CONCEPT-1: BASED ON UNIT & DIMENSIONAL FORMULAE

SL NO	PROBLEM	SOLUTION
1	The SI unit of electrochemical equivalent is (a) kg C (b) C kg^{-1} (c) kg C^{-1} (d) kg^2 C^{-1}	
2	The sum of numbers 436.32, 227.2 and 0.301 in appropriate significant figures in (a) 663.821 (b) 664 (c) 663.8 (d) 663.82	
3	A sextant is used to measure (a) Area of hill (b) Height of an object (c) Breadth of a tower (d) Volume of the building	
4	You measure two quantities as A = 1.0m ± 0.2m, B = 2.0m ± 0.2m. We should report correct value for $\sqrt{AB}$ as (a) 1.4 m ± 0.4 m (b) 1.41 m ± 0.15 m (c) 1.4 m ± 0.3 m (d) 1.4 m ± 0.2 m	
5	A pressure of 10^6 dyne cm^{-2} is equivalent to (a) 10^5 Nm^{-2} (b) 10^4 Nm^{-2} (c) 10^6 Nm^{-2} (d) 10^7 Nm^{-2}	
6	Universal time is based on (a) Rotation of earth on its axis (b) Oscillations of quartz crystal (c) Vibrations of cesium atom (d) Earth's orbital motion around the sun	
7	Which of the following cannot be regarded as an essential characteristic of a unit measurement? (a) Inaccessibility (b) Indenstructibility (c) Invariability (d) Reproductibility	
8	Young modulus of steel is 1.9 x 10^{11} N/m^2. When expressed in CGS units of dyne/cm^2, it will be equal to (1 N = 10^5 dyne, 1 m^2 = $10^4$$cm^2$) (a) 1.9 x 10^{10} (b) 1.9 x 10^{11} (c) 1.9 x 10^{12} (d) 1.9 x 10^{13}	
9	Which one of the following pairs of quantities and their unit is properly matched? (a) Electric field-coulomb/m (b) Magnetic flux-Weber/m^2 (c) Power-Farad (d) Capacitance-Henry	

10	The mean length of an object is 5 cm. Which is the following measurements is most accurate? (a) 4.9 cm (b) 4.805 cm (c) 5.25 cm (d) 5.4 cm	
11	Energy per unit volume represents (a) Pressure (b) force (c) Thrust (d) work	
12	Which of the following pairs of physical quantities does not have same dimensional formula? (a) Work and torque (b) Angular momentum and Planck's constant (c) Tension and surface tension (d) Impulse and linear momentum	
13	The surface tension of mercury is 32 dyne cm^{-1}. Its value in SI units is (a) 0.032 (b) 0.32 (c) 3200 (d) 32000	
14	In the relation $y = r\sin(\omega t - kx)$, the dimensional formula of ω / R are (a) $\left[M^0L^0T^0\right]$ (b) $\left[M^0L^1T^{-1}\right]$ (c) $\left[M^0L^0T^1\right]$ (d) $\left[M^0L^1T^0\right]$	
15	One light year is defined as the distance travelled by light in one year. The speed of light 3 x 10^8 ms^{-1}. The same is metre is (a) 3 x 10^{12}m (b) 9.461 x 10^{15}m (c) 3 x 10^{15}m (d) None of these	
16	One slug is equivalent to 14.6 kg. A force of 10 pound is applied on a body of 1 kg. The acceleration of the body is (a) 44.5 ms^{-2} (b) 4.448 ms^{-2} (c) 44.4 ms^{-2} (d) None of these	
17	If the acceleration due to gravity is 10 ms^{-2} and the units of length and time are changed in kilometre and hour respectively, the numerical value of acceleration is (a) 360000 (b) 72000 (c) 36000 (d) 129600	
18	One amu is equivalent to 931 Mev energy. The rest mass of electron is 9.1 x 10^{-31} kg. The mass energy is (1 amu = 1.67 x 10^{-17} kg) (a) 0.5073 MeV (b) 0.693 Mev (c) 4.0093 MeV (d) None of these	
19	The value of universal gas constant is R = 8.3 J/k-mol. The value of R in atmosphere litre per Kelvin per mol (a) 8.12 (b) 0.00812 (c) 81.2 (d) 0.0812	

20	Electron-volt is the unit of energy (1 eV =1.6 x 10^{-19} J). In H-atom, the binding energy of electron in first orbit is 13.6 eV. The same in joule (J) is (a) 10 x 10^{-19} J (b) 21.76 x 10^{-19} J (c) 13.6 x 10^{-19} J (d) None of these	
21	The expression for centripetal force (F) depends upon mass of body (m), speed(υ) of the body and the radius (r) of circular path will be expression for centripetal force (a) $F=\frac{mv^2}{2r^3}$ (b) $F=\frac{mv^2}{r}$ (c) $F=\frac{mv^2}{r^2}$ (d) $F=\frac{m^2v^2}{2r}$	
22	The damping force of an oscillating particle is observed to be proportional to velocity. The constant of proportionality can be measured in (a) kg s^{-1} (b) kg s (c) kg ms^{-1} (d) kg m^{-1} s^{-1}	
23	The fundamental unit, which has the same power in the dimensional formulate of surface tension and viscosity is (a) Mass (b) Length (c) Time (d) None of these	
24	The mass and volume of a body are 4.237 g and 2.5cm^3 respectively. The density of material of the body in correct significant figures is. (a) 1.6048 g cm^{-3} (b) 1.69 g cm^{-3} (c) 1.7 g cm^{-3} (d) 1.695 g cm^{-3}	
25	What is the power of a 100 W bulb in CGS units? (a) 10^6 $ergs^{-1}$ (b) 10^7 $ergs^{-1}$ (c) 10^9 $ergs^{-1}$ (d) 10^{11} $ergs^{-1}$	
26	If the units of M and L are increased three times, then the unit of energy will be increased by (a) 3 times (b) 6 times (c) 27 times (d) 81 times	
27	$\int\frac{dx}{\sqrt{2ax-x^2}}=a^n\sin^{-1}\left(\frac{x}{a}-1\right)$. The value of n is (a) 0 (b) -1 (c) 1 (d) None of these	
28	SI units of intensity of wave is (a) J $m^{-2}s^{-1}$ (b) J $m^{-1}s^{-2}$ (c)W m^{-2} (d) J m^{-2}	

29	A suitable unit for gravitational constant is (a) kg-m s^{-1} (b) Nm^{-1} s (c) Nm2 kg^{-2} (d) kg ms^{-1}	
30	If L denotes the inductance of an inductor through which a current I is flowing, then the dimensional formula of L I^2 is (a) $[MLT^{-2}]$ (b) $[ML^2T^{-2}]$ (c) $[M^2L^2T^{-2}]$ (d) Not expressible in terms of M, L, T	
31	One yard in SI unit is equal (a) 1.9144 m (b) 0.9144 m (c) 0.09144 km (d) 1.0936 km	
32	The equation of alternating current is $I = I_0 e^{-t/CR}$ where t is time, C is capacitance and R is resistance of coil, then the dimensions of C R is (a) $[MLT^{-1}]$ (b) $[M^0LT]$ (c) $[M^0L^0T]$ (d) None of these	
33	Which of the following pairs has same dimensions? (a) Current density and charge density (b) Angular momentum and momentum (c) Spring constant and surface energy (d) Force and torque	
34	How many wavelengths of Kr^{86} are there in one metre? (a) 1553164.13 (b) 1650763.73 (c) 652189.63 (d) 2348123.73	
35	Taking frequency *f*, velocity *v* and density ρ to be the fundamental quantities, then the dimensional formula for momentum will be (a) $\left[\rho v^4 f^{-3}\right]$ (b) $\left[\rho v^3 f^{-1}\right]$ (c) $\left[\rho v f^2\right]$ (d) $\left[\rho^2 v^2 f^2\right]$	
36	If ρ represents radiation pressure, c represents speed of light and q represents radiation energy striking a unit area per second, then non-zero integers a, b and c are such that $p^a q^b c^c$ is dimensionless, then (a) a = 1, b = 1, c = 1 (b) a = 1, b = -1, c = 1 (c) a = -1, b = 1, c = 1 (d) a = 1, b = 1, c = 1	
37	Farad is not equivalent to (a) $\frac{q}{V}$ (b) qv^2 (c) $\frac{q^2}{J}$ (d) $\frac{J}{V^2}$ (q = coulomb, V = colt and J = joule)	

38	In the equation $y = a\sin(\omega t + kx)$, the dimensional formula of ω is (a) $\left[M^0L^0T^{-1}\right]$ (b) $\left[M^0LT^{-1}\right]$ (c) $\left[ML^0T^0\right]$ (d) $\left[M^0L^{-1}T^0\right]$	
39	A new unit of length is chosen such that the speed of light in vacuum is unity. Then the distance between the sun and the earth in terms of the new unit, if light takes 8 min and 20 s to cover this distance? (a) 300 new unit of length (b) 500 new unit of length (c) 600 new unit of length (d) None of these	
40	The dimensional formula of magnetic permeability is (a) $\left[M^0L^{-1}T\right]$ (b) $\left[M^0L^2T^{-1}\right]$ (c) $\left[M^0L^2T^{-1}A^2\right]$ (d) $\left[MLT^{-2}A^{-2}\right]$	
41	$\left[ML^{-2}T^{-2}\right]$ Represents dimensional formula of which of the following physical quantities? (a) Energy (b) Pressure (c) Torque (d) Pressure gradient	
42	The period of a body under SHM is respected by $T = p^aD^bS^c$, where p is pressure, D is density and S is surface tension. The value of a, b and c are (a) $-\frac{3}{2}, \frac{1}{2}, 1$ (b) -1, -2, 3 (c) $\frac{1}{2}, \frac{-3}{2}, \frac{-1}{2}$ (d) 1, 2, $\frac{1}{3}$	
43	The length, breadth and thickness of a rectangular sheet of metal are 4.234 m, 1.005 m and 2.01 cm respectively. The area and volume of the sheet to correct significant figures are (a) 8.72 m^2 and 0.0855 m^3 (b) 8.7 m^2 and 0.085 m^3 (c) 0.87 m^2 and 0.855 m^3 (d) 0.087 m^2 and 0.0855 m^3	
44	The dimensions of emf in MKS is (a) $\left[ML^{-1}T^{-2}Q^{-2}\right]$ (b) $\left[ML^2T^{-2}Q^{-2}\right]$ (c) $\left[MLT^{-2}Q^{-1}\right]$ (d) $\left[ML^2T^{-2}Q^{-1}\right]$	
45	The physical quantity which has the dimensional formula $\left[M^1T^{-3}\right]$ is (a) Surface tension (b) Density (b) Solar constant (d) Compressibility	

46	Force constant has same dimensions as (a) Coefficient of viscosity (b) Surface tension (c) Frequency (d) Impulse	
47	The dimensional formula of the ration of angular to linear momentum is (a) $\left[M^0LT^0\right]$ (b) [MLT] (c) $\left[ML^2T^{-1}\right]$ (d) $\left[M^{-1}L^{-1}T^{-1}\right]$	
48	The maximum static friction on a body is F = μN. Here, N = normal reaction force on the body μ = coefficient of static friction. The dimensions of μ are (a) $\left[MLT^{-2}\right]$ (b) $\left[M^0L^0T^0\theta^{-1}\right]$ (c) Dimensionless (d) None of these	
49	One mole of an ideal gas at standard temperature and pressure occupies 22.4 L (molar volume). The ratio of molar volume to the atomic volume of a mole of hydrogen? (Take the size of hydrogen molecule to be about 1 $\overset{0}{\mathrm{A}}$) (a) 9.1 x 10^4 (b) 6 x 10^4 (c) 7.1 X 10^4 (d) 8.1 x 10^5	
50	If I is the moment of inertia and ω the angular velocity, what is the dimensional formula of rotational kinetic energy (a) $\left[ML^2T^{-1}\right]$ (b) $\left[M^2L^{-1}T^{-2}\right]$ (c) $\left[ML^2T^{-2}\right]$ (d) $\left[M^2L^{-1}T^{-2}\right]$	
51	A gas bubble from an explosion under water oscillates with a time period T, depends upon static pressure p, density of water ρ and the total energy of explosion E. The expression for the time period T. (Where, k is a dimensionless constant) is (a) $T = kp^{-5/6}\rho^{1/2}E^{1/3}$ (b) $T = kp^{-4/7}\rho^{1/2}E^{1/3}$ (c) $T = kp^{-5/6}\rho^{1/2}E^{1/2}$ (d) $T = kp^{-4/7}\rho^{1/3}E^{1/2}$	
52	Solar constant is defined as energy received by earth per cm^2 per minute. The dimensions of solar constant are (a) $\left[ML^2T^{-3}\right]$ (b) $\left[M^2L^0T^{-1}\right]$ (c) $\left[ML^0T^{-3}\right]$ (d) $\left[MLT^{-2}\right]$	

53	Electric displacement is given by D = ε E, Here, ε = electric permittivity E = electric field strength The dimensions of electric displacement are (a) $\left[ML^{-2}TA\right]$ (b) $\left[L^{-2}T^{-1}A\right]$ (c) $\left[L^{-2}TA\right]$ (d) None of these	
54	The work done by a battery is W = $\varepsilon\Delta q$, where Δq charge transferred by battery, ε = emf of the battery. What are dimensions of emf of battery? (a) $\left[M^0L^0T^{-2}A^{-2}\right]$ (b) $\left[ML^2T^{-3}A^{-2}\right]$ (c) $\left[M^2L^0T^{-3}A^0\right]$ (d) $\left[ML^2T^{-3}A^{-1}\right]$	
55	In the formula, a = 3bc^2, a and c have dimensions of electric capacitance and magnetic induction respectively. What are dimensions of b in MKS system? (a) $\left[M^{-3}L^{-2}T^4Q^4\right]$ (b) $\left[M^{-3}T^4Q^4\right]$ (c) $\left[M^{-3}T^3Q\right]$ (d) $\left[M^{-3}L^2T^4Q^{-4}\right]$	
56	The dimensions of the power of lens are (a) $\left[LT^{-2}\right]$ (b) $\left[M^0L^{-1}T^0\right]$ (c) $\left[M^0L^0T^0\right]$ (d) None of these	
57	$\left[ML^2T^{-3}A^{-2}\right]$ is the dimensional formula of (a) Electric resistance (b) Capacity (c) Electric potential (d) Specific resistance	
58	The concorde is the fastest airlines used for commercial service. It can cruise at 1450 mile per hour (about two times the speed of sound or in other words mach 2). What is it in m/s? (a) 644.4 m/s (b) 80 m/s (c) 40 m/s (d) None of these	
59	Which of the following is the most precise device for measuring length? (a) A vernier callipers with 20 divisions on the sliding scale (b) A screw gauge of pitch 1 mm and 100 divisions on the circular scale (c) An optical instrument that can measure length to within a wavelength of light? (d) All are equally precise device for measuring length	

60	A student measures the thickness of a human hair by looking at it through a microscope of magnification 100. He makes 20 observations and finds that the average width of the hair in the field of view of the microscope is 3.5 mm. The thickness of hair is (a) 0.035 mm (b) 0.04 mm (c) 0.35 mm (d) 0.40 mm	
61	The photograph of a house occupies an area of 1.75 cm^2 on a 35 mm slide. The slide is projected on to a screen and the area of the house on the screen is 1.55 m^2. The linear magnification of the projector-screen arrangement, is (a) 84.1 (b) 96.1 (c) 94.1 (d) 86.1	
62	A highly rigid cubical block A of small mass M and side L is fixed rigidly on to another cubical block of same dimensions and of low modulus of rigidity η such that the lower face of A completely covers the upper face of B. The lower face of B is rigidly held on a horizontal surface. A small force F is applied perpendicular to one of the side faces of A. After the force is withdrawn, block A executes small oscillations, the time period of which is given by (a) $2\pi\sqrt{M\eta L}$ (b) $2\pi\sqrt{\frac{M\eta}{L}}$ (c) $2\pi\sqrt{\frac{ML}{\eta}}$ (d) $2\pi\sqrt{\frac{M}{\eta L}}$	
63	If C is the restoring couple per unit radian twist and I is the moment of inertia, then the dimensional representation of $2\pi\sqrt{\frac{I}{C}}$ will be (a) $\left[M^0L^0T^{-1}\right]$ (b) $\left[M^0L^0T\right]$ (c) $\left[M^0LT^{-1}\right]$ (d) $\left[ML^2T^{-2}\right]$	
64	The velocity υ of water waves may depend on their wavelength (λ), the density of water (ρ) and the acceleration due to gravity (g). The method of dimensions gives the relation between these quantities as (a) $V^2 \propto \lambda^{-1}\rho^{-1}$ (b) $V^2 \propto g\lambda$ (c) $V^2 \propto g\lambda\rho$ (d) $g^{-1} \propto \lambda^3$	
65	If E, m, J and G represent energy, mass, angular momentum and gravitational constant respectively, then the dimensional formula of EJ^2/m^5G^2 is (a) $\left[MLT^{-2}\right]$ (b) $\left[M^0L^0T\right]$ (c) $\left[M^0L^2T^0\right]$ (d) Dimensionless	

66	Crane is British unit of volume (one crane = 170.4742). convert crane into SI units. (a) 0.170474 m^3 (b) 17.0474 m^3 (c) 0.00170474 m^3 (d) 1704.74 m^3	
67	The wavelength associated with a moving particle depends upon power p of its mass m, qth power of its velocity υ and rth power of Planck's constant h. Then the correct set of values of p, q and r is (a) p = 1, q = -1, r =1 (b) p = 1, q = 1, r = 1 (c) p = -1, p = -1, r = -1 (d) p = -1, q = -1, r = 1	
68	The time taken by an electron to go from ground state to excited state is one shake (one shake = 10^{-8} s). This time in nanosecond will be (a) 10 (b) 4 (c) 2 (d) 25	

CONCEPT-2: BASED ON ERROR AND MEASUREMENT

1	If x = a-b, then the maximum percentage error in the measurement of x will be (a) $\left(\frac{\Delta a+\Delta b}{a-b}\right)$ x 100% (b) $\left(\frac{\Delta a}{a}-\frac{\Delta b}{b}\right)$ x 100% (c) $\left(\frac{\Delta a}{a-a}+\frac{\Delta b}{a-b}\right)$ x 100% (d) $\left(\frac{\Delta a}{a-a}-\frac{\Delta b}{a-b}\right)$ x 100%	
2	If X = A x B and ΔX , ΔB are maximum absolute errors in X, A and B respectively, then the maximum relative error in X is given by (a) $\Delta X=\Delta A+\Delta B$ (b) $\Delta X=\Delta A-\Delta B$ (c) $\frac{\Delta X}{X}=\frac{\Delta A}{A}-\frac{\Delta B}{B}$ (d) $\frac{\Delta X}{X}=\frac{\Delta A}{A}+\frac{\Delta B}{B}$	
3	The percentage errors in the measurement of mass and speed are 2% and 3% respectively. How much will be the maximum error in the estimate of kinetic energy obtained by measuring mass and speed? (a) 11% (b) 8% (c) 5% (d) 1%	
4	Error in the measurement of radius of sphere is 2%. The error in the measurement of volume is (a) 1% (b) 5% (c) 3% (d) 6%	
5	There are atomic clocks capable of measuring time with an accuracy of 1 part in 10^{11}. If two such clocks are operated with precision, then after running for 5000 yr, these will record (a) A difference of nearly 2s (b) A difference of 1 day	

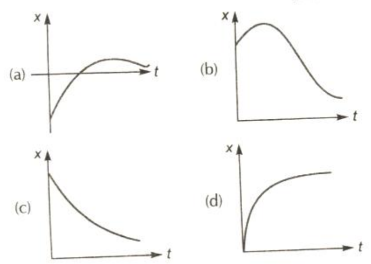
	(c) A difference of 10^{11} s (d) A difference of 1 yr	
6	If there is a positive error of 50% in the measurement of speed of a body, then the error in the measurement of kinetic energy is (a) 25% (b) 50% (c) 100% (d) 125%	
7	The radius of the sphere is (4.3 ± 0.1) cm. The percentage error in its volume is (a) $\frac{0.1}{4.3}$ x 100 (b) 3 x $\frac{0.1x100}{4.3}$ (c) $\frac{1}{3}x\frac{0.1x100}{4.3}$ (d) 3 + $\frac{0.1x100}{4.3}$	
8	A public park, in the form of a square, has an area of (100 ± 0.2) m^2. The side park is (a) (10 ± 0.01)m (b) (10 ± 0.1)m (c) (10.0 ± 0.1)m (d) (10.0 ± 0.2)m	
9	The specific resistance ρ of a circular wire f radius r, resistance R and length l is given by $\rho = \frac{\pi r^2 R}{l}$. Given r = 0:(24 ± 0.02) cm, R = (30 ± 1) Ω and l = (4.80 ± 0.01) cm. The percentage error in ρ is nearly. (a) 7% (b) 9% (c) 13% (d) 20%	
10	The initial temperature of a liquid is $(80.0 \pm 0.1)^0$ C. After it has been cooled, its temperature is $(10.0 \pm 0.1)^0$ C. The fall in temperature in degree centigrade is (a) 70.0 (b) 70.0 ± 0.3 (c) 70.0 ± 0.2 (d) 70.0 ± 0.1	
11	A physical quantity is represented by X $=M^aL^bT^{-c}$. If percentage errors in the measurements of M,L and T are α%, β% and γ % respectively, then total percentage error is (a) (αa + βb - γ c)% (b) (αa + βb + γ c)% (c) (αa - βb - γ c)% (d) 0%	
12	A physical quantity is represented by X $=M^aL^bT^{-c}$. If percentage errors in the measurements of M,L and T are α%, β% and γ % respectively, then total percentage error is (a) (αa + βb - γ c)% (b) (αa + βb + γ c)% (c) (αa - βb - γ c)% (d) 0%	
13	The internal and external diameters of a hollow cylinder are measured with the help of a vernier callipers. Their values are 4.23 ± 0.01 cm and 3.87 ± 0.01 cm respectively. The thickness of the wall of the cylinder is (a) 0.36 ± 0.02 cm (b) 0.18 ± 0.02 cm (c) 0.36 ± 0.01 cm (d) 0.18 ± 0.01 cm	
14	The density of the material of a cube is measured by measuring its mass and length of its side. If the maximum errors in the measurement of mass and the length are 3% and 2% respectively, the maximum error in the	

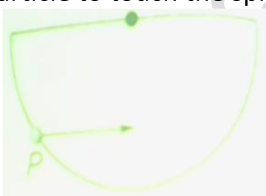
	measurement of density is (a) 1% (b) 5% (c) 7% (d) 9%	
15	When the planet Jupiter is at a distance of 824.7 million km from the earth, its angular diameter is measured to be 35.72'' of arc. The diameter of Jupiter can be calculated as (a) 1329 x 10^7 km (b) 1429 x 10^5 km (c) 929 x 10^5 km (d) 1829 x 10^5 km	
16	In an experiment, we measure quantities a, b and c. Then x is calculated from the formula, x = $\frac{ab^2}{c^3}$. The percentage errors in a, b, c are ± 1%, ±3% and ±2% respectively. The percentage error in x can be (a) ± 1% (b) ± 4% (c) 7% (d) ± 13%	
17	The time dependence of a physical quantity P is given by p = p_0e^{-at2}, where α is a constant and t is time. Then constant α is (a) Dimensionless (b) Dimension of t^{-2} (c) Dimensions of p (d) Dimension of t^2	
18	The least count of a stop watch is 0.2 s. The time of 20 oscillations of a pendulum is measured to be 25 s. The percentage error in the measurement of time will be (a) 8% (b) 1.8% (c) 0.8% (d) 0.1%	
19	The pressure on a square plate is measured by measuring the force on the plate and the length of the sides of the plate by using the formula p = $\frac{F}{l^2}$. If the maximum errors in the measurement of force and length are 4% and 2% respectively, then the maximum error in the measurement of pressure is (a) 1% (b) 2% (c) 8% (d) 10%	
20	Given, potential difference V = (8 ± 0.5) V and current I = (2 ± 0.2)A. The value of resistance R is (a) 4 ± 16.25% (b) 4 ± 6.25% (c) 4 ± 10% (d) 4 ± 8%	
21	The length, breadth and thickness of a block is measured to be 50 cm, 2.0 cm and 1.00 cm. The percentage error in the measurement of volume is (a) 0.8% (b) 8% (c) 10% (d) 12.5%	
22	Given π = 3.14. the value of π^2 with due regard for significant figures is (a) 9.86 (b) 9.859 (c) 9.8596 (d) 9.85960	
23	One side of a cubical block is measured with the help of a vernier callipers of vernier constant 0.01 cm. This side comes out to be 1.23 cm. What is the percentage error in the measurement of area? (a) $\frac{1.23}{0.01}$ x 100 (b) $\frac{0.01}{1.23}$ x 100 (c) 2 x $\frac{0.01}{1.23}$ x 100 (d) 3 x $\frac{0.01}{1.23}$ x 100	

24	A physical quantity P is related to four observables a, b, c and d are as follows $P = a^3b^2/\sqrt{cd}$. The percentage errors of measurement in a, b, c and d are 1%, 3%, 4% and 2% respectively. What is the percentage error in the quantity P, if the value of P calculated using the above relation turns out to be 3.763, to what value should you round-off the result? (a) 13% and 3.8 (b) 1.3% and 0.38 (c) 1.3% and 3.8 (d) 3.8% and 13	
25	Length is measured in metre and time in second as usual. But a new unit of mass is so chosen that G = 1. This new unit of mass is equal to (a) 1.5×10^7 kg (b) 1.5×10^{10} kg (c) 6.67×10^{-11} kg (d) 6.67×10^{-8} kg	
26	The length, breadth and thickness of a metal block is given by l = 90 cm, b = 8 cm, t = 2.45 cm. The volume of the block is (a) 2×10^2 cm^3 (b) 1.8×10^2 cm^3 (c) 1.77×10^2 cm^3 (d) 1.764×10^2 cm^2	
27	The focal length of a mirror is given by $\frac{1}{f} = \frac{1}{u} + \frac{1}{\upsilon}$ where u and υ represent object and image distances respectively. The maximum relative error in f is (a) $\frac{\Delta f}{f} = \frac{\Delta u}{u} + \frac{\Delta v}{v}$ (b) $\frac{\Delta f}{f} = \frac{1}{\Delta u/u} + \frac{1}{\Delta v/v}$ (c) $\frac{\Delta f}{f} = \frac{\Delta u}{u} + \frac{\Delta v}{v} + \frac{\Delta(u+v)}{u+v}$ (d) $\frac{\Delta f}{f} = \frac{\Delta u}{u} + \frac{\Delta v}{v} + \frac{\Delta u}{u+v} + \frac{\Delta v}{u+v}$	
28	The measured mass and volume of a body are 23.42 g and 4.9 cm^3 respectively with possible error 0.01 g and 0.1 cm^3. The maximum error in density is nearly (a) 0.2% (b) 2% (c) 5% (d) 10%	
29	The velocity of transverse wave in a string is $\upsilon = \sqrt{\frac{T}{M}}$ where T is the tension in the string and M is mass per unit length. If T = 3.0 kgf, mass of string is 2.5 g and length of string is 1.00m, then the percentage error in the measurement of velocity is (a) 0.5 (b) 0.7 (c) 2.3 (d) 3.6	

