radius 4 units is located withits centre at the origin 'O' at co-ordinates. Two spheres of equal radii 1 unit, with their centres at A (-2, 0, 0) and B (2, 0, 0) respectively are taken out of the solid leaving behind spherical cavities as shown



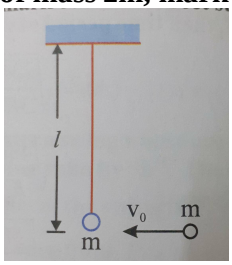
A) the gravitational force due to this object at the origin is zero

B) the gravitational force at the point B (2, 0, 0) is zero

C) the gravitational potential is the same at all points of the circle $z^2 + y^2 = 36$

D) the gravitational potential is the same at all points of the circle $z^2 + y^2 = 4$

13. A simple pendulum consists of a bob of mass 'm' and a light string of length 'ℓ' as shown. Another identical ball moving with the same velocity V_o collides with the pendulum's bob and sticks to it. For this new pendulum of mass 2m, mark out correct statement(s)



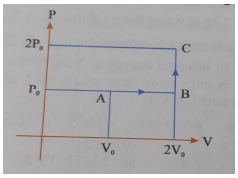
A) Time period of the pendulum is $2\pi\sqrt{\dfrac{l}{g}}$

B) Equation of motion for this pendulum is $\theta = \dfrac{V_o}{2\sqrt{g\ell}}\sin\left(\sqrt{\dfrac{g}{\ell}}\,t\right)$

C) Equation of motion for this pendulum is $\theta = \dfrac{V_o}{2\sqrt{g\ell}}\cos\left(\sqrt{\dfrac{g}{\ell}}\,t\right)$

D) Time period of the pendulum is $2\pi\sqrt{\dfrac{2l}{g}}$

14. One mole of an ideal monoatomic gas is taken from A to C along the path ABC. The temperature of the gas at A is T_0 . For the process ABC :



A) Work done by the gas is RT_0 B) Change in internal energy of the gas is $\dfrac{11}{2}RT_0$

C) heat absorbed by the gas is $\frac{11}{2}RT_0$ D) heat absorbed by the gas is $\frac{13}{2}RT_0$

15. $PV = nRT$ **holds good for**

A) Isobaric process B) Isothermal process C) Isochoric process D) Adiabatic process

16. **In Newton's law of cooling** $\frac{d\theta}{dt} = -k(\theta - \theta_0)$**, the constant 'k' is proportional to**

A) surface of the body (A) B) specific heat of the body (s)

C) mass of the body $\left(\frac{1}{m}\right)$ D) emissivity of the body (e)

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COMPREHENSION-1

A stationary uniform string of modulus Y, density ρ and length 'ℓ' is hanging from a rigid support.

17. **The stress at a distance x from the point of its suspension**

A) ρxg B) $\rho(\ell - x)g$ C) $\rho\ell g$ D) $\frac{\rho x^2 g}{\ell}$

18. **The elongation of the string is**

A) $\Delta\ell = \frac{\rho g\ell^2}{2Y}$ B) $\Delta\ell = \frac{\rho g\ell^2}{3Y}$ C) $\Delta\ell = \frac{2\rho g\ell^2}{Y}$ D) $\Delta\ell = \frac{3\rho g\ell^2}{Y}$

COMPREHENSION-2

A man of mass 100 kg stands at the rim of a turn table of radius 2m, moment of inertia $4000\ Kg - m^2$**. The table is mounted on a vertical smooth axis, through its center. The whole system is initially at rest. The man now walks on table with a velocity 1 m/s relative to earth**

19. **With what angular velocity will the turn table rotate**

A) 0.5 rad/sec B) 0.1 rad/sec C) 0.05 rad/sec D) 0.2 rad/sec

20. **Through what angle will the turn table have rotated when the man reached his initial position on it**

A) $\frac{\pi}{11}\ rad/\sec$ B) $\frac{3\pi}{11}\ rad/\sec$ C) $\frac{2\pi}{11}\ rad/\sec$ D) $\frac{4\pi}{11}\ rad/\sec$

