MELUHA INTERNATIONAL SCHOOL

HYDERABAD

OUTGOING SR BITSAT | **BITSAT MODEL** | **Date: 05-05-2020**

Time: 3 Hours | **Max. Marks: 450**

PHYSICS

SYLLABUS: *JR Syllabus complete, Magnetism and Matter, Ray optics, Wave optics.*

1. **Dimensions of the quantity $\frac{P}{\in_0 \mu_0}$, where p is pressure, $\in_0$ is electric permittivity of free space, μ_0 is permeability of free space, will be**

1) MLT^{-4} 2) ML^2T^{-2} 3) ML^3T^{-3} 4) ML^2T^{-4}

2. **If energy (E), velocity (v) and force (F) be taken as fundamental quantities, then what are the dimensions of mass**

1) $\left[EV^2\right]$ 2) $\left[EV^{-2}\right]$ 3) $\left[FV^{-1}\right]$ 4) $\left[FV^{-2}\right]$

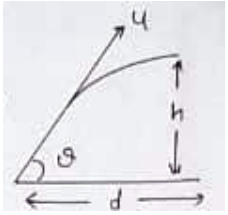
3. **Two particles start moving from the same point along the same straight-line. The first moves with constant velocity V and second with constant acceleration a. During the time that elapses before the second catches the first, the greatest distance between the particles is**

1) $\frac{V^2}{a}$ 2) $\frac{V^2}{2a}$ 3) $\frac{2V^2}{a}$ 4) $\frac{V^2}{4a}$

4. **Consider a vehicle moving with a velocity 54 KMPH. At a distance of 400 m from the traffic light brakes are applied. The acceleration of the vehicle, after application of brakes is $-0.3\ m/s^2$. The vehicle's position relative to the traffic light is**

1) 25 m 2) 375 m 3) 425 m 4) 30 m

5. **If a stone is to hit at a point which is at a distance d away and at a height 'h' above the point from where the stone starts, then what is the value of initial velocity u, if stone is launched at angle θ.**



1) $\frac{g}{\cos\theta}\sqrt{\frac{d}{2(d\tan\theta - h)}}$ 2) $\frac{d}{\cos\theta}\sqrt{\frac{g}{2(d\tan\theta - h)}}$ 3) $\sqrt{\frac{gd^2}{h\cos^2\theta}}$ 4) $\sqrt{\frac{gd^2}{(d-h)}}$

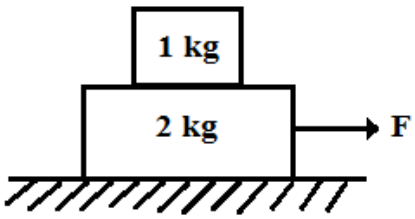
6. **The potential energy of a projectile at its maximum height is equal to its kinetic energy there. If velocity of projection is 20 m/s, its time of flight is $\left(g = 10\ m/s^2\right)$**

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

7. **A particle of mass m moves on the X- axis under the influence of force of attraction towards the origin O given by $F = \frac{-K}{x^2}i$. If particle starts from rest at $x = a$, the speed it will attain**

1) $\sqrt{\frac{2K}{m}\left(\frac{1}{x} - \frac{1}{a}\right)}$ 2) $\frac{2K}{m}\left(\frac{1}{x} - \frac{1}{a}\right)$ 3) $\sqrt{\frac{2K}{ma}}$ 4) $\sqrt{\frac{2K}{mx}}$

8. Find the minimum force required to pull the lower block. If the coefficient of friction between the blocks is 0.1 and between the ground and 2kg block is 0.2 $\left(g = 10\ m/s^2\right)$



1) 1 N 2) 5 N 3) 7 N 4) 10 N

9. A stationary shell explodes into two fragments of masses m_1 and m_2. The kinetic energy released in the explosion is E. The velocity of m_1 after explosion is

1) $\sqrt{\frac{2m_2E}{m_1\left(m_1+m_2\right)}}$ 2) $\sqrt{\frac{2m_1E}{m_2\left(m_1+m_2\right)}}$ 3) $\sqrt{\frac{2m_1E}{\left(m_1+m_2\right)^2}}$ 4) $\sqrt{\frac{2m_2E}{\left(m_1+m_2\right)^2}}$

10. A constant power P is applied to a particle of mass m. The distance travelled by the particle when its velocity increases from v_1 to v_2 is (neglect friction)

1) $\frac{3P}{m}\left(v_2^2-v_1^2\right)$ 2) $\frac{m}{3P}\left(v_2-v_1\right)$ 3) $\frac{m}{3P}\left(v_2^3-v_1^3\right)$ 4) $\frac{m}{3P}\left(v_2^2-v_1^2\right)$

11. A particle executes SHM and is located at $x = a, b\ and\ c$ at time t_0, $2t_0$ and $3t_0$ respectively. The frequency of oscillation is

1) $\frac{1}{2\pi t_0}\cos^{-1}\left(\frac{a+c}{2b}\right)$ 2) $\frac{1}{2\pi t_0}\cos^{-1}\left(\frac{a+2b}{3c}\right)$

3) $\frac{1}{2\pi t_0}\cos^{-1}\left(\frac{a+b}{2c}\right)$ 4) $\frac{1}{2\pi t_0}\cos^{-1}\left(\frac{2a+3c}{b}\right)$

12. A body of mass m is attached to the lower end of spring whose upper end is fixed. The spring has negligible mass. When the m is slightly pulled down and released, it oscillates with a time period of 3s. When the mass m is increased by 1 kg the time period of oscillation becomes 5s. The value of m in kg is

1) $\frac{9}{16}$ 2) $\frac{3}{4}$ 3) $\frac{4}{3}$ 4) $\frac{16}{9}$

13. A stretched wire vibration in fundamental mode is in unison with a tuning fork, keeping the same tension, the length of the wire between the bridges is doubled. The turning fork can still be in resonance with the wire provided the wire now vibrates in

1) 4 Segments 2) 6 Segments 3) 3 Segments 4) 2 Segments

14. Two different sound sources $S_1\ and\ S_2$ have frequencies ratio 1 : 2. Source S_1 is approaching towards an observer and S_2 is receding from the same observer. Speeds of both $S_1\ and\ S_2$ are the same and equal to V. Speed of sound in air is 300 m/s. If no beats are heard by the observer the value of V is

1) 125 m/s 2) 100 m/s 3) 75 m/s 4) 50 m/s

15. The refractive index of denser medium with respect to rarer medium is 1.125. The difference between the velocities of light in the two media is 0.25×10^8 m/s. Find the velocities of light in the two media and their refractive indices $\left(c = 3\times10^8\ \text{m/s}\right)$

1) 2.0×10^8 m/s ; 2.25×10^8 m/s ; 1.500 ; 1.333 2) 2.5×10^8 m/s ; 2.25×10^8 m/s ; 1.500 ; 1.333

3) 2.0×10^8 m/s ; 2.25×10^8 m/s ; 1.333 ; 1.500 4) 2.25×10^8 m/s ; 2.0×10^8 m/s ; 1.500 ; 1.333

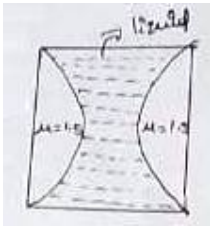
16. A person can see clearly up to 1m. Find the nature and power of the lens which will enable him to see things at a distance of 3m

1) concave, – 0.66D 2) convex, – 0.66D 3) concave, – 0.33D 4) convex, – 0.33D

17. You are asked to design a shaving mirror assuming that a person keeps it 10 cm from his face and views the magnified image of the face at the closest comfortable distance of 25 cm. The radius of curvature of the mirror would then be:

1) 24 cm 2) 30 cm 3) – 24 cm 4) 60 cm

18. The effective focal length of the lens combination shown in figure is – 6 cm. The radii of curvature of the curved surfaces of the plano – convex lenses are 12 cm each and refractive index of the material of the lense is 1.5. The refractive index of the liquid is



1) 1.33 2) 1.42 3) 1.53 4) 1.60

19. If B is the bulk modules of a metal and a pressure P is applied uniformly on all sides of the metal with density D, then the fractional increase in density is given by

1) $\frac{B}{P}$ 2) $\frac{P}{B}$ 3) $\frac{PD}{B}$ 4) $\frac{BD}{P}$

20. One end of a long metallic wire of length L is tied to the ceiling. The other end is tied to massless spring of spring constant K. A mass (m) hangs freely from the free end of the spring. The area of cross-section and young modulus of the wire are A and Y respectively. Find the time period with which mass m will oscillate if it is slightly pulled down and released

1) $2\pi\sqrt{\frac{AYK}{m(AY+KL)}}$ 2) $2\pi\sqrt{\frac{m(AY+KL)}{AYK}}$ 3) $2\pi\sqrt{\frac{YK}{mA(AY+KL)}}$ 4) None of these

21. A large number of liquid drops each of r coalesce to form a single drop of radius R. The energy released in the process is converlid in to the kinetic energy of the big drop so formed. The speed of the big deep is: (given surface tension of liquid is T, density of liquid is ρ)

1) $\sqrt{\frac{T}{\rho}\left(\frac{1}{r}-\frac{1}{R}\right)}$ 2) $\sqrt{\frac{2T}{\rho}\left(\frac{1}{r}-\frac{1}{R}\right)}$ 3) $\sqrt{\frac{4T}{\rho}\left(\frac{1}{r}-\frac{1}{R}\right)}$ 4) $\sqrt{\frac{6T}{\rho}\left(\frac{1}{r}-\frac{1}{R}\right)}$