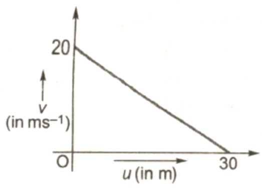
30	The unit of length convenient on the atomic scale is known as an angstrom and is denoted by $\overset{0}{\mathrm{A}}$. 1 $\overset{0}{\mathrm{A}}$ = 10^{-10}m. The size of the hydrogen atom is about 0.5 $\overset{0}{\mathrm{A}}$. The total atomic volume in m^3 of a mole of hydrogen atoms would be (a) 3.15×10^{-7} m^3 (b) 3.0×10^{-8} m^3 (c) 3.85×10^{-7} m^3 (d) 2.85×10^{-7} m^3	
31	The relative density of the material of a body is the ratio of its weight in air and the loss of its weight in water. By using a spring balance, the weight of the body in air is measured to be 5.00 ± 0.05 N. The weight of the body in water is measured to be 4.00 ± 0.05 N. Then, the maximum possible percentage error in relative density is (a) 11% (b) 10% (c) 9% (d) 7%	
32	The length l, breadth b and thickness t of a block are measured with the help of a metre scale. Given l = 15.12 ± 0.01 cm, b = 10.15 ± 0.01 cm, t = 5.28 ± 0.01 cm. The percentage error in volume is (a) 0.64 % (b) 0.28% (c) 0.37% (d) 0.48%	

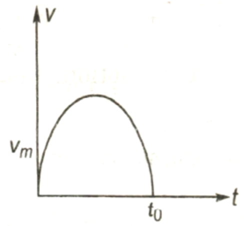
CONCEPT-3: BASED ON SPEED, VELOCITY AND ACCELERATION

1	A wheel of radius 1 m rolls forward half a revolution on a horizontal ground. The magnitude of the displacement of the point of the wheel initially in contact with the ground is (a) 2π (b) $\sqrt{2\pi}$ (c) $\sqrt{\pi^2+4}$ (d) π	
2	A point particle starting from rest has a velocity that increases linearly with time such that υ = pt, where p = 4 ms^{-2}. The distance covered in the first 2 s will be (a) 6 m (b) 4 m (c) 8 m (d) 10 m	
3	Among the four graphs, there is only one graph for which average velocity over the time interval (0, T) can vanish for a suitably chosen T. Which one is it? 	
4	A particle moves with constant acceleration and υ_1, υ_2 and υ_3 denote the average velocities in the three successive intervals t_1, t_2 and t_3 of time. Which of the following	

	relations is correct? (a) $\frac{v_1-v_2}{v_2-v_3}=\frac{t_1-t_2}{t_2-t_3}$ (b) $\frac{v_1-v_2}{v_2-v_3}=\frac{t_1-t_2}{t_1-t_2}$ (c) $\frac{v_1-v_2}{v_2-v_3}=\frac{t_1-t_2}{t_2-t_3}$ (d) $\frac{v_1-v_2}{v_2-v_3}=\frac{t_1+t_2}{t_2+t_3}$	
5	The displacement of a body along x-axis depends on time as $\sqrt{x}$ = t + 1. Then, the velocity of body (a) Increase with time (b) Decrease with time (c) Independent of time (d) None of these	
6	A car moving along a straight highway with speed of 126 km/h is brought to a stop within a distance of 200 m. What is the retardation of the car (assumed uniform) and how long does it take for the car to stop? (a) 3.06 m/s^2 and 11.4 s (b) 2.06 m/s^2 and 11.4 s (c) 3.06 m/s^2 and 10.4 s (d) 3.06 m/s^2 and 4.1 s	
7	A particle of mass m is initially situated at the point P inside a hemispherical surface of radius r as shown in figure. A horizontal acceleration of magnitude α_0 is suddenly produced on the particle in the horizontal direction. If gravitational acceleration is neglected, the time taken by particle to touch the sphere again is  (a) $\sqrt{\frac{4r\sin\alpha}{a_0}}$ (b) $\sqrt{\frac{4r\tan\alpha}{a_0}}$ (c) $\sqrt{\frac{4r\cos\alpha}{a_0}}$ (d) None of these	
8	A body starts from rest and moves with a constant acceleration. The ratio of distance covered in the nth second to the distance covered in n second is (a) $\frac{2}{n}-\frac{1}{n^2}$ (b) $\frac{1}{n^2}-\frac{1}{n}$ (c) $\frac{2}{n^2}-\frac{1}{n}$ (d) $\frac{2}{n}-\frac{1}{n^2}$	

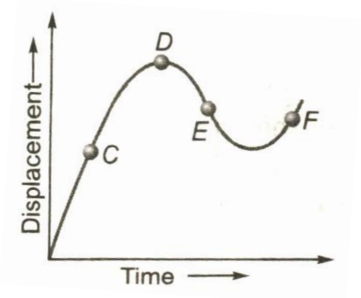
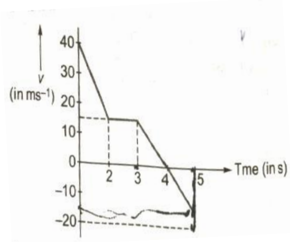
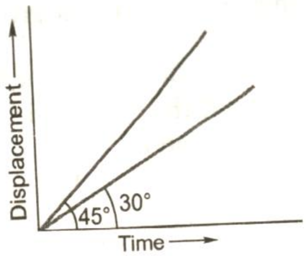
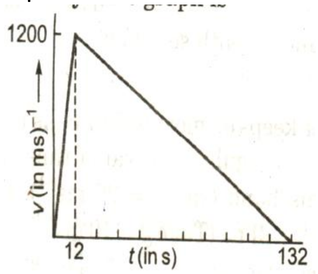
9	A particle moving with a uniform acceleration along a straight line covers distance a and b in successive intervals of p and q second. The acceleration of the particle is (a) $\frac{pq(p+q)}{2(bp-aq)}$ (b) $\frac{2(aq-bp)}{pq(p-q)}$ (c) $\frac{bp-aq}{pq(p-q)}$ (d) $\frac{2(bp-aq)}{pq(p-q)}$	
10	A bee flies a line from a point A to another point B in 4 s with a velocity of $\|t-2\|$ ms^{-1}. The distance between A and B in metre is (a) 2 (b) 4 (c) 6 (d) 8	
11	A 2 m wide truck is moving with a uniform speed υ_0 = 8 ms^{-1} along a straight horizontal road. A pedestrian starts to cross the road with a uniform speed υ when the truck is 4 m away from him. The minimum value of υ, so that he can cross the road safely is (a) 2.62 ms^{-1} (b) 4.6 ms^{-1} (c) 3.57 ms^{-1} (d) 1.414 ms^{-1}	
12	A bus moves over a straight level road with a constant acceleration α. A body in the bus drops a ball outside. The acceleration of the ball with respect to the bus and the earth are respectively. (a) a and g (b) a + g and g – a (c) $\sqrt{a^2+g^2}$ and g (d) $\sqrt{a^2+g^2}$ and a	
13	A car is moving along a straight road with uniform acceleration. It passes through two points P and Q separated by a distance with velocities 30 kmh^{-1} and 40 kmh^{-1} respectively. The velocity of car midway between P and Q is (a) 33.3 km^{-1} (b) 1 km^{-1} (c) $25\sqrt{2}$ km^{-1} (d) 35.35 km^{-1}	
14	A particle starts from the origin and moves along the X-axis such that the velocity at any instant is given by $4t^3 - 2t$, where t is in second and velocity is in ms^{-1}. What is the acceleration of the particle when it is 2 m from the origin? (a) 10 ms^{-2} (b) 12 ms^{-2} (c) 22 ms^{-2} (d) 28 ms^{-2}	

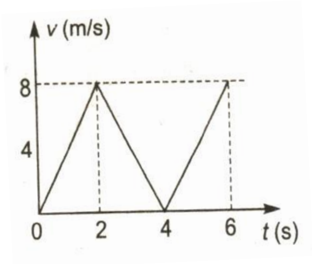
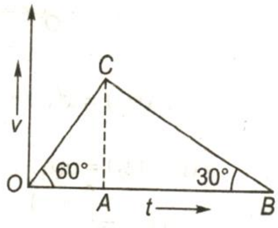
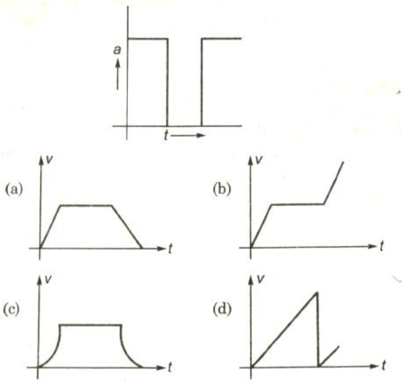
15	The retardation experienced by a moving motor boat, after its engine is cut-off, is given by $\frac{d\upsilon}{dt} = -k\upsilon^3$, where k is a constant. If υ_0 is the magnitude of the velocity at cut –off, the magnitude of the velocity at time t after the cut-off is (a) v_0 (b) $\frac{v_0}{2}$ (c) $v_0 e^{-kt}$ (d) $\frac{v_0}{\sqrt{2v^2{}_0 kt + 1}}$	
16	The driver of a car moving with a speed of 10 ms^{-1} sees a red light ahead, applies brakes and stops after covering 10 m distance. If the same car were moving with a speed of 20 ms^{-1}, the same driver would have stopped the car after covering 30 m distance. Within what distance the car can be stopped if travelling with a velocity of 15 ms^{-1}? Assume the same reaction time and the same deceleration in each case. (a) 18.75 m (b) 20.75 m (c) 22.75 m (d) 25 m	
17	A lift is coming from 8th floor and is just about to reach 4th floor. Taking ground floor as origin and positive direction upwards for all quantities, which one of the following is correct? (a) $x < 0, v < 0, a > 0$ (b) $x > 0, v < 0, a < 0$ (c) $x > 0, v < 0, a > 0$ (d) $x > 0, v > 0, a < 0$	
18	A target is made of two plates, one of wood and the other of iron. The thickness of the wooden plate is 4 cm and that of iron plate is 2 cm. A bullet fired goes through the wood first and then penetrates 1 cm into iron. A similar bullet fired with the same velocity from opposite direction goes through iron first and then penetrates 2 cm into wood. If α_1 and α_2 be the retardation offered to the bullet by wood and iron plates respectively, then (a) $t_1 + t_2$ (b) $a_2 = 2\ a_1$ (c) $a_1 = a_2$ (d) Data insufficient	
19	If the velocity υ of a particle moving along a straight line decreases linearly with its displacement s from 20 ms^{-1} to a value approaching zero at s = 30 m, then acceleration of the particle at s = 15 m is 	

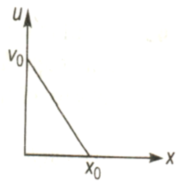
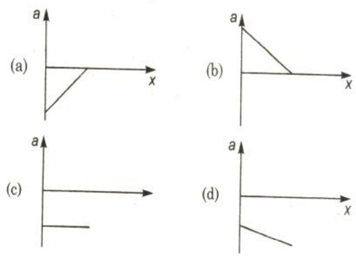
	(a) $\frac{2}{3}$ ms^{-2} (b) - $\frac{2}{3}$ ms^{-2} (c) $\frac{20}{3}$ ms^{-2} (d)- $\frac{20}{3}$ ms^{-2}	
20	The velocity of a particle moving in a straight line varies with time in such a manner that υ versus t graph is velocity is υ_m and the total time of motion is t_0  (i) Average velocity of the particle is $\frac{\pi}{4}\upsilon_m$ (ii) Such motion cannot be realized in practical terms (a) Only (i) is correct (b) Only (ii) is correct (c) Both (i) and (ii) are correct (d) Both (i) and (ii) are wrong	
21	A police van moving on a highway with a speed of 30 km/h fires a bullet at a thief's car speeding away in the same direction with a speed of 192 km/h. If the muzzle speed of the bullet is 150 m/s, with what speed does the bullet hit the thief's car? (Note Obtain that speed which is relevant for damaging the thief's car. (a) 105 m/s (b) 100 m/s (c) 95 m/s (d) 110 m/s	
22	A particle starts from rest and travels a distance s with uniform acceleration, then it travels a distance 2s with uniform speed, finally it travels a distance 3s with uniform retardation and comes to rest. If the complete motion of the particle in a straight line then the ratio of its average velocity to maximum velocity in (a) 6/7 (b) 4/5 (c) 3/5 (d) 2/5	
23	A particle moving in a straight line with uniform acceleration is observed to be a distance α from a fixed point initially. It is at distances b, c, d from the same point after n, 2n, 3n second. The acceleration of the particle is (a) $\frac{c-2b+a}{n^2}$ (b) $\frac{c+b+a}{9n^2}$ (c) $\frac{c+2b+a}{4n^2}$ (d) $\frac{c-b+a}{n^2}$	

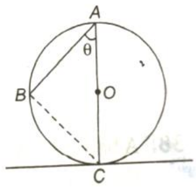
24	A body is moving along a straight line path with constant velocity. At an instant of time the distance travelled by it is s and its displacement is D, then (a) D < s (b) D > s (c) D = s (d) D ≤ s	
25	Three particles start from the origin at the same time, one with a velocity υ_1 along x-axis, the second along the y-axis with a velocity υ_2 and the third along x = y line. The velocity of the third so that the three may always lie on the same line is (a) $\frac{v_1 v_2}{v_1 + v_2}$ (b) $\frac{\sqrt{2v_1 v_2}}{v_1 + v_2}$ (c) $\frac{\sqrt{3v_1 v_2}}{v_1 + v_2}$ (d) zero	
26	In one dimensional motion, instantaneous speed υ satisfies $0 \le \upsilon < \upsilon_0$. (a) The displacement in time T must always take non-negative values (b) The displacement x in time T satisfies $-v_0T < x < v_0T$ (c) The acceleration is always a non-negative number (d) The motion has no turning points	
27	The engine of a train can impart a maximum acceleration of 1 ms^{-2} and the brakes can give a maximum retardation of 3 ms^{-2}. The least time during which a train can go from one place to the other place at a distance of 1.2 km is nearly (a) 108 s (b) 191 s (c) 56.6 s (d) Time is fixed	
28	The acceleration of a particle increasing linearly with time t is bt. The particle starts from the origin with an initial velocity υ_0. The distance travelled by the particle in time t will be (a) $v_0 t + \frac{1}{6}bt^3$ (b) $v_0 t + \frac{1}{6}bt^2$ (c) $v_0 t + \frac{1}{3}bt^3$ (d) $v_0 t + \frac{1}{3}bt^2$	

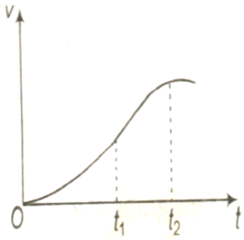
CONCEPT-4: BASED ON GRAPHICAL REPRESENTATION

1	The displacement-time graph of a moving particle is shown below. The instantaneous velocity of the particle is negative at the point  (a) C (b) D (c) E (d) F	
2	1. In the given $\upsilon - t$ graph, the distance travelled by the body in 5 s will be  (a) 20 m (b) 40 m (c) 80 m (d) 100 m	
3	The displacement-time graphs of two moving particles make angles of 30^0 and 45^0 with the x-axis. The ratio of the two velocities is  (a) $\sqrt{3}:1$ (b) 1 : 1 (c) 1: 2 (d) $1:\sqrt{3}$	
4	A rocket is fired upwards. Its engine explodes fully is 12 s. The height reached by the rocket as calculated from its velocity-time graph is  (a) 1200 x 66 m (b) 1200 x 132 m	

	(c) $\frac{1200}{12}$ m (d) 1200 x 12^2 m	
5	$\upsilon - t$ graph for a particle is as shown. the distance travelled in the first 4 s is  (a) 12 m (b) 16 m (c) 20 m (d) 24 m	
6	The velocity-time graph of a body is shown in figure. The ratio of the .....during the intervals OA and AB is....  (a) Average velocities: 2 (b) $\frac{OA}{AB}$: $\frac{1}{3}$ (c) Average accelerations, same as distances covered (d) Distances covered : $\frac{1}{2}$	
7	Figure shows the acceleration-time graph of a particle. Which of the following represents the corresponding velocity-time graphs? 	

8	The given graph shows the variation of velocity with displacement. Which one of the graph given below correctly represents the variation of acceleration with displacement?   	
9	A ball A is thrown up vertically with a speed υ and at the same instant another ball B is released from a height h. At time t, the speed of A relative to B is (a)u (b) 2u (c) u – gt (d) $\sqrt{\left(u^2 - gt\right)}$	
10	A body falls freely from rest. It covers as much distance in the last second of its motion as covered in the first three seconds. The body has fallen for a time of (a) 3 s (b) 5 s (c) 7 s (d) 9 s	
11	Rain is falling vertically with a speed of 30 m/s. A woman rides a bicycle with a speed of 10 m/s in the north to south direction. What is the direction in which she should hold her umbrella? (a) 18^0 with vertical (b) 18^0 with horizontal (c) 28^0 with vertical (d) 28^0 with horizontal	
12	A ball P is dropped vertically and another ball Q is thrown horizontally with the same velocities from the same height and at the same time. If air resistance is neglected, then (a) Ball P reaches the ground first (b) Ball Q reaches the ground first (c) Both reach the ground at the same time (d) The respective masses of the two balls will decide the time	
13	A particle moves along x-axis as X = 4(t - 2) + α (t – 2)^2 Which of the following is true? (a) The initial velocity of particle is 4 (b) The acceleration of particle is 2 a (c) The particle is at origin at t = 0 (d) None of the above	

14	A ball is thrown vertically upwards. It was observed at a height h twice with a time a interval Δt the initial velocity of the ball is (a) $\sqrt{8gh+g^2(\Delta t)^2}$ (b) $\sqrt{8gh+\left(\frac{g\Delta t}{2}\right)^2}$ (c) $1/2\sqrt{8gh+g^2(\Delta t)^2}$ (d) $\sqrt{8gh+4g^2(\Delta t)^2}$	
15	A frictionless wire AB is fixed on a sphere of radius R. A very small spherical ball slips on this wire the time taken by this ball to slip from A to B is  (a) $\frac{2\sqrt{gR}}{g\cos\theta}$ (b) $2\sqrt{gR}\frac{\cos\theta}{g}$ (c) $2\sqrt{\frac{R}{g}}$ (d) $\frac{gR}{\sqrt{g\cos\theta}}$	
16	A jet airplane travelling at a speed of 500 km/h ejects its products of combustion at the speed of 1500 km/h relative to the jet plane. What is the speed of the latter with respect to an observer on the ground? (a) – 1000 km/h (b) 1000 km/h (c) 100 km/h (d) – 100 km/h	
17	A body is thrown vertically up with a velocity u. It passes three points A, B and C in its upward journey with velocities $\frac{u}{2},\frac{u}{3}$ and $\frac{u}{4}$ respectively. The ratio of the separations between points A and B and between B and C, i.e., $\frac{AB}{BC}$ is (a) 1 (b) 2 (c) $\frac{10}{7}$ (d) $\frac{20}{7}$	
18	A boy released a ball from the top of a building. It will clear a window 2 m high at a distance 10m below the top is nearly (a) 1 s (b) 1.3 s (c) 0.6 s (d) 0.13 s	

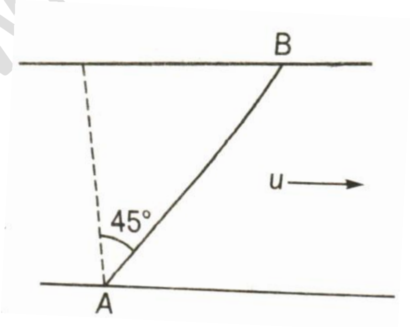
19	A stone is allowed to fall from the top of a tower 100 m high and at the same time another stone is projected vertically upwards from the ground with a velocity of 254 ms^{-1}. The two stones will meet after (a) 4 s (b) 0.4 s (c) 0.04 s (d) 40 s	
20	From a balloon rising vertically upwards at 5 m/s a stone is thrown up at 10 m/s relative to the balloon. Its velocity with respect to ground after 2 s is (assume g = 10 m/s^2) (a) 0 (b) 20 m/s (c) 10 m/s (d) 5 m/s	
21	A body thrown vertically upward with an initial velocity u reaches maximum height in 6 second. The ratio of the distances travelled by the body in the first second and distances second is (a) 1 : 1 (b) 11 : 1 (c) 1 : 2 (d) 1 : 11	
22	A juggler keeps on moving four balls in the air throws the balls in regular interval of time. When one ball leaves his hand (speed =20 ms^{-1}), the position of other ball will be (Take g = 10 ms^{-2}) (a) 10 m, 20 m, 10 m (b) 15 m, 20 m, 15 m (c) 5 m, 15 m, 20 m (d) 5 m, 10 m, 20 m	
23	The velocity-time graph of a particle in one-dimensional motion is shown in figure. Which of the following formulae are correct for describing the motion of the particle over the time interval t_1 to t_2.  (i) $x(t_2)=x(t_1)+\upsilon(t_1)(t_2-t_1)+\frac{1}{2}a(t_2-t_1)^2$ (ii) $x(t_2)=\upsilon(t_1)+a(t_2-t_1)$ (iii) $\upsilon_{av}=\left[\frac{x(t_2)-x(t_1)}{(t_2-t_1)}\right]$ (iv) $\upsilon_{av}=\frac{[\upsilon(t_2)-\upsilon(t_1)]}{(t_2-t_1)}$ (v) $x(t_2)=x(t_1)+\upsilon_{av}(t_2-t_1)+\frac{1}{2}a_{av}(t_2-t_1)^2$ (vi) $x(t_2)-x(t_1)=$ Area under $\upsilon-t$ curve bounded by the t-axis and the dotted line shown (a) (iii) and (vi) (b) (iii), (iv) and (vi) (c) (ii), (iii) and (iv) (d) (iv) and (vi)	

24	Water drops fall from a tap on the floor 5 m below at regular intervals of time, the first drop striking the floor when the fifth drop begins to fall. The height at which the third drop will be, from ground, at the instant when first drop strikes the ground, will be ($g = 10\ ms^{-2}$) (a) 1.25 m (b) 2.15 m (c) 2.73 m (d) 3.75 m	
25	From an elevated point A, a stone is projected vertically upwards. When the stone reaches a distance h below A, its velocity is double of what was at a height above A? The greatest height attained by the stone is (a) $\frac{h}{3}$ (b) $\frac{2h}{2}$ (c) $\frac{h}{2}$ (d) $\frac{5h}{3}$	
26	A ball is thrown vertically upwards from the top of a tower of height h with velocity υ. The ball strikes the ground after (a) $\frac{v}{g}\left[1+\sqrt{1+\frac{2gh}{v^2}}\right]$ (b) $\frac{v}{g}\left[1+\sqrt{1-\frac{2gh}{v^2}}\right]$ (c) $\frac{v}{g}\left(1+\frac{2gh}{v^2}\right)^{1/2}$ (d) $\frac{v}{g}\left(1-\frac{2gh}{v^2}\right)^{1/2}$	
27	A body freely falling from rest has a velocity υ after it falls through distance h. The distance it has to fall down further for its velocity to become double is (a) h (b) 2 h (c) 3 h (d) 4 h	
28	Two balls A and B are thrown simultaneously from the top of a tower. A is thrown vertically up with a speed of 4 ms^{-1}. B is thrown vertically down with a speed of 4 ms^{-1}. The ball A and B hit the ground with speed υ_A and υ_B respectively. Then, (a) $v_A < v_B$ (b) $v_A > v_B$ (c) $v_A \geq v_B$ (d) $v_A = v_B$	
29	A particle starting from rest falls from a certain height. Assuming that the value of acceleration due to gravity remains the same throughout motion, its displacements in three successive half second intervals are S_1, S_2, S_3. Then, (a) $S_1 : S_2 : S_3 = 1 : 5 : 9$ (b) $S_1 : S_2 : S_3 = 1 : 2 : 3$ (c) $S_1 : S_2 : S_3 = 1 : 1 : 1$ (d) $S_1 : S_2 : S_3 = 1 : 3 : 5$	

30	A ball thrown upward from the top of a tower with speed υ reaches the ground in t_1 second. If this ball is thrown downward from the top of the same tower with speed υ it reaches the ground in t_2 second. In what time the ball shall reach the ground if it is allowed to falls freely under gravity from the top of the tower? (a) $\frac{t_1+t_2}{2}$ (b) $\frac{t_1-t_2}{2}$ (c) $\sqrt{t_1t_2}$ (d) $t_1 + t_2$	
31	A ball is dropped on the floor from a height of 10 m. It rebounds to a height of 2.5 m. If the ball is in contact with the floor for 0.01 s, the average acceleration during contact is nearly (Take g = 10 ms^{-2}) (a) 500 $\sqrt{2}$ ms^{-2} upwards (b) 1800 ms^{-2} downwards (c) 1500 $\sqrt{5}$ ms^{-2} upwards (d) 1500 $\sqrt{2}$ ms^{-2} downwards	
32	A stone thrown vertically upwards attains a maximum height of 45 m. In what time the velocity of stone become equal to one-half the velocity of throw? (Given g = 10 ms^{-2}) (a) 2 s (b) 1.5 s (c) 1 s (d) 0.5 s	
33	A body released from a great height falls freely towards the earth. Another body is released from the same height exactly one second later. The separation between the two bodies two second after the release of the second body is (a) 9.8 m (b) 4.9 m (c) 24.5 m (d) 19.6 m	
34	particle covers 4 m, 5 m, 6 m and 7 m in 3^{rd}, 4^{th}, 5^{th} and 6^{th} second respectively. The particle starts (a) With an initial non-zero velocity and moves with uniform acceleration (b) From rest and moves with uniform velocity (c) With an initial velocity and moves with uniform velocity (d) From rest and moves with uniform acceleration	
35	A balls is released from the top of a tower travels $\frac{11}{36}$ of the height of the tower in the last second of its journey. The height of the tower is (Take g = 10 ms^{-2}) (a) 11 m (b) 36 m (c) 47 m (d) 180 m	

CONCEPT-5: BASED ON RELATIVE MOTION

1	At a metro station, a girl walks up a stationary escalator in time t_1. If she remains stationary on the escalator, then the escalator take her up in time t_2. The time taken by her to walk up on the moving escalator will be (a) $(t_1 + t_2)/2$ (b) $t_1t_2/(t_2 - t_1)$	

	(c) $t_1t_2/(t_2 + t_1)$ (d) $t_1 - t_2$	
2	A 120 m long train is moving in a direction with speed 20 m/s. A train B moving with 30 m/s in the opposite direction and 130 m long crosses the first train in a time. (a) 6 s (b) 36 s (c) 38 s (d) None of these	
3	For a body moving with relative speed of the velocity is doubled, then (a) Its linear momentum is doubled (b) Its linear momentum will be less than doubled (c) Its linear momentum will be more than doubled (d) Its linear momentum remains unchanged	
4	An express train is moving with a velocity υ_1 its driver finds another train is moving on the same track in the same direction with velocity υ_2. To avoid collision driver applies a retardation a on the train. The minimum time of avoiding collision will be (a) t = $\frac{v_1 - v_2}{a}$ (b) $\frac{v_1^2 - v_2^2}{2}$ (c) None (d) Bothe (a) and (b)	
5	Rain drops fall vertically at a speed of 20 ms^{-1}. At what angle do they fall on the wind screen of a car moving with a velocity of 15 ms^{-1}, if the wind screen velocity inclined at an angle of 23^0 to the vertical? $\left[\cot^{-1}\left(\frac{4}{3}\right) \approx 36^0\right]$ (a) 60^0 (b) 30^0 (c) 45^0 (d) 90^0	
6	A man wants to reach point B on the opposite bank of a river flowing at a speed as shown in figure. What minimum speed relative to water should the man have so that he can reach point B?  (a) $u\sqrt{2}$ (b) $u/\sqrt{2}$ (c) 2u (d) u / 2	