CHEMISTRY

SYLLABUS: ***Periodic classifications, Chemical Bonding, Alkali and Alkali Earth Metals, Elements of IIIA, IVA, Environmental Chemistry, Metallurgy, Groups – 15,16,17,18, d & f Blocks, Atomic Structure, States of Matter, Stoichiometry, Thermodynamics, Chemical Bonding, Ionic Equilibrium***

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21. The ionization energy of Lithium is $500 KJmol^{-1}$. The amount of energy required to convert 70 mg of lithium atoms in gaseous state into Li^+ ions is

22. The ratio of copper and tin in bell metal alloy is

23. The number of Pi bonds present in tetracyano ethylene molecule is

24. Among the triatomic molecules /ions, $BeCl_2, N_3^-, N_2O, NO_2^+, O_3, SCl_2, ICl_2^-, I_3^-$ and XeF_2, the total number of linear molecules / ions where the hybridization of the central atom does not have contribution from the d-orbitals is

25. On heating a mxture containing 3 moles of each of Li_2CO_3 and K_2CO_3, how many moles of CO_2 are evolved

26. How many EDTA molecules are required to form an octahedral complex of Ca^{2+} ion

27. The weight of hydrogen gas obtained from 42 gr of CaH_2 by treatment with water is ____gr

28. Gas (Ax) has the ratio of specific heat, equal to 1.66. The value of x will be

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29. Which of the following oxides have rock salt structure with coordination number 6 : 6
A) BeO B) MgO C) CaO D) SrO

30. The following processes occur in the troposphere
A) Photosynthesis B) Combustion C) Green House effect D) Acid Rain

31. Ortho boric acid (H_3BO_3) and meta boric acid (HBO_2) differ in respect of
A) Basicity B) Structure C) Melting Point D) Oxidation

32. 1 mole of $^{14}_{7}N^{3-}$ ion contains
A) $7\times6.023\times10^{23}$ electrons B) $7\times6.023\times10^{23}$ protons
C) $7\times6.023\times10^{23}$ neutrons D) $14\times6.023\times10^{23}$ protons

33. An increase in temperature increases which of the following ?
i) The rate constant of a reaction
ii) The product of water
iii) The equilibrium constant of an exothermic reaction
Select the correct answer using code given below
A) i and ii only B) i and iii only C) ii and iii only D) I, ii and iii only

34. Extraction of metal from the ore cassiterire involves
A) carbon reduction of an oxide ore B) self reduction of a sulphide ore
C) removal of copper impurity D) removal of iron impurity

35. Which of the following statements are incorrect ?

A) SF_6 does not react with water B) SF_6 is SP^3d hybridized

C) $S_2O_3^{2-}$ is a linear ion D) There is no π-bonding in SO_4^{2-} ion

36. Which among the following species act both as an acid as well as a base?

A) SO_4^{2-} B) HSO_4^- C) PO_4^{3-} D) NH_3

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COMPREHENSION-1

The hydrogen like species Li^{2+} is in a spherically symmetric state S_1, with one radical node upon absorbing light the ion undergoes transition to a state S_2. The state S_2 has one radical node and its energy is equal to the ground state energy of the hydrogen atom

37. The state S_1 is

A) 1S B) 2S C) 2P D) 3S

38. The orbital Angular momentum quantum number of the state S_2 is

A) 0 B) 1 C) 2 D) 3

COMPREHENSION-2

Element (A) burns in nitrogen atmosphere to give an ionic compound (B). Compound (B) gets hydrolysis by water giving (C) and (D). A solution of (C) becomes milky on passing CO_2 through it. Element (A) reacts quite readily with cold water liberating hydrogen and forming metal hydroxide.