22. When a capillary tube of radius r is immersed in a liquid of density ρ. The liquid rises to a height h in it. If m is the mass of liquid in the capillary tube, the P.E of this mass of the liquid in the tube is:

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

23. A stream-lined body falls through air from a height h on the surface of a liquid. Let d and D denote the densities of the material of the body and the liquid respectively. If D > d, then the time after which the body will be instantaneously at rest is:

1) $\sqrt{\frac{2h}{g}}$ 2) $\sqrt{\frac{2h}{g}}\frac{D}{d}$ 3) $\sqrt{\frac{2h}{g}}\frac{d}{D}$ 4) $\sqrt{\frac{2h}{g}}\left(\frac{d}{D-d}\right)$

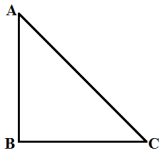
24. Two Straight metallic strips each of thickness t and length L are rivetted together. Their coefficients of linear expansions are α_1 and α_2. If they are heated through temperature $\Delta\theta$, the bimetallic strip will bend to form an arc of radius

1) $\frac{t}{\left[(\alpha_1+\alpha_2)\Delta T\right]}$ 2) $\frac{t}{\left[(\alpha_2-\alpha_1)\Delta T\right]}$ 3) $t(\alpha_1+\alpha_2)\Delta T$ 4) $t(\alpha_2-\alpha_1)\Delta T$

25. Water at $0^\circ C$, contained in a closed vessel, is abruptly opened in an evacuated chamber. If the specific latent heats of fusion and vapourization at $0^\circ C$ are in the ratio $\lambda:1$, the fraction of water evaporated will be.

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

26. Three rods of identical cross-sectional area and made from the same metal form the sides of an isosceles triangle ABC, right angled at B. The points A and B are maintained at temperatures T and $\sqrt{2}T$ respectively in the steady state. Assuming that only heat conduction takes place, temperature of the point C will be:



1) $\frac{3T}{\sqrt{2}+1}$ 2) $\frac{T}{\sqrt{2}+1}$ 3) $\frac{T}{\sqrt{3}\left(\sqrt{2}-1\right)}$ 4) $\frac{T}{\sqrt{2}-1}$

27. 5 moles of hydrogen $\left(\gamma=\frac{7}{5}\right)$ initially at STP are compressed adiabatically so that its temperature becomes 400°C. The increase in the internal energy of the gas (in kilo- Joules) is: $\left(R=8.30\ \text{J/mol}-\text{K}\right)$

1) 21.55 2) 41.50 3) 65.55 4) 80.55

28. An insulated container of gas has two chambers separated by an insulating partition. One of the chambers has volume V_1 and contains ideal gas at pressure P_1 and temperature T_1. The other chamber has volume V_2 and contains ideal gas at pressure P_2 and temperature T_2. If the partition is removed without doing any work on the gas, the final equilibrium temperature of the gas in the container will be:

1) $\frac{T_1T_2\left(P_1V_1+P_2V_2\right)}{P_1V_1T_2+P_2V_2T_1}$ 2) $\frac{P_1V_1T_1+P_2V_2T_2}{P_1V_1+P_2V_2}$ 3) $\frac{P_1V_1T_2+P_2V_2T_1}{P_1V_1+P_2V_2}$ 4) $\frac{T_1T_2\left(P_1V_1+P_2V_2\right)}{P_1V_1T_1+P_2V_2T_2}$

29. One mole of an ideal monoatomic gas undergoes a process described by the equation $pv^3=\text{constant}$. The heat capacity of the gas during the process is:

1) R 2) $\frac{3}{2}R$ 3) $\frac{5}{2}R$ 4) $2R$

30. The molecules of a given mass of a gas have r.m.s velocity of $200\ ms^{-1}$ at 27°C and $1.0\times10^5\ Nm^{-2}$ pressure when the temperature and pressure of the gas are respectively. 127°C and $0.05\times10^5\ NM^{-2}$, the r.m.s velocity of its molecules in ms^{-1} is:

1) $100\sqrt{2}$ 2) $\frac{400}{\sqrt{3}}$ 3) $\frac{100\sqrt{2}}{3}$ 4) $\frac{100}{3}$

31. A sample of gas has N molecules with velocity $v, 2v, 3v, ...Nv$. The ratio of the root mean square to the average speed is:

1) $\sqrt{\frac{3\pi}{8}}$ 2) $\sqrt{\frac{2\left(2N+1\right)}{3\left(N+1\right)}}$ 3) $\sqrt{\frac{\left(N+1\right)\left(2N+1\right)}{3}}$ 4) $\sqrt{\frac{2\left(N+1\right)}{3\left(2N+1\right)}}$

32. In the Young's double slit experiment, the intensity of light at a point on the screen where the path difference is λ is k, (λ being the wavelength of light used). The intensity at a point where the path difference is $\frac{\lambda}{4}$, will be

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

33. An unpolarised light is incident on a plate of refractive index $\sqrt{3}$ and the reflected light is found to be completely plane polarised. The angles of incidence and refraction are respectively

1) $60^\circ, 30^\circ$ 2) $30^\circ, 60^\circ$ 3) $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right), 45^\circ$ 4) $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right), 30^\circ$

34. **A bar magnet of moment M is cut in to two identical pieces along the length. One piece is bent in the form of a semi-circle. If two pieces are perpendicular to each other, then resultant magnetic moment is:**

1) $\left(\frac{M}{\pi}\right)^2+\left(\frac{M}{2}\right)^2$ 2) $\sqrt{\left(\frac{M}{\pi}\right)^2+\left(\frac{M}{2}\right)^2}$ 3) $\sqrt{\left(\frac{M}{\pi}\right)^2-\left(\frac{M}{2}\right)^2}$ 4) $\frac{M}{\pi}+\frac{M}{2}$

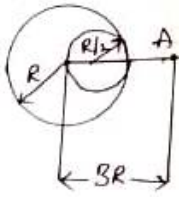
35. **A magnet of magnetic moment $50\hat{i}\ Am^2$ is placed along the x-axis in a magnetic field $\vec{B}=\left(0.5\hat{i}+30\hat{j}\right)T$. The torque acting on the magnet is:**

1) $175\,\hat{k}\ N-m$ 2) $150\,\hat{k}\ N-m$ 3) $75\,\hat{k}\ N-m$ 4) $25\sqrt{37}\,\hat{k}\ N-m$

36. **A uniform disc of radius R lies in xy plane with its centre at origin. Its moment of inertia about the axis *x*=2R and y=0 is equal the moment of inertia about the axis y=d and z=0. Where d is equal to:**

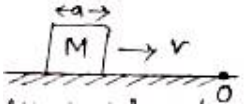
1) $\frac{4}{3}R$ 2) $\frac{\sqrt{17}}{2}R$ 3) $\sqrt{13}R$ 4) $\frac{\sqrt{15}}{2}R$

37. **A solid sphere of uniform density and radius R applies a gravitational force of attraction equal to F_1 on a particle placed at a distance 3R from the centre of the sphere. A spherical cavity of radius $\frac{R}{2}$ is now made in the sphere as shown in the figure. The sphere with the cavity now applies a gravitational force F2 on the same particle. The ratio F_2/F_1 is**



1) $\frac{9}{50}$ 2) $\frac{41}{50}$ 3) $\frac{3}{25}$ 4) $\frac{22}{25}$

38. **A cubical block of slide a moving with velocity v on a horizontal smooth plane as shown. It hits a ridge at point O. The angular speed of the block after it hits O is**



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

39. **Imagine a light planet revolving around a very massive star in a circular orbit of radius R with a period of revolution T. if the gravitational force of attraction between the planet and the star is proportional to $R^{-5/2}$, then T^2 is proportional to**

1) R^3 2) $R^{7/2}$ 3) $R^{3/2}$ 4) $R^{9/2}$

40. **The moment of inertia at cylinder about its own axis is equal to its M.I about an axis passing through centre and normal to its length. The ratio of length to radius is**

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

CHEMISTRY

SYLLABUS: ***JR and SR Physical and Inorganic Chemistry.***

41. **In graphite the electrons are**

1) Present in anti-bonding orbitals 2) Spread out between the structure
3) Localized on each carbon atom 4) Localized on every third carbon atom

42. **The magnitude of magnetic moment of $\left[NiCl_4\right]^{-2}$ will be:**

1) 2.82 B.M 2) 3.25 B.M 3) 1.23 B.M 4) 5.64 B.M

43. The correct statement regarding hydrogen is

1) It has same electronegativity as halogens
2) It is not liberated at anode
3) It has – 1 and + 1 oxidation number
4) It has same ionization potential as alkali metals

44. Number of protons, neutrons and electrons in $_{89}X^{231}$ is

1) 89, 71, 89 2) 89, 231, 89 3) 89, 89, 242 4) 89, 142, 89

45. The compound which cannot be formed is

1) He 2) He^{+} 3) He_2 4) He^{+2}

46. The ferroelectric compound is

1) $K_4\left[Fe(CN)_6\right]$ 2) $Ba\ TiO_3$ 3) Pb_2O_3 4) None of these

47. For the manufacture of NH_3 by the following reaction

$$N_2 + 3H_2 \rightleftharpoons 2NH_3 + 23 \text{ kcal}$$

The favourable condition are:

1) Low temp., high pressure and catalyst 2) Low temp., low pressure and catalyst
3) High temp., high pressure and catalyst 4) High temp., low pressure and catalyst

48. A gas sample has volume of 0.2 litre measured at 1 atm and O^0C. At same pressure and at 273^0C, its volume is:

1) 0.2 litre 2) 0.4 litre 3) 0.8 litre 4) 1.6 litre

49. In gas equation PV = n RT the incorrect statement is:

1) P is the pressure of one mole of gas 2) V is the volume of one mole of gas
3) n is the number of moles of gas 4) n is the number of molecules of gas

50. First law of thermodynamics can be represented by the equation

1) $\Delta E = Q - W$ 2) $\Delta E = Q + W$ 3) $W = Q + \Delta E$ 4) None of these

51. The correct electronic configuration of Fe^{+2} is

1) $1s^2,\ 2s^2 2p^6,\ 3s^2 3p^6 3d^8,\ 4s^2$ 2) $1s^2,\ 2s^2 2p^6,\ 3s^2 3p^6 3d^8$

3) $1s^2,\ 2s^2 2p^6,\ 3s^2 3p^6 3d^6$ 4) $1s^2,\ 2s^2 2p^6,\ 3s^2 3p^6 3d^6,\ 4s^2$

52. The volume of air needed for complete combustion on 1 kg carbon at STP is

1) 3333.35 L 2) 6666.66 L 3) 9333.35 L 4) 9999.99 L

53. For the reaction, A + B $\rightleftharpoons$ 2C

2 moles of A and 3 moles of B are allowed to react. If the equilibrium constant is 4 at 400°C, then the mole of C at equilibrium is

1) 1 2) 2.4 3) 3.6 4) 4

54. If $\Delta_0 < P$, the correct electronic configuration for d^4 system will be:

1) $t_{2g}^4 e_g^0$ 2) $t_{2g}^3 e_g^1$ 3) $t_{2g}^0 e_g^4$ 4) $t_{2g}^2 e_g^6$

55. The element which is used as semiconductor is:

1) Al 2) Bi 3) Cr 4) Si

56. The most stable compound is:

1) LiF 2) $LiCl$ 3) $LiBr$ 4) Lil

57. On adding 0.750 gm of compound in 25 gm of solvent lowered the freezing point of the solvent by 0.502°C. The molecular wt. of the substance is [the molecular depression constant = 50.2°C per 100 gm of solvent]

1) 100 2) 200 3) 300 4) 400

58. One mole of an ideal gas at 27°C is expanded isothermally from 1 lit to 10 lit the value of ΔE is $\left[R = 2Cal.K^{-1}mol^{-1}\right]$

1) zero 2) 104 3) 157 4) 175

59. BF_3 act as an acid according to the concept of

1) Bronsted 2) Arrhenius 3) Lewis 4) All of these

60. **Total number of electrons in all the p-orbitals of bromine are:**

1) 17 2) 24 3) 27 4) 33

61. **From the complete decomposition of 20 gm $CaCO_3$ at STP the volume of CO_2 obtained is**

1) 2.24 lit 2) 4.48 lit 3) 20 lit 4) 22.4 lit

62. **The formula of plaster of Paris is:**

1) $CaSO_4.\frac{1}{2}H_2O$ 2) $CaSO_4.2H_2O$

3) $CaSO_4.H_2O$ 4) $CaSO_4.4H_2O$

63. **If two moles of an ideal gas at 273°C occupy a volume of 44.8 lit, then pressure is**

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

64. **One mole of an ideal gas is allowed to expand reversibly and adiabatically from a temperature of 27°C. The work done is 3 kJ. The final temperature of the gas is equal to** $\left[C_v = 20\,kJ^{-1}\right]$

1) 75 K 2) 150 K 3) 225 K 4) 300 K

65. **P_2O_5 is an anhydride of**

1) HPO_3 2) H_3PO_4 3) H_3PO_3 4) $H_2P_2O_7$

66. **Duralumin is an alloy of**

1) *Al* and *Cu* 2) *Mg* and *Cu* 3) *Al* and *Mg* 4) *Al*, *Mg*, *Mn* and *Cu*

67. **During electrolysis the species migrate to cathode are:**

1) Cation 2) Anion 3) both (1) and (2) 4) None of these

68. **The most acidic oxide is:**

1) MgO 2) CaO 3) Na_2O 4) Al_2O_3

69. **The common oxidation state of the elements of lanthanide series is:**

1) + 1 2) + 3 3) + 4 4) + 6

70. **Producer gas is mixture of**

1) CO + H_2 2) CO + N_2 3) H_2 + N_2 4) CO + CO_2

71. $H_2 + Cl_2 \rightarrow 2HCl,\ \Delta H = -194\,kJ.$ **In the above reaction the heat of formation of** HCl **is:**

1) + 97 kJ 2) – 97 kJ 3) + 107 kJ 4) – 107 kJ

72. **Flux is used to remove**

1) Silica 2) metal oxide

3) Silica and metal oxide 4) Impurities from ore

73. **The number of moles of oxygen obtained by the electrolytic decomposition of 90 gm water is:**

1) 2.5 2) 5 3) 7.5 4) 10

74. **Arrange the electrons represented by the following set of quantum numbers in the decreasing order of energy.**

(i) $n = 4,\ l = 0,\ m = 0,\ s = +1/2$

(ii) $n = 5,\ l = 1,\ m = 1,\ s = -1/2$

(iii) $n = 3,\ l = 2,\ m = 0,\ s = -1/2$

(iv) $n = 3,\ l = 0,\ m = 0,\ s = -1/2$

1) $(i) > (ii) > (iii) > (iv)$ 2) $(iv) > (iii) > (ii) > (i)$

3) $(iii) > (i) > (ii) > (iv)$ 4) $(i) > (iii) > (ii) > (iv)$

75. **A crystal is made of particles X and Y, X forms FCC packing and Y occupies all the octahedral voids. If all the particles along one body diagonal are removed then the formula of the crystal would be:**

1) X_4Y_3 2) X_5Y_4 3) X_4Y_5 4) None of these

76. **If** $E^0_{Fe^{+2}/Fe} = x_1 v,\ E^0_{Fe^{+3}/Fe^{+2}} = x_2 v,$ **what is the** $E^0_{Fe^{+3}/Fe}$ **?**

1) $\frac{2x_1 + x_2}{4}$ 2) $\frac{2x_1 + x_2}{3}$ 3) $\frac{2x_1 + x_2}{2}$ 4) $2x_1 + x_2$

77. A first order reaction is 50% completed in $1.26\times10^{14}s$. How much time would it take for 100% completion?

1) $1.26\times10^{15}s$ 2) $2.52\times10^{14}s$ 3) $2.52\times10^{28}s$ 4) Infinite

78. Rate law for the reaction $A+2B\rightarrow C$ is found to be Rate = k[A][B] concentration of reactant 'B' is doubled, keeping the concentration of 'A' constant, the value of rate constant will be:

1) The same 2) Doubled 3) Quadrupled 4) Halved

79. Which of the following is not applicable to the phenomenon of adsorption?

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

80. Which of the following are peroxoacids for sulphur?

1) H_2SO_5 and $H_2S_2O_8$ 2) H_2SO_3 and $H_2S_2O_7$

3) $H_2S_2O_7$ and $H_2S_2O_8$ 4) $H_2S_2O_6$ and $H_2S_2O_7$

ENGLISH

DIRECTIONS (Qs. 81-84): Read the passage and answer the questions that follow:

India is not, as you may imagine, a distant, strange, or at the very utmost, a curious country, India for the further belongs to Europe, it has its place in the Indo-European world, it has place in our town history and what is the very life of history, the history of the human mind, you know how some of the best talents and the noblest genius for our age has been devoted to the study of the development of the outward or material worth, the growth of the earth, the first appearance of the living cells, their combination and differentiation leading up to the beginning of organic life, and its study progress form the lowest to the highest stages, Is their not inward intellectual world also which has to be studied in its historical development, from the first appearance of predicative administrative roots, their combination and differentiation, lead up to the beginning of rational though in its study progress from the lowest level to highest level and in that study of the history of the human mind, in that the study of ourselves, of our true selves, India occupies a place second to no other countries, whatever sphere of the human mind you may select for your special study, whether it be language, or religion, or mythology, or philosophy art or primitive science, everywhere you have to go to India, Whether you like it or not, because some of the most valuable and most instructive material in the history of man are treasured up in India, and in India only.

81. In what field of human endeavour has India surpassed the rest of mankind?

1) In industrialization
2) In materialization
3) In games and sports
4) In study of the history of the human mind

82. What position does India occupy in the study of the history of the human mind?

1) No place at all 2) First place 3) Third place 4) Second place

83. Philosophy means:

1) The study of human mind
2) The study of systems of thought about soul etc
3) The study of political systems
4) The study of stars and cosmos

84. The historical development of intellectual world leads up to:

1) The beginning of rational thought
2) Spiritual illumination
3) Physical development
4) Deflation

DIRECTIONS (Qs. 85-87): Each question below has a word capitalizes followed by four words or phrases. Choose the word that has nearly the same meaning

85. ENSCONCE

1) To surround 2) To promote 3) To honour 4) To settle comfortably

86. TRANSGRESS

1) To take loan
2) To go beyond the limit
3) To show a clean pair of heels
4) To discuss at length

87. AUGURY

1) Dispute
2) Altar
3) Place of refuge
4) Omen

DIRECTIONS (Qs. 88-90): In each of the following a capitalised word is followed by four words. Choose the word that is most opposite to the meaning.