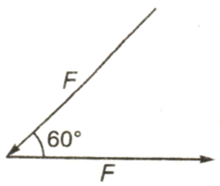
7	A steam boat goes across a lake and comes back (i) on a quiet day when the water is still and (ii) on a rough day when there is a uniform current so as to help the journey onwards and to impede the journey back. If the speed of the launch on both days was same, the time required for complete journey on the rough day, as compared to the quiet day will be (a) More (b) Less (c) Same (d) None of these	
8	Two trains travelling on the same track are approaching each other with equal speeds of 40 ms^{-1}. The drivers of the trains begin to decelerate simultaneously when they are just 2 km apart. If the decelerations are both uniform and equal, then the value of deceleration to barely avoid collision should be (a) 0.8 ms^{-2} (b) 2.1 ms^{-2} (c) 11.0 ms^{-2} (d) 13.2 ms^{-2}	
9	A 210 m long train is moving due North at a speed of 25 m/s. A small bird is flying due South, a little above the train with speed 5 m/s. The time taken by the bird to cross the train is (a) 6 s (b) 7 s (c) 9 s (d) 10 s	
10	A police jeep is chasing with velocity of 45 km/h a thief in another jeep moving with velocity 153 km/h. Police fires a bullet with muzzle velocity of 180 m/s. The velocity with which is will strike of the car of the thief is (a) 150 m/s (b) 27 m/s (c) 450 m/s (d) 250 m/s	
11	A boat is sent across a river with a velocity of 8 km/h. If the resultant velocity of boat is 10 km/h, then velocity of river is (a) 10 km/h (b) 8 km/h (c) 6 km/h (d) 4 km/h	
12	The distance between two particles moving towards each other is decreasing at the rate of 6 m/s. If these particles travel with same speed and in the same direction then the separation increase at the rate of 4 m/s. The particles have speed as (a) 5 m/s 1 m/s (b) 4 m/s; 1 m/s (c) 4 m/s; 2 m/s (d) 5 m/s; 2 m/s	
13	A train is moving towards east and a car is along north, both with same speed. The observed direction of a car to the passenger in the train is (a) East-north direction (b) West-north direction (c) South-east direction (d) None of the above	

14	A boat crosses a river from part A to part B which are just on opposite side. The speed of the water is υ_w and that of boat is υ_b relative to still water. Assume $\upsilon_b = 2\upsilon_w$. What is the time taken by the boat? If it has to cross the river directly on the AB line. (a) $\frac{2D}{v_b\sqrt{3}}$ (b) $\frac{\sqrt{3}D}{2v_b}$ (c) $\frac{D}{v_b\sqrt{2}}$ (d) $\frac{D\sqrt{2}}{v_b}$	
15	Two cars A and B are moving with same speed of 45 km/h along same direction. If a third car C coming from the opposite direction with a speed of 36 km/h meets two cars in an interval of 5 minutes. The distance between cars A and B should be (in km) (a) 6.75 (b) 7.25 (c) 5.55 (d) 8.35	
16	Two trains A and B of length 400 m each are moving on two parallel tracks with a uniform speed of 72 km/h in the same direction, with A ahead of B. The driver of B decides to overtake A and accelerates by 1 m/s^2. If after 50 s, the guard of B just brushes past the driver of A, what was the original distance between them? (a) 1250 m (b) 1350 m (c) 1450 m (d) None of these	
17	On a two lane road, car A is travelling with a speed of 36 km/h. Two cars B and C approach car A in opposite directions with a speed of 54km/h each. At a certain instant, when the distance AB is equal to AC, both being 1 km, B decides to overtake A before C does. In this case, the acceleration of car B is required to avoid an accident (a) 1m/s^2 (b) 0.1m/s^2 (c) 1.9m/s^2 (d) 0.2m/s^2	
18	A passenger arriving in a new town wishes to go from the station to a hotel located 10 km away on a straight road from the station. A dishonest cabman takes him along a circuitoius path 23 km long and reaches the hotel in 28 min. What are the average speed of the taxi and the magnitude of average velocity respectively (in km/h)? (a) 49.3 and 21.43 (b) 48.3 and 24.43 (c) 21 and 20 (d) 21.3 and 49.3	
19	A man can swim with a speed of 4 km/h in still water. How	

	long does he take to cross a river 1 km wide, if the river flows steadily 3 km/h and he makes his strokes normal to the river current. How far down the river does he go when he reaches the other bank? (a) 850 m (b) 750 m (c) 650 m (d) None of these	

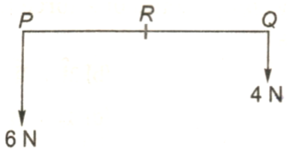
CONCEPT-6: BASED ON ADDITION OF VECTORS

1	Two forces, each equal to $\frac{P}{2}$ act at right angles. Their effect may be neutralised by a third force acting along their bisector in the opposite direction with a magnitude of (a) P (b) $\frac{P}{2}$ (c) $\frac{P}{\sqrt{2}}$ (d) $\sqrt{2}P$	
2	What is the numerical value of the vector $3\hat{i}+4\hat{j}+4\hat{k}$? (a) $3\sqrt{2}$ (b) $5\sqrt{2}$ (c) $7\sqrt{2}$ (d) $9\sqrt{2}$	
3	A = $3\hat{i}-\hat{j}+7\hat{k}$ and B = $5\hat{i}-\hat{j}+9\hat{k}$. The direction cosine, m of the vector A + B is (a) zero (b) $\frac{3}{\sqrt{31}}$ (c) $\frac{8}{\sqrt{336}}$ (d) 5	
4	Given A = $\hat{i}+2\hat{j}-3\hat{k}$. When a vector B is added to A, we get a unit vector along X-axis. Then, B is (a) $-2\hat{j}+3\hat{k}$ (b) $-\hat{i}-2\hat{j}$ (c) $-\hat{i}+3\hat{k}$ (d) $2\hat{j}-3\hat{k}$	
5	Two forces F_1 and F_2 are acting at right angles to each other. Then their resultant is (a) $F_1 + F_2$ (b) $\sqrt{F_1^2+F_2^2}$ (c) $\sqrt{F_1^2-F_2^2}$ (d) $\frac{F_1+F_2}{2}$	
6	The x and y components of a force are 2 N and -3N. The force is (a) $2\hat{i}-3\hat{j}$ (b) $2\hat{i}+3\hat{j}$ (c) $-2\hat{i}-3\hat{j}$ (d) $3\hat{i}+2\hat{j}$	

7	Given R = A + B and R = A = B. The angle between A and B is (a) 60^0 (b) 90^0 (c) 120^0 (d) 180^0	
8	The magnitude of the X and Y components of A are 7 and 6. Also the magnitudes of X and Y components of A + B are 11 and 9 respectively. What is the magnitude of B? (a) 5 (b) 6 (c) 8 (d) 9	
9	One of the rectangular components of a velocity of 60 kmh^{-1} is 30 kmh^{-1}. The other rectangular component is (a) 30 kmh^{-1} (b) $30\sqrt{3}$ kmh^{-1} (c) $30\sqrt{2}$ kmh^{-1} (d) Zero	
10	The angle between the z-axis and the vector $\hat{i}+\hat{j}+\sqrt{2}\hat{k}$ is (a) 30^0 (b) 45^0 (c) 60^0 (d) 90^0	
11	The resultant of two forces, each P, acting at an angle θ is (a) $2P\sin\frac{\theta}{2}$ (b) $2P\cos\frac{\theta}{2}$ (c) $2P\cos\theta$ (d) $P\sqrt{2}$	
12	The resultant of two vectors of magnitudes 2A and $\sqrt{2}$ A acing at an angle θ is $\sqrt{10}$ A. The correct value of θ is (a) 30^0 (b) 45^0 (c) 60^0 (d) 90^0	
13	If, $0.5\hat{i}+0.8\hat{j}+c\hat{k}$ is a unit vector, then the value of c is (a) $\sqrt{0.11}$ (b) $\sqrt{0.22}$ (c) $\sqrt{0.33}$ (d) $\sqrt{0.89}$	
14	Two forces, each equal to F, act as shown in figure. Their resultant is  (a) $\frac{F}{2}$ (b) F (c) $\sqrt{3}F$ (d) $\sqrt{5}F$	

15	If P = $4\hat{i}-2\hat{j}+6\hat{k}$ and Q = $\hat{i}-2\hat{j}-3\hat{k}$, then the angle which P + Q makes with x-axis is (a) $\cos^{-1}\left(\frac{3}{\sqrt{50}}\right)$ (b) $\cos^{-1}\left(\frac{4}{\sqrt{50}}\right)$ (c) $\cos^{-1}\left(\frac{5}{\sqrt{50}}\right)$ (d) $\cos^{-1}\left(\frac{12}{\sqrt{50}}\right)$	
16	If A + B = C and A = $\sqrt{3}$, B = $\sqrt{3}$ and C = 3, then the angle between A and B is (a) 0^0 (b) 30^0 (c) 60^0 (d) 90^0	
17	The angle between A = $\hat{i}+\hat{j}$ and B = $\hat{i}-\hat{j}$ is (a) 45^0 (b) 90^0 (c) -45^0 (d) 180^0	
18	If the magnitude of the sum of the two vectors is equal to the difference of their magnitudes, then the angle between vectors is (a) 0^0 (b) 45^0 (c) 90^0 (d) 180^0	
19	The simple sum of two co-initial vectors is 16 units. Their vector sum is 8 units. The resultant of the vectors is perpendicular to the smaller vector. The magnitudes of the two vectors are (a) 2 units and 14 units (b) 4 units and 12 units (c) 6 units and 10 units (d) 8 units and 8 units	
20	If, the resultant of two forces (A + B) and (A − B) is $\sqrt{A^2+B^2}$, then the angle between these forces is (a) $\cos^{-1}\left[-\frac{(A^2-B^2)}{A^2+B^2}\right]$ (b) $\cos^{-1}\left[-\frac{(A^2+B^2)}{(A^2-B^2)}\right]$ (c) $\cos^{-1}\left[-\frac{A^2+B^2}{2(A^2-B^2)}\right]$ (d) $\cos^{-1}\left[-\frac{2(A^2+B^2)}{A^2-B^2}\right]$	
21	If, A = $\hat{i}+\hat{j}-2\hat{k}$ and B = $2\hat{i}-\hat{j}+\hat{k}$, then the magnitude of 2A – 3 B is (a) $\sqrt{90}$ (b) $\sqrt{50}$ (c) $\sqrt{190}$ (d) $\sqrt{30}$	

22	If the resultant of A and B makes angle α with A and β with B, then (a) α < β, always (b) α < β, if A < B (c) α < β, if A > B (d) α < β, if A = B	
23	A proton in a cyclotron changes its velocity from 30 kms^{-1} north to 40 kms^{-1} east in 20 s. What is the average acceleration during this time (a) 2.5 km s^{-2} at 37^0 E of S (b) 2.5 km s^{-2} at 37^0 N of E (c) 2.5 km s^{-2} at 37^0 N of S (d) 2.5 km s^{-2} at 37^0 E of N	
24	What is the angle between P and Q. The resultant of (P + Q) and (P – Q)? (a) Zero (b) $\tan^{-1}(P/Q)$ (c) $\tan^{-1}(Q/P)$ (d) $\tan^{-1}(P - Q)/(P + Q)$	
25	The resultant of two forces at right angle is 5N. When the angle between them is 120^0, the resultant is $\sqrt{13}$. Then, the forces are (a) $\sqrt{12}N$, $\sqrt{13}N$ (b) $\sqrt{20}N$, $\sqrt{5}N$ (c) 3 N, 4 N (d) $\sqrt{40}N$, $\sqrt{15}N$	
26	If the resultant of the vectors $(\hat{i}+2\hat{j}-\hat{k})$, $(\hat{i}-\hat{j}+2\hat{k})$ and C is a unit vector along the y-direction, then C is (a) $-2\hat{i}-\hat{k}$ (b) $-2\hat{i}+\hat{k}$ (c) $2\hat{i}-\hat{k}$ (d) $-2\hat{i}+\hat{k}$	
27	Which one of the following statements is true? (a) A scalar quantity is the one that is conserved in a process (b) A scalar quantity is the one that is can never take negative values (c) A scalar quantity is the one that does not vary from one point to another in space (d) A scalar quantity has the same value for observers with different orientations of the axes	
28	(P + Q) is a unit vector along X-axis. If, P = $\hat{i}-\hat{j}+\hat{k}$, then what value is Q? (a) $\hat{i}+\hat{j}-\hat{k}$ (b) $\hat{j}-\hat{k}$ (c) $\hat{i}+\hat{j}+\hat{k}$ (d) $\hat{j}+\hat{k}$	
29	What vector must be added to the sum of two vectors $2\hat{i}-\hat{j}+3\hat{k}$ and $3\hat{i}-2\hat{j}-2\hat{k}$ so that the resultant is a unit vector along Z-axis?	

	(a) $5\hat{i}+\hat{k}$ (b) $-5\hat{i}+3\hat{j}$ (c) $3\hat{j}+5\hat{k}$ (d) $-3\hat{j}+2\hat{k}$	
30	The resultant of a system of forces shown in figure is a force of 10 N parallel to given forces through R, where PR equals  (a) (2/5) RQ (b) (3/5) RQ (c) (2/3) RQ (d) (1/2) RQ	

CONCEPT-7: BASED ON PRODUCT OF VECTORS

1	Given, vector, A = $\hat{i}-\hat{j}+2\hat{k}$ and vector B = $3\hat{i}-3\hat{j}+6\hat{k}$, then which one of the following statements is true? (a) A is perpendicular to B (b) A is parallel to B (c) Magnitude of A is half of that of B (d) Magnitude of B is equal to that of A	
2	Given, θ is the angle between A and B. Then |A x B| is equal to (a) sin θ (b) cos θ (c) tan θ (d) cot θ	
3	Given, P = $3\hat{j}+4\hat{k}$ and Q = $2\hat{i}+5\hat{k}$. The magnitude of the scalar product of these vectors, is (a) 20 (b) 23 (c) 26 (d) $5\sqrt{33}$	
4	If P.Q = 0, then |P x Q| is (a) |P||Q| (b) zero (c) 1 (d) $\sqrt{PQ}$	
5	Given, c = a x b. The angle which a makes with c is (a) 0^0 (b) 45^0 (c) 90^0 (d) 180^0	
6	If P = $2\hat{i}-3\hat{j}+\hat{k}$ and Q = $3\hat{i}-2\hat{j}$, then P.Q is (a) zero (b) 6 (c) 12 (d) 15	
7	If AB = AB, then the angle between A and B is (a) 0^0 (b) 45^0 (c) 90^0 (d) 180^0	

8	What is the unit vector along $\hat{i}+\hat{j}$? (a) $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$ (b) $\sqrt{2}\left(\hat{i}+\hat{j}\right)$ (c) $\hat{i}+\hat{j}$ (d) $\hat{k}$	
9	The adjacent sides of a parallelogram are represented by co-initial vectors $2\hat{i}+3\hat{j}$ and $\hat{i}+4\hat{j}$. The area of the parallelogram is (a) 5 units along z-axis (b) 5 units in x-y plane (c) 3 units in x-z plane (d) 3 units in y-z plane	
10	The magnitudes of the two vectors a and b are α and b, respectively. The vector product of a and b cannot be (a) Equal to zero (b) Less than ab (c) Equal to ab (d) Greater than ab	
11	Given, P = A + B and P = A + B. The angle between A and B is (a) 0^0 (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{2}$ (d)π	
12	Given, r = $4\hat{j}$ and p = $2\hat{i}+3\hat{j}+\hat{k}$. The angular momentum is (a) $4\hat{i}-8\hat{k}$ (b) $8\hat{i}-4\hat{k}$ (c) $8\hat{j}$ (d) $9\hat{k}$	
13	A force of $\left(10\hat{i}-3\hat{j}+6\hat{k}\right)$ N acts on a body of mass 100 g and displaces it from $\left(6\hat{i}+5\hat{j}-3\hat{k}\right)$m to $\left(10\hat{i}-2\hat{j}+7\hat{k}\right)$ m. The work done is (a) 21 J (b) 121 J (c) 361 J (d) 1000 J	
14	A force, F = $2\hat{i}+2\hat{j}$ N displaces a particle through S = $2\hat{i}+2\hat{k}$ m in 16 s. The power developed by F is (a) 0.25 J s^{-1} (b) 25 J s^{-1} (c) 225 J s^{-1} (d) 450 J s^{-1}	
15	Projection of P on Q is (a) $P\hat{Q}$ (b) $\hat{P}Q$ (c) $Px\hat{Q}$ (d) P x Q	
16	Two vectors a and b are such that |a + b| = |a – b|. What is the angle between a and b?	

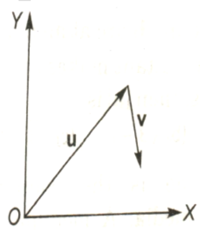
	(a) 0^0 (b) 90^0 (c) 60^0 (d) 180^0	
17	Given, A = $4\hat{i}+6\hat{j}$ and B = $2\hat{i}+3\hat{j}$. Which of the following is correct? (a) A x B = 0 (b) A . B = 24 (c) $\frac{\|A\|}{\|B\|} = \frac{1}{2}$ (d) A and B are anti-parallel	
18	If A . B = 0 and A x B = 1, then A and B are (a) Perpendicular unit vectors (b) Parallel unit vectors (c) Parallel (d) Perpendicular	
19	The torque of a force F = $-3\hat{i}+\hat{j}+5\hat{k}$ acting at a point is τ. If the position vector of the point is $7\hat{i}+3\hat{j}+\hat{k}$, then τ is (a) $7\hat{i}-8\hat{j}+9\hat{k}$ (b) $14\hat{i}-\hat{j}+3\hat{k}$ (c) $2\hat{i}-3\hat{j}+8\hat{k}$ (d) $14\hat{i}-38\hat{j}+16\hat{k}$	
20	The area of a parallelogram formed by the vectors A = $\hat{i}-2\hat{j}+3\hat{k}$ and B = $3\hat{i}-2\hat{j}+\hat{k}$ as its adjacent sides, is (a) 8$\sqrt{3}$ units (b) 64 units (c) 32 units (d) 4$\sqrt{6}$ units	
21	Given that, A + B + C = 0. Out of three vectors, two are equal in magnitude and the magnitude of third vector is $\sqrt{2}$ times that of either of the two having equal magnitude. Then, the angles between vectors are given by (a) 45^0, 45^0, 90^0 (b) 90^0, 135^0, 135^0 (c) 30^0, 60^0, 90^0 (d) 45^0, 60^0, 90^0	
22	The magnitude of the vectors product of two vectors is $\sqrt{3}$ times their scalar product. The angle between the two vectors is (a) 90^0 (b) 60^0 (c) 45^0 (d) 30^0	
23	If, A = $2\hat{i}+3\hat{j}+4\hat{k}$ and B = $4\hat{i}+3\hat{j}+2\hat{k}$, then angle between A and B is (a) $\sin^{-1}\left(\frac{25}{29}\right)$ (b) $\sin^{-1}\left(\frac{29}{25}\right)$	

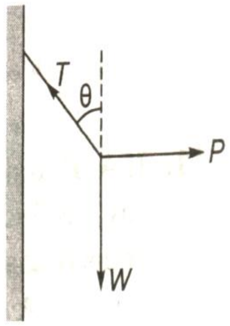
	(c) $\cos^{-1}\left(\frac{25}{29}\right)$ (d) $\cos^{-1}\left(\frac{29}{25}\right)$	
24	Consider the quantities, pressure, power, energy, impulse, gravitational potential, electrical charge, temperature, area. Out of these, the only vector quantities are (a) Impulse, pressure and area (b) Impulse and area (c) Area and gravitational potential (d) Impulse and pressure	
25	Three vectors A, B and C satisfy the relation AB = 0 and AC = 0. If B and C are not lying in the same plane, then A is parallel to (a) B (b) C (c) B x C (d) BC	
26	A force of $\left(7\hat{i}+6\hat{k}\right)$N makes a body move on a rough plane with a velocity of $\left(3\hat{j}+4\hat{k}\right)$ ms^{-1}. Calculate the power in watt (a) 24 (b) 34 (c) 21 (d) 45	
27	What is the angle between $\left(\hat{i}+2\hat{j}+2\hat{k}\right)$ and $\hat{i}$? (a) 0^0 (b) $\pi/6$ (c) $\pi/3$ (d) None of these	
28	If A = B, then which of the following is not correct? (a) $\hat{A}=\hat{B}$ (b) $\hat{A}.\hat{B}$ = AB (c) |A| = |B| (d) $A\hat{B}$ || $B\hat{A}$	
29	For what value of α, A = $2\hat{i}+a\hat{j}+\hat{k}$ will be perpendicular to B = $4\hat{i}-2\hat{j}-\hat{k}$? (a) 4 (b) zero (c) 3 (d) 1	
30	The sum of two vectors A and B is at right angles to their difference. Then (a) A = B (b) A = 2B (c) B = 2A (d) A and B have the same direction	
31	A point of application of a force F = $5\hat{i}-4\hat{j}+2\hat{k}$ is moved from r_1 = $2\hat{i}+7\hat{j}+4\hat{k}$ to r_2 = $-5\hat{i}+2\hat{j}+3\hat{k}$ the work done is (a) -17 units (b) -22 units (c) 33 units (d) -33 units	
32	The momentum of a particle is P = 2cos t. $\hat{i}+2\sin t\ \hat{j}$. What is the angle between the force F acting	

	on the particle and the momentum P. (a) 65^0 (b) 90^0 (c) 150^0 (d) 180^0	
33	A vector F_1 is along the positive Y-axis. If its vector product with another vector F_2 is zero, then F_2 could be (a) $4\hat{j}$ (b) $\hat{j}+\hat{k}$ (c) $\hat{j}-\hat{k}$ (d) $-4\hat{i}$	
34	If the vectors A = $2\hat{i}+4\hat{j}$ and B = $5\hat{i}-p\hat{j}$ are parallel to each other, the magnitude of B is (a) $5\sqrt{5}$ (b) 10 (c) 15 (d) $2\sqrt{5}$	
35	If the magnitudes of scalar and vector products of two vectors are 6 and 6 $\sqrt{3}$ respectively, then the angle between two vectors is (a) 15^0 (b) 30^0 (c) 60^0 (d) 75^0	
36	What is the angle between $\hat{i}+\hat{j}+\hat{k}$ and $\hat{i}$? (a) 0^0 (b) π/6 (c) π/3 (d) None of these	
37	An object moves along a straight line path from P to Q under the action of a force $(4\hat{i}-3\hat{j}+3\hat{k})$ N. If the coordinates P and Q in metres are (3, 3, -1) and (2, -1, 4) respectively, then the work done by the force is (a) + 23 J (b) – 23 J (c) 1015 J (d) $\sqrt{35}(4\hat{i}-3\hat{j}+2\hat{k})\,J$	
38	For motion in a plane with constant acceleration a, initial velocity v_0 and final velocity v after time t, we have (a) v . (v – at) = v_0 . (v_0 + at) (b) v . v_0 = at^2 (c) v . v_0 = a . v_0t (d) v_0 . v_0 = a . v_0t	
39	Given that A and B are greater than 1. The magnitude of (A x B) cannot be (a) Equal to AB (b) Less than AB (c) More than AB (d) Equal to A/B	
40	A force, F = $-K(y\hat{i}+x\hat{j}$ (where, K is a positive constant) acts on a particle moving in the xy plane. Starting from the	

	origin, the particle is taken along the positive x-axis to the point (α, 0) and then parallel to the y-axis to the point (α, α). The total work done by the force, F on the particle is (a) $-2\ Ka^2$ (b) $2\ Ka^2$ (c) $-Ka^2$ (d) Ka^2	

CONCEPT-8: BASED OF COMPONENTS OF A VECTOR

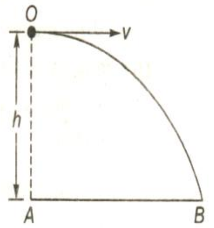
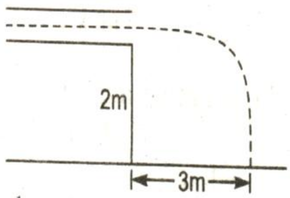
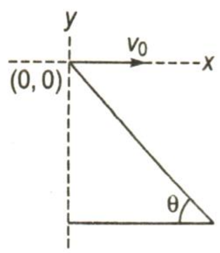
1	The coordinates of a moving particle at time t are given by $x = ct^2$ and $y = bt^2$. The instantaneous speed of the particle is (a) 2t (b + c) (b) $2t\ (b + c)^{1/2}$ (c) $2t\ (c^2 - b^2)$ (d) $2t\ (c^2 + b^2)^{1/2}$	
2	Following forces start acting on a particle at rest at the origin of the coordinate system simultaneously $F_1 = 5\hat{i} - 5\hat{j} + 5\hat{k}$, $F_2 = 2\hat{i} + 8\hat{j} + 6\hat{k}$, $F_3 = -6\hat{i} + 4\hat{j} - 7\hat{k}$, $F_4 = -\hat{i} - 3\hat{j} - 2\hat{k}$. The particle will move (a) In x-y plane (b) In y-z plane (c) In x-z plane (d) Along x-axis	
3	A force is inclined at 60^0 to the horizontal. If its rectangular component in the horizontal direction is 50 N, then magnitude of the force in the vertical direction is (a) 25 N (b) 75 N (c) 87 N (d) 100 N	
4	Figure shows the orientation of two vectors u and v in the XY plane  If u = $a\hat{i} + b\hat{j}$ and v = $p\hat{i} + q\hat{j}$, Which of the following is correct? (a) a and p are positive while b and q are negative (b) a, p and b are positive while q is negative (c) a, q and b are positive while p is negative (d) a, b, p and q are all positive	
5	A small sphere is hung by a string fixed to a wall. The	

	sphere is pushed away from the wall by a stick. The force acting on the sphere are shown in figure. Which of the following statements is wrong?  (a) P = W tan θ (b) τ + P + W = 0 (c) $T^2 = P^2 + W^2$ (d) T = P + W	
6	The X and Y components of vector A have numerical values 6 and 6 respectively and that of (A + B) have numerical values 10 and 9. What is the numerical value of B? (a) 2 (b) 3 (c) 4 (d) 5	
7	A particle of mass = 5 is moving with a uniform speed $\upsilon = 3\sqrt{2}$ in the XOY plane along the line y = x + 4. The magnitude of the angular momentum of the particle about the origin is (a) 60 units (b) $40\sqrt{2}$ units (c) 7.5 units (d) zero	
8	The component of a vector r long X-axis will have maximum value if (a) r is along positive Y-axis (b) r is along positive X-axis (c) r makes an angle of 45^0 with the X-axis (d) r is along negative Y-axis	
9	There are two forces each of magnitude 10 units. One inclined at an angle of 30^0 and the other at an angle of 135^0 to the positive direction of x-axis. The x and y components of the resultant are respectively. (a) 1.59 $\hat{i}$ and 12.07 $\hat{j}$ (b) 10 $\hat{i}$ and 10 $\hat{j}$ (c) 1.59 $\hat{i}$ (d) 15.9 $\hat{i}$ and 12.07 $\hat{j}$	

10	A body of mass $\sqrt{3}$ kg is suspended by a string from a rigid support. The body is pulled horizontally by a force F until the string makes an angle of 30^0 with the vertical. The value of F and tension in the string are (a) 19.6 N; 19.6 N (b) 9.8 N, 9.8 N (c) 9.8 N, 19.6 N (d) 19.6 N, 9.8 N	

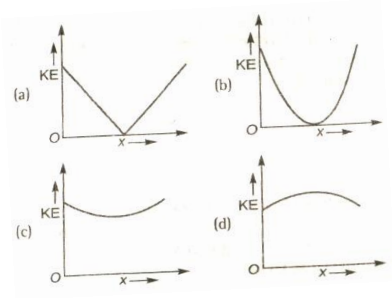
CONCEPT-9: BASED ON HORIZONTAL PROJECTION

1	The horizontal range of a projectile fired at an angle of 15^0 is 50 m. If it is fired with the same speed at an angle of 45^0, its range will be (a) 60 m (b) 71 m (c) 100 m (d) 141 m	
2	A tennis ball rolls off the top of a sister case way with a horizontal velocity u ms^{-1}. If the steps are b metre wide and h meter high, the ball will hit the edge of the nth step, if (a) n = $\frac{2hu}{gb^2}$ (b) n = $\frac{2hu^2}{gb^2}$ (c) n = $\frac{2hu^2}{gb}$ (d) n = $\frac{hu^2}{gb^2}$	
3	A bomber plane moves horizontally with a speed of 500 ms^{-1} and a bomb releases from it, strikes the ground in 10 s. Angle at which it strikes the ground will be ($g = 10\ ms^{-2}$) (a) $\tan^{-1}\left(\frac{1}{5}\right)$ (b) $\tan\left(\frac{1}{5}\right)$ (c) $\tan^{-1}(1)$ (d) $\tan^{-1}(5)$	
4	An aeroplane is flying in a horizontal direction with a velocity 600 kmh^{-1} at a height of 1960 m. When it is vertically above the point A on the ground, a body is dropped from it. The body strikes the ground at point B. Calculate the distance AB.	