39. The compound is

A) $Mg(OH)_2$ B) CaO C) $Ca(OH)_2$ D) NaOH

40. Select the correct statement with respect to (D)

A) It is a gas with a characteristic smell B) It is pyramidal in shape

C) It can be obtained by hydrolysis of $CaCN_2$ D) All of the above

MATHEMATICS

SYLLABUS:

MATHS-A: Algebra(Both I & II year), Trigonometry, Complex numbers

MATHS-B: Geometry (Both I & II year except 3D Geometry)

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41. **For a real number α if the system $\begin{bmatrix} 1 & \alpha & \alpha^2 \\ \alpha & 1 & \alpha \\ \alpha^2 & \alpha & 1 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}$ of linear equations, has infinitely many solutions, then $1+\alpha+\alpha^2 =$**

42. **The coefficient of x^9 in the expansion of $(1+x)(1+x^2)(1+x^3)...(1+x^{100})$ is**

43. **The smallest value of k for which both the roots of the equation $x^2-8kx+16(k^2-k+1)=0$ are real, distinct and have values atleast 4 is**

44. **If z is any complex number satisfying $|z-3-2i|\le 2$ then the minimum value of $|2z-6+5i|$ is**

45. **Let the curve C be the mirror image of the parabola $y^2=4x$ with respect to the line $x+y+4=0$. If A and B are the points of intersections of C with the line y = -5 then the distance between A and B is**

46. **For how many values of p the circle $x^2+y^2+2x+4y-p=0$ and the coordinate axeshave exactly three common points**

47. **Suppose that the foci of the ellipse $\frac{x^2}{9}+\frac{y^2}{5}=1$ are $(f_1,0)$ and $(f_2,0)$ where $f_1>0$ and $f_2<0$. Let P_1 *and* P_2 be two parabolas with a common vertex at (0, 0) with focii at $(f_1,0)$ and $(2f_2,0)$ respectively. Let T_1 be the tangent to P_1 which passes through $(2f_2,0)$ and T_2 be the tangent to P_2 which passes through $(f_1,0)$. If m_1 is the slope of T_1 and m_2 is the slope of T_2 then the value of $\frac{1}{m_1^2}+m_2^2$ is**

48. **Let $n_1<n_2<n_3<n_4<n_5$ be positive integers such that $n_1+n_2+n_3+n_4+n_5=20$. The number of such distinct arrangements (n_1,n_2,n_3,n_4,n_5) is**

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49. **For $a>b>c>0$, the distance between (1, 1) and the point of intersection of the lines $ax+by+c=0$ and $bx+ay+c=0$ is less than $2\sqrt{2}$ then**

A) $a+b-c>0$ B) $a-b+c<0$ C) $a-b+c>0$ D) $a+b-c<0$

50. **If $2x-y+1=0$ is a tangent to the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{16}=1$ then which of the following CANNOT be sides of a right angled triangle**

A) a, 4, 1 B) 2a, 4, 1 C) a, 4, 2 D) 2a, 8, 1

51. **Consider the hyperbola $H: x^2-y^2=1$ and a circle S with centre $N(x_2,0)$. Suppose that H and S touch each other at a point $P(x_1,y_1)$ with $x_1>0, y_1>0$. The common tangent to H and**

Sat P intersects X-axis at point M. If (ℓ, m) is the centroid of ΔPMN then the correct expression(s) is/are

A) $\frac{d\ell}{dx_1} = 1 - \frac{1}{3x_1^2}$ *for* $x_1 > 1$

B) $\frac{dm}{dx_1} = \frac{x_1}{3\sqrt{x_1^2 - 1}}$ *for* $x_1 > 1$

C) $\frac{d\ell}{dx_1} = 1 + \frac{1}{3x_1^2}$ *for* $x_1 > 1$

D) $\frac{dm}{dy_1} = \frac{1}{3}$ *for* $y_1 > 0$

52. If $\alpha = 2Sin^{-1}\left(\frac{6}{11}\right)$ and $\beta = 3Cos^{-1}\left(\frac{4}{9}\right)$ where the inverse trigonometric functions take only the principle values, then the correct option(s) is/are

A) $\cos\beta > 0$ B) $\sin\beta < 0$ C) $\cos(\alpha + \beta) > 0$ D) $\cos\alpha < 0$