88. APOCRYPHAL

1) Confusing
2) Modern
3) True
4) Unsophisticated

89. SCINTILLA

1) Unscientific
2) huge quantity
3) unpromising
4) mealy mouthed

90. Knave

1) Ignorant
2) timid
3) belligerent
4) honest

DIRECTIONS (Qs. 91-92): Each sentence below has a blank space indicating that something has been left out. Choose the word that makes the sentence meaningful.

91. His _____ of the topic was so good that student had few doubts to raise at the end.

1) Exposition
2) Clarity
3) Exposure
4) Picturisation

92. John was so good at mathematics that his friends considered him to be a _____

1) Prodigal
2) Primeval
3) Prodigy
4) Profligate

DIRECTIONS (Qs. 93-94): In each of the following question a pair of words with certain relationship between them is given. Select the pair where in the words closest relationship to original pair.

93. DRIVER : DRIVING

1) Garden : Plants
2) Counsellor : Counselling
3) Carpenter : Wood
4) Psychologist : Teaching

94. WATER : SWIM

1) Ground : Play
2) Graze : Grass
3) Knot : Tie
4) Plan : Implement

95. In each question you find a set of sentences arranged in a haphazard way. Choose the correct arrangement of sentences to make a coherent paragraph.

A) Galileo saw, too, that all the planets, including the earth travel round the sun
B) On the sun he saw dark spots that moved slowly across its surface and this proved that the sun, like the earth, spins around itself
C) Galileo made many important scientific discoveries and from the year 1609 onwards, he was the maker of the first telescope
D) With these he studied the heavens, and there he saw many wonderful things that men had never seen before
E) He studied at Pisa University and become a professor of mathematics there and afterwards at Padua.
F) The man who is described as the first truly modern scientist was an Italian astronomer Galileo Galilei, who was born in Pisa.

1) FEDCBA
2) BDEAFC
3) BEACDF
4) BEDCAF

LOGICAL REASONING

96. Bulb is to Edison as Telephone is to

1) Newton
2) Einstein
3) Graham Bell
4) None of these

97. Find the next number in the below series
1888, 1892, 1896, _____

1) 1904
2) 1901
3) 1899
4) 1908

98. Find the odd one in the given series
89, 53, 21, 37, 97, 43
1) 89 2) 21 3) 97 4) 37

99. Which of the following option replaces the "?" in the following

1	2	3
11	7	5
120	45	?

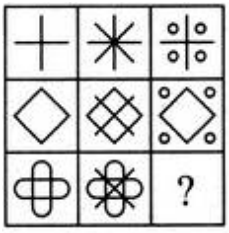
1) 15 2) 18 3) 17 4) 16

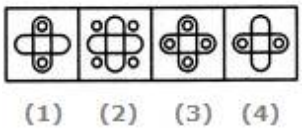
100. In this question, two statements followed by two conclusions numbered I and II are given. You have to take the given two statements to be true even if they seem to be at variance from commonly known facts. Read the conclusion and then decide which of the given conclusions logically follows from the two given statements, disregarding commonly known facts.
Statements:
All cakes are candies.
No candy is pastry.
Conclusions:
I. Some cakes are pastries.
II. No cake is pastry.
1) Only conclusion I follows 2) Only conclusion II follows
3) Neither I nor II follows 4) Both I and II follow

101. Select a figure from amongst the Answer Figures which will continue the same series as established by the five Problem Figures.
Problem Figures: **Answer Figures:**

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

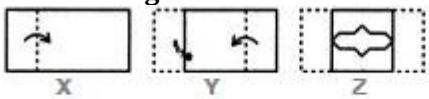
102. Select a suitable figure from the four alternatives that would complete the figure matrix.





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

103. Choose a figure which would most closely resemble the unfolded form of Figure (Z).

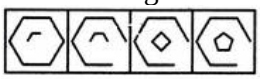


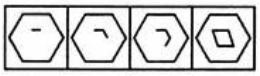
X Y Z

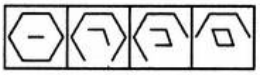
(1) (2) (3) (4)
1) 1 2) 2 3) 3 4) 4

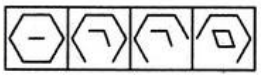
104. Choose the set of figures which follows the given rule.

Rule: Closed figures losing their sides and open figures gaining their sides.

(1) 

(2) 

(3) 

(4) 

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

105. Choose the alternative which is closely resembles the mirror image of the given combination.

TARAIN1014A

(1) A41014NIARAT (2) A1014NIARAT

(3) A1014TARAIN (4) A41014NIARAT

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

MATHEMATICS

SYLLABUS: *Sets and Relations, Functions, Matrices and Determinants, Permutations and Combination, Binomial Theorem, Quadratic Equations, Theory of Equations, Trigonometry(complete), Complex Numbers, Demoivre's Theorem, Straight lines, Pair of straight lines, Circles, System of Circles, Parabola, Ellipse, Hyperbola, Limits, Continuity & Differentiability, Derivatives, Applications of Derivatives, Indefinite Integration, Definite Integration, Areas, Differential Equations.*

106. If $\frac{\sin x+\cos x}{\cos^3 x}=a\tan^3 x+b\tan^2 x+c\tan x+d$ **then a + b + c + d =**

1) 0 2) 2 3) 4 4) – 2

107. If $cat A\cot B=2$ **and** $\cos(A+B)=\frac{3}{5}$ **then** $\sin A\sin B=$

1) $\frac{2}{5}$ 2) $\frac{1}{5}$ 3) $\frac{4}{5}$ 4) $\frac{3}{5}$

108. The Value of the expression $\tan^6 20^0-33\tan^4 20^0+27\tan^2 20^0=$

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

109. $\frac{1-4\sin 10^0\sin 70^0}{2\sin 10^0}=$

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

110. Period of sec $\left(x^0+\frac{x^0}{4}+\frac{x^0}{16}+.....\infty\right)$ **is**

1) 90 2) 180 3) 270 4) 360

111. Minimum value of $2+27\tan^2\theta+3\cot^2\theta$ **is**

1) 15 2) 18 3) 20 4) 24

112. The maximum value of all possible third order determinants formed with elements {0, 1, 2, 3} is

1) 27 2) 54 3) 81 4) – 54

113. $\begin{vmatrix} a+b+2c & a & b \\ c & b+c+2a & b \\ c & a & c+a+2b \end{vmatrix}=k(a+b+c)^2$ **then k =**

1) 2 2) 2(a + b + c) 3) 2abc 4) $2(a+b+c)^2$

114. **If** $A=\begin{bmatrix}1 & 2\\ 3 & 5\end{bmatrix}$ **then the value of** $\left|A^{2009}-5A^{2008}\right|$ **is**

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

115. **If A is a square matrix of order 3, then** $\left|Adj\left(AdjA^2\right)\right|=$

1) $|A|^2$ 2) $|A|^4$ 3) $|A|^8$ 4) $|A|^{16}$

116. $f:[-1,1]\to[-1,1]$ **defined by** $f(x)=x|x|$ **is**

1) one one but not onto 2) onto but not one one
3) neither one one nor onto 4) Bijection

117. **The Domain of the function** $f(x)=\log_2\left[\log_3\left(\log_4^x\right)\right]$ **is**

1) $x<0$ 2) $x>4$ 3) $0<x<2$ 4) $2<x<4$

118. **The modulus – amplitude form of** $1+i\tan\theta$ **is**

1) $\sec\theta cis\theta$ 2) $cis\theta$ 3) $\sec\theta cis\left(\frac{\pi}{2}-\theta\right)$ 4) $\sec\theta$

119. $\log(1+i)^{12}=$

1) $\log\frac{\pi}{4}+\frac{i\pi}{2}$ 2) $6\log 2+i3\pi$ 3) $12\log 2+i9\pi$ 4) $16\log 2+i9\pi$

120. **If** α,β **are non –real cube roots of 2 then** $\alpha^6+\beta^6=$

1) 8 2) 4 3) 2 4) 1

121. **The number of real roots of the equation** $5+\left|2^x-1\right|=2^x\left(2^x-2\right)$ **is**

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

122. **If 1,2,3,4 are the roots of the equation** $x^4+ax^3+bx^2+cx+d=0$ **then a + 2b + c =**

1) -25 2) 0 3) 10 4) 24

123. **The number of permutations of the letter of the word 'PROPORTATION' taken 4 at a time in which 3 are alike and one is different is**

1) 20 2) 24 3) 15 4) 120

124. **The coefficient of** x^2 **in expansion of** $\left(1+4x+x^2\right)^{1/2}$ **is**

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

125. **The number of solution of** $\sec x\cos 5x+1=0$ **in** $[0,2\pi]$ **is**

1) 5 2) 8 3) 10 4) 12

126. **If x, y, z are in A.P and** $\tan^{-1}x,\tan^{-1}y,\tan^{-1}z$ **are also in A.P then**

1) 6x = 3y = 2z 2) 6x = 4y = 3z 3) x = y = z 4) 2x = 3y = 6z

127. **In a** ΔABC **the altitudes from A, B, C on opposite side are in H.P then** $\sin A,\sin B,\sin C$ **are in**