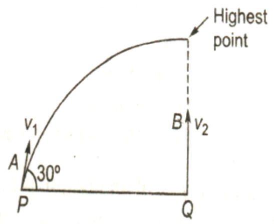
	 (a) 3.33 km (b) 333 km (c) 33.3 km (d) 3330 km	
5	The height y and distance x along the horizontal for a body projected in the xy-plane are given by $y = 8t - 5t^2$ and $x = 6t$. The initial speed of projection is (a) 8 m/s (b) 9 m/s (c) 10 m/s (d) (10/3) m/s	
6	Water is flowing from a horizontal pipe fixed at a height of 2 m from the ground. If it falls at a horizontal distance of 3 m, as shown in figure, the speed of water when it leaves the pipe is (Take, $g = 9.8\ ms^{-2}$)  (a) $2.4\ ms^{-1}$ (b) $4.7\ ms^{-1}$ (c) $7.4\ ms^{-1}$ (d) $6.2\ ms^{-1}$	
7	A stone is just released from the window of a moving train along a horizontal straight track. The stone will hit the ground following (a) Straight path (b) Circular path (c) Parabolic path (d) Hyperbolic path	
8	A man standing on a hill top projects a stone horizontally with speed v_0 as shown in figure. Taking the coordinate system as given in the figure. The coordinates of the point where the stone will hit the hill surface  (a) $\left(\frac{2v_0^2 \tan\theta}{g}, \frac{-2v_0^2 \tan^2\theta}{g}\right)$	

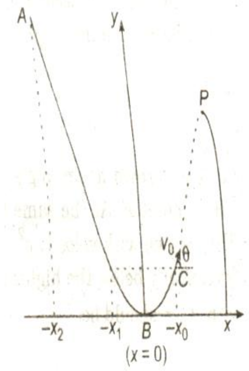
	(b) $\left(\frac{2v_0^2}{g}, \frac{2v_0^2 \tan^2\theta}{g}\right)$ (c) $\left(\frac{2v_0^2 \tan\theta}{g}, \frac{2v_0^2}{g}\right)$ (d) $\left(\frac{2v_0^2 \tan\theta}{g}, \frac{2v_0^2 \tan\theta}{g}\right)$	
9	A particle moves in the xy-plane with velocity υ_x = 8t – 2 and υ_y = 2. If it passes through the point x = 14 and y = 4 at t = 2 s, find the equation (x-y relation) of the path. (a) x = y^2 – y + 2 (b) x = $2y^2$ + 2y – 3 (c) x = $3y^2$ + 5 (d) Cannot be found from above date	
10	The ceiling of a long hall is 25 m high. Then, the maximum horizontal distance that a ball thrown with a speed of 40 m/s can go without hitting the ceiling of the ball, is (a) 95.5 m (b) 105.5 m (c) 100 m (d) 150.5 m	
11	A particle leaves the origin with an initial velocity v = (3.00 $\hat{i}$) ms^{-1} and a constant acceleration a = (- 1.00 $\hat{i}$ - 0.50 $\hat{j}$) ms^{-2}. When the particle reaches its maximum x-coordinate, what is its y-component a velocity? (a) -2.0 ms^{-1} (b) -1.0 ms^{-1} (c) -1.5 ms^{-1} (d) 1.0 ms^{-1}	
12	A projectile can have same range from two angles of projection with same initial speed. If h_1 and h_2 be the maximum heights, then (a) R = $\sqrt{h_1 h_2}$ (b) R = $\sqrt{2h_1 h_2}$ (c) R = $2\sqrt{h_1 h_2}$ (d) R = $4\sqrt{h_1 h_2}$	
13	A stone is thrown at an angle θ to be the horizontal reaches a maximum height H. Then, the time of flight of stone will be (a) $\sqrt{\frac{2H}{g}}$ (b) $2\sqrt{\frac{2H}{g}}$ (c) $\frac{2\sqrt{2H\sin\theta}}{g}$ (d) $\frac{\sqrt{2H\sin\theta}}{g}$	
14	A bomb is dropped on an enemy post by an aeroplane flying horizontally with a velocity of 60 kmh^{-1} and at a	

	height of 490 m. At the time of dropping the bomb, how far the aeroplane should be from the enemy post so that the bomb may directly hit the target? (a) $\frac{400}{3}$ m (b) $\frac{500}{3}$ (c) $\frac{1700}{3}$ (d) 498 m	
15	A body projected with velocity u at projection angle θ has horizontal range R. For the same velocity and projection angle, its range on the moon surface will be $g_{moon} = g_{earth}$ / 6) (a) 36 R (b) $\frac{R}{36}$ (c) $\frac{R}{16}$ (d) 6 R	
16	A boy throws a ball with a velocity u at an angle θ with the horizontal. At the same instant he starts running with uniform velocity to catch the ball before if hits the ground. To achieve this he should run with a velocity of (a) $u\cos\theta$ (b) $u\sin\theta$ (c) $u\tan\theta$ (d) $u\sec\theta$	
17	An arrow is shot into air. Its range is 200 m and its time of flight is 5 s. If = 10 m/s^2, then horizontal component of velocity and the maximum height will be respectively (a) 20 m/s, 62.50 m (b) 40 m/s, 31.25 m (c) 80 m/s, 62.5 m (d) None of these	
18	A body of mass m thrown horizontally with velocity υ, from the top of tower of height h touches the level ground at distance of 250 m from the foot of the tower. A body of mass 2 m thrown horizontally with velocity $\frac{\upsilon}{2}$, from the top of tower of height 4h will touch the level ground at a distance x from the foot of tower. The value of x is (a) 250 m (b) 500 m (c) 125 m (d) $250\sqrt{2}$ m	
19	A ball is thrown up with a certain velocity at an angle θ to the horizontal. The kinetic energy (KE) of the ball varies in the horizontal displacement x as	

		
20	Two paper screen A and B are separated by a distance of 100 m. A bullet pierces A and B. The hole in B is 10 cm below the hole in A. If the bullet is travelling horizontally at the time of hitting A. Then, the velocity of the bullet at A is (a) 100 m/s (b) 200 m/s (c) 600 m/s (d) 700 m/s	
21	It was calculated that a shell when fired from a gun with a certain velocity and at an angle of elevation $\frac{5\pi}{36}$ rad should strike a given target. In actual practice, it was found that a hill just prevented the trajectory. At what angle of elevation should the gun be to hit the target? (a) $\frac{5\pi}{36}$ rad (b) $\frac{11\pi}{36}$ rad (c) $\frac{7\pi}{36}$ rad (d) $\frac{13\pi}{36}$ rad	
22	Two projectiles thrown from the same point at angles 60^0 and 30^0 with the horizontal attain the same height. The ratio of their initial velocities is (a) 1 (b) 2 (c) $\sqrt{3}$ (d) $\frac{1}{\sqrt{3}}$	
23	A projectile is thrown at angle β with vertical. It reaches a maximum height H. The time taken to reach the highest point of its path is (a) $\sqrt{\frac{H}{g}}$ (b) $\sqrt{\frac{2H}{g}}$ (c) $\sqrt{\frac{H}{2g}}$ (d) $\sqrt{\frac{2H}{g\cos\beta}}$	
24	A cricket ball is hit at 30^0 with the horizontal with kinetic energy E_k. What is the kinetic energy at the highest point? (a) $\frac{E_k}{2}$ (b) $\frac{3E_k}{4}$	

	(c) $\frac{E_k}{4}$ (d) Zero	
25	A cricket ball is hit at 30^0 m/s, at an angle $\theta_0 = \tan^{-1}\left(\frac{3}{4}\right)$. After 1 s, the particle is moving at an angle θ to the horizontal, where tan θ will be equal to (g = 10 m/s^2) (a) 1 (b)2 (c) $\frac{1}{2}$ (d) $\frac{1}{3}$	
26	When a projectile is projected at a certain angle with the horizontal, its horizontal range is R and time of flight is T_1. When the same projectile is throwing with the same speed at some other angle with the horizontal, its horizontal range is R and time of flight is T_2. The product of T_1 and T_2 is (a) $\frac{R}{g}$ (b) $\frac{2R}{g}$ (c) $\frac{3R}{g}$ (d) $\frac{4R}{g}$	
27	A projectile of mass m is thrown with a velocity υ making an angle of 45^0 with the horizontal. The change in momentum from departure to arrival along vertical direction, is (a) 2mv (b) $\sqrt{2}$ mv (c) mv (d) $\frac{mv}{2}$	
28	Two stones thrown at different angles have same initial velocity and same range. If H is the maximum height attained by one stone thrown at an angle of 30^0, then the maximum height attained by the other stone is (a) $\frac{H}{2}$ (b) H (c) 2H (d) 3H	
29	A projectile shot into air at some angle with the horizontal has a range of 200 m. If the time of flight is 5 s, then the horizontal component of the velocity of the projectile at the highest point of trajectory is (a) 40 ms^{-1} (b) 0 ms^{-1} (c) 9.8 ms^{-1} (d) Equal to the velocity of projection of the projectile	
30	The kinetic energy of a project at the height point is half of the initial kinetic energy. What is the angle of projection with the horizontal?	

	(a) 30^0 (b) 45^0 (c) 60^0 (d) 90^0	
31	A ball is projected from a certain point on the surface of a planet at a certain angle with the horizontal surface. The horizontal and vertical displacement x and y vary with time t in second as x = $10\sqrt{3}$ t and y = 10 t – t^2. The maximum height attained by the ball is (a) 100 m (b) 75 m (c) 50 m (d) 25 m	
32	A projectile A is thrown at an angle of 30^0 to the horizontal from point P. At the same time, another projectile B is thrown with velocity υ^2 upwards from the point Q vertically below the highest point. For B to collide with A, $\frac{\upsilon^2}{\upsilon_1}$ should be  (a) 1 (b) 2 (c) $\frac{1}{2}$ (d) 4	
33	For a projectile thrown into space with a speed υ, the horizontal range is $\frac{\sqrt{3}\upsilon^2}{2g}$. The vertical range is $\frac{\upsilon^2}{8g}$. The angle which the projectile makes with the horizontal initially is (a) 15^0 (b) 30^0 (c) 45^0 (d) 60^0	
34	The velocity of projection of an oblique projectile is $\left(6\hat{i}+8\hat{j}\right)$ ms^{-1}. The horizontal range of the projectile is (a) 4.9 m (b) 9.6 m (c) 19.6 m (d) 14 m	
35	A body is projected at an angle θ to the horizontal with kinetic energy E_k. The potential energy at the highest point of the trajectory is (a) E_k (b) $E_k \cos^2 \theta$ (c) $E_k \sin^2 \theta$ (d) $E_k \tan^2 \theta$	
36	Two projectiles A and B are thrown with velocities υ and $\frac{\upsilon}{2}$ respectively. They have the same range. If B is thrown at an angle of 15^0 to the horizontal, A must have been thrown at an angle	

	(a) $\sin^{-1}\left(\frac{1}{16}\right)$ (b) $\sin^{-1}\left(\frac{1}{4}\right)$ (c) $2\sin^{-1}\left(\frac{1}{4}\right)$ (d) $\frac{1}{2}\sin^{-1}\left(\frac{1}{8}\right)$	
37	A particle slides down a frictionless parabolic ($y = x^2$) track ($A - B - C$) starting from rest at point A. Point B is at the vertex of parabola and point C is at a height less than that of point A. After C, the particle moves freely in air as a projectile. If the particle reaches highest point at P, then  (a) KE at P = KE at B (b) Height at P = height at A (c) Total energy at P = total energy at A (d) Time of travel from A to B = time of travel from B to P.	
38	The horizontal range of an oblique projectile is equal to the distance through which a projectile has a fall freely from rest to acquire a velocity equal to the velocity of projection in magnitude. The angle of projection is (a) 15^0 (b) 60^0 (c) 45^0 (d) 30^0	
39	A projectile is thrown with velocity υ making an angle θ with the horizontal. It just crosses the tops of two poles, each of height h, after 1 s and 3 s respectively. The time of flight of the projectile is (a) 1 s (b) 3 s (c) 4 s (d) 7.8 s	
40	Two stones are projected so as to reach the same distance from the point of projection on a horizontal surface. The maximum height reached by one exceeds the other by an amount equal to half the sum of the height attained by them. Then, angle of projection of the stone which attains smaller height is (a) 45^0 (b) 60^0 (c) 30^0 (d) $\tan^{-1}(3/4)$	
41	Two particles are simultaneously projected in opposite directions horizontally from a given point in space whose gravity g is uniform. If u_1 and u_2 be their initial speeds, then the time t after which their velocities are mutually	

	perpendicular is given by (a) $\frac{\sqrt{u_1 u_2}}{g}$ (b) $\frac{\sqrt{u_1^2 u_2^2}}{g}$ (c) $\frac{\sqrt{u_1(u_1+u_2)}}{g}$ (d) $\frac{\sqrt{u_2(u_1+u_2)}}{g}$	
42	A plane surface is inclined making an angle θ with the horizontal. From the bottom of this inclined plane, a bullet is fired with velocity υ. The maximum possible range of the bullet on the inclined plane is (a) $\frac{v^2}{g}$ (b) $\frac{v^2}{g(1+\sin\theta)}$ (c) $\frac{v^2}{g(1-\sin\theta)}$ (d) $\frac{v^2}{g(1+\sin\theta)^2}$	
43	A projectile is fired with a velocity υ at an angle θ with the horizontal. The speed of the projectile when its direction of motion makes an angle β with the horizontal is (a) v cos θ (b) v cos θ cos β (c) v cos θ sec β (d) v cos θ tan β	
44	A ball is projected up an incline of 30^0 with a velocity of 30 ms^{-1} at an angle of 30^0 with reference to the inclined plane from the bottom of the inclined plane. If g = 10 ms^{-2}, then the range on the inclined plane is (a) 12 m (b) 60 m (c) 120 m (d) 600 m	
45	A cricketer can throw a ball to a maximum horizontal distance of 100 m. How much high above the ground can the cricketer throw the same ball? (a) 40 m (b) 45 m (c) 500 m (d) 50 m	
46	A piece of marble is projected from earth's surface with velocity of 50 ms^{-1}. 2 s later it just clears a wall 5 m high. What is the angle of projection? (a) 45^0 (b) 30^0 (c) 60^0 (d) None of these	
47	A body is projected with speed υ ms^{-1} at angle θ. The kinetic energy at the highest point is half of the initial kinetic energy. The value of θ is (a) 30^0 (b) 45^0 (c) 60^0 (d) 90^0	
48	A ball is projected with velocity u at an angle α with horizontal plane. Its speed when it makes an angle β with the horizontal is	

	(a) u cos α (b) $\dfrac{u}{\cos\beta}$ (c) u cos α cos β (d) $\dfrac{u\cos a}{\cos\beta}$	
49	The angle of projection of a projectile for which the horizontal range and maximum height are equal to (a) $\tan^{-1}(2)$ (b) $\tan^{-1}(4)$ (c) $\cot^{-1}(2)$ (d) 60^0	
50	A particle is projected from horizontal making an angle 60^0 with initial velocity 40 ms^{-1}. The time taken by the particle to make angle 45^0 from horizontal, is (a) 15 s (b) 2.0 s (c) 20 s (d) 1.5 s	
51	Two bodies are projected from the same point with equal speeds in such directions that they both strike the same point on a plane whose inclination is β. If α be the angle of projection of the first body with the horizontal the ratio of their times of flight is (a) $\dfrac{\cos\alpha}{\sin(\alpha+\beta)}$ (b) $\dfrac{\sin(\alpha+\beta)}{\cos\alpha}$ (c) $\dfrac{\cos\alpha}{\sin(\alpha-\beta)}$ (d) $\dfrac{\sin(\alpha-\beta)}{\cos\alpha}$	
52	A particle is projected with velocity $2\sqrt{gh}$ so that it just clears two walls of equal height h, which are at a distance of 2h from each other. What is the time interval of passing between the two walls? (a) $\dfrac{2h}{g}$ (b) $\sqrt{\dfrac{gh}{g}}$ (c) $\sqrt{\dfrac{h}{g}}$ (d) $2\sqrt{\dfrac{h}{g}}$	
53	A projectile is thrown with a velocity of 10 m/s at an angle 60^0 with horizontal. The interval between the moment when speed is $\sqrt{5}$ g m/s, is (g = 10 m/s^2). (a) 1 s (b) 3 s (c) 2 s (d) 4 s	
54	A particle is projected from the ground with an initial speed of υ at an angle θ with horizontal. The average velocity of the particle between its point of projection and highest point of trajectory is (a) $\dfrac{v}{2}\sqrt{1+2\cos^2\theta}$ (b) $\dfrac{v}{2}\sqrt{1+\cos^2\theta}$	

(c) $\frac{v}{2}\sqrt{1+3\cos^2\theta}$ (d) v cos θ

55 A body of mass m is thrown upward at an angle θ with the horizontal with velocity υ. While rising up the velocity of the mass after t second will be

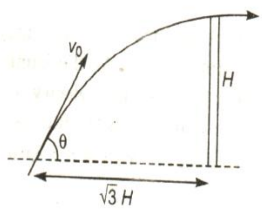
(a) $\sqrt{(v\cos\theta)^2+(v\sin\theta)^2}$

(b) $\sqrt{(v\cos\theta-v\sin\theta)^2-gt}$

(c) $\sqrt{v^2+g^2t^2-(2v\sin\theta)gt}$

(d) $\sqrt{v^2+g^2t^2-(2v\cos\theta)gt}$

56 A projectile is thrown at an angle θ such that it is just able to cross a vertical wall as its highest point as shown in the figure. The angle θ at which the projectile is thrown is given by



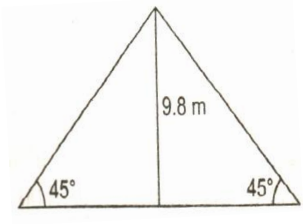
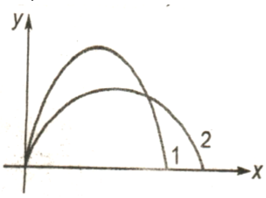
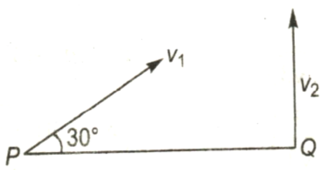
(a) $\tan^{-1}\left(\frac{1}{\sqrt{3}}\right)$ (b) $\tan^{-1}\sqrt{3}$

(c) $\tan^{-1}\left(\frac{2}{\sqrt{3}}\right)$ (d) $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$

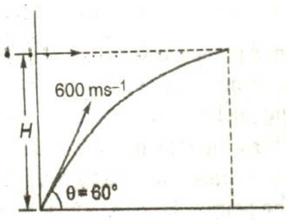
57 A particle is projected with speed υ at an angle $\theta\left(0<\theta<\frac{\pi}{2}\right)$ above the horizontal from a height H above the ground. If υ = speed with which particle hits the ground and t = time taken by particle to reach ground, then

(a) as θ increases, v decreases and t increases
(b) as θ increases, v increases and t increases
(c) as θ increases, v remains same and t increases
(d) as θ increases, v remains same and t decreases

58 Two inclined planes are located as shown in figure. A particle is projected from the foot of one frictionless plane along its line with a velocity sufficient to carry it o top after which the particle slides down the other frictionless inclined plane. The total time it will take to reach the point C is

	 (a) 2 s (b) 3 s (c) $2\sqrt{2}$ s (d) 4 s	
59	The equation of motion of a projectile are given by x = 36t. If and 2y = 96t – 9.8t^2 m. The angle of projectile is (a) $\sin^{-1}\left(\frac{4}{5}\right)$ (b) $\sin^{-1}\left(\frac{3}{5}\right)$ (c) $\sin^{-1}\left(\frac{4}{3}\right)$ (d) $\sin^{-1}\left(\frac{3}{4}\right)$	
60	Trajectories of two projectiles are shown in figure. Let T_1 and T_2 be the time periods and u_1 and u_2 their speeds of projection. Then,  (a) $T_2 > T_1$ (b) $T_1 = T_2$ (c) $u_1 > u_2$ (d) $u_1 = u_2$	
61	A projectile A is thrown at an angle 30^0 to the horizontal from point P. At the same time another projectile B is thrown with velocity υ_2 upwards from the point Q vertically below the highest point A would reach. For B to collide with A the ratio $\frac{\upsilon_2}{\upsilon_1}$ should be  (a) $\frac{\sqrt{3}}{2}$ (b) 2 (c) $\frac{1}{2}$ (d) $\frac{2}{\sqrt{3}}$	
62	A fighter plane enters inside the enemy territory, at time t = 0 with velocity υ_0 = 250ms^{-1} and moves horizontally with constant acceleration α = 20 ms^{-2} (see figure). An enemy tank at the border, spot the plane and fire shots at an angle θ = 60^0 with the horizontal and withvelocity u = 600 ms^{-1}. At what altitude H of the plane it can be hit by the	

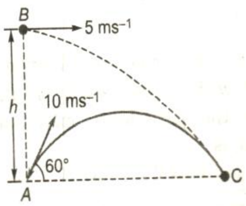
shot?



(a) $1500\sqrt{3}$ m (b) 125 m
(c) 1400 m (d) 2473 m

63 An aircraft, diving at an angle of 53.0^0 with the vertical releases a projectile at an altitude of 730 m. The projectile hits the ground 5.00 s after being released. What is the speed of the aircraft?
(a) 282 ms^{-1} (b) 202 ms^{-1}
(c) 182 ms^{-1} (d) 102 ms^{-1}

64 A particle A is projected from the ground with an initial velocity of 10 ms^{-1} at an angle of 60^0 with horizontal. From what height h should an another particle B be projected horizontal with velocity 5 ms^{-1} so that both the particles collide with velocity 5 ms^{-1} so that both the particles collide on the ground at point C if both are projected simultaneously (g = 10 ms^{-2})



(a) 10 m (b) 30 m (c) 15 m (d) 25 m

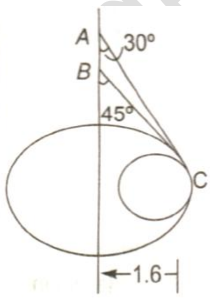
65 A very broad elevator is going up vertically with a constant acceleration of 2ms^{-2}. At the instant when its velocity is 4 ms^{-1} a ball is projected from the floor of the list with a speed of 4 ms^{-1} relative to the floor at an elevation of 30^0. The time taken by the ball to return the floor is (g = 10 ms^{-2})
(a) 1/2 s (b) 1/3 s (c) 1/4 s (d) 1 s

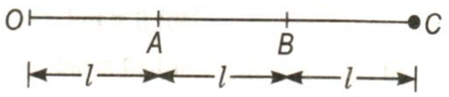
66 projectile is fired at an angle of 30^0 to the horizontal such that the vertical component of its initial velocity is 80 ms^{-1}. Its time of flight is T. Its velocity at t = $\frac{T}{4}$ has a magnitude of nearly
(a) 200 ms^{-1} (b) 300 ms^{-1}
(c) 140 ms^{-1} (d) 100 ms-1

67 A car is moving rectilinearly on a horizontal path with acceleration α_0. A person sitting inside the car observes that an insect S is crawling up the screen with an acceleration α. If θ is the inclination of the screen with the horizontal the acceleration of the insect

	(a) Parallel to screen is $a_0 \cos\theta$ (b) Along the horizontal is $a_0 - a\cos\theta$ (c) Perpendicular to screen is $a_0 \sin\theta$ (d) Perpendicular to screen is $a_0 \tan\theta$	
68	A particle is projected from the ground at an angle of 60^0 with horizontal with speed u = $20 ms^{-1}$. The radius of curvature of the path of the particle, when its velocity makes an angle of 30^0 with horizontal is (g = 10 ms^{-2}) (a) 10.6 m (b) 12.8 m (c) 15.4 m (d) 24.2 m	

CONCEPT-10: BASED ON MOTION ALONG HORIZONTAL CIRCLE

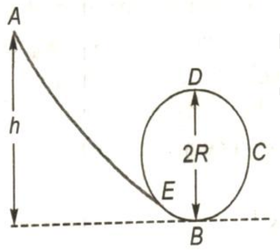
1	A car-wheel is rotated to uniform angular acceleration about its axis., Initially its angular velocity is zero. It rotates through an angle θ_1 in the first 2 s, in the next 2 s, it rotates through an additional angle θ_2, the ratio of $\frac{\theta_2}{\theta_1}$ is (a) 1 (b) 2 (c) 3 (d) 5	
2	A sphere of mass 0.2 kg is attached to an inextensible string of length 0.5 m whose upper end is fixed to the ceiling. The sphere is made to describe a horizontal circle of radius 0.3 m. The speed of the sphere will be (a) 1.5 ms^{-1} (b) 2.5 ms^{-1} (c) 3.2 ms^{-1} (d) 4.7 ms^{-1}	
3	Two wires AC and BC are tied at C of small sphere of mass 5 kg, which revolves at a constant speed υ in the horizontal circle of radius 1.6 m. The minimum value of υ is  (a) 3.01 ms^{-1} (b) 4.01 ms^{-1} (c) 8.2 ms^{-1} (d) 3.96 ms^{-1}	
4	A particle describes a horizontal circle in a conical funnel whose inner surface is smooth with speed of 0.5 m/s. What is height of the plane of circle from vertex of the funnel? (a) 0.25 m (b) 2 cm (c) 4 cm (d) 2.5 cm	
5	Three identical particles are joined together by a thread as shown in figure. All the three particles are moving in a horizontal plane. If the velocity of the outermost particle is	