53. Let $a, b \in R$ and $a^2 + b^2 \neq 0$. Suppose $S = \left\{ z \in C, z = \frac{1}{a + ibt}, t \in R, t \neq 0 \right\}$ where $i = \sqrt{-1}$. If $z = x + iy$ and $z \in S$ then (x, y)lies on

A) the circle with radius $\frac{1}{2a}$ and centre $\left(\frac{1}{2a}, 0\right)$ for $a > 0, b \neq 0$

B) the circle with radius $\frac{-1}{2a}$ and centre $\left(\frac{-1}{2a}, 0\right)$ for $a < 0, b \neq 0$

C) the X-axis for $a \neq 0, b = 0$ D) the Y-axis for $a = 0, b \neq 0$

54. If the adjoint of a 3×3 matrix P is $\begin{bmatrix} 1 & 4 & 4 \\ 2 & 1 & 7 \\ 1 & 1 & 3 \end{bmatrix}$ then the possible value(s) of the determinant of P is/are

A) -2 B) -1 C) 1 D) 2

55. The number of ways of arranging seven persons (having A, B, C & D among them) in a row so that A, B, C, & D are always in order $A - B - C - D$ (not necessarily together) is

A) 210 B) 5040 C) $6 \times {}^7C_4$ D) ${}^7P_3$

56. If $(1 + x + x^2)^n = a_0 + a_1 x + a_2 x^2 + ... + a_{2n} x^{2n}$ then

A) $a_0 - a_2 + a_4 - a_6 + ... = 0$ if n is odd

B) $a_1 - a_3 + a_5 - a_7 + ... = 0$ if n is even

C) $a_0 - a_2 + a_4 - a_6 + ... = 0$ if $n = 4p, p \in I^+$

D) $a_1 - a_3 + a_5 - a_7 + ... = 0$ if $n = 4p + 1, p \in I^+$

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COMPREHENSION-1

Let PQ be a focal chord of the parabola $y^2 = 4ax$. The tangents to the parabola at P and Q meet at a point lying on the line $y = 2x + a, a > 0$

57. Length of the chord PQ is

A) 7a B) 5a C) 2a D) 3a

58. If the chord PQ subtends an angle θ at the vertex of $y^2 = 4ax$ then $\tan\theta =$

A) $\frac{2\sqrt{7}}{3}$ B) $\frac{-2\sqrt{7}}{3}$ C) $\frac{2\sqrt{5}}{3}$ D) $\frac{-2\sqrt{5}}{3}$

COMPREHENSION-2

Let $a,b,c \in R$ satisfying $\begin{bmatrix} a & b & c \end{bmatrix}\begin{bmatrix} 1 & 9 & 7 \\ 8 & 2 & 7 \\ 7 & 3 & 7 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 \end{bmatrix}$ **___ (i)**

59. If the point $P(a,b,c)$ with reference (i) lies on the plane $2x + y + z = 1$ then the value of $7a + b + c$ is

A) 0 B) 12 C) 7 D) 6

60. Let b = 6 with a and c satisfying eqn. (i). If α *and* β are the roots of the quadratic equation $ax^2 + bx + c = 0$ then $\sum_{n=0}^{\infty}\left(\frac{1}{\alpha} + \frac{1}{\beta}\right)^n =$

A) 6 B) 7 C) $\frac{6}{7}$ D) $\frac{7}{6}$

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JR IIT IC	**JEE ADVANCE**	**Date: 30-04-2020**
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KEY SHEET
PHYSICS

1) **1**	2) **2**	3) **4**	4) **3**	5) **8**
6) **4**	7) **9**	8) **4**	9) **A,B,C,D**	10) **A,D**
11) **A,C,D**	12) **A,C,D**	13) **A,B**	14) **A,C**	15) **A,B,C,D**
16) **A,C**	17) **B**	18) **C**	19) **C**	20) **A**