1) A.P 2) G.P 3) H.P 4) A.G.P

128. **Let** $R\{(x,y):x,y\in A,x+y=5\}$ **where** $A=\{1,2,3,4,5\}$ **then**

1) R is only reflexive 2) R is only symmetric
3) R is only Transitive 4) R is an equivalence relation

129. **If an equilateral triangle, having centroid at the origin, has a side along the line x + y = 2 then the area of its triangle is**

1) $3\sqrt{6}$ 2) 6 3) $6\sqrt{3}$ 4) $\frac{9}{2}\sqrt{3}$

130. **A straight line L through the point (3,-2) is inclined at an angle of** 60^0 **to the line** $\sqrt{3}x+y=1$**. If L also intersects the x-axis then the equation of L is**

1) $y+\sqrt{3}x+2-3\sqrt{3}=0$ 2) $y-\sqrt{3}x+2+3\sqrt{3}=0$
3) $\sqrt{3}y-x+3+2\sqrt{2}=0$ 4) $\sqrt{3}y+x-3+2\sqrt{3}=0$

131. The Orthocentre of the triangle formed by the lines xy = 0 and x + y = 1 is

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

132. If $f(x)=\frac{\sin[x]}{[x]}$, for $[x]\neq 0$

$= 0$ for $[x]=0$

1) Continuous at x = 0 2) discontinuous at x = 0

3) L.H.L = 0 4) R.H.L = 1

133. If $f(x)=\left(1+|\sin x|\right)^{\frac{a}{|\sin x|}}$, **if** $\frac{-\pi}{6}<x<0$

= b, if x=0

$= e^{\frac{\tan 2x}{\tan 3x}}$, **if** $0<x<\frac{\pi}{6}$ **is continuous at x = 0 then**

1) $a=e^{\frac{2}{3}},b=\frac{2}{3}$ 2) $a=\frac{2}{3},b=e^{\frac{2}{3}}$ 3) $a=\frac{1}{3},b=e^{\frac{1}{3}}$ 4) $a=e^{\frac{1}{3}},b=e^{\frac{1}{3}}$

134. The angle between the curves $x^3-3xy^2=2$ **and** $3x^2y-y^3=2$ **is**

1) $\frac{\pi}{6}$ 2) $\frac{\pi}{4}$ 3) $\frac{\pi}{3}$ 4) $\frac{\pi}{2}$

135. The number of critical points of $f(x)=\frac{|x-1|}{x^2}$ **is**

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

136. If $a\neq b$ **then the length of common chord of the circles** $(x-a)^2+(y-b)^2=c^2$ **and** $(x-b)^2+(y-a)^2=c^2$ **is**

1) $\sqrt{4c^2-2(a-b)^2}$ 2) $\sqrt{c^2-(a-b)^2}$ 3) $\sqrt{3c^2-(a-b)^2}$ 4) $\sqrt{2c^2-(a-b)^2}$

137. If the angle between two equal circles with centres (3,10) ,(-5,4) is 120^0 **then the radius of the circle is**

1) 10 2) 5 3) 2 4) 1

138. If the chord joining the points t_1 **and** t_2 **on the parabola** $y^2=4ax$ **subtends a right angle at its vertex then** t_2 **=**

1) $\frac{2}{t_1}$ 2) $\frac{-2}{t_1}$ 3) $\frac{4}{t_1}$ 4) $\frac{-4}{t_1}$

139. If the equation $25\left\{(x-5)^2+(y-3)^2\right\}=(3x-4y+1)^2$ **represents a parabola then its axis is**

1) 4x+3y-10=0 2) 4x+3y-15=0 3) 4x+3y-29=0 4) 4x+3y-17=0

140. The tangent at P to the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ **cuts the major axis in T and PN is the perpendicular to x axis. If C is the centre of the ellipse then CT.CN =**

1) a 2) b 3) b^2 4) a^2

141. For the hyperbola $\frac{x^2}{\cos^2\alpha}-\frac{y^2}{\sin^2\alpha}=1$ **Which of the following remains constant when** α **varies?**

1) Abscissae of foci 2) eccentricity 3) directrix 4) abscissae of vertices

142. $\int \frac{2+\cos\frac{x}{2}}{x+\sin\frac{x}{2}}dx =$

1) $\log\left|x+\sin\frac{x}{2}\right|+c$ 2) $\frac{1}{2}\log\left|x+\sin\frac{x}{2}\right|+c$

3) $2\log\left|x+\sin\frac{x}{2}\right|+c$ 4) $\frac{-1}{2}\log\left|x+\sin\frac{x}{2}\right|+C$

143. $\int \frac{dx}{(x+1)^{\frac{3}{4}}(x-2)^{\frac{5}{4}}} =$

1) $4\left(\frac{x-2}{x+1}\right)^{\frac{1}{4}}+C$ 2) $\frac{-4}{3}\left(\frac{x+1}{x-2}\right)^{\frac{1}{4}}+C$ 3) $4\left(\frac{x+1}{x-2}\right)^{\frac{1}{4}}+C$ 4) $\frac{-4}{3}\left(\frac{x-2}{x+1}\right)^{\frac{1}{4}}+C$

144. If the tangent lines to the curve y=f(x) form angles $\frac{\pi}{3}$ and $\frac{\pi}{4}$ with $\overline{OX}$ at the points x=a ,x=b respectively then $\int_a^b f''(x)dx =$

1) $1-\sqrt{3}$ 2) $\sqrt{3}-1$ 3) 1 4) 0

145. Let f be a positive function. Let $I_1=\int_{1-k}^{k} xf\{x(1-x)\}dx,\ I_2=\int_{1-k}^{k} f\{x(1-x)\}dx$ **where 2k-1>0 then** $\frac{I_1}{I_2}$ **is**

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

146. The area of the region bounded by $y=|x|-1$ **and** $y=-|x|+1$ **is**

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

147. The solution of $ydx-\left(x+2y^2\right)dy=0$ **is** $x=f(y)$. **If f(-1)=1 then f(1)=**

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

148. If the differential equation representing the family of all circles touching x-axis at (0,0) is $\left(x^2-y^2\right)\frac{dy}{dx}=g(x).y$ **then g(x)=**

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

149. If $y=\cos^{-1}\left(\frac{x-x^{-1}}{x+x^{-1}}\right)$ **then** $\frac{dy}{dx}$ **=**

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

150. If $f(x)=-3x+2, x<1$

$= \frac{x^2}{2}+7, x\geq 1$ **then which of the following is not true**

1) $f'(1+)=1$ 2) $f'(1-)=-3$

3) $f'(1-)=f'(1+)=1$ 4) f is not differentiable at x = 1

* * *

MELUHA INTERNATIONAL SCHOOL

HYDERABAD

OUTGOING SR BITSAT | **BITSAT MODEL** | **Date: 05-05-2020**

Time: 3 Hours | **Max. Marks: 450**

KEY SHEET

PHYSICS

1) **1**	2) **2**	3) **2**	4) **1**	5) **2**	6) **2**	7) **1**	8) **3**	9) **1**	10) **3**
11) **1**	12) **1**	13) **4**	14) **2**	15) **1**	16) **1**	17) **4**	18) **4**	19) **2**	20) **2**
21) **4**	22) **2**	23) **4**	24) **2**	25) **2**	26) **1**	27) **2**	28) **1**	29) **1**	30) **2**
31) **2**	32) **3**	33) **1**	34) **2**	35) **2**	36) **2**	37) **2**	38) **1**	39) **2**	40) **2**

CHEMISTRY

41) **2**	42) **1**	43) **3**	44) **4**	45) **3**	46) **2**	47) **1**	48) **2**	49) **4**	50) **2**
51) **3**	52) **3**	53) **2**	54) **2**	55) **4**	56) **1**	57) **3**	58) **1**	59) **3**	60) **1**
61) **2**	62) **1**	63) **2**	64) **2**	65) **1**	66) **4**	67) **1**	68) **4**	69) **2**	70) **2**
71) **2**	72) **3**	73) **1**	74) **3**	75) **2**	76) **2**	77) **4**	78) **2**	79) **1**	80) **1**

ENGLISH

81) **4**	82) **2**	83) **2**	84) **1**	85) **4**	86) **2**	87) **4**	88) **3**	89) **2**	90) **4**
91) **1**	92) **3**	93) **2**	94) **1**	95) **1**					

LOGICAL REASONING

96) **3**	97) **1**	98) **2**	99) **4**	100) **2**	101) **2**	102) **2**	103) **2**	104) **3**	105) **4**

MATHEMATICS

106) **3**	107) **4**	108) **3**	109) **2**	110) **3**	111) **2**	112) **2**	113) **4**	114) **1**	115) **3**
116) **4**	117) **2**	118) **1**	119) **2**	120) **1**	121) **1**	122) **3**	123) **2**	124) **2**	125) **4**
126) **3**	127) **1**	128) **2**	129) **3**	130) **2**	131) **3**	132) **2**	133) **2**	134) **4**	135) **3**
136) **1**	137) **1**	138) **4**	139) **3**	140) **4**	141) **1**	142) **3**	143) **2**	144) **1**	145) **3**
146) **2**	147) **2**	148) **3**	149) **1**	150) **3**					