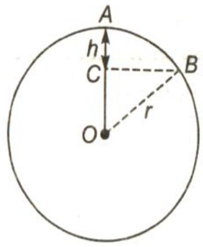
	υ_0 then the ratio of tensions in the three sections of the string is  (a) 3 : 5 : 7 (b) 3 : 4 : 5 (c) 7 : 11 : 6 (d) 3 : 5 : 6	
6	Two particles of equal mass are connected to a rope AB of negligible mass such that one is at end A and other dividing the length of rope in the ratio 1 : 2 from B. The rope is rotated about end B in a horizontal plane. Ratio of tensions in the smaller part to the other is (ignore the effect of gravity) (a) 4 : 3 (b) 1 : 4 (c) 1 : 2 (d) 1 : 3	
7	A coin is placed on a gramophone record rotating at a speed of 45 rpm. It flies away when the rotational speed is 50 rpm. If two such coins are placed over the other on the same record, both of them will fly away when rotational speed is (a) 100 rpm (b) 25 rpm (c) 12.5 rpm (d) 50 rpm	
8	The maximum and minimum tension in the string whirling in a circle of radius 2.5 m with constant velocity are in the ratio 5 : 3, then its velocity is (a) $\sqrt{98}$ ms^{-1} (b) 7 ms^{-1} (c) $\sqrt{490}$ ms^{-1} (d) $\sqrt{4.9}$ ms^{-1}	
9	A long horizontal rod has a bead, which can slide along its length and initially placed at a distance L from one end A of the rod. The rod is set in angular acceleration α. If the coefficient of friction, between the rod and the bead is μ and gravity is neglected, then the time after which the bead starts slipping is (a) $\sqrt{\mu/\alpha}$ (b) $\mu/\sqrt{\alpha}$ (c) $1/\sqrt{\mu\alpha}$ (d) Infinitesimal	
10	A car moving on a circular path and takes a turn. If R_1 and R_2 be the reactions on the inner and outer wheels respectively, then (a) $R_1 = R_2$ (b) $R_1 < R_2$ (c) $R_1 > R_2$ (d) $R_1 \geq R_2$	
11	The length of second's hand in a watch is 1 cm. The change in velocity of its tip in 15 s is	

	(a) zero (b) $\frac{\pi}{30\sqrt{2}}$ cm/s (c) $\frac{\pi}{30}$ cm/s (d) $\frac{\pi\sqrt{2}}{30}$ cm/s	
12	A wheel rotates with a constant angular velocity of 300 rpm. The angle through which the wheel rotates in one second is (a) π rad (b) 5π rad (c) 10π rad (d) 20π rad	
13	If a particle covers half the circle of radius R with constant speed, then (a) Change in momentum is mvr (b) Change in KE is $\frac{1}{2}mv^2$ (c) Change in KE is mv^2 (d) Change in KE is zero	
14	The string of a pendulum of length l is displaced through 90^0 from the vertical and released. Then, the minimum strength of the string in order to withstand the tension as the pendulum passes through the mean position is (a) mg (b) 6 mg (c) 3 mg (d) 5 mg	
15	An object is being weighed on a spring balance moving around a curve of radius 100 m at a speed 7 ms^{-1}. The object has a weight of 60 kg-wt. The reading registered on the spring balance would be (a) 60.075 kg-wt (b) 60.125 kg-wt (c) 60.175 kg-wt (d) 60.225 kg-wt	

CONCEPT-11: BASED ON MOTION IN VERTICAL CIRCLE

1	A stone of mass m is tied to a string and is moved in a vertical circle of radius r making n revolution per minute. The total tension in the string when the stone is at its lowest point is (a) mg (b) $m(g + \pi nr^2)$ (c) $m(g + \pi nr)$ (d) $m\{g + (\pi^2n^2r)/900\}$	
2	A stone of mass 1 kg is tied to a string 4 m long and is rotated at constant speed of 40 ms^{-1} in a vertical circle. The ratio of the tension at the top and the bottom is (a) 11 : 12 (b) 39 : 41 (c) 41 : 39 (d) 12 : 11	
3	A weightless thread can bear tension upto 3.7 kg-wt. A stone of mass 500 g is tied to it and revolved in a circular path of radius 4 m in a vertical plane. If g = 10 ms^{-2}, then	

	the maximum angular velocity of the stone will be (a) 4 rad/s (b) 16 rad/s (c) $\sqrt{21}$ rad/s (d) 2 rad/s	
4	A 2 kg stone at the end of a string 1 m long is whirled in a vertical circle at a constant speed. The speed of the stone is 4 m/s. The tension in the string will be 52 N, when the stone is (a) At the top of the circle (b) At the bottom of the circle (c) Halfway down (d) None of the above	
5	An object is tied to a string and rotated in a vertical circle of radius r. Constant speed is maintained along the trajectory. If $T_{max}/T_{min} = 2$, then υ^2 / rg is (a) 1 (b) 2 (c) 3 (d) 4	
6	A body crosses the topmost point of a vertical circle with critical speed. What will be its acceleration when the string is horizontal? (a) g (b) 2g (c) 3 g (d) 6 g	
7	A frictionless track ABCDE ends in a circular loop of radius R, figure. A body slides down the track from point A which is at a height h = 5 cm. Maximum value of R for the body to successfully complete the loop is  (a) 5 cm (b) 15/4 cm (c) 10/3 cm (d) 2 cm	
8	A simple pendulum oscillates in a vertical plane. When it passes through the mean position the tension in the string is 3 times the weight of pendulum bob. What is the maximum displacement of the pendulum with respect to the vertical? (a) 30^0 (b) 45^0 (c) 60^0 (d) 90^0	
9	In figure, a particle is placed at the highest point A of a smooth sphere of radius r. It is given slight push, and it leaves the sphere at B, at a depth h vertically below A such that h is equal to	

	 (a) $\frac{r}{6}$ (b) $\frac{1}{4}$ r (c) $\frac{1}{3}$ r (d) $\frac{1}{2}$ r	
10	A stone tied to a string of length L is whirled in a vertical circle, with the other end of the string at the centre. At a certain instant of time, the stone is at its lowest position, and has a speed u. The magnitude of change in its velocity as it reaches a position, where the string is horizontal is (a) $\sqrt{u^2-2gL}$ (b) $\sqrt{2gL}$ (c) $\sqrt{u^2-gL}$ (d) $\sqrt{2(u^2-gL)}$	
11	Read each of the following statements carefully and state with reasons, chose the correct statement (S) (i) The net acceleration of a particle in the circular motion is always along the radius of the circle (ii) The velocity vector of a particle at a point is always along the tangent to the path of the particle at that point. (iii) The acceleration vector of a particle in uniform circular motion averaged over one cycle is a null vector. (a) (i) and (iii) (b) (ii) and (iii) (c) (iii) only (d) All the three	
12	A particle is moving in a vertical circle. The tensions in the string when passing through two positions at angles 30^0 and 60^0 from vertical (lowest position) are T_1 and T_2 respectively. (a) $T_1 = T_2$ (b) $T_2 > T_1$ (c) $T_1 > T_2$ (d) Tension in the string always remains the same	
13	A body of mass 1 kg is rotating in a vertical circle of radius 1 m. What will be the difference in its kinetic energy at the top and bottom of the circle? (Take g = 10 ms^{-2}) (a) 10 J (b) 20 J (c) 30 J (d) 50 J	

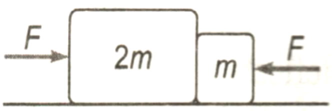
CONCEPT-12: BASED ON BENDING OF ROADS AND RAILWAY TRACKS

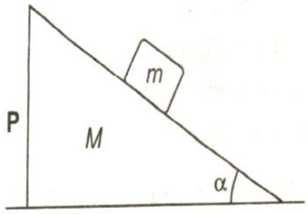
1	A fan is making 600 revolution per minute. If after some time it makes 1200 revolution per minute, then increase in its angular velocity is (a) 10 π rad/s (b) 20 π rad/s (c) 40 π rad/s (d) 60 π rad/s	

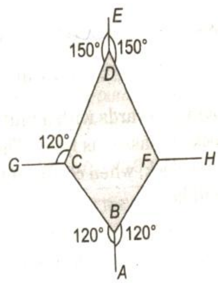
2	A body moves along a circular path of radius 5 m. The coefficient of friction between the surface of path and the body is 0.5. The angular velocity, in rad/s, with which the body should move so that it does not leave the path is (g = 10 ms^{-2}) (a) 4 (b) 3 (c) 2 (d) 1	
3	A car is moving on a circular level road of radius of curvature 300 m. If the coefficient of friction is 0.3 and acceleration due to gravity 10 ms^{-2}, the maximum speed of the car can have is (in kmh^{-1}) (a) 30 (b) 81 (c) 108 (d) 162	
4	A railway carriage has its centre of gravity at a height of 1 m above the rails, which are 1.5 m apart. The maximum safe speed at which it could travel round an unbanked curve of radius 100 m is (a) 12 ms^{-1} (b) 18 ms^{-1} (c) 22 ms^{-1} (d) 27 ms^{-1}	
5	A car of mass 2000 kg is moving with a speed of 10 ms^{-1} on a circular path of radius 20 m on a level road. What must be the frictional force between the car and the road so that the car does not slip? (a) 10^4 N (b) 10^3 N (c) 10^5 N (d) 10^2 N	
6	A stone tied to the end of a string 80 cm long is whirled in a horizontal circle with a constant speed. If the stone makes 14 revolutions in 25 s, what is the magnitude and direction of acceleration of the stone? (a) 9.9 m/s^2 along the tangent (b) 7.9 m/s^2 along the radius (c) 9.9 m/s^2 along the radius (d) None of the above	
7	An aircraft executes a horizontal loop of radius 1 km with a speed of 900 km/h. Compare its centripetal acceleration with the acceleration due to gravity. (a) 6 (b) 7 (c) 8 (d) 5	
8	A coin placed on a rotation turn table slops when it is placed at a distance of 9 cm from the centre. If the angular velocity of the turn table is tripled. It will just slip. If its distance from the centre is (a) 27 cm (b) 9 cm (c) 3 cm (d) 1 cm	
9	What should be the coefficient of friction between the tyres and the road, when a car travelling at 60 kmh^{-1} makes a level turn of radius 40 m?	

	(a) 0.5 (b) 0.66 (c) 0.71 (d) 0.80	
10	The maximum speed with which a car is driven round a curve of radius 18 m without skidding (where, g = 10 ms^{-2} and the coefficient of friction between rubber tyres and the roadway is 0.2) is (a) 36.0 kmh^{-1} (b) 18.0 kmh^{-1} (c) 21.6 kmh^{-1} (d) 14.4 kmh^{-1}	
11	What is the smallest radius of a circle at which a cyclist can travel it its speed is 36 kmh^{-1}, angle of inclination is 45^0 and g = 10 ms^{-2}? (a) 20 m (b) 10 m (c) 30 m (d) 40 m	
12	The angle which the bicycle and its rider must make with the vertical when going round a curve of 7 m radius at 5 ms^{-1} is (a) 20^0 (b) 15^0 (c) 10^0 (d) 5^0	
13	A car rounds an unbanked curve of radius 92 m without skidding at a speed of 26 ms^{-1}. The smallest possible coefficient of static friction between the tyres and the road is (a) 0.75 (b) 0.60 (c) 0.45 (d) 0.30	
14	A particle moves in circular path of radius R. If centripetal force F is kept constant but the angular velocity is double, the new radius of the path will be (a) 2R (b) R/2 (c) R/4 (d) 4R	
15	A curved road of 50 m radius is banked at correct angle for a given speed. If the speed is to be doubled keeping the same banking angle, the radius of curvature of the road should be changed to (a) 25 m (b) 100 m (c) 150 m (d) 200 m	

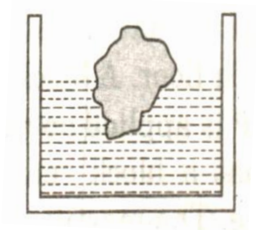
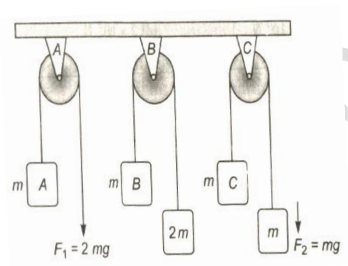
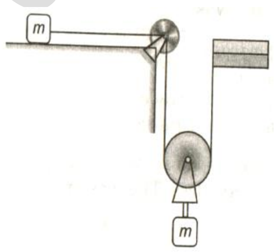
CONCEPT-13: BASED ON FORCE, MOMENTUM AND FRICTION

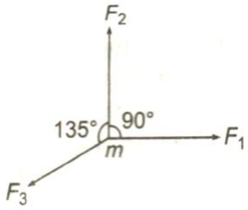
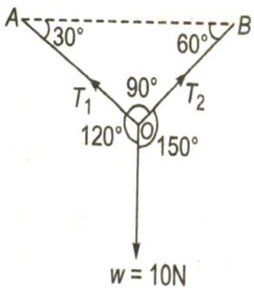
1	Two blocks are in contact on a frictionless table. One has mass m and other 2m. A force f is applied on 2m as shown in figure. Next the same force F is applied from the right on m. In the two cases respectively, the force of contact between the two blocks will be  (a) 2 : 1 (b) 1 : 3 (c) 1 : 2 (d) 3 : 1	
2	A ball of mass 0.2 kg is thrown vertically upwards by applying a force by hand. If the hand moves 0.2 m while applying force and the ball goes upto 2 m height further	

	find, the magnitude of the force. Consider g = 10 m/s^2 (a) 16 N (b) 20 N (c) 22 N (d) 44 N	
3	A wooden wedge of mass M and inclination angle α rests on a smooth floor. A block of mass m is kept on wedge. A force P is applied on the wedge as shown in figure, such that a block remains stationary with respect to wedge. The magnitude of force P is  (a) (M + m) g tan α (b) g tan α (c) mg cos α (d) (M + m)gcosec α	
4	Conservation of momentum in a collision between particles can be understood from (a) Conservation of energy (b) Newton's first law only (c) Newton's second law only (d) Both Newton's second and third law	
5	A body of mass 0.05 kg is observed to fall with an acceleration of 9.5 ms^{-2}. The opposite force of air on the body is (g = 9.8 ms^{-2}) (a) 0.015 N (b) 0.15 N (c) 0.030 N (d) zero	
6	A rocket with a lift-off mass 20000 kg is blasted upwards with an initial acceleration of 5.0 m/s^2. Calculate the initial thrust (force) of the blast. (a) 3×10^5 N (b) 2×10^5 N (c) 4×10^5 N (d) 5×10^5 N	
7	A lift is moving upwards with a uniform velocity υ in which a block of mass m is lying. The frictional force offered by the block, when coefficient of the frictional force is μ, will be (a) zero (b) mg (c) μ mg (d) 2μ mg	
8	Two blocks of masses m_1 = 4 kg and m_2 = 2 kg are connected to the ends of a string which passes over a massless, frictionless pulley. The total downward thrust on the pulley is nearly (a) 27 N (b) 54 N (c) 0.8 N (d) zero	
9	A man wants to slide down a rope. The breaking load for	

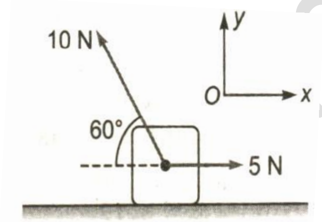
	the rope $\frac{2}{3}$rd of the weight of the man. With what minimum acceleration should fireman slide down? (a) $\frac{g}{4}$ (b) $\frac{g}{3}$ (c) $\frac{2g}{3}$ (d) $\frac{g}{6}$	
10	A body weighs 8 g when placed in one pan and 18 g when placed on the other pan of a false balance. If the beam is horizontal when both the pans are empty, the true weight of the body is (a) 13 g (b) 12 g (c) 15.5 g (d) 15 g	
11	A body of mass 5 kg is acted upon by two perpendicular forces 8 N and 6 N. Give the magnitude and direction of the acceleration of the body (a) 2 m/s^2 at an angle 37^0 to force (b) 2 m/s^2 at an angle 57^0 to force (c) 4 m/s^2 at angle 37^0 to force (d) 4 m/s^2 at an angle 57^0 to force	
12	A sphere is accelerated upward by a cord whose breaking strength is four times its weight. The maximum acceleration with which the sphere can move up without breaking the cord is (a) g (b) 3 g (c) 2 g (d) 4 g	
13	A body of mass 2 kg travels according to law $x(t) = pt + qt^2 + rt^3$, where $p = 3\ ms^{-1}$, $q = 4\ ms^{-2}$ and $r = 5\ ms^{-3}$. The force acting on the body at t = 2 s is (a) 136 N (b) 134 N (c) 158 N (d) 68 N	
14	The adjacent figure is the part of a horizontally stretched net section AB is stretched with a force of 10 N. The tension in the section BC and BF are  (a) 10 N, 11 N (b) 10 N, 6 N (c) 10 N, 10 N (d) Can't calculate due to insufficient data	
15	A bag of sand of mass m is suspended by a rope. A bullet	

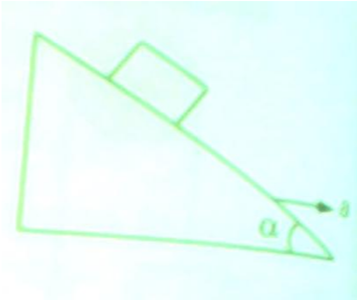
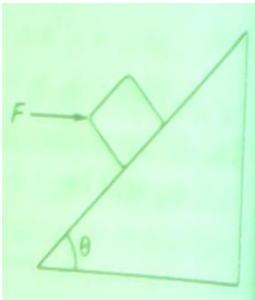
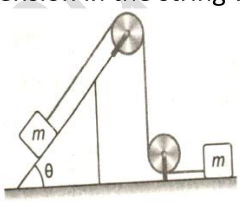
	of mass $\frac{m}{20}$ is fired at it with a velocity υ and gets embedded into it. The velocity of the bag finally is (a) $\frac{v}{20}$ x 21 (b) $\frac{20v}{21}$ (c) $\frac{v}{20}$ (d) $\frac{v}{21}$	
16	The engine of a car produces an acceleration of 6 ms^{-2} in the car. If this car pulls another car of the same mass, then the acceleration would be (a) 6 ms^{-2} (b) 12 ms^{-2} (c) 3 ms^{-2} (d) 1.5 ms^{-2}	
17	A constant force acting on a body of mass 3.0 kg changes its speed from 2.0 m/s to 3.5 s. The direction of motion of the body remains unchanged. What is the magnitude and direction of the force? (a) 0.18 N, along the direction of motion (b) 0.18 N, opposite to the direction of motion (c) 0.28 N, along the direction of motion (d) 0.28 N, opposite to the direction of motion	
18	If a body of mass m is moving on a rough horizontal surface of coefficient of kinetic friction μ, the net electromagnetic force exerted by surface on the body is (a) mg $\sqrt{1+\mu^2}$ (b) μmg (c) mg (d) mg $\sqrt{1-\mu^2}$	
19	An open carriage in a goods train is moving with a uniform velocity of 10 ms^{-1}. If the rain adds water with zero velocity at the rate of 5 kgs^{-1}, then the additional force applied by the engine to maintain the same velocity of the train is (a) 0.5 N (b) 2.0 N (c) 50 N (d) 25 N	
20	A batsman deflects a ball by an angle 45^0 without changing its initial speed which equal to 54 km/h. What is the impulse imparted to the ball? (Mass of the ball is 0.15 kg). (a) 4 kg-m/s (b) kg-m/s (c) 2 kg-m/s (d) 5 kg-m/s	
21	A body floats in a liquid contained in a beaker. If the whole system as shown in figure of all freely under gravity, then the upthrust on the body due to liquid is	

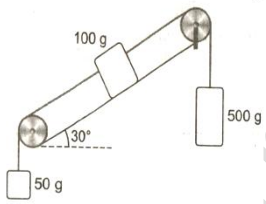
	 (a) Zero (b) Equal to the weight of liquid displaced (c) Equal to the weight of the body in air (d) None of the above	
22	An object at rest in space suddenly explodes into three parts of same mass. The momentum of the two parts are 2 $p\hat{i}$ and $p\hat{j}$. The momentum of the third part (a) Will have a magnitude $p\sqrt{3}$ (b) Will have a magnitude $p\sqrt{5}$ (c) Will have a magnitude p (d) Will have a magnitude 2p	
23	In figure, the blocks A, B and C each of mass m have acceleration a_1, a_2 and a_3 respectively. F_1 and F_2 are external forces of magnitude 2 mg and mg respectively. Then  (a) $a_1 = a_2 = a_3$ (b) $a_1 > a_3 > a_2$ (c) $a_1 = a_2$, $a_2 = a_3$ (d) $a_1 = a_2$, $a_1 = a_3$	
24	If the surface is smooth, the acceleration of the block m_2 will be  (a) $\frac{m_2 g}{4m_1 + m_2}$ (b) $\frac{2m_2 g}{4m_1 + m_2}$ (c) $\frac{2m_1 g}{m_1 + 4m_2}$ (d) $\frac{2m_1 g}{m_1 + m_2}$	
25	If a force of 250 N act on body the momentum acquired is	

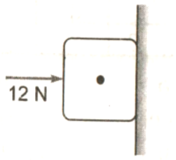
	125 kg-m/s. What is the period for which force acts on the body? (a) 0.5 s (b) 0.2 s (c) 0.4 s (d) 0.25 s	
26	A point mass m is moving along inclined plane with acceleration a with respect to smooth triangular block. The triangular block is moving horizontally with acceleration a_0. The value of a is (a) g sin θ + a_0 cos θ (b) g sin θ - a_0 cos θ (c) g cos θ - a_0 sin θ (d) None of these	
27	When a force F acts on a body of mass m, the acceleration produced in the body is a. If three equal forces $F_1 = F_2 = F_3$ = F act on the same body as shown in figure, the acceleration produced is  (a) $\left(\sqrt{2}-1\right)$ a (b) $\left(\sqrt{2}+1\right)$ a (c) $\sqrt{2}$ a (d) a	
28	Two weights w_1 and w_2 are suspended from the ends of a light string over a smooth fixed pulley. If the pulley is pulled up with acceleration g, the tension in the string will be (a) $\frac{4w_1w_2}{w_1+w_2}$ (b) $\frac{2w_1w_2}{w_1+w_2}$ (c) $\frac{w_1-w_2}{w_1+w_2}$ (d) $\frac{w_1w_2}{2(w_1+w_2)}$	
29	A ball of mass 1 kg hangs in equilibrium from two strings OA and OB as shown in figure. What are the tensions in strings OA and OB? (Take g = 10 ms^{-2})  (a) 5 N, zero (b) Zero, N (c) 5 N, 5$\sqrt{3}$ N (d) 5$\sqrt{3}$ N, 5 N	

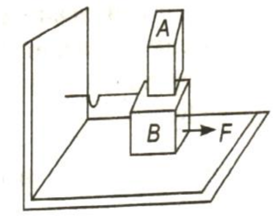
30	A disc of mass 10 g is kept floating horizontally in air by firing bullets, each of mass 5 g, with the same velocity at the same rate of 10 bullets per second. The bullets rebound with the same speed in positive direction. The velocity of each bullet at the time of impact is (a) 196 cms^{-1} (b) 98 cms^{-1} (c) 49 cms^{-1} (d) 392 cms^{-1}	
31	A ball is travelling with uniform translator motion. This means that (a) It is at rest (b) The path can be a straight line or circular and the ball travels with uniform speed (c) All parts of the ball have the same velocity (magnitude and direction) and the velocity is constant (d) The centre of the ball moves with constant velocity and the ball spins about its centre uniformly	
32	A satellite in force free space sweeps stationary interplanetary dust at a rate dM/dt = $\alpha\upsilon$, where M is the mass, υ is the velocity of the satellite and α is a constant. What is the deacceleration of the satellite? (a) $-2\,\alpha v^2/M$ (b) $-\alpha v^2/M$ (c) $+\alpha v^2/M$ (d) $-\alpha v^2$	
33	A metre scale is moving with uniform velocity. This implies (a) The force acting on the scale is zero, but a torque about the centre of mass can act on the scale (b) The force acting on the scale is zero and the torque acting about centre of mass of the scale is also zero (c) The total force acting on it need not be zero but the torque on it is zero (d) Neither the force nor the torque need to be zero	
34	A bird is sitting in a large closed cage which is placed in a spring balance. It records a weight of 25 N. The bird (mass m = 0.5 kg) flies upward in the cage with an acceleration of 2 m/s^2. The spring balance will now record a weight if (a) 24 N (b) 25 N (c) 26 N (d) 27 N	
35	A cricket ball of mass 150 g has an initially velocity u = $(3\hat{i}+4\hat{j})$ ms^{-1} and a final velocity $\upsilon=(3\hat{i}+4\hat{j})$ ms^{-1}. After behind hit. The change is (in kg ms^{-1}) (a) Zero (b) $-(0.45\hat{i}+0.6\hat{j})$ (c) $-(0.9\hat{i}+1.2\hat{j})$ (d) $-5(\hat{i}+\hat{j})$	
36	In the above question the magnitude of the momentum	

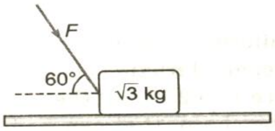
	transferred during the hit is (a) Zero (b) 0.75 kg ms^{-1} (c) 1.5 kg ms^{-1} (d) 14 kg ms^{-1}	
37	A frictionless inclined plane of length l having inclination θ is placed inside a lift which is accelerating downward with an acceleration α(< g). If a block is allowed to move. Down the inclined plane, from rest, then the time taken by the block to slide from top of the inclined plane to the bottom of the inclined plane is (a) $\sqrt{\frac{2l}{g}}$ (b) $\sqrt{\frac{2l}{g-a}}$ (c) $\sqrt{\frac{2l}{g+a}}$ (d) $\sqrt{\frac{2l}{(g-a)\sin\theta}}$	
38	A rocket with a lift-off mass 10^5 kg is blasted upward with an initial acceleration of 5 ms^{-2}. If g = 10 ms^{-2}, then the initial thrust of the blast is (a) 1.5 x 10^2 N (b) 1.5 x 10^3 N (c) 1.5 x 10^5 N (d) 1.5 x 10^6 N	
39	A block of mass $\sqrt{3}$ kg rests on a horizontal frictionless xy-plane. What would be the acceleration of the block if it is subjected to two forces as shown in figure?  (a) 2.5 ms^{-2} (b) 5 ms^{-2} along y-axis (c) 10 ms^{-2} along x-axis (d) 15 ms^{-2} along y-axis	
40	Two masses of 3 kg and 5 kg are suspended from the ends of an unstreatchable massless cord passing over a frictionless pulley. When the masses are released, the pressure on the pulley is (a) 2 kgf (b) 7.5 kgf (c) 8 kgf (d) 15 kgf	
41	In a rocket of mass 1000 kg fuel is consumed at a rate of 40 kg/s. The velocity of the gases ejected from the rocket is 5 x 10^4 m/s. The thrust on the rocket is (a) 2 x 10^3 N (b) 5 x 10^4 N (c) 2 x 10^6 N (d) 2 x 10^9 N	
42	A block is kept on a frictionless inclined surface with angle of inclination (α). The incline is given an acceleration α to	

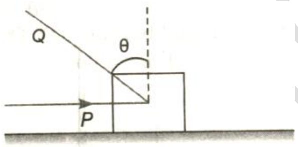
	keep the block stationary. Then α is equal to  (a) g (b) g tan α (c) g / tan α (d) g cosec α	
43	A horizontal force is applied on a block of mass m placed on a rough inclined plane of inclination θ. The normal reaction N is  (a) mg cos θ (b) mg sin θ (c) mg cos θ - Fcos θ (d) mg cos θ + F sin θ	
44	For the system shown in figure, the pulleys are light and frictionless. The tension in the string will be  (a) $\frac{2}{3}mg\sin\theta$ (b) $\frac{3}{2}mg\sin\theta$ (c) $\frac{1}{2}mg\sin\theta$ (d) $2mg\sin\theta$	
45	An object is kept on a smooth inclined plane of 1 in l. The horizontal acceleration to be imparted to the inclined plane so that the object is stationary relative to the inclined is (a) $g\sqrt{l^2-1}$ (b) $g(l^2-1)$	