CHEMISTRY

21) **5**	22) **4**	23) **9**	24) **4**	25) **3**
26) **1**	27) **4**	28) **1**	29) **B,C,D**	30) **A,B,C,D**
31) **A,B,C**	32) **B,C**	33) **A**	34) **A,D**	35) **B,C,D**
36) **B,D**	37) **B**	38) **B**	39) **C**	40) **D**

MATHS

41) **1**	42) **8**	43) **2**	44) **5**	45) **4**
46) **2**	47) **4**	48) **7**	49) **A,C**	50) **A,B,C**
51) **A,B,D**	52) **B,C,D**	53) **A,C,D**	54) **A,D**	55) **A,C,D**
56) **A,B**	57) **B**	58) **D**	59) **D**	60) **B**

HINTS & SOLUTOINS
PHYSICS

1. For A $100-50=10a_1 \Rightarrow a_1=5m/s^2$

   For B $50-18=8a_2 \Rightarrow a_2=4m/s^2$

   $a_{rel}=1m/s^2$ & $V_{rel}=1cm/s^2$

2. Find acceleration of A from $\sum T\cdot a=0$ method then take v=u+at

3. Along Y-direction

   We get $a=\dfrac{mg-t}{m}=\left(\ell\cos 30^0\right)\alpha$ .. (1)

   And $\tau=I\alpha \Rightarrow T\left(\ell\cos 30^0\right)=\dfrac{m(2L)^2}{12}\alpha$ …(2)

   Solving (1) & (2) for T we get $T=\dfrac{4}{13}mg$

4. If 'T' is the tension in the string

   $T+F_{gr}=ma_r$

   $\Rightarrow T+\dfrac{6Mm}{\left(R+\ell\right)^2}=m\left(R+\ell\right)\omega^2$

   Solve for T

5. For small value of θ, equation of torque about 'O' is

   $K_1\left(b\theta\right)b+K_2\left(\ell\theta\right)\ell=I\dfrac{d^2\theta}{dt^2}$

   $\left(K_1b^2+K_2\ell^2\right)\theta=I\alpha=\dfrac{m\ell^2}{3}\alpha$

   (or)

   $\alpha=\left(\dfrac{3}{m\ell^2}\left(K_1b^2+K_2\ell^2\right)\right)\theta$

   Comparing with S.H.M condition & solve for ω

6. $A\ell\sigma g-Ax\rho g=A\ell\sigma a$ (id 'x' is the depth immersed)

   And $\int_0^x v.dv=\int_0^x g-\dfrac{\rho gx}{\sigma x}dx$

   Solve 'x'

7. $\dfrac{1}{2}mv^2+ms\Delta T=\Delta m_{ice}L_{ice}$

8. $T_1V^{\gamma-1}=xT_1\left(\dfrac{v}{32}\right)^{\gamma-1}$, solve for 'x'

9. $y=u_yt-\dfrac{1}{2}gt^2$ and $\theta=Tan^{-1}\left(\dfrac{vx}{vy}\right)$

   $s=\sqrt{x^2+y^2}$

10. $F_1=mg\sin\theta+\mu mg\cos\theta$

    $F_2=mg\sin\theta-\mu mg\cos\theta$

    And $\mu=\tan\phi, mg=W$

11. $F=-\dfrac{dU}{dx}\hat{i}-\dfrac{dU}{dy}\hat{j}$

    $\bar{a}=-3i-4j$

$|\bar{a}|=5$, also on y-axis, x=0

$0-6=\frac{-1}{2}\times 3t^2, t=2\sec, V_x=-6$

$V_y=10m/s$

$\therefore y=2$

12. The mass of the sphere with cavities is symmetrically situated w.r.t origin. The circle $y^2+z^2=36$ has radius of 6 units and all points on it are at a distance 6 units from the centre. Similarly is the case with circle $y^2+z^2=4$