HINTS & SOLUTIONS

PHYSICS

1. $P = ML^{-1}T^{-2}$

$$\frac{1}{\mu_0 \in_0} = V^2 = L^2T^{-2}$$

$$\frac{P}{\mu_0 \in_0} = MLT^{-4}$$

2. $E = mc^2$

$$m = \frac{E}{c^2} = EV^{-2}$$

3. $x = ut - \frac{1}{2}at^2$

x to be maximum $\frac{dx}{dt} = 0$

$v - at = 0$

$t = \frac{v}{a}$

Sub in above equation

4. u = 54 KMPH = 15 m/s

$v^2 - u^2 = 2as$

$s = 375\ m$

Distance from traffic light $400 - 375 = 25\ m$

5. $h = u\sin\theta t - \frac{1}{2}gt^2 \qquad (1)$

$d = u\cos\theta t$

$t = \frac{d}{u\cos\theta}$

Sub in (1)

$u = \frac{d}{\cos\theta}\sqrt{\frac{g}{2\left(d\tan\theta - h\right)}}$

6. PE = KE

$mg\frac{u^2}{2g}\sin^2\theta = \frac{1}{2}mu^2\cos^2\theta$

Find θ

Then $T_f = \frac{2u}{g}\sin\theta$

7. $F = \frac{dp}{dt}$

$\frac{dp}{dt} = -\frac{k}{x^2}$

$\frac{d}{dt}(mv) = -\frac{k}{x^2}$

$m\frac{dv}{dx}\frac{dx}{dt} = -\frac{k}{x^2}$

$mvdv = -\frac{k}{x^2}dx$

Take integration

8. Minimum force required to pull block M is (2 kg)

$F = \mu_1 N_1 + \mu_2 N_2$

$= \mu_1 mg + \mu_2 \left(Mg + N_1 \right)$

$= \mu_1 mg + \mu_2 \left(Mg + mg \right)$

9. $m_1 v_1 = m_2 v_2$

$E = \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2$

10. P = F.v

$P = \left(ma \right) v$

$a = \frac{P}{mv}$

$v \frac{dv}{ds} = \frac{P}{mv}$

$v^2 dv = \frac{P}{m} ds$

$\frac{P}{m} \int ds = \int_{v_1}^{v_2} v^2 dV$

$s = \frac{m}{3P} \left(v_2^3 - v_1^3 \right)$

11. $a = A \sin w t_0$

$b = A \sin 2 w t_0$

$c = A \sin 3 w t_0$

Do $a + c$

$w = \frac{1}{t_0} \cos^{-1} \left(\frac{a+c}{2b} \right)$

$f = \frac{1}{2\pi t_0} \cos^{-1} \left(\frac{a+c}{2b} \right)$

12. $T = 2\pi \sqrt{\frac{m}{K}}$

13. $n_x = \frac{K}{2l} \sqrt{\frac{T}{\mu}}$

$K \alpha \, l$

$\frac{K_2}{K_1} = \frac{l_2}{l_1}$

$\frac{K_2}{1} = \frac{2l_2}{l_1}$

$K_2 = 2$

14. $n_1 = n_2 \left[\frac{V}{V - V_s} \right]$

$n = \left(\frac{V}{V + V_1} \right) 2n$

$3V_s = V$

$V_s = \frac{V}{3} = 100$ m/s

15. $\mu_d = 1.125 = \frac{V_r}{V_d}$

$V_1 - V_d = 0.25 \times 10^8$ m/s

$1.125\,V_d - V_d = 0.25 \times 10^8$

$V_d = 2 \times 10^8$ m/s

$V_r = 2.25 \times 10^8$ m/s

$\mu_d = \frac{3 \times 10^8}{2 \times 10^8} = 1.5$

$\mu_r = \frac{3 \times 10^8}{2.25 \times 10^8} = 1.33$

16. $P = \frac{1}{f} = -\frac{1}{F.P} - \frac{1}{-u}$

17. $\frac{1}{f} = \frac{1}{V} + \frac{1}{u}$

$-\frac{1}{f} = \frac{1}{10} + \frac{1}{15}$

$-\frac{1}{f} = \frac{-3+2}{30} = \frac{1}{30}$

$f = 30$

$R = 2f = 60\,cm$

18. $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$

19. $D = \frac{M}{V}\ D' = \frac{M}{V - \Delta V}$

$\frac{D'}{D} = \frac{V}{V - \Delta V} = \left(1 - \frac{\Delta V}{V}\right)^{-1}$

$\frac{D' - D}{D} = \frac{\Delta V}{V} = \frac{\Delta D}{D}$

$\frac{\Delta V}{V} = \frac{P}{B}$

$\frac{\Delta D}{D} = \frac{P}{B}$

20. For the spring $F_1 = Kx_1$

$x_1 = \frac{F_1}{K}$

$Y = \frac{F_2 L}{A x_2}\,(or)\ x_2 = \frac{F_2 L}{AY}$

Total extension $= x_1 + x_2$

$F_1 = F_2 = F$

$F = \left(\frac{AYK}{AY + KL}\right) x$

Where $w=\sqrt{\frac{AYK}{m(AY+KL)}}$

$T=\frac{2\pi}{w}=2\pi\sqrt{\frac{m(AY+KL)}{AYK}}$

21. $W=T\Delta A$

$W=T\left[4\pi r^2 n-4\pi R^2\right]$

Where $n\frac{4}{3}\pi r^3=\frac{4}{3}\pi R^3$

$w=\frac{1}{2}mv^2$

$v=\sqrt{\frac{6T}{\rho}\left(\frac{1}{r}-\frac{1}{R}\right)}$

22. $dm=\pi r^2\rho dx$

The PE of liquid in a column of height h is

$=\int_o^h\left(\pi r^2\right)x\rho g dx$

$=\frac{mgh}{2}$

23. Velocity u of the body when it enters the liquid is given by

$mgh=\frac{1}{2}mu^2$

$u=\sqrt{2gh}$

Net upward force $=VDg-Vdg$

$=Vg(D-d)$

$\text{Retardation}=\frac{\text{Net weight}}{\text{Mass}}$

$=\frac{V(D-d)g}{Vd}=\frac{(D-d)}{d}g$

$v=u+at$

$v=0$

$t=\left(\frac{d}{D-d}\right)\sqrt{\frac{2h}{g}}$

24. Suppose the angle subtended by the arc formed be θ, then

$\theta=\frac{l}{r}(or)\,\theta=\frac{dl}{dr}=\frac{l_2-l_1}{r_2-r_1}$

$\theta=\frac{l(\alpha_2-\alpha_1)\Delta T}{t}$

$\frac{l}{r}=\frac{l(\alpha_2-\alpha_1)\Delta T}{t}$

$r=\frac{t}{(\alpha_2-\alpha_1)\Delta T}$

25. Given $\frac{\text{latent heat of fusion}}{\text{latent heat of vaporization}}$

$\Rightarrow \lambda = \frac{L_f}{L_v}$

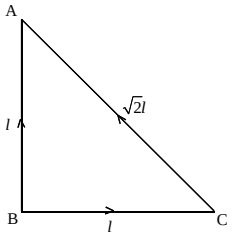
$L_f = \lambda L_v$

If k is fraction

$(1-k)L_f = kL_v$

$k = \frac{\lambda}{\lambda+1}$

26. As $T_B > T_A$ heat flows from B to A through both paths BA and BCA



$\frac{Q}{t} across\ BC = \frac{Q}{t} across\ CA$

$\frac{KA\left(\sqrt{2}T - T_C\right)}{l} = \frac{KA\left(T_C - T\right)}{\sqrt{2}l}$

$\therefore T_C = \frac{3T}{\sqrt{2}+1}$

27. $\frac{C_P}{C_V} = \gamma = \frac{7}{5}$

$\text{workdone} = \frac{\mu R}{\gamma - 1}\Delta T$

28. $u = u_1 + u_2$

$u = \frac{f\left(n_1 + n_2\right)RT}{2}$

$u_1 = \frac{fn_1RT_1}{2}, u_2 = \frac{fn_2RT_2}{2}$

29. $PV^3 = \text{constant}$

$C = C_V + \frac{R}{1-\alpha} = \frac{3R}{2} + \frac{R}{1-3}$

= R

30. $V_{rms} = \sqrt{\frac{3k_BT}{m}}$

31. $V_{rms} = \sqrt{\frac{\Sigma v^2}{N}}$

$V_{avg} = \frac{1}{N}\Sigma v$

32. $\Delta\phi = \frac{2\pi}{\lambda}\Delta x$

$I = 4I_0\cos^2\frac{\phi}{2}$

$\Delta\phi = \frac{2\pi}{\lambda}\frac{\lambda}{4} = \frac{\pi}{2}$

$I' = 4I_0 \cos^2 \frac{\pi}{4}$

$I' = 2I_0 = \frac{K}{2}$

33. $\mu = \tan i_p$

34. $M' = \sqrt{M_1^2 + M_2^2 + 2M_1 M_2 \cos\theta}$

35. $\bar{\tau} = \overline{M} \times \overline{B}$

36. At $x = 2R$

$I_1 = \frac{mR^2}{2} + m(2R)^2 = \frac{9}{2}mR^2$

$y = d$

$I_2 = \frac{mR^2}{4} + md^2$

$\frac{mR^2}{4} + md^2 = \frac{9}{2}mR^2$

$d = \frac{\sqrt{17}}{2}R$

37. F_2 = force due to remaing

F_c = force due to cavity

$F_1 = \frac{GMm}{(3R)^2} = \frac{GMm}{9R^2}$

$F_c = \frac{G\left(\frac{M}{8}\right)m}{\left(\frac{5}{2R}\right)^2} = \frac{GMm}{50R^2}$

But $F_1 = F_2 + F_c$

$F_2 = F_1 - F_c$

$= \frac{41GMm}{450R^2}$

$\frac{F_2}{F_1} = \frac{41}{50}$

38. $L = I\ w$

$mv\left(\frac{a}{2}\right) = I_0 w$

$= \left(I_{cm} + Mr^2\right)w$

$w = \frac{3v}{4a}$

39. $mRw^2 = R^{-5/2}$

$w = \frac{2\pi}{T}$

40. $\frac{MR^2}{2} = \frac{Ml^2}{12} + \frac{MR^2}{4}$

CHEMISTRY

41. In the structure of graphite, electrons are spread out between the structure. In graphite carbon atoms is sp^2 hybridized and has a delocalized $\pi-$electron cloud.