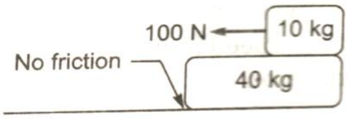
	(c) $\frac{g}{\sqrt{l^2-1}}$ (d) $\frac{g}{l^2-1}$	
46	The monkey B shown in figure is holding on to the tail of the monkey A which is climbing up a rope. The masses of the monkeys A and B are 5 kg and 2 kg respectively. If A can tolerate a tension of 30 N in its tail, what force should it apply on the rope in order to carry the monkey B with its? (Take g = 10 ms^{-2})  (a) 105 N (b) 108 N (c) 10.5 N (d) 100 N	
47	The acceleration of the 500 g block in figure is  (a) $\frac{6g}{13}$ downwards (b) $\frac{7g}{13}$ downwards (c) $\frac{8g}{13}$ downwards (d) $\frac{9g}{13}$ upwards	
48	An elevator and its load have a total mass of 800 kg. The elevator is originally moving downwards at 10 ms^{-1}, it slows down to stop with constant acceleration in a distance of 25 m. Find the tension T in the supporting cable while the elevator is being brought to rest. (Take g = 10 ms^{-2}) (a) 8000 N (b) 1600 N (c) 9600 N (d) 6400 N	
49	A body with mass 5 kg is acted upon by a force F = $\left(-3\hat{i}+4\hat{j}\right)$N. If its initial velocity at t = 0 is v = $\left(6\hat{i}-12\hat{j}\right)$ ms^{-1}, the time at which it will just have a velocity along the y-axis is	

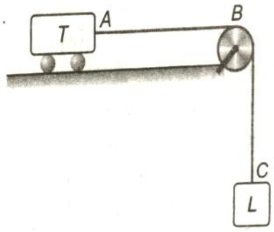
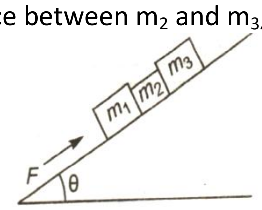
	(a) Never (b) 10 s (c) 2 s (d) 15 s	
50	A 1000 kg lift is supported by a cable that can support 2000 kg. The shortest distance in which the lift can be stopped when it is descending with a speed of 2.5 ms^{-1} is [Take g = 10 ms^{-2}] (a) 1 m (b) 2 m (c) $\frac{5}{32}$ m (d) $\frac{5}{16}$ m	
51	A block of weight 5 N is pushed against a vertical wall by a force 12 N. The coefficient of friction between the wall and block is 0.6. The magnitude of the force exerted by the wall on the block is  (a) 12 N (b) 5 N (c) 7.2 N (d) 13 N	
52	A blumb bob is hung from the ceiling of a train compartment. The train moves on an inclined track of inclination 30^0 with horizontal. Acceleration of train up the plane is α = 9/2. The angle which the string supporting the bob makes with normal to the ceiling in equilibrium is (a) 30^0 (b) $\tan^{-1}\left(\frac{2}{\sqrt{3}}\right)$ (c) $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (d) $\tan^{-1}(2)$	
53	A block is gently placed on a conveyor belt moving horizontally with constant speed. After 4 s the velocity of the block becomes equal to the velocity of belt. If the coefficient of friction between the block and the belt is 0.2, then velocity of the conveyor belt is (a) 2 ms^{-1} (b) 4 ms^{-1} (c) 6 ms^{-1} (d) 8 ms^{-1}	
54	A cricket ball of mass 150 g collides straight with a bat with a velocity of 10 ms^{-1}. Batsman hits it straight back with a velocity of 20 ms^{-1}. If ball remains in contact with bat for 0.1s, then average force exerted by the bat on the ball is (a) 15 N (b) 45 N (c) 150 N (d)4.5 N	
55	A block of mass 1 kg is at rest on a horizontal table. The coefficient of static friction between the block and the table is 0.5. If g = 10 ms^{-2}, then the magnitude of the force	

	acting upwards at an angle of 60^0 from the horizontal that will just start the block moving is (a) 5 N (b) 5.36 N (c) 74.6 N (d) 10 N	
56	100 g of an iron ball having velocity 10 ms^{-1} collides with wall at an angle 30^0 and rebounds with the same angle. If the period of contact between the ball and wall is 0.1s, then the average force experienced by the wall is (a) 10 N (b) 100 N (c) 1.0 N (d) 0.1 N	
57	A heavy uniform chain lies on a horizontal table top. If the coefficient of friction between the chain and the table surface is 0.25 then the maximum fraction of length of the chain, that can hang over one edge of the table is (a) 20% (b) 25% (c) 35% (d) 15%	
58	A block A with mass 100 kg is resting on another block B of mass 200 kg. As shown in figure, a horizontal rope tied to a wall holds it. The coefficient of friction between A and B is 0.2 while coefficient of friction between B and the ground is 0.3. the minimum required force F to start moving B will be  (a) 900 N (b) 100 N (c) 1100 N (d) 1200 N	
59	A maximum speed that can be achieved without skidding by a car on a circular unbanked road of radius R and coefficient of static friction μ is (a) μ Rg (b) Rg $\sqrt{\mu}$ (c) $\mu\sqrt{Rg}$ (d) $\sqrt{\mu Rg}$	
60	A chain lies on a rough horizontal table. It starts sliding when one-fourth of its length hangs over the edge of the table. The coefficient of static friction between the chain and the surface of the table is (a) $\frac{1}{2}$ (b) $\frac{1}{3}$ (c) $\frac{1}{4}$ (d) $\frac{1}{5}$	
61	A fireman of mass 60 kg slides down a pole He is pressing the pole with a force of 600 N. The coefficient of friction between the hands and the pole is 0.5 with what acceleration with the fireman slide down? (g = 10 m/s^2) (a) 1 m/s^2 (b) 2.5 m/s^2 (c) 10 m/s^2 (d) 5 m/s^2	
62	The minimum velocity (in ms^{-1}) with which a car driver must traverse a flat curve of radius 150 m and coefficient	

	of friction 0.6 to avoid skidding is (a) 60 ms^{-1} (b) 30 ms^{-1} (c) 15 ms^{-1} (d) 25 ms^{-1}	
63	A block of mass $\sqrt{3}$ kg resting on a horizontal surface. A force F is applied on the block as shown in figure. If coefficient of friction between the block be $\frac{1}{2\sqrt{3}}$ what can be the maximum value of force F so that block does not start moving? (Take g = 10 ms^{-2})  (a) 20 N (b) 10 N (c) 12 N (d) 15 N	
64	A heavy uniform chain lies on horizontal table top. If the coefficient of friction between the chain and the table surface is 0.25, then the maximum fraction of the length of the chain that can hang over one edge of the table is (a) 20% (b) 25% (c) 35% (d) 15%	
65	A block moves down a smooth inclined plane of inclination θ. Its velocity on reaching the bottom is υ. If it slides down a rough inclined plane of same inclination, its velocity on reaching the bottom is υ / n, where n is a number greater than 1. The coefficient of friction is given by (a) $\mu = \tan\theta\left(1-\frac{1}{n^2}\right)$ b) $\mu = \cot\theta\left(1-\frac{1}{n^2}\right)$ (c) $\mu = \tan\theta\left(1-\frac{1}{n^2}\right)^{1/2}$ (d) $\mu = \cot\theta\left(1-\frac{1}{n^2}\right)^{1/2}$	
66	A smooth inclined plane of length L having inclination θ with the horizontal is inside a lift which is moving down with retardation α. The time taken by a body to slide down the inclined plane, from rest, will be (a) $\sqrt{\frac{2L}{(g+a)\sin\theta}}$ (b) $\sqrt{\frac{2L}{(g-a)\sin\theta}}$ (c) $\sqrt{\frac{2L}{g\sin\theta}}$ (d) $\sqrt{\frac{2L}{a\sin\theta}}$	

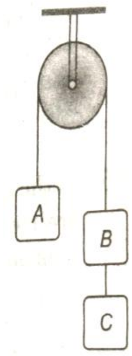
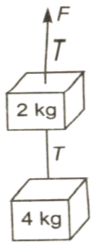
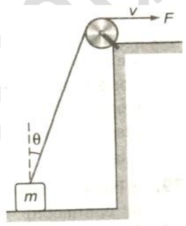
67	A wooden box of mass 8 kg slides down an inclined plane of inclination 30^0 to the horizontal with a constant acceleration of 0.4 ms^{-2}. What is the force of friction between the box and inclined plane? (g = 10 ms^{-2}) (a) 36.8 N (b) 76.8 N (c) 65.6 N (d) 97.8 N	
68	The coefficient of kinetic friction between a 20 kg box and the floor is 0.40. How much work does a pulling force do on the box in pulling it 8.0 m across the floor at constant speed? The pulling force is directed 37^0 above the horizontal (a) 343 J (b) 482 J (c) 14.4 J (d) None of these	
69	A car starts from rest to cover a distance s. The coefficient of friction between the road and the tyres is m. The minimum time in which the car can cover the distance is proportional to (a) μ b) $\sqrt{\mu}$ (c) 1/μ (d) $1/\sqrt{\mu}$	
70	A block of mass m lying on a rough horizontal plane is acted upon by a horizontal force P and another force Q inclined at an angle θ to the vertical. The block will remain in equilibrium if the coefficient of friction between it and the surface is  (a) $\frac{P+Q\sin\theta}{mg+Q\cos\theta}$ (b) $\frac{P\cos\theta+Q}{mg-Q\sin\theta}$ (c) $\frac{P+Q\cos\theta}{mg+Q\sin\theta}$ (d) $\frac{P\sin\theta-Q}{mg-Q\cos\theta}$	
71	A partly hanging uniform chain of length L is resting on a rough horizontal table. l is the maximum possible length that can hang in equilibrium. The coefficient of friction between the chain and table is (a) $\frac{l}{L-l}$ (b) $\frac{L}{l}$ (c) $\frac{l}{L}$ (d) $\frac{lL}{L+l}$	
72	A box of mass m kg is placed on the rear side of an open truck accelerating at 4 ms^{-2}. The coefficient of friction between the box and the surface below it is 0.4. The net acceleration of the box with respect to the truck is zero.	

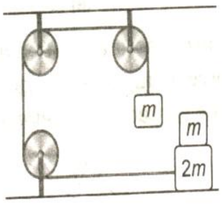
	The value of m is [Given g = 10 ms^{-2}) (a) 4 kg (b) 8 kg (c) 9.78 kg (d) It could be any value	
73	A 40 kg slab rests on a frictionless floor. A 10 kg block rests on top of the slab. The static coefficient of friction between the block and the slab is 0.60 while the kinetic coefficient of friction is 0.40. The 10 kg block is acted upon by a horizontal force of 100 N. If g = 9.8 ms^{-2}, the resulting acceleration of the slab will be  (a) 1.47 ms^{-2} (b) 1.69 ms^{-2} (c) 9.8 ms^{-2} (d) 0.98 ms^{-2}	
74	A body of mass 40 kg resting on a rough horizontal surface is subjected to a force P which is just enough to start the motion of the body. If μ_s = 0.5, μ_k = 0.4, g = 10 ms^{-2} and the force P is continuously applied on the body, then the acceleration of the body is (a) Zero (b) 1 ms^{-2} (c) 2 ms^{-2} (d) 2.4 ms^{-2}	
75	The coefficient of friction between a body and the surface of an inclined plane at 45^0 is 0.5 if g = 9.8 m/s^2. The acceleration of the body downwards in m/s^2 is (a) $\frac{4.9}{\sqrt{2}}$ (b) $4.9\sqrt{2}$ (C) $19.2\sqrt{2}$ (d) 4.9	
76	A rope of length L and mass M is hanging from a right support. The tension in the rope at a distance x from the rigid support is (a) Mg (b) $\left(\frac{L-X}{L}\right)Mg$ (c) $\left(\frac{L}{L-X}\right)Mg$ (d) $\frac{X}{L}Mg$	
77	A plate of mass M is placed on a horizontal frictionless surface (see figure) and a body of mass m is placed on this plate. The coefficient of dynamics friction between this body and the plate is μ. If a force 2 μmg is applied to the body of mass m along the horizontal, the acceleration of the plate will be	

	 (a) $\frac{\mu m}{M}g$ (b) $\frac{\mu m}{(M+m)}g$ (c) $\frac{2\mu m}{M}g$ (d) $\frac{2\mu m}{(M+m)}g$	
78	A man weighing 60 kg is standing on a trolley weighing 240 kg. The trolley is resting on frictionless horizontal rails. If the man starts walking on the trolley with a velocity of 1 ms^{-1}, then after 4s, his displacement relative to the ground is (a) 6 m (b) 4.8 m (c) 3.2 m (d) 2.4 m	
79	light frictionless pulley to a hanging block of mass 5 kg. The coefficient of kinetic friction between the block and the surface is 0.5. Tension in the cord is (Take g = 9.8 ms^{-2}) (a) 49 N (b) 36 N (c) 36.75 N (d) 2.45 N	
80	Three blocks are placed at rest on a smooth inclined plane with force acting on m_1 parallel to the inclined plane. Find the contact force between m_2 and m_3,  (a) $\frac{(m_1+m_2+m_3)F}{m_3}$ (b) $\frac{m_3 F}{m_1+m_2+m_3}$ (c) F – $(m_1 + m_2)g$ (d) None of these	

CONCEPT-14: BASED ON CONNECTED BODY MOTION

1	Three equal weight A, B and C of mass 2 kg each are hanging on a string passing over a fixed frictionless pulley as shown in the figure. The tension in the string connecting weight B and C is	

3	 (a) Zero (b) 13 N (c) 3.3 N (d) 19.6 N	
2	Two blocks are connected by a string as shown in the diagram. The upper block is hung by another string. A force applied on the upper string produces an acceleration of 2 m/s^2 in the upward direction in both the blocks. If T and T' be the tensions in the two parts of the string, then (g = 9.8 m/s^2)  (a) T = 70.8 N and T' = 47.2 N (b) T = 58.8 N and T' = 47.2 N (c) T = 70.8 N and T' = 58.8 N (d) T = 70.8 N and T' = 0	
3	A block is dragged on a smooth horizontal plane with the help of a light rope which moves with a velocity υ as shown in figure. The horizontal velocity of the block is  (a) v (b) v sin θ (c) $\frac{v}{\sin\theta}$ (d) $\frac{v}{\cos\theta}$	
4	A mass of 3 kg descending vertically downward supports a mass of 2 kg by means the end of 5s, the string breaks. How much higher the 2 kg mass will go further?	

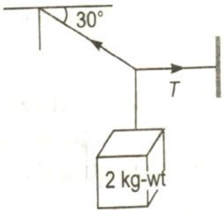
	 (a) 4.9 m (b) 9.8 m (c) 19.6 m (d) 2.45 m	
5	Two bodies of masses m_1 and m_2 are connected by a light, inextensible string which passes over a frictionless pulley. If the pulley is moving upward with uniform acceleration g, then the tension in the string is (a) $\frac{4m_1m_2}{m_1+m_2}$ (b) $\frac{m_1m_2}{4m_1m_2}g$ (c) $\frac{m_1m_2}{m_1+m_2}g$ (d) $\frac{m_1-m_2}{m_1+m_2}g^2$	
6	In the given arrangement, n number of equal masses are connected by strings of negligible masses. The tension in the string connected to nth mass is (a) $\frac{mMg}{nm+M}$ (b) $\frac{mMg}{nmM}$ (c) mg (d) mng	
7	In the figure, the ball A is released from rest when the spring is at its natural length. For the block B of mass M to leave contact with the ground at same stage, the minimum mass of A must be  (a) 2 M (b) M (c) $\frac{M}{2}$ (d) a function of M and the force constant of the spring	
8	A shell is fired from a cannon with velocity υ ms^{-1} at an angle θ with the horizontal direction. At the highest point in its path it explodes into two pieces of equal mass. One of the pieces retraces its path to the cannon and the speed	

in m/s of the piece immediately after the explosion is

(a) 3v cos θ (b) 2v cos θ

(c) $\frac{3v}{2}\cos\theta$ (d) $\frac{\sqrt{3}v\cos\theta}{2}$

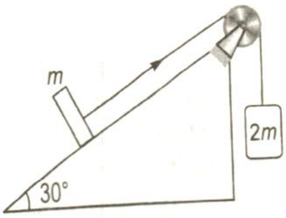
9 A body of weight 2 kg is suspended as shown in figure. The tension T_1 in the horizontal string (in kg-wt) is



(a) $2/\sqrt{3}$ (b) $\sqrt{3}/2$

(c) $2\sqrt{3}$ (d) 2

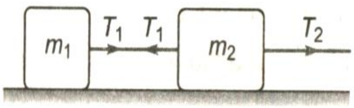
10 Two blocks of masses m and 2m are connected by a light string passing over a frictionless pulley. As shown in the figure, the mass m is placed on a smooth inclined plane of inclination 30^0 and 2m hangs vertically. If the system is released, the blocks move with an acceleration equal to



(a) $\frac{g}{4}$ (b) $\frac{g}{3}$

(c) $\frac{g}{2}$ (d) g

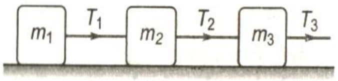
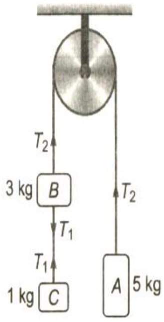
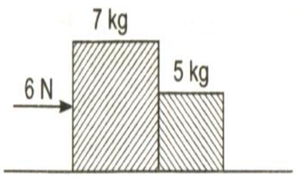
11 Refer to the system shown in figure. The ratio of tensions T_1 and T_2 is

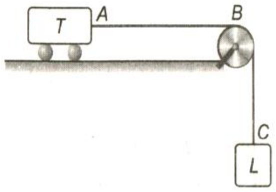


(a) $\frac{m_1}{m_1+m_2}$ (b) $\frac{m_2}{m_1+m_2}$

(c) $\frac{m_1}{m_2}$ (d) $\frac{m_2}{m_1}$

12 In the figure a smooth pulley of negligible weight is suspended by a spring balance. Weights of 1 kg and 5 kg are attached to the opposite ends of a string passing over the pulley and move with acceleration because of gravity.

	During their motion, the spring balance reads a weight of  (a) 6 kg (b) Less than 6 kg (c) More than 6 kg (d) May be more or less than 6 kg	
13	Three blocks of masses m_1, m_2 and m_3 are connected by massless strings as shown on a frictionless table in figure. They are pulled with a force T_3 = 40 N. If m_1 = 10 kg, m_2 = 6 kg and m_3 = 4 kg, the tension T_2 will be  (a) 20 N (b) 40 N (c) 10 N (d) 32 N	
14	Refer to the system shown in figure. The acceleration of the masses is  (a) $\frac{g}{3}$ (b) $\frac{g}{6}$ (c) $\frac{g}{9}$ (d) $\frac{g}{12}$	
15	Two block of masses 7 kg and 5 kg are placed in contact with each other on a smooth surface. If a force of 6 N is applied on a heavier mass the force on the lighter mass is  (a) 3.5 N (b) 2.5 N (c) 7 N (d) 5 N	
16	A trolley T (mass 5 kg) on a horizontal smooth surface is	

	pulled by a load L (2 kg) through a uniform rope ABC of length 2 m and mass 1kg. As the load falls from BC = 0 to BC = 2 m, its acceleration (in ms^{-2}) changes from (Take g = 10 ms^{-2})  (a) 20/6 to 20/5 (b) 20/8 to 30/8 (c) 20/5 to 30/6 (d) None of these	

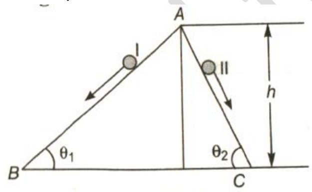
CONCEPT-15: BASED ON WORK & ENERGY

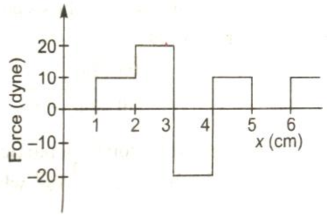
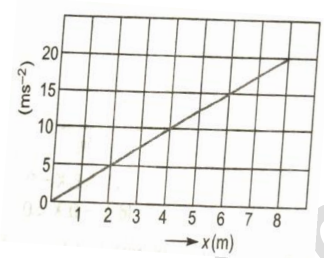
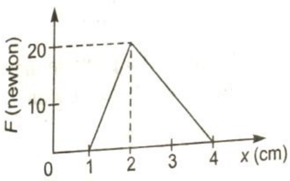
1	Under the action of a force, a 2 kg body moves such that its position x as a function of time t is given by $x = t^3/3$, where x is in metre and t in second. The work done by the force in the first two seconds is (a) 1.6 J (b) 16 J (c) 160 J (d) 1600 J	
2	The work done in pulling up a block of wood weighing 2 kN for a length of 10 m on a smooth plane inclined at an angle of 15^0 with the horizontal is [sin 15^0 = 0.2588] (a) 4.36 kJ (b) 5.13 kJ (c) 8.91 kJ (d) 9.82 kJ	
3	A mass M is lowered with the help of a string by a distance h at a constant acceleration g/2. The work done by the string will be (a) $\frac{Mgh}{2}$ (b) $\frac{-Mgh}{2}$ (c) $\frac{3Mgh}{2}$ (d) $\frac{-3Mgh}{2}$	
4	An electron and a proton are moving under the influence of mutual forces. In calculating the change in the kinetic energy of the system during motion, one ignores the magnetic force of one on another. This is because, (a) The two magnetic forces are equal and opposite, so they produce no net effect (b) The magnetic forces do no work on each particle (c) The magnetic forces do equal and opposite (but non-zero) work on each particle (d) The magnetic forces are necessarily negligible	
5	A ball of mass 0.2 kg is thrown vertically upwards by applying a force by hand. If the hand moves 0.2 m while applying the force and the ball goes upto 2 m height further. Find the magnitude of force (Consider g = 10 m/s^2) (a) 22 N (b) 4 N (c) 16 N (d) 20 N	

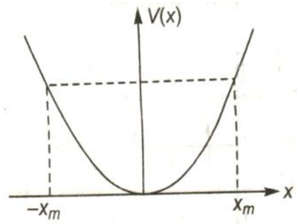
6	A 5 kg brick of 20 cm x 10 cm x 8 cm dimensionless lying on the largest base. It is now made to stand with length vertical. If g = 10 ms^{-2}, then the amount of work done is (a) 3 J (b) 5 J (c) 7 J (d) 9 J	
7	A block of mass 10 kg slides down a rough slope which is inclined at 45^0 to the horizontal. The coefficient of sliding friction is 0.30. when the block has slide 5 m, the work done on the block by the force of friction is nearly (a) 115 J (b) $75\sqrt{2}$ J (c) 321.4 J (d) - 321.4 J	
8	In a children's park, there is a slide which has a total length of 10 m and a height of 8.0 m. A vertical ladder is provided to reach the top. A boy weighing 200 N climbs up the ladder to the top of the slide and slides down to the ground. The average friction offered by the slide is three-tenth of his weight. The work done by the slide on the boy as he comes down is  (a) Zero (b) + 600 J (c) – 600 J (d) + 1600 J	
9	A proton is kept at rest. A positively charged particle is released from rest at a distance d in its field. Consider two experiments; one in which the charged particle is also a proton and in another, a positron. In the same time t, the work done on the two moving charged particles is (a) Same as the same force law is involved in the experiments (b) Less for the case of a positron, as the positron moves away more rapidly and the force on it weakness. (c) More for the case of a positron, as the positron moves away a larger distance (d) Same as the work done by charged particle on the stationary proton	
10	A man squatting on the ground gets straight up and stand. The force of reaction of ground on the man during the process is (a) Constant and equal to mg in magnitude (b) Constant and greater than mg in magnitude (c) Variable but always greater than mg (d) At first greater than mg, and later becomes equal to mg	
11	A ball is released from the top of a tower. The ratio of	

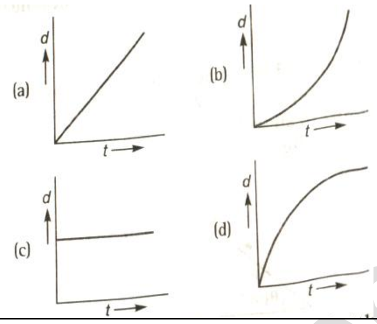
	work done by force of gravity in 1st second, 2nd second and 3rd second of the motion of ball is (a) 1 : 2 : 3 (b) 1 : 4 : 16 (c) 1 : 3 : 5 (d) 1 : 9 : 25	
12	A plate of mass m, length b and breadth α is initially lying on a horizontal floor with length parallel to the floor and breadth perpendicular to the floor. The work done to erect it on its breadth is (a) $mg\left[\frac{b}{2}\right]$ (b) $mg\left[a+\frac{b}{2}\right]$ (c) $mg\left[\frac{b-a}{2}\right]$ (d) $mg\left[\frac{b+a}{2}\right]$	
13	The displacement x in metre of a particle of mass m kg moving in one dimension under the action of a force is related to the time t in second by the equation t = $\sqrt{x}$ + 3, the work done by the force (in joule) in first six second is (a) 18 m (b) zero (c) 9 m/2 (d) 36 m	
14	A position-dependent force F = $3x^2 - 2x + 7$ acts on a body of mass 7 kg and displaces it from x = 0 m to x = 5 m. The work done on the body is x' joule. If both F and x are measured is SI units, the value of x' is (a) 135 (b) 235 (c) 335 (d) 935	
15	A body of mass 0.5 kg travels n a straight line with velocity, $\upsilon = ax^{3/2}$, where a = 5 $m^{-1/2}/s$. What is the work done by the net force during its displacement from x = 0 to x = 2 m? (a) 30 J (b) 40 J (c) 20 J (d) 50 J	
16	A uniform chain of length L and mass M overhangs a horizontal table with its two-third part on the table. The friction coefficient between the table and the chain is μ. The work done by the friction during the period the chain slips off the table is (a) $-\frac{1}{4}\mu MgL$ (b) $-\frac{2}{9}\mu MgL$ (c) $-\frac{4}{9}\mu MgL$ (d) $-\frac{6}{7}\mu MgL$	
17	A 5 kg stone of relative density 3 is resting at the bed of a lake. It is lifted through a height of 5 m in the lake. If g = 10 ms^{-2}, then the work done is (a) $\frac{500}{3}J$ (b) $\frac{350}{3}J$	