13. $T=2\pi\sqrt{\frac{\ell}{g}}$

$\theta=\theta_0\sin\omega t$

$\frac{1}{2}(2m)\left(\frac{V_0}{2}\right)^2=2mg\ell(1-\cos\theta_0)$. Find θ

14. Process AB, P = constant

$\Delta w_{AB}=P_0V_0RT_0$

$\Delta V_{AB}=\frac{3}{2}RT_0$

$\Delta Q_{AB}=C_P\Delta T=\frac{5}{2}RT_0$

Process BC, V = constant

$\Delta W_{BC}=0$

$\Delta Q_{BC}=C_voT=3RT_0=\Delta U_{BC}$

Solve for net W, Q & U

15. Conceptual

16. Conceptual

17. $stress=\frac{F}{A}=\frac{T}{A}$

Here $T=m^1g=\left(\frac{m}{\ell}\right)\times xg=\left(\frac{V\rho}{\ell}\right)\times xg=A\rho xg$

18. $P=\rho(\ell-x)g$

$\Delta\ell=\frac{1}{y}\int_0^{\ell}pdx,\ so\ \Delta\ell=\frac{\rho g\ell^2}{2Y}$

19. By conservation of angular momentum on man-table system

$O=I_mw_m+I_tw_t$

Solve w_t

20. If the man completes one revolution relative to the table then $2\pi=\theta_m-\theta_t$

$2\pi=w_mt-w_tt$

$t=\frac{2\pi}{w_m-w_t}$

$\theta_t=w_tt$

CHEMISTRY

21. 70 mg = $70\times10^{-3}g=\frac{70\times10^{-3}}{7}=1\times10^{-2}mole$

Amount of energy required = $1\times10^{-2}\times500KJ=5KJ$

22. Cu – 80%, Sn – 20%
Ratio = 80/20=4

24 $\dfrac{Cl-Be-Cl, N^{-1}=N^{-1}=N^{-1}, N\equiv N\rightarrow O, O=\overset{+}{N}=O}{SP-hybridization}$

25. Only Li_2CO_3 decomposes and gives out CO_2

$Li_2CO_3 \rightarrow Li_2O + CO_2$

1 *mole* 1 *mole*

28. For a mono atomic gas, $r=\dfrac{C_p}{C_v}=\dfrac{5}{3}=1.66$

$\therefore x=1$

37. 2S is symmetrical having one radial node

38. Orbital angular momentum quantum number of 3P shell i.e., $\ell=1$

$\begin{bmatrix} S_1 \xrightarrow{Trans} S_2 \\ 2S \qquad\quad 3P \end{bmatrix}$

MATHS

41. $\begin{vmatrix} 1 & \alpha & \alpha^2 \\ \alpha & 1 & \alpha \\ \alpha^2 & \alpha & 1 \end{vmatrix}=0\Rightarrow\alpha^2=1$

$\therefore \alpha=-1\left(\because \alpha=1\ not\ \ possible\right)$

42. Term having

$x^9=\left[1^{99}\cdot x^9, 1^{98}\cdot x\cdot x^8, 1^{98}\cdot x^2\cdot x^7, 1^{98}\cdot x^3\cdot x^6, 1^{98}\cdot x^4\cdot x^5, 1^{97}\cdot x\cdot x^2\cdot x^6, 1^{97}\cdot x\cdot x^3\cdot x^5, 1^{97}\cdot x^2\cdot x^3\cdot x^4\right]$

Coeff of x^9 is 8

43. (i) $\Delta=64\left\{k^2-\left(k^2-k+1\right)\right\}>0\Rightarrow k>0$

(ii) $\dfrac{-b}{2a}>4\Rightarrow k>1$

(iii) $f(x)\geq 0\Rightarrow 16-32k+16\left(k^2-k+1\right)\geq 0$

$(k-1)(k-2)\geq 0\Rightarrow k\leq 1, k\geq 2\therefore k=2$

44. $|2z-6+5i|=2\left|z-3+\dfrac{5i}{2}\right|$

$\left||z_1|-|z_2|\right|\leq|z_1+z_2|$

$\left|z-3+\dfrac{5i}{2}\right|=\left|z-3-2i+2i+\dfrac{5i}{2}\right|\geq\left||z-3-2i|-\dfrac{9}{2}\right|\geq\left|2-\dfrac{9}{2}\right|\geq\dfrac{5}{2}$