42. $\left[NiCl_4\right]^{2-} \Rightarrow x-4=-2$

$x=-2+4=+2$

$\therefore n=2$

$u=\sqrt{n(n+2)}=\sqrt{2(2+2)}=\sqrt{2(4)}=\sqrt{8}=2.82\,B.M$

43. Hydrogen have + 1 and – 1 oxidation state. This is the correct statement regarding hydrogen.

44. We know that, atomic number (z) = number of proton = number of electron

89 = 89 = 89

Mass number (A) = number of proton + number of neutron

$\therefore$ Number of neutron = mass number – number of proton

= 231 – 89 = 142

$\therefore$ Number of proton = 89, Number of neutron = 142 and Number of electron = 89.

45. He_2 cannot be formed because He is a monoatomic gas and it can be represented as He. After removing one electron it becomes H^+ and after removing both the electrons it becomes He^{+2}.

46. Some crystals have permanent alignment of dipoles even in the absence of electric field. When electric field is applied, then the direction of polarization of ions is altered. Such crystals are known as ferroelectric.

The ferroelectric crystals are $BaTiO_3$ and sodium potassium tartarate.

47. Synthesis of ammonia by Habers' process takes place at high pressure, low temperature and in presence of catalyst.

48. We know that $\frac{V_1}{V_2}=\frac{T_1}{T_2}$

Here, $V_1=0.2\,\text{litre},\ T_1=0^0C,\ T_2=273^0C,\ V_2=?$

$\therefore V_2=\frac{T_2V_1}{T_1}=\frac{0.2\times546}{273}=0.4\,\text{lit}$

49. In gas equation PV = n RT, P and V represent pressure and volume of one mole of gas, respectively and n is the number of moles of gas. Hence, the incorrect statement is n is the number of molecules of gas.

50. First law of thermodynamics states that energy can neither be created nor destroyed or the total energy of universe is constant. i.e. $\Delta E=Q+W$.

51. We know that the configuration of Fe is as follows:

$_{26}Fe:1s^2,\ 2s^2\,2p^6,\ 3s^2\,3p^6\,3d^6,\ 4s^2$

$Fe^{+2}:1s^2,\ 2s^2\,2p^6,\ 3s^2\,3p^6\,3d^6$

52. $C+O_2\rightarrow CO_2$

12 gm carbon requires O_2 = 22.4 lit

$\therefore$ 1000 gm carbon requires $O_2=22.4\times\frac{1000}{12}$ = 1866.67 lit

O_2 is $1/5^{th}$ part of air

$\therefore$ Volume of air = 5 $\times$ Volume of O_2

$=5\times1866.67$

= 9333.35 litre.

53.

Initial moles	A	+	B	$\rightarrow$	$2C$
	2		3		0
Equilibrium moles	$(2-x)$		$(3-x)$		$2x$

Suppose volume of container is V litre.

$\therefore K_c = \dfrac{[C]^2}{[A][B]} = \dfrac{(2x/V)^2}{[(2-x)/V][(3-x)/V]}$

Or $4 = \dfrac{4x^2}{(2-x)(3-x)}$

$\therefore \quad x = 12$

$\therefore$ Moles of carbon at equilibrium $= 2x = 2 \times 12 = 2.4$.

54. If pairing energy (p) higher, then electron exited.
eg Orbital
$t_{2g}^3 e_g^1$ is correct.

55. Semi-conductors are those solids which are perfect insulators at absolute zero but conduct electric current at room temperature. Silicon (Si) and germanium (Ge) are semi-conductors.

56. The electronegative character of halogens is F > Cl > Br > I
Therefore, F is the most electronegative atom among halogens.
Among alkali metals the electropositive character increases in the order Li < Na < K < Rb < Cs
Therefore, LiF is the most stable compound.

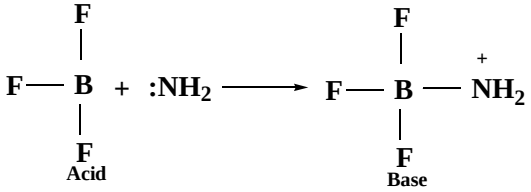
57. We know the molecular weight $m = \dfrac{100 \times K_1 \times w}{\Delta T_1 \times W}$

Where, K_1 = molecular depression constant = 50.2°C per 100 gm,
w = weight of compound = 0.750 gm,
ΔT_1 = lowering of freezing point of solvent = 0.502°C and
W = weight of solvent = 25 gm.

$\therefore m = \dfrac{100 \times 50.2 \times 0.750}{0.502 \times 25} = 300.$

58. The gas is expanded isothermally. Therefore, T is constant.
Hence, $\Delta T = 0$
When ΔT is zero, then ΔE is also zero.

59. BF_3 is known as Lewis acid.
According to Lewis definition, an acid is a substance that can accept an electron pair.



BF_3 accepts a lone pair of electron therefore it is Lewis acid.

60. The electronic configuration of bromine atom is $1s^2,\ 2s^2 2p^6,\ 3s^2 3p^6 3d^{10},\ 4s^2 4p^5$
Hence, total number of electrons in p-orbitals = 6 + 6 + 5 = 17.

61. We know that $\underset{100\text{ gm}}{CaCO_3} \xrightarrow{\text{Heat}} \underset{22.4\text{ lit at STP}}{CaO + CO_2}$

$\because$ 100 gm $CaCO_3$ 22.4 lit CO_2 at STP.

$\therefore$ 20 gm $CaCO_3$ produce $CO_2 = \dfrac{22.4 \times 20}{100} = 4.48\,\text{lit.}$

62. Plaster of Paris is $CaSO_4.\dfrac{1}{2}H_2O.$

63. We know that PV = n RT

$\therefore\ P = \dfrac{nRT}{V} = \dfrac{2 \times 0.0821 \times 546}{44.8} = 2.00$ atm.

64. Work done $W = {}^nC_v(T_1 - T_2)$
Here, $W = 3kJ = 3000J$

n = number of moles = 1

T_1 = initial temperature = $27^oC + 273 = 300K$.

$C_v = 20\ kJ^{-1}$

Putting the values, we get

$3000 = 1 \times 20(300 - T_2)$

$= 6000 - 20T_2$

$\therefore 20T_2 = 6000 - 20T_2$

$= 6000 - 3000 = 3000$

$\therefore T_2 = \frac{3000}{20} = 150\ K$

65. P_2O_5 is an anhydride of HPO_3

$HPO_3 + HPO_3 \xrightarrow[H_2O]{} P_2O_5$

66. Conceptual

67. Cathode have $-ve$, charge, therefore, during electrolysis cations having $+ve$, charge migrate to cathode and forms a neutral atom.

68. Conceptual

69. Lanhanides have different oxidation state because there is only a small difference between the energies of the electrons in the n-s orbital and d orbital. The common oxidation state is +3.

70. Producer gas is a mixture of carbon monoxide and nitrogen (CO + N_2).

71. $H_2 + Cl_2 \rightarrow 2HCl.$ $\Delta H = -194kJ$. Here, 2 molecules of HCl are formed and the value of ΔH is – 194 kJ.

Hence, the change in enthalpy (ΔH) for the formation of one molecule of $HCl = \frac{-194}{2} = -97$ kJ.

72. Flux is used to remove silica and undesirable metal oxide. It is an external material added during smelting to convert infusible impurities into an easily fusible material known as slag.

73. $2H_2O \xrightarrow{\text{Electrolysis}} 2H_2 + O_2$

$2 \times 18\text{gm} = 36\text{gm} = 1\text{mole}$

$\because$ 36 gm H_2O produce 1 mole of oxygen

$\therefore$ 90 gm H_2O produce oxygen $= \frac{90}{36} = 2.5$ moles.

74. (i) 4s (ii) 3p (iii) 3d (iv) 3s

The energy of these orbitals follows the order:

3d > 4s > 3p > 3s $\left[(n+l)\text{ rule}\right]$

(iii) > (i) > (ii) > (iv)

75. along one body diagonal

$2 \times \frac{1}{8}$ atoms from 2 corners

One Y particle (at the centre of cube) will be removed.