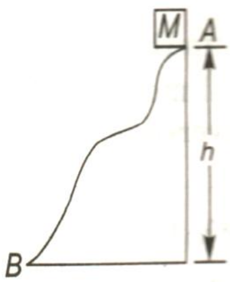
	(c) $\frac{750}{3}J$ (d) Zero	
18	A force acts on a 30 g particle in such a way that the position of the particle as function of time is given by x = 3t – 4t^2 + t^3, where x is in metre and t is in second. The work done during the first 4 seconds is (a) 5.28 J (b) 450 mJ (c) 490 mJ (d) 530 mJ	
19	A car weighing 1400 kg is moving at a speed of 54 kmh^{-1} up a hill when the motor stops. If it is just able to reach the destination which is at a height of 10 m above the point, then the work done against friction (negative of the work done by the friction) is (Take g = 10 ms^{-2}) (a) 10 kJ (b) 15 kJ (c) 17.5 kJ (d) 25 kJ	
20	A cord is used to lower vertically a block of mass M by a distance d with constant downward acceleration g/4 work done by the cord on the block is (a) Mg $\frac{d}{4}$ (b) 3Mg $\frac{d}{4}$ (c) -3Mg$\frac{d}{4}$ (d) Mgd	
21	Water is drawn from a well in a 5 kg drum of capacity 55 L by two ropes connected to the top of the drum. The linear mass density of each rope is 0.5 kgm^{-1}. The work done in lifting water to the ground from the surface of water in the well 20 m below is (g = 10 ms^{-2}) (a) 1.4 x 10^4 J (b) 1.5 x 10^4 J (c) 9.8 x 10 x 6 J (d) 18 J	
22	A wire of length L suspended vertically from a rigid support is made to suffer extension l in its length by applying a force F. The work is (a) $\frac{Fl}{2}$ (b) Fl (c) 2 Fl (d) Fl	
23	A bicyclist comes to a skidding stop in 10 m. During this process, the force on the bicycle due to the road is 200 N and is directly opposed to the motion. The work done by the cycle on the road is (a) + 2000 J (b) – 200 J (c) Zero (d) – 20,000 J	
24	A uniform chain of length L and mass M is lying on a smooth table and one third of its length is hanging	

	vertically down over the edge of the table. If g is acceleration due to gravity, the work required to pull the hanging part on the table is (a) MgL (b) MgL/3 (c) MgL/9 (d) MgL/18	
25	During inelastic collision between two bodies, which of the following quantities always remain conserved? (a) Total kinetic energy (b) Total mechanical energy (c) Total linear momentum (d) Speed of each body	
26	A spring of spring constant 5×10^3 Nm^{-1} is stretched initially by 5 cm from the unstretched position. Then the work required to stretch it further by another 5 cm is (a) 12.50 N-m (b) 18.75 N-m (c) 25.00 N-m (d) 6.25 N-m	
27	A rod AB of mass 10 kg and length 4 m rests on a horizontal floor with end A fixed so as to rotate it in vertical. Work done on the rod is 100 J. The height to which the end B be raised vertically above the floor is (a) 1.5 m (b) 2.0 m (c) 1.0 m (d) 2.5 m	
28	Two inclined frictionless tracks, one gradual and the other steep meet at A from where two stones are allowed to slide down from rest, one on each track as shown in figure.  Which of the following statement is correct? (a) Both the stones reach the bottom at the same time but not with the same speed (b) Both the stones reach the bottom with the same speed and stone I reaches the bottom earlier than stone II (c) Both the stones reach the bottom with the same speed and stone II reaches the bottom earlier than stone I (d) Both the stones reach the bottom at different times and with different speeds	
29	A force $F = Ay^2 + By + C$ acts on a body in the y-direction. The work done by this force during a displacement from y = - a to y = a is (a) $\frac{2Aa^5}{3}$ (b) $\frac{2Aa^5}{3} + 2Ca$	

	(c) $\frac{2Aa^5}{3}+\frac{Ba^2}{2}+Ca$ (d) None of these	
30	The relationship between force and position is shown in figure given (in one dimensional case). The work done by the force is displaying a body from x = 1 cm to x = 5 cm is  (a) 20 erg (b) 60 erg (c) 70 erg (d) 700 erg	
31	A 10 kg brick moves along an x-axis. Its acceleration as a function of its position is shown in figure. What is the net work performed on the brick by the force causing the acceleration as the brick moves from x = 0 to x = 8.0 m?  (a) 4 J (b) 8 J (c) 2 J (d) 1 J	
32	A 2.0 kg block is dropped from a height of 40 cm onto a spring of spring constant k = 1960 Nm^{-1}. Find the maximum distance the spring is compressed. (a) 0.080 m (b) 0.20 m (c) 0.40 m (d) 0.10 m	
33	The graph between the resistive force F acting on a body and the distance covered by the body is shown in the figure. The mass of the body is 2.5 kg and initial velocity is 2 m/s. When the distance covered by the body is 4 m, its kinetic energy would be  (a) 50 J (b) 40 J (c) 20 J (d) 10 J	
34	A stone tied to a string of length L is whirled in a vertical circle with the other end of the string at the centre. At a certain instant of time, the stone is at its lowest position and has a speed u. The magnitude of the change in its	

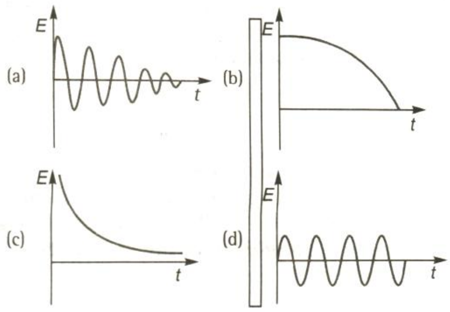
	velocity as it reaches a position where the string is horizontal is (a) $\sqrt{u^2-2gl}$ (b) $\sqrt{2gl}$ (c) $\sqrt{u^2-gl}$ (d) $\sqrt{2(u^2-gL)}$	
35	The potential energy function for a particle executing linear SHM is given by V (x) = $\frac{1}{2}$ kx^2 where k is the force constant of the oscillator. For k = 0.5 N/m, the graph of V(x) versus x is shown in the figure. A particle of total energy E turns back when it reaches x = ± x_m. If V and K indicate the PE and KE respectively of the particle at x = ± x_m then which of the following is correct?  (a) V = 0, K = E (b) V = E, K = 0 (c) V < E, K = 0 (d) V = 0, K < 0	
36	An elastic string of unstretched length L and force constant k is stretched by a small length x. It is further stretched by another small length y. The work done in the second stretching is (a) $\frac{1}{2}ky^2$ (b) $\frac{1}{2}k(x^2+y^2)$ **(c)** $\frac{1}{2}k(x+y)^2$ (d) $\frac{1}{2}ky(2x+y)$	
37	A ball is projected vertically upwards with a certain initial speed. Another ball of the same mass is projected at an angle of 60^0 with the vertical with the same initial speed. At highest point of their journey, the ratio of their potential energies will be (a) 1 : 1 (b) 2 : 1 (c) 3 : 2 (d) 4 : 1	
38	The kinetic energy K of a particle moving in straight line depends upon the distance s as K = as^2 The force acting on the particle is (a) 2 as (b) 2 mas (c) 2a (d) $\sqrt{as^2}$	
39	A body of mass 0.5 kg travels in a straight line with velocity $\upsilon = a\, x^{3/2}$ where a = 5m$^{-1/2}$s^{-1}. The work done by the net force during its displacement from x = 0 to x = 2m is (a) 1.5 J (b) 50 J (c) 10 J (d) 100 J	

40	When a man increases his speed by 2 ms^{-1}, he finds that his kinetic energy is doubled, the original speed of the man is (a) $2(\sqrt{2}-1)$ ms^{-1} (b) $2(\sqrt{2}+1)$ ms^{-1} (c) 4.5 ms^{-1} (d) None of these	
41	A 0.5 kg ball is thrown up with an initial speed 14 m/s and reaches a maximum height of 8.0 cm. How much energy is dissipated by air drag acting on the ball during the time of ascent? (a) 19.6 J (b) 4.9 J (c) 10 J (d) 9.8 J	
42	A body is moving unidirectionally under the influence of a source of constant power supplying energy. Which of the diagrams shown in figure correctly shows the displacement-time curve for its motion? 	
43	A stone of mass 2 kg is projected upward with kinetic energy of 98 J. The height at which the kinetic energy of the body becomes half its original value, is given by (Take g = 10 ms^{-2}) (a) 5 m (b) 2.5 m (c) 1.5 m (d) 0.5 m	
44	A ball whose kinetic energy is E, is projected at an angle 45^0 to the horizontal. The kinetic energy of the ball at the highest point of its flight will be (a) E (b) $\frac{E}{\sqrt{2}}$ (c) $\frac{E}{2}$ (d) Zero	
45	A body is falling freely under the action of gravity alone in vacuum. Which of the following quantities remain constant during the fall? (a) Kinetic energy (b) Potential energy (c) Total mechanical energy (d) Total linear energy	
46	The potential energy as a function of the force between two atoms in a diatomic molecules is given by $U(x)=\frac{a}{x^{12}}-\frac{b}{x^{6}}$, where a and b are positive constants and x is the distanc between the atoms. The position of stable equilibrium for the system of the two atoms is given	

	(a) x = $\frac{a}{b}$ (b) x = $\sqrt{\frac{a}{b}}$ (c) x = $\frac{\sqrt{3a}}{b}$ (d) x = $\sqrt[6]{\left(\frac{2a}{b}\right)}$	
47	The potential energy of a particle of mass 5 kg moving in the xy-plane is given by U = (-7x + 24y) J, x and y being in metre. If the particle starts from rest from origin, then speed of particle at t = 2s is (a) 5 ms^{-1} (b) 01 ms^{-1} (c) 17.5 ms^{-1} (d) 10 ms^{-1}	
48	A running man has half the kinetic energy of that of a boy of half of his mass. The man speeds up by 1 m/s, so as to have same kinetic energy as that of the boy. The original speed of the man will be (a) $\sqrt{2}$ m/s (b) $\sqrt{2}-1$ m/s (c) $\frac{1}{\sqrt{2}-1}$ m/s (d) $\frac{1}{\sqrt{2}}$ m/s	
49	If a body looses half of its velocity on penetrating 3 cm in a wooden block, then how much will it penetrate more before coming to rest? (a) 1 cm (b) 2 cm (c) 3 cm (d) 4 cm	
50	In the given curved road, if particle is released from A, then  (a) Kinetic energy at B must be mgh (b) Kinetic energy at B may be zero (c) Kinetic energy at B must be less than mgh (d) Kinetic energy at B must not be equal to zero	
51	Two springs have force constants k_1 and k_2. These are extended through the same distance x. If their elastic energies are E_1 and E_2, then $\frac{E_1}{E_2}$ is equal to	

(a) $k_1 : k_2$ (b) $k_2 : k_1$
(c) $\sqrt{k_1} : \sqrt{k_2}$ (d) $k_1^2 : k_2^2$

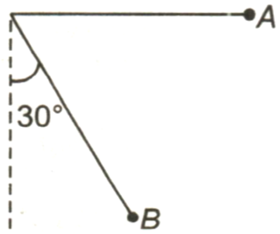
52 Which of the diagrams shown in figure represents variation of total mechanical energy of a pendulum oscillating in air as function of time?



53 A 50 g bullet moving with a velocity of 10 ms^{-1} gets embedded into a 950 g stationary body. The loss in kinetic energy of the system will be
(a) 95% (b) 100% (c) 5% (d) 50%

54 A car is moving with a speed of 100 kmh^{-1}. If the mass of the car is 950 kg, then its kinetic energy is
(a) 0.367 M J (b) 3.67 J
(c) 3.67 M J (d) 367 J

55 A simple pendulum is released from A as shown. If M and l represent the mass of the bob and length of the pendulum respectively, the gain in kinetic energy at B is



(a) $\frac{Mgl}{2}$ (b) $\frac{\sqrt{3}}{2}Mgl$
(c) $\frac{Mgl}{\sqrt{2}}$ (d) $\frac{2}{\sqrt{3}}mgl$

56 Two masses of 1 g and 4 g are moving with equal kinetic energies. The ration of the magnitudes of their linear momenta is
(a) 4 : 1 (b) $\sqrt{2}$: 1
(c) 1 : 2 (d) 1 : 16

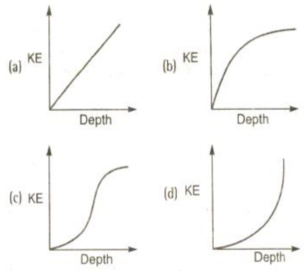
57 A mass of 5 kg is moving along a circular path of radius 1 m. If the mass moves with 300 revolutions per minute, its kinetic energy would be

	(a) $250\pi^2$ (b) $100\pi^2$ (c) $5\pi^2$ (d) 0	
58	A body of mass 2 kg is thrown up vertically with kinetic energy of 490 J. The height at which the kinetic energy of the body becomes half of its original value is (a) 50 m (b) 12.25 m (c) 25 m (d) 10 m	
59	In a shotput event an athlete throws the shotput of mass 10 kg with an initial speed of 1 ms^{-1} at 45^0 from height 1.5 m above ground. Assuming air resistance to be negligible and acceleration due to gravity to be 10 ms^{-2}, the kinetic energy of the shotput when it just reaches the ground will be (a) 2.5 J (b) 5.0 J (c) 52.5 J (d) 155.0 J	
60	A machine which is 75% efficient uses 12 J of energy in lifting up a 1 kg mass through a certain distance. The mass is then allowed to fall through that distance. The velocity of the ball at the end of its fall is (a) $\sqrt{24}$ ms^{-1} (b) $\sqrt{32}$ ms^{-1} (c) $\sqrt{18}$ ms^{-1} (d) 3 ms^{-1}	
61	A body of mass 4 kg is moving with momentum of 8 kg-ms^{-1}. A force of 0.2 N acts on it in the direction of motion of the body for 10 s. The increase in kinetic energy in joule is (a) 10 (b) 8.5 (c) 4.5 (d) 4	
62	A body of mass M is dropped from a height h on a sand floor. If the body penetrates x cm into the sand, the average resistance offered by the sand to the body is (a) $Mg\left(\frac{h}{x}\right)$ (b) $Mg\left(1+\frac{h}{x}\right)$ (c) Mgh + Mgx (d) $Mg\left(1-\frac{h}{x}\right)$	
63	A mass of 50 kg is raised through a certain height by a machine whose efficiency is 90%, the energy is 5000 J. If the mass is now released, its kinetic energy on hitting the ground shall be (a) 5000 J (b) 4500 J (c) 4000 J (d) 5500 J	
64	Given that the position of the body in metre is a function of time as follows $X = 2t^4 + 5t + 4$ The mass of the body is 2 kg. What is the increase in its	

	kinetic energy, one second after the start of motion? (a) 168 J (b) 169 J (c) 32 J (d) 144 J	
65	A bomb of mass 3.0 kg explodes in air into two pieces of mass2.0 kg and 1.0 kg. The smaller mass goes at a speed of 80 m/s. The total energy imparted to the two fragment is (a) 1.07 k J (b) 2.14 k J (c) 2.4 k J (d) 4.8 k J	
66	A bomb of mass 9 kg explodes into 2 pieces of mass 3 kg and 6 kg. The velocity of mass 3 kg is 1.6 m/s, the kinetic energy of mass 6 kg is (a) 3.84 J (b) 9.6 J (c) 1.92 J (d) 2.92 J	
67	An engine pumps water continuously through a hole. Speed with which water passes through the hole nozzle is υ and k is the mass per unit length of the water jet as it leaves the nozzle. Find the rate at which kinetic energy is being imparted to the water. (a) $\frac{1}{2}kv^2$ (b) $\frac{1}{2}kv^3$ (c) $\frac{v^2}{2k}$ (d) $\frac{v^3}{2k}$	
68	In the stable equilibrium position, a body has (a) Maximum potential energy (b) Minimum potential energy (c) Minimum kinetic energy (d) Maximum kinetic energy	
69	A stone is dropped from the top of a tall tower. The ratio of the kinetic energy of the stone at the end of three second to the increase in the kinetic energy of the stone during the next three seconds is (a) 1 : 1 (b) 1 : 2 (c) 1 : 3 (d) 1 : 9	
70	A rectangular plank of mass m_1 and height a is kept on a horizontal surface. Another rectangular plank of mass m_2 and height b is placed over the first plank. The gravitational potential energy of the system is (a) $[m_1 + m_2(a+b)]g$ (b) $\left[\left(\frac{m_1+m_2}{2}a + m_2\frac{b}{2}\right)\right]g$ (c) $\left[\left(\frac{m_1}{2}+m_2\right)a + m_2\frac{b}{2}\right]g$ (d) $\left[\left(\frac{m_1}{2}+m_2\right)a + m_1\frac{b}{2}\right]g$	

CONCEPT-16: BASED ON POWER

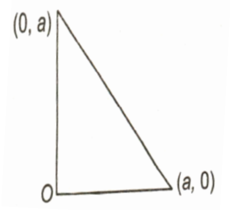
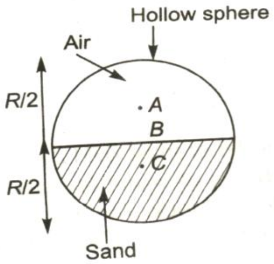
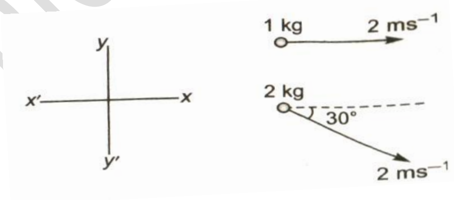
1	A body is initially at rest. It undergoes one-dimensional motion with constant acceleration. The power delivered to it at time t is proportional to (a) $t^{1/2}$ (b) t (c) $t^{3/2}$ (d) t^2	
2	A 10 m long iron chain of linear mass density 0.8 kg m^{-1} is hanging freely from a rigid support. If g = 10 ms^{-2}, then the power required to lift the chain upto the point of support in 10 s is (a) 10 W (b) 20 W (c) 30 W (d) 40 W	
3	A 10 HP motor pump out water from a well of depth 20 m and falls a water tank of volume 22380 litre at a height of 10 m from the ground the running time of the motor to fill the empty water tank is (g = 10 ms^{-2}) (a) 5 min (b) 10 min (c) 15 min (d) 20 min	
4	An engine of power 7500 W makes a train move on a horizontal surface with constant velocity of 20 ms^{-1}. The force involved in the problem is (a) 375 N (b) 400 N (c) 500 N (d) 600 N	
5	A one kilowatt motor is used to pump water from a well 10 m deep. The quantity of water pumped out per second is nearly (a) 1 kg (b) 10 kg (c) 100 kg (d) 1000 kg	
6	A car manufacturer claims that his car can be accelerated from rest to a velocity of 10 ms^{-1} in 5 s. If the total mass of the car and its occupants is 1000 kg, then the average horse power developed by the engine is (a) $\frac{10^3}{746}$ (b) $\frac{10^4}{746}$ (c) $\frac{10^5}{746}$ (d) 8	
7	Which of the diagrams in figure correctly shows the	

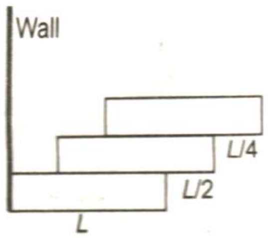
	change in kinetic energy of an iron sphere falling freely in a lake having sufficient depth to impart it a terminal velocity?  	
8	A dam is situated at a height of 550 m above sea level and supplies water to a power house which is at a height of 50 m above sea level. 2000 kg of water passes through the turbines per second. What would be the maximum electrical power output of the power house if the whole system were 80% efficient? (a) 8 MW (b) 10 MW (c) 12.5 MW (d) 16 MW	
9	An automobile weighing 1200 kg climbs up a hill that rises 1 m in 20 s. Neglecting frictional effects, the minimum power developed by the engine is 9000 W. If $g = 10\ ms^{-2}$, then the velocity of the automobile is (a) $36\ kmh^{-1}$ (b) $54\ kmh^{-1}$ (c) $72\ kmh^{-1}$ (d) $90\ kmh^{-1}$	
10	A 500 kg car, moving with a velocity of $36\ kmh^{-1}$ on a straight road unidirectionally, doubles its velocity in one minute. The power delivered by the engine for doubling the velocity is (a) 750 W (b) 1050 W (c) 1150 W (d) 1250 W	
11	The power of a water jet flowing through an orifice of radius r with velocity υ is (a) Zero (b) $500\ \pi^2v^2$ (c) $500\ \pi r^2v^3$ (d) πr^4v	
12	A motor of power P_0 is used to deliver water at a certain rate through a given horizontal pipe. To increase the rate of flow of water through the same pipe n times. The power of the motor is increased to p_1. The ratio of p_1 to p_0 is (a) n : 1 (b) n^2 : 1 (c) n^3 : 1 (d) n^4 : 1	
13	A quarter horse power motor runs at a speed of 600 rpm. Assuming 40% efficiency, the work done by the motor in one rotation will be (a) 7.46 J (b) 7400 J	

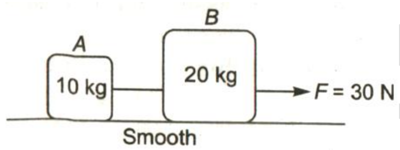
	(c) 7.46 erg (d) 74.6 J	
14	Ten litre of water per second is lifted from well through 20 m and delivered with a velocity of 10 ms^{-1}, then the power of the motor is (a) 1.5 kW (b) 2.5 kW (c) 3.5 kW (d) 4.5 kW	
15	A body is moved along a straight line by machine delivering a constant power. The distance moved by the body in time t is proportional to (a) $t^3/4$ (b) $t^{3/2}$ (c) $t^{1/4}$ (d) $t^{1/2}$	
16	One man takes 1 minute to raise a box to a height of 1 m and another man takes $\frac{1}{2}$ minute to do so. The energy of the two is (a) Different (b) Same (c) Energy of the first is more (d) Energy of the second is more	
17	The power supplied by a force acting on a particle moving in a straight line is constant. The velocity of the particle varies with the displacement x as (a) $x^{1/2}$ (b) x (c) x^2 (d) $x^{1/3}$	
18	A particle of mass m is moving in a circular path of constant radius r such that its centripetal acceleration a_0 is varying with time t as $a_0 = k^2rt^2$. The power is (a) $2\pi mk^2r^2t$ (b) mk^2r^2t (c) $\frac{mk^4r^2t^5}{3}$ (d) Zero	

CONCEPT-17: BASED ON CENTRE OF MASS

1	cricket bat is cut at the location of its centre of mass as shown. Then,  (a) The two pieces will have the same mass (b) The bottom piece will have larger mass (c) The handle piece will have larger mass (d) Mass of handle piece is double the mass of bottom piece	
2	Three rods of the same mass are placed as shown in figure. What will be the coordinates of centre of mass of the system?	

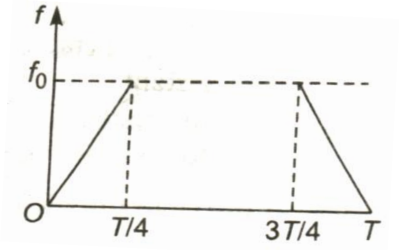
	 (a) $\left[\frac{a}{2},\frac{a}{2}\right]$ (b) $\left[\frac{a}{\sqrt{2}},\frac{a}{\sqrt{2}}\right]$ (c) $\left[\sqrt{2}a,\sqrt{2}a\right]$ (d) $\left[\frac{a}{3},\frac{a}{3}\right]$	
3	Which of the following does the centre of mass lie outside the body? (a) A pencil (b) A shotput (c) A dice (d) A bangle	
4	A man of mass M stands at one end of a plank of length L which is at rest on a frictionless horizontal surface. The man walks to the other end of the plank. If mass of the plank M/3, the distance that the man moves relative to ground is (a) L (b) L/4 (c) 3L/4 (d) L/3	
5	Which of the following points is the likely position of the centre of mass of the system shown in figure.  (a) A (b) B (c) C (d) D	
6	Find the velocity of centre of the system shown in the figure.  (a) $\left(\frac{2+2\sqrt{3}}{3}\right)\hat{i}-\frac{2}{3}\hat{j}$ (b) 4 $\hat{i}$ (c) $\left(\frac{2-2\sqrt{3}}{3}\right)\hat{i}-\frac{2}{3}\hat{j}$ (d) None of these	
7	Four particles of mass 1 kg, 2 kg, 3 kg and 4 kg are placed at the corners A, B, C and D respectively of a square ABCD	

<table>
<tr><td></td><td>of edge X-axis and edge AD is taken along Y-axis, the coordinates of centre of mass is SI unit is
(a) (1, 1) m (b) (5, 7) m
(c) (0.5, 0.7) m (d) None of these</td><td></td></tr>
<tr><td>8</td><td>Three bricks each of length L and mass M are arranged as shown from the wall. The distance of the centre of mass of the system from the wall is


(a) $\frac{L}{4}$ (b) $\frac{L}{2}$
(c) $\frac{3}{2}L$ (d) $\frac{11}{12}L$</td><td></td></tr>
<tr><td>9</td><td>Two blocks A and B are connected by a massless string shown in figure). A force of 30 N is applied on block B. The distance travelled by centre of mass in 2 s starting from rest is


(a) 1 m (b) 2 m
(c) 3 m (d) None of these</td><td></td></tr>
<tr><td>10</td><td>A circular hole of radius 1 cm is cut-off from a disc of radius 6 cm. The centre of hole is 3 m from the centre of the disc. The position of centre of mass of the remaining disc from the centre of disc is
(a) $-\frac{3}{35}$ cm (b) $\frac{3}{35}$ cm
(c) $\frac{3}{10}$ cm (d) None of these</td><td></td></tr>
<tr><td>11</td><td>A non-uniform thin rod of length L is placed along X-axis as such its one of ends is at the origin. The linear mass density of rod is $l = l_0$ x. The distance of centre of mass of rod from the origin is
(a) $\frac{L}{2}$ (b) $\frac{2L}{3}$ (c) $\frac{L}{4}$ (d) $\frac{L}{5}$</td><td></td></tr>
<tr><td>12</td><td>Two boys of masses 10 kg and kg are moving along a vertical rope. The former climbing up with acceleration of 2 ms^{-1} while later coming down with uniform velocity of 2 ms^{-1}. Then tension in rope at fixed support will be (Take g</td><td></td></tr>
</table>

	$= 10\ ms^{-2}$) (a) 200 N (b) 120 N (c) 180 N (d) 160 N	
13	A body of mass M moving with velocity υ ms^{-1} suddenly breaks into two pieces. One part having mass M/4 remains stationary. The velocity of the other part will be (a) v (b)| 2 v (c) $\frac{3v}{4}$ (d) $\frac{4v}{3}$	
14	A particle of mass M is moving in a horizontal circle of radius R with uniform speed υ. When it moves from one point to a diametrically opposite point, its (a) Momentum does not change (b) Momentum changes by 2Mv (c) Kinetic energy changes by Mv^2 (d) None of the above	
15	In the HCL molecule, the separation between the nuclei of the two atoms is about 1.27 $\overset{0}{A}$ (1 $\overset{0}{A}$ = 10^{-10} m). Find the approximate location of the centre of mass of the molecule, given that a chlorine atom is about 35.5 times as massive as a hydrogen atom and nearly all the mass of an atom is concentrated in its nucleus. (a) $r_{CM} = 1.24\ \overset{0}{A}$ (b) $r_{CM} = 2.24\ \overset{0}{A}$ (c) $r_{CM} = 0.24\ \overset{0}{A}$ (d) $r_{CM} = 3.24\ \overset{0}{A}$	
16	When a meteorite burns in the atmosphere, then (a) The momentum conservation principle is applicable to the meteorite system (b) The energy of meteorite remains constant (c) The conservation principle of momentum is applicable to a system consisting of meteorites, earth and air molecules (d) The momentum of meteorite remains constant	
17	A particle of mass m moving with a velocity υ makes an elastic one dimensional collision with a stationary particle of mass establishing a contact with it for extremely small time T. Their force of contact increase from zero to f_0 linearly in time T/4 remains constant for the further time $\frac{T}{2}$ and decrease linearly from f_0 to zero in further time $\frac{T}{4}$ as shown. The magnitude possessed by f_0 is	



(a) $\frac{mv}{T}$ (b) $\frac{2mv}{T}$ (c) $\frac{4mv}{3T}$ (d) $\frac{3mv}{T}$

18 The density of a non-uniform rod of length 1 m is given by $\rho(x) = a(1+bx^2)$ where a and b are constants and $0 \le x \le 1$. The centre of mass of the rod will be at

(a) $\frac{3(2+b)}{4(3+b)}$ (b) $\frac{4(2+b)}{3(3+b)}$

(c) $\frac{3(2+b)}{4(2+b)}$ (d) $\frac{4(3+b)}{3(2+b)}$

19 If momentum of a body remains constant, then mass-speed graph of body is

(a) Circle (b) Straight line

(c) Rectangular hyperbola (d) Parabola

20 A machine gun fires a steady stream of bullets at the rate of n per minute into a stationary target in which the bullets get beaded. If each bullet has a mass ma and arrive at the target with a velocity υ, the average force on the target is

(a) 60 mnv (b) $\frac{60v}{mn}$

(c) $\frac{mnv}{60}$ (d) $\frac{mv}{60n}$

21 A body in equilibrium may not have

(a) Momentum (b) Velocity

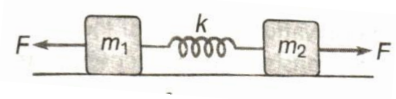
(c) Acceleration (d) Kinetic energy

22 A bomb is kept stationary at a point. It suddenly explodes into two fragments of masses 1 g and 3 g. The total kinetic energy of the fragments is 6.4×10^4 J. What is the kinetic energy of the smaller fragment?