45. Let $P\left(t^2,2t\right)$ on $y^2=4x$ whose image is Q (x, y) w.r.t x+y+4=0

$\dfrac{x-t^2}{1}=\dfrac{y-2t}{1}=\dfrac{-2\left(t^2+2t+4\right)}{1^2+1^2}\Rightarrow x=-2t-4, y=-t^2-4$

Now the st line y= - 5 meets the mirror image

$-t^2-4=-5\Rightarrow t=\pm1$

$\therefore A=(-6,-5), B=(-2,-5)\Rightarrow AB=4$

46. The circle and the coordinate axes can have 3 common points, if it passes through origin (p=0)
If the circle is cutting one axis and touching the other axis
Only possibility is of touching X-axis and cutting Y-axis (p=-1)
No. of values of p is 2

47. Focii of the parabola P_1 & P_2 are resp $(2,0),(-4,0)$

Focii of the ellipse are $(2,0),(-2,0)$

Eqn of the parabola are $y^2=8x$ *and* $y^2=-16x$

Tangent to P_1 passes through $(-4,0)$

$T_1: y=m_1x+\frac{2}{m_1}\Rightarrow m_1^2=\frac{1}{2}$

Tangent to P_2 passes through $(2,0)$

$T_2: y=m_2x+\frac{-4}{m_2}\Rightarrow m_2^2=2$

48. $n_1\geq 1, n_2\geq 2, n_3\geq 3, n_4\geq 4, n_5\geq 5$

Let $n_1-1=x_1\geq 0, n_2-2=x_2\geq 0, \ldots n_5-5=x_5\geq 0$

$x_1+x_2+x_3+x_4+x_5=20-15=5$

Now $x_1\leq x_2\leq x_3\leq x_4\leq x_5$

00005, 00014,00023,00113,00122,01112,11111

So 7 possible cases

49. Length of the perpendicular from (x_1,y_1) to ax+by+c=0 is $\frac{|ax_1+by_1+c|}{\sqrt{a^2+b^2}}$

As $a>b>c>0\Rightarrow a-c>0$ *and* $b>0$

Pt of intersection of ax+by+c=0 and bx+ay+c=0 is $\left(\frac{-c}{a+b},\frac{-c}{a+b}\right)$

Distance b/w $(1,1)$ *and* $\left(\frac{-c}{a+b},\frac{-c}{a+b}\right)$ *is* $<2\sqrt{2}$

$\Rightarrow\left(\frac{a+b+c}{a+b}\right)\sqrt{2}<2\sqrt{2}$

$\Rightarrow a+b+c<2a+2b$

50. point is $(a\sec\theta,4\tan\theta)$

Tangent is $\frac{x\sec\theta}{a}-\frac{y\tan\theta}{4}=1$

Comparing we get $\sec\theta=-2a, \tan\theta=-4$

$4a^2-16=1\Rightarrow a=\frac{\sqrt{17}}{2}$

51. Eqn of the family of circles touching hyperbola at (x_1,y_1) is

$(x-x_1)^2+(y-y_1)^2+\lambda(xx_1-yy_1-1)=0$

Centre $N(x_2,0)=\left(\frac{-(\lambda x_1-2x_1)}{2},\frac{-(-2y_1-\lambda x_1)}{2}\right)$

$\therefore\lambda=-2\Rightarrow x_2=2x_1$

$\therefore P\left(x_1,\sqrt{x_1^2-1}\right)$ *and* $N(2x_1,0)$

As tangent intersects X-axis at $M\left(\frac{1}{x_1},0\right)$

Centroid of $\Delta PMN = (\ell, m) = \left(\dfrac{3x_1 + \dfrac{1}{x_1}}{3}, \dfrac{\sqrt{x_1^2 - 1}}{3} \right)$