So, effective no. of X particles in a unit cell $= 4 - 2 \times \frac{1}{8} = \frac{15}{4}$

And effective no. of Y particles in a unit cell $= 4 - 1 = 3$

X : Y = $\frac{15}{4} : 3 = 5 : 4 = X_5Y_4$

76. $Fe^{+2} + 2e^- \rightarrow Fe;\ E^0_{Fe^{+2}/Fe} = x_1v$

$\Delta G_1 = -nFE_1 = 2x_1F$

$Fe^{+3} + e^- \rightarrow Fe^{2+};\ E^0_{Fe^{+3}/Fe^{+2}} = x_2v$

$\Delta G_2 = -nFE_2 = -1x_2F$

$Fe^{+3} + 3e^- \rightarrow Fe;\ E^0_{Fe^{+3}/Fe} = ?$

$\Delta G_3 = \Delta G_1 + \Delta G_2$

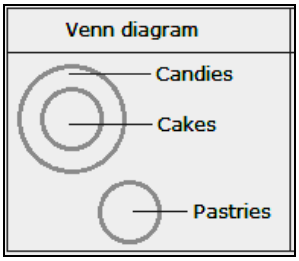
$-nFE_3 = -2x_1F - X_2F \Rightarrow -3F_3 = -2x_1 - x_2$

$E_3 = \left(\frac{2x_1 + x_2}{3}\right)$

77. It is impossible to perform 100% of the reaction because in every half-life, 50% of the substance reacts. Hence, time taken for 100% completion of a reaction is infinite.
78. Rate law can be written as, Rate = k[A][B]
Rate of reaction w.r.t. B is of first order R_1 = k[A][B]
When concentration of reactant 'B' is doubled then rate (R_2)
R_2 = k[A][2B]
R_2 = 2k[A][B]
$R_2 = 2R_1$
Therefore, as concentration of B is doubled keeping the concentration of A constant rate of reaction doubles.
79. Adsorption is an exothermic process and $\Delta H < 0$
$\Delta H > 0$ is endothermic and not applicable to adsorption.
80. Peroxoacids of sulphur must contain one –o–o–

LOGICAL REASONING

96. Bulb was invented by Thomas Edison and Telephone was invented by Alexander Graham Bell
97. Consecutive Leap Years. (1900 is not a leap year. Century year should be divisible by 400, then only it becomes a leap year)
98. Except 21 the remaining numbers are primes
99. 1^{st} column $11^2 - 1^2 = 120$
2^{nd} column $7^2 - 2^2 = 45$
3^{rd} column $5^2 - 3^2 = 16$ = Answer
100.



101. Similar figure reappears in every second step. Each time the first figure reappears, the elements interchange positions in the order:  .

And, each time the second figure reappears, the elements interchange positions in the order: 
102. In each row, the second figure is obtained from the first figure by adding two mutually perpendicular line segments at the centre and the third figure is obtained from the first figure by adding four circles outside the main figure.
103. Second figure only come if cut the paper after the above foldings.
104. Only the third option satisfied the Rule
105. 4^{th} option is the right Mirror Image.

MATHEMATICS

106. $\tan x \sec^2 x + \sec^2 x = \left(1 + \tan^2 x\right)\left(1 + \tan x\right)$
107. $\cos A \cos B = 2 \sin A \sin B$
108. $\tan 60^0 = \tan 3\left(20^0\right)$

109. $\dfrac{1-2(\cos 80-\cos 60)}{2\sin 10^0}$

110. $\sec\left[x^0\left(1+\dfrac{1}{4}+\dfrac{1}{16}+.....\infty\right)\right]$

111. $AM \geq GM$

112. Maximum value of Det $= \begin{vmatrix} 0 & 3 & 3 \\ 3 & 0 & 3 \\ 3 & 3 & 0 \end{vmatrix}$

113. Put a=0,b=1,c=2

114. $|A|^{2008}|A-5I|$

115. $|adj(adjA)| = |A|^{(n-1)^2}$

116. Conceptual

117. $\log_3\left(\log_4^x\right) > 0$

118. $r = \sec\theta, \theta = \tan^{-1}(\tan\theta)$

119. $1+i = \sqrt{2}cis\dfrac{\pi}{4}$

120. $\alpha = 2^{1/3}\omega, \beta = 2^{1/3}\omega^2$

121. Put $2^x - 1 = y$

122. a=-10, b=35, c=-50

123. $6\times\dfrac{4!}{3!}$

124. Use $(1+x)^{p/q}$ expansion

125. $\cos 5x + \cos x = 0$

126. $2\tan^{-1} y = \tan^{-1} z + \tan^{-1} x$

on solving we get $y^2 = 3x$

$\Rightarrow x, y, z$ are in G.P

$\Rightarrow x, y, z$ are in AP and GP

127. $P_1 = \dfrac{2\Delta}{a}, P_2 = \dfrac{2\Delta}{b}, P_3 = \dfrac{2\Delta}{c}$

$\Rightarrow \dfrac{1}{a}, \dfrac{1}{b}, \dfrac{1}{c}$ are in H.P

$\Rightarrow a, b, c$ are in AP

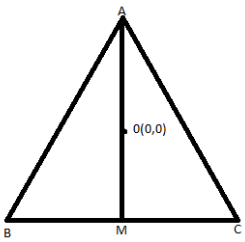
128. Cleary $(x, x) \notin R$

If $x + y = 5$ then $y + x = 5$

$\Rightarrow (x, y) \in R \Rightarrow (y, x) \in R$

$\therefore R$ is only symmetric

129.



$OM = \frac{2}{\sqrt{2}} = \sqrt{2}$

$AM = 3\sqrt{2}$

In a ΔABM

$AB^2 = AM^2 + BM^2$

$a^2 = \left(3\sqrt{2}\right)^2 + \left(\frac{a}{2}\right)^2$

$\frac{3a^2}{4} = 18$

$a^2 = 24$

$Area = \frac{\sqrt{3}}{4}a^2 = \frac{\sqrt{3}}{4} \times 24 = 6\sqrt{3}$

130. $\text{Tan}\,60 = \left|\frac{m-\left(-\sqrt{3}\right)}{1+m\left(-\sqrt{3}\right)}\right|$

$\left(m+\sqrt{3}\right)^2 = 3\left(1-\sqrt{3}m\right)^2$

m=0 or $m=\sqrt{3}$

Equation of required line is $y+2=\sqrt{3}\left(x-3\right)$

$y-\sqrt{3}x+2+3\sqrt{3}=0$

131. Orthocentre (0, 0)

132. $L.H.L = \lim_{x\to 0^-} \frac{\sin(-1)}{-1} = \sin 1$

$R.H.L = 0$

133. $\lim_{x\to 0^-} f(x) = \lim_{x\to 0^+} f(x) = f(0)$

134. $m_1 m_2 = -1$

135. $f(x) = \frac{|x-1|}{x^2}$, f is not defined for x=0

$f'(x) = 0 \Rightarrow x = 2$

f is not differentiable for x=1

Critical points are 0,1,2

136. Apply $2\sqrt{r^2-d^2}$

137. $\cos\theta = \frac{d^2-r_1^2-r_2^2}{2r_1r_2}$ where $r_1 = r_2$ and $\theta = 120^0$

138. $PA \perp PB \Rightarrow \frac{2at_1}{at_1^2} \times \frac{2at_2}{at_2^2} = -1$

$t_1t_2 = -4$

139. Equation of parabola is of the form $SP^2 = PM^2$

$\left(x-5\right)^2 + \left(y-3\right)^2 = \left(\frac{3x-4y+1}{5}\right)^2$

Focus = (5, 3)

Directrix = 3x-4y+1=0

Hence axis is 4x+3y=20+9=29

140. $CT = a\sec\theta \quad CN = a\cos\theta$

141. $e = \sqrt{\frac{a^2+b^2}{a^2}} = \sec\alpha$

$Foci = (\pm ae, 0) = (\pm 1, 0)$

142. $\int \frac{2+\cos\frac{x}{2}}{x+\sin\frac{x}{2}}dx = \int \frac{2\left(1+\frac{1}{2}\cos\frac{x}{2}\right)}{x+\sin\frac{x}{2}}dx$

143. $\int \frac{dx}{\left(\frac{x+1}{x-2}\right)^{\frac{3}{4}}(x-2)^2}$ Take $\frac{x+1}{x-2} = t$

$\frac{-3}{(x-2)^2}dx = dt$

$\frac{1}{3}\int t^{\frac{-3}{4}}dt$

$\frac{-1}{3}\times\frac{t^{\frac{-3}{4}+1}}{\frac{-3}{4}+1}$

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

144. $\int_a^b f''(x)dx = f'(b) - f'(a)$

145. $I_1 = \int_{1-k}^{k} x\{f(1-x)\}dx$

Use $\int_a^b f(x)dx = \int_a^b f(a+b-x)dx$

$2I_1 = I_2$

$\frac{I_1}{I_2} = \frac{1}{2}$

146. y =x-1 y=-x+1

y=-x-1 y=x+1

Required area $= 4\left[\frac{1}{2}\times 1\times 1\right]$

=2

147. $y\frac{dx}{dy} = x + 2y^2$

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

$I.F = e^{\int -\frac{1}{y}dy} = \frac{1}{y}$

Solution $x\left(\frac{1}{y}\right)=\int 2y\left(\frac{1}{y}\right)dy+c$

$\frac{x}{y}=2y+c$

$x=1, y=-1\Rightarrow c=1$

$\frac{x}{y}=2y+1$

Put $y=1\Rightarrow x=3$

148. Equation of circle $x^2+\left(y-k\right)^2=k^2$

$x^2+y^2-2ky=0$

Differentiate W.R. to x and eliminate K

149. Put $x=\tan\theta$

150. $f'(x)=-3 \quad x<1$

$=x \quad x\geq 1$

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