$\dfrac{d\ell}{dx_1} = 1 - \dfrac{1}{3x_1^2}; \dfrac{dm}{dx_1} = \dfrac{1}{3} \dfrac{1}{2\sqrt{x_1^2 - 1}} 2x_1; m = \dfrac{y_1}{3} \Rightarrow \dfrac{dm}{dy_1} = \dfrac{1}{3}$

52. $\dfrac{6}{11} > \dfrac{1}{2} \Rightarrow Sin^{-1}\left(\dfrac{6}{11}\right) > Sin^{-1}\left(\dfrac{1}{2}\right) = \dfrac{\pi}{6} \Rightarrow \alpha > \dfrac{\pi}{2}$

$\dfrac{4}{9} < \dfrac{1}{2} \Rightarrow Cos^{-1}\left(\dfrac{4}{9}\right) < Cos^{-1}\left(\dfrac{1}{2}\right) = \dfrac{\pi}{3} \Rightarrow \beta > \pi$

$\dfrac{4}{9} < \dfrac{1}{2} \Rightarrow Cos^{-1}\left(\dfrac{4}{9}\right) < Cos^{-1}\left(\dfrac{1}{2}\right) = \dfrac{\pi}{3} \Rightarrow \beta > \pi$

53. $x + iy = \dfrac{1}{a + ibt}\left(\dfrac{a - ibt}{a - ibt}\right) = \dfrac{a - ibt}{a^2 + b^2t^2}$

$\dfrac{y}{x} = \dfrac{-bt}{a} \Rightarrow t = \dfrac{-ay}{bx}$

$x^2 + y^2 = \dfrac{a^2 + b^2t^2}{\left(a^2 + b^2t^2\right)^2} = \dfrac{x^2}{a^2\left(x^2 + y^2\right)}$

$\left(x^2 + y^2\right)^2 - \dfrac{x^2}{a^2} = 0 \Rightarrow x^2 + y^2 - \dfrac{x}{a} = 0 \text{ or } x^2 + y^2 + \dfrac{x}{a} = 0$

$centre = \left(\dfrac{1}{2a}, 0\right), \ radius = \dfrac{1}{2a}$

For $a \neq 0, b = 0, z = \dfrac{1}{a} = \left(\dfrac{1}{a}, 0\right), lies\ on\ X - axis$

For $a = 0, b \neq 0, z = \dfrac{1}{ibt} = \left(0, \dfrac{1}{ibt}\right), lies\ on\ Y - axis$

54. $|AdjP| = |P|^{3-1} = 4 \Rightarrow |P| = \pm 2$

55. Reqd. $= \dfrac{7!}{4!} = 210 = {}^7P_3 = 3!\ {}^7C_3$

56. Put x=i

$i^n = (a_0 - a_2 + a_4 - ...) + i(a_1 - a_3 + a_5 - ...)$

57. Since $R\left(-a, a\left(t - \dfrac{1}{t}\right)\right)$ lies on y=2x+a

$\Rightarrow t - \dfrac{1}{t} = -1$

Length of focal chord = $a\left(t + \dfrac{1}{t}\right)^2 = a\left(\left(t - \dfrac{1}{t}\right)^2 + 4\right) = 5a$

58. $P\left(at^2, 2at\right), Q\left(\dfrac{a}{t^2}, \dfrac{-2a}{t}\right)$

Slope of OP $= \dfrac{2}{t}$, Slope of OQ = -2t

$$\tan\theta = \frac{\frac{2}{t}+2t}{1-4} = \frac{-2\sqrt{5}}{3}$$

59. (a, b, c) lies on 2x+y+z=1 $\Rightarrow$ 2a+b+c=1
Also a+8b+7c=0, 9a+2b+3c=0,a+b+c=0
Solving a=1, b=6, c=-7

60. $ax^2+bx+c=0 \Rightarrow x^2+6x-7=0 \Rightarrow x=1,-7$

$$\sum_{n=0}^{\infty}\left(\frac{1}{1}-\frac{1}{7}\right)^n = 1+\frac{6}{7}+\left(\frac{6}{7}\right)^2+\ldots = 7$$