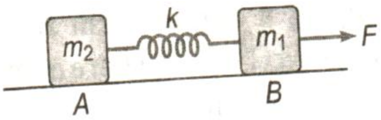
(a) 2.5×10^4 J (b) 3.5×10^4 J

(c) 4.8×10^4 J (d) 5.2×10^4 J

23 In the given figure, two bodies of mass m_1 and m_2 are connected by massless spring of force constant k and are placed on a smooth surface (shown in figure), then



(a) The acceleration of centre of mass must be zero at

	every instant (b) The acceleration of centre of mass may be zero at every instant (c) The system always remains in rest (d) None of the above	
24	A particle moves in the xy-plane under the action of a force F such that the value of its linear momentum P at any time t is $p_x = 2\cos t$, $p_y = 2\sin t$. The angle θ between F and P at a given time t will be (a) 90^0 (b) 0^0 (c) 180^0 (d) 30^0	
25	A set of n identical cubical blocks lies at rest parallel to each other along a line on a smooth horizontal surface. The separation between the near surfaces of any two adjacent blocks is L. The block at one end is given a speed υ towards the next one at time t = 0. All collisions are completely elastic. Then  (a) The last blocks starts moving at time t = (a-1) $\frac{1}{v}$ (b) The last block starts moving at time t = $\frac{(n-1)L}{2v}$ (c) The centre of mass of the system will have a final speed v (d) The centre of mass of the system will have a final speed v/n	
26	Two blocks of masses m_1 and m_2 are connected by a massless spring and placed at smooth surface. The spring initially stretched and released. Then (a) The momentum of each particle remains constant separately (b) The magnitude of momentum of both bodies are same to each other (c) The mechanical energy of system remains constant (d) Both (b) and (c) are correct	
27	When two blocks A and B coupled by a spring on a frictionless table are stretched and then released, then (a) Kinetic energy of body at any instant after releasing is inversely proportional to their masses (b) Kinetic energy of body at any instant may or may not be inversely proportional to their masses (c) $\frac{KE\ of\ B}{KE\ of\ A} = \frac{mass\ of\ B}{mass\ of\ A}$, when spring is massless (d) Both (b) and (c) are correct	

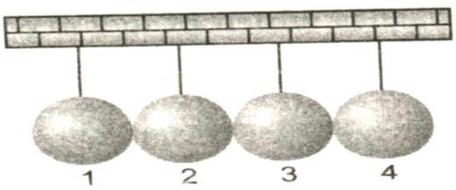
28	An isolated particle of mass m is moving in a horizontal plane (x-y), along the x-axis, at a certain height above the ground. It suddenly explodes into two fragments of masses m/4 and 3m/4. An instant later, the smaller fragment is at y = +15 cm. The larger fragment at this instant is at (a) y = - 5 cm (b) y = + 20 m (c) y = + 5 cm (d) y = - 20 cm	
29	A bomb at rest explodes in air into two equal fragments. If one of the fragments is moving vertically upwards with velocity υ_0 , then the other fragment will move (a) Vertically up with velocity v_0 (b) Vertically down with velocity v_0 (c) In arbitrary direction with velocity v_0 (d) Horizontally with velocity v_0	

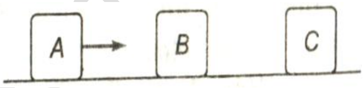
CONCEPT-18: BASED ON COLLISION & COEFFICIENT OF RESTITUTION

1	Which of the following is not a perfectly inelastic collision? (a) Striking of two glass ball (b) A bullet striking a bag of sand (c) An electron captured by a proton (d) A man jumping onto a moving car	
2	A ball of mass m moving with velocity υ collides with another ball of mass 2m and sticks to it. The velocity of the final system is (a) v/3 (b) v/2 (c) 2v (d) 3v	
3	An example of inelastic collision is (a) Scattering of α-particle from a nucleus (b) Collision of ideal gas molecules (c) Collision of two steel balls lying on a frictionless table (d) Collision of a bullet with a wooden block	
4	In an elastic collision (a) Only KE of system is conserved (b) Only momentum is conserved (c) Both KE and momentum are conserved (d) Neither KE nor momentum is conserved	
5	A body of a mass 3 kg is moving with a velocity of 4 ms^{-1} towards right, collides head on with a body of mass 4 kg moving in opposite direction with a velocity of 3 ms^{-1}. After collision the two bodies stick together and move with a common velocity, which is (a) Zero (b) 12 ms^{-1} towards left	

	(c) 12 ms^{-1} towards right (d) $\frac{12}{7}$ ms^{-1} towards left	
6	A sphere of mass m moving with a constant velocity υ hits another stationary sphere of same mass. If e is the coefficient of restitution, then the ratio of velocity of two spheres after collision will be (a) $\frac{1-e}{1+e}$ (b) $\frac{1+e}{1-e}$ (c) $\frac{e+1}{e-1}$ (d) $\frac{e-1}{e+1}t^2$	
7	Two perfectly elastic objects A and B of identical mass are moving with velocities 15ms^{-1} and 10 ms^{-1} respectively, collide along the direction of line joining the. Their velocities after collision are respectively (a) 10 ms^{-1}, 15 ms^{-1} (b) 20 ms^{-1}, 5 ms^{-1} (c) 0 ms^{-1}, 25 ms^{-1} (d) 5 ms^{-1}, 20 ms^{-1}	
8	Two spherical bodies of the same mass M are moving with velocities υ_1 and υ_2. These collide perfectly inelastically. (a) $\frac{1}{2}M(v_1-v_2)^2$ (b) $\frac{1}{2}M(v_1^2-v_2^2)$ (c) $\frac{1}{4}M(v_1-v_2)^2$ (d) $2M(v_1^2-v_2^2)$	
9	Two equal masses m_1 and m_2 moving along the same straight line with velocities +3 m/ and -5 m/s respectively collide elastically. Their velocities after the collision will be respectively (a) + 4 m/s for both (b) – 3 m/s and + 5 m/s (c) – 4 m/s and + 4 m/s (d) – 5 m/s and + 3 m/s	
10	A particle of mass m collides with another stationary particle of mass M. If the particle m stops just after collision, the coefficient of restitution for collision is equal to (a) 1 (b) $\frac{m}{M}$ (c) $\frac{M-m}{M+m}$ (d) $\frac{m}{M+m}$	
11	A bullet of mass m hits a target of mass M hanging by a string and gets embedded in it. If the block rises to a	

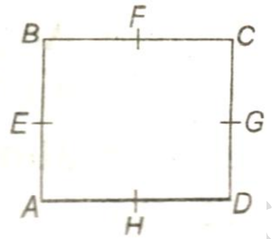
	height h as a result of this collision, the velocity of the bullet before collision is (a) v = $\sqrt{2gh}$ (b) v = $\sqrt{2gh}\left(1+\frac{m}{M}\right)$ (c) v = $\left(1+\frac{m}{M}\right)\sqrt{2gh}$ (d) v = $\sqrt{2gh}\left(1-\frac{m}{M}\right)$	
12	Two particles of masses m_1 and m_2 in projectile motion have velocities v_1 and v_2 respectively at time t = 0. They collide at time t_0. Their velocities become v_1 and v_2 at time 2 t_0 while still moving in air. The value of $[(m_1v_1 + m_2v_2) - (m_1v_1 - m_2v_2)]$ is (a) Zero (b) $(m_1 + m_2)\, gt_0$ (c) $2(m_1 + m_2)\, gt_0$ (d) $\frac{1}{2}(m_1 + m_2)\, gt_0$	
13	In an elastic head on collision between two particles (a) Velocity of separation is equal to the velocity of approach (b) Velocity of the target is always more than the velocity of the projectile (c) The maximum velocity of the target is double to that of the projectile (d) Maximum transfer to kinetic energy occurs when masses of both projectile and target are equal	
14	In a one dimensional collision between two identical particles A and B, where B is stationary and A has momentum p before impact. During impact B gives an impulse J to A. Then coefficient of restitution between the two is (a) $\frac{2J}{p}-1$ (b) $\frac{2J}{p}+1$ (c) $\frac{J}{p}+1$ (d) $\frac{J}{p}-1$	
15	A body of mass 2 kg moving with a velocity of 3m/s collides head-on with a body of mass 1 kg moving in opposite direction with a velocity of 4m/s, after collision two bodies stick together and moves with a common velocity which in m/s is equal to (a) $\frac{1}{4}$ (b) $\frac{1}{3}$ (c) $\frac{2}{3}$ (d) $\frac{3}{4}$	
16	A body is dropped and observed to bounce a height greater than the dropping height. Then (a) The collision is elastic (b) There is additional source of energy during collision (c) It is not possible	

	(d) This type of phenomenon does not occur in nature	
17	A particle of mass m moving with a velocity $\left(3\hat{i}+2\hat{j}\right)$ ms^{-1} collides with a stationary body of mass M and finally moves with a velocity $\left(-2\hat{i}+\hat{j}\right)$ ms^{-1}. If $\frac{m}{M}$ = $\frac{1}{13}$, then (a) The impulse received by M is m (5 $\hat{i}+\hat{j}$) (b) The velocity of the M is $\frac{1}{13}$ (5 $\hat{i}+\hat{j}$) (c) The coefficient of restitutions $\frac{11}{17}$ (d) All of the above are correct	
18	A small block of mass M moves with velocity 5 ms^{-1} towards an another block of same mass M placed at a distance of 2 m on a rough horizontal surface. Coefficient of friction between the two blocks is elastic, the separation between the blocks, when both of them come to rest, is (g = 10 ms^{-2}) (a) 3 m (b) 4 m (c) 2 m (d) 1.5 m	
19	A thick uniform bar lies on a frictionless horizontal surface and is free to move in any way on the surface. Its, mass is 0.16 kg and length is 1.7 m. Two particles each of mass 0.08 kg are moving on the same surface and towards the bar in the direction perpendicular to the bar, one with a velocity of 10 ms^{-1} and other with velocity 6 ms^{-1}. If collision between particles and bar is completely inelastic, both particles strike with the bar simultaneously. The velocity of centre of mass after collision is (a) 2 ms^{-1} (b) 4 ms^{-1} (c) 10 ms^{-1} (d) 167 ms^{-1}	
20	In the given figure four identical spheres of equal mass m are suspended by wires of equal length l_0, so that all spheres are almost touching to one other. If the sphere 1 is released from the horizontal position and all collisions are elastic, the velocity of sphere 4 just after collision is  (a) $\sqrt{2gl_0}$ (b) $\sqrt{3gl_0}$ (c) $\sqrt{gl_0}$ (d) $\frac{\sqrt{gl_0}}{2}$	
21	A ball moving with a certain velocity hits another identical	

	ball at rest. If the plane is frictionless and collision is elastic, the angle between the directions in which the balls move after collision, will be (a) 30^0 (b) 60^0 (c) 90^0 (d) 120^0	
22	A body at rest breaks up into 3 parts. If 2 parts having equal masses fly off perpendicularly each after with a velocity of 12 m/s, then the velocity of the third part which has 3 times mass of each part is (a) $4\sqrt{2}$ m/s at an angle of 45^0 from each body (b) $24\sqrt{2}$ m/s at an angle of 135^0 from each body (c) $6\sqrt{2}$ m/s at 135^0 from each body (d) $4\sqrt{2}$ m/s at 135^0 from each body	
23	Two bodies A and B of definite shape (dimensions of bodies are not ignored). A is moving with speed of 10 ms^{-1} and B is in rest, collides elastically. The (a) Body A comes to rest and B moves with speed of 10 ms^{-1} (b) They may move perpendicular to each other (c) A and B may come to rest (d) They must move perpendicular to each other	
24	If a ball is dropped from rest, its bounces from the floor. The coefficient of restitution is 0.5 and the speed just before the first bounce is 5 ms^{-1}. The total time taken by the ball to come to rest is (a) 2 s (b) 1 s (c) 0.5 s (d) 0.25 s	
25	Three identical blocks A, B and C are placed on horizontal frictionless surface. The blocks A and C are at rest. But A is approaching towards B with a speed of 10 ms^{-1}. The coefficient of restitution for all collisions is 0.5. The speed of the block C just after collision is  (a) 5.6 ms^{-1} (b) 6 ms^{-1} (c) 8 ms^{-1} (d) 10 ms^{-1}	
26	A smooth steel ball strikes a fixed smooth steel plate at an angle θ with the vertical. If the coefficient of restitution is e, the angle at which the rebounce will take place is (a) θ (b) $\tan^{-1}\left(\frac{\tan\theta}{e}\right)$	

	(c) e tan θ (d) $\tan^{-1}\left(\frac{e}{\tan\theta}\right)$	
27	A tennis ball bounces down flight of stairs striking each step in turn and rebounding to the height of the step above. The coefficient of restitution has a value (a) 1/2 (b) 1 (c) $1/\sqrt{2}$ (d) $1/2\sqrt{2}$	

CONCEPT-19: BASED ON MOMENT OF INERTIA

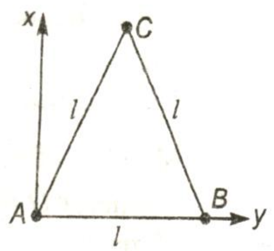
1	Moment of inertia of a uniform circular disc about a diameter is I . Its moment of inertia about an axis perpendicular to its plane and passing through a point on its rim will be (a) 5 I (b) 3 I (c) 6 I (d) 4 I	
2	In a rectangle ABCD (BC = 2AB). The moment of inertia along which axes will be minimum.  (a) BC (b) BD (c) HF (d) EG	
3	Two wheels A and B are mounted on the same axle. Moment of inertia of A is 6 kgm^2 and it is rotating at 600 rpm when B is at rest. What is moment of inertia of B, if their combined speed of 400 rpm? (a) 8 kg m^2 (b) 4 kg m^2 (c) 3 kg m^2 (d) 5 kg m^2	
4	Moment of inertia of a thin rod of mass M and length L about an axis passing through its centre is $\frac{ML^2}{12}$. Its moment of inertia about a parallel axis at a distance of $\frac{L}{4}$ from this axis given by (a) $\frac{ML^2}{48}$ (b) $\frac{ML^3}{48}$ (c) $\frac{ML^2}{12}$ (d) $\frac{7ML^2}{48}$	
5	Two thin uniform circular rings each of radius 10 cm and	

mass 0.1 kg are arranged such that they have a common centre and their planes are perpendicular to each other. The moment of inertia of this system about an axis passing through their common centre and perpendicular to the plane of one of the rings in kgm^2 is

(a) 15×10^{-3} (b) 5×10^{-3}

(c) 1.5×10^{-3} (d) 18×10^{-4}

6 Three particles each of mass m gram, are situated at the vertices of an equilateral triangle ABC of side l cm (as shown in figure). The moment of inertia of the system about a line AX perpendicular to AB and in the plane of ABC in g-cm^2 unit will be



(a) $\frac{3}{4}ml^2$ (b) 2 ml^2

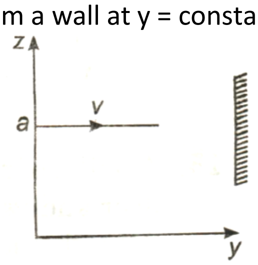
(c) $\frac{5}{4}ml^2$ (d) $\frac{3}{2}ml^2$

7 The moment of inertia of a sphere of mass M and radius R about an axis passing through its centre is $\frac{2}{5}MR^2$. The radius of gyration of the sphere about a parallel axis to the above and tangent to the sphere is

(a) $\frac{2}{5}R$ (b) $\frac{3}{5}R$

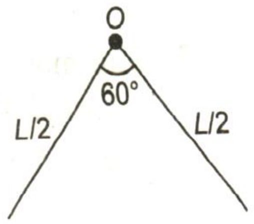
(c) $\left(\sqrt{\frac{7}{5}}\right)R$ (d) $\left(\sqrt{\frac{3}{5}}\right)R$

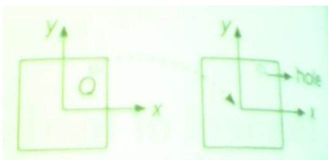
8 A particle of mass m is moving in yz-plane with a uniform velocity υ with its trajectory running parallel to + ve y-axis and intersecting z-axis at z = a. The change in its angular momentum about the origin as it bounces elastically from a wall at y = constant is



(a) mva e_x (b) 2 mva e_x

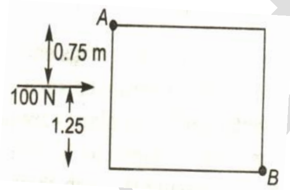
(c) ymv e_x (d) 2ymv e_x

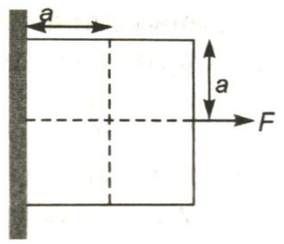
9	Three identical thin rods each of length l and mass M are joined together to form a ladder H. What is the moment of inertia of the system about one of the sides of H? (a) $\frac{Ml^2}{4}$ (b) $\frac{Ml^2}{3}$ (c) $2\frac{Ml^2}{3}$ (d) $4\frac{Ml^2}{3}$	
10	Two discs have same mass and thickness. Their materials have densities d_1 and d_2. The ratio of their moments of inertia about central axis will be (a) $d_1 : d_2$ (b) $d_1d_2 : 1$ (c) $1 : d_1d_2$ (d) $d_2 : d_1$	
11	When a disc rotates with uniform angular velocity, which of the following is not true? (a) The sense of rotation remains same (b) The orientation of the axis of rotation remains same (c) The speed of rotation is non-zero and remains same (d) The angular acceleration is non-zero and remains same	
12	Of the two eggs those have identical sizes, shapes and weights, one is raw, and other is half boiled. The ratio between the moment of inertia of the raw to the half boiled egg about central axis is (a) One (b) Greater than one (c) Less than one (d) Not comparable	
13	Moment of inertia of a solid cylinder of length L and diameter D about an axis passing through its centre of gravity and perpendicular to its geometric axis is (a) $M\left(\frac{D^2}{4}+\frac{L^2}{12}\right)$ (b) $M\left(\frac{L^2}{16}+\frac{D^2}{8}\right)$ (c) $M\left(\frac{D^2}{4}+\frac{L^2}{6}\right)$ (d) $M\left(\frac{L^2}{12}+\frac{D^2}{16}\right)$	
14	A thin rod of length L and mass M is bent at the middle point O at an angle of 60^0. The moment of inertia of the rod about an axis passing through O and perpendicular to the plane of the rod will be  	

	(a) $\frac{ML^2}{6}$ (b) $\frac{ML^2}{12}$ (c) $\frac{ML^2}{24}$ (d) $\frac{ML^2}{3}$	
15	A bullet of mass 10 g and speed 500 m/s is fired into a door and gets embedded exactly at the centre of the door. The door is 1.0 m wide and weight 12 kg. It is hinged at one end and rotates about a vertical axis practically without friction. The angular speed of the door just after the bullet embeds into it is (a) 0.390 rad/s (b) 0.625 rad/s (c) 0.062 rad/s (d) 3.9 rad/s	
16	The moment of inertia of a dumb-bell, consisting of point masses m_1 = 2.0 kg and m_2 = 1.0 kg, fixed to the ends of a rigid massless rod of length L = 0.6 m, about an axis passing through the centre of mass and perpendicular to its length, is (a) 0.72 kg m^2 (b) 0.36 kg m^2 (c) 0.27 kg m^2 (d) 0.24 kg m^2	
17	Four spheres of diameter 2 a and mass M are placed with their centres on the four corners of a square of side b. Then the moment of inertia of the system about an axis along one of the sides of the square is (a) $\frac{4}{5}$ $Ma^2 + 2\ Mb^2$ (b) $\frac{8}{5}$ $Ma^2 + 2\ Mb^2$ (c) $\frac{8}{5}$ Ma^2 (d) $\frac{4}{5}$ $Ma^2 + 4\ Mb^2$	
18	A uniform square plate has a small piece Q of an irregular shape removed and glued to the centre of the plate leaving a hole behind. The moment of inertia about the z-axis is then  (a) Increased (b) Decreased (c) The same (d) Changed in unpredicted manner	
19	The radius of gyration of a uniform rod of length L about an axis passing through its centre of mass and	

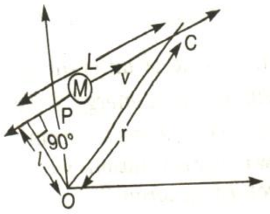
	perpendicular to its length is (a) $L/\sqrt{12}$ (b) $L^2/12$ (c) $L/\sqrt{3}$ (d) $L/\sqrt{2}$	

CONCEPT-20: BASED ON TORQUE, ANGULAR MOMENTUM AND KINETIC ENERGY OF ROTATION; CONSERVATION OF ANGULAR MOMENTUM

1	If the earth suddenly changes its radius x times the present value, the new period of rotation would be (a) $6x^2$h (b) $12x^2$h (c) $24x^2$h (d) $48x^2$h	
2	What torque will increase angular velocity of a solid disc of mass 16 kg and diameter 1 m from zero to 120 rpm in 8 s? (a) $\frac{\pi}{4}$ N-m (b) $\frac{\pi}{2}$ N-m (c) $\frac{\pi}{3}$ N-m (d) π N-m	
3	A force of 100 N is applied perpendicularly to the left edge of the rectangle as shown in figure. The torque (magnitude and direction) produced by this force with respect to an axis perpendicular to the plane of the rectangle at corner A and with respect to a similar axis at corner B are respectively.  (a) 75 N-m counter clockwise, 125 N-m clockwise (b) 125 N-m counter clockwise, 75 N-m clockwise (c) 125 N-m clockwise, 75 N-m counter clockwise (d) 125 N-m clockwise, 75 N-m counter clockwise	
4	What constant force tangential to the equator should be applied to the earth to stop its rotation is one day? (a) 1.3×10^{22} N (b) 8.26×10^{28} N (c) 1.3×10^{23} N (d) None of these	
5	A cord is wound round the circumference of a wheel of radius r. The axis of the wheel of horizontal and moment of inertia about it is I. A weight mg is attached to the end of the cord and falls from rest. After falling through a distance h, the angular velocity of the wheel will be (a) $\left(\frac{2gh}{1+mr}\right)^{1/2}$ (b) $\left(\frac{2mgr}{1+mr^2}\right)^{1/2}$	

	(c) $\left(\dfrac{2mgh}{1+2m}\right)^{1/2}$ (d) $(2gh)^{1/2}$	
6	A 3 kg particle moves with constant speed of 2 ms^{-1} in the xy-plane in the y-direction along the line x = 4 m. The angular momentum (in kg-m^2s^{-1}) relative to the origin and the torque about the origin needed to maintain this motion are respectively (a) 12, 0 (b) 24, 0 (c) 0, 24 (d) 0, 12	
7	A horizontal force F is applied such that the block remains stationary, then which of the following statement is false?  (a) F = mg (where f is the frictional force) (b) F = N (where N is the normal force) (c) F will not produce torque (d) N will not produce torque	
8	What is the torque of the force F = ($2\hat{i}-3\hat{i}+4\hat{k}$)N acting at the point r = $(3\hat{i}+2\hat{j}+3\hat{k})$ m about the origin? (a) $-17\hat{i}+6\hat{j}+13\hat{k}$ (b) $-6\hat{i}+6\hat{j}-12\hat{k}$ (c) $17\hat{i}-6\hat{j}-13\hat{k}$ (d) $6\hat{i}-6\hat{j}+12\hat{k}$	
9	The moment of inertia of a body about a given axis is 1.2 kg-m^2. Initially, the body is at rest. In order to produce a rotational kinetic energy of 1500 J, and angular acceleration of 25 $rads^{-2}$ must be applied about that axis for a duration of (a) 4 s (b) 2 s (c) 8 s (d) 10 s	
10	A flywheel of moment of inertia 3 x 10^2 kg-m^2 is rotating with uniform angular speed of 4.6 rad/s. If a torque of 6.9 x 10^2 N-m retards the wheel, then the time in which the wheel comes to rest is (a) 1.5 s (b) 2 s (c) 0.5 s (d) 1 s	
11	A ring of diameter 0.4 m and of mass 10 kg is rotating about its axis at the rate of 1200 rpm. The angular momentum of the ring is (a) 60.28 kg-m^2s^{-1} (b) 55.26 kg-m^2s^{-1} (c) 40.28 kg-m^2s^{-1} (d) 50.28 kg-m^2s^{-1}	
12	The oxygen molecule has a mass of 5.30 x 10^{-26} kg and a moment of inertia of 1.94 x 10^{-46} kg-m^{-2} about an axis	

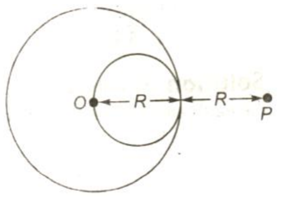
	through its centre perpendicular to the lines joining the two atoms. Suppose the mean speed of such a molecule in a gas is 500 m/s and that is KE of rotation is $\frac{2}{3}$ of its KE translation. Find the average angular velocity of the molecule. (a) 3.75 x 10^{12} rad/s (b) 5.75 x 10^{12} rad/s (c) 9.75 x 10^{12} rad/s (d) 6.75 x 10^{12} rad/s	
13	A ring and a disc of different masses are rotating with the same kinetic energy. If we apply a retarding torque τ on the ring stops after making n revolutions, then in how many revolutions will the disc stop under the same retarding torque? (a) n (b) 2n (c) 4 n (d) n/2	
14	A flywheel of moment of inertia 0.4 kg-m^2 and radius 0.2 m is free to rotate about a central axis. If a string is wrapped around it and it is pulled with a force of 10N, then its angular velocity after 4 s will be (a) 10 rad s^{-1} (b) 5 rad s^{-1} (c) 20 rad s^{-1} (d) None of these	
15	A hoop of radius 2 m weight 100 kg. It rolls along a horizontal floor so that its centre of mass has a speed of 20/cm. How much work has to be done to stop it? (a) Zero (b) $mv^2/4\sqrt{2g}$ (c) $mv^2/\sqrt{2g}$ (d) $m(2gh^2)$	
16	A stone of mass m tied to a string of length l is rotating along a circular path with constant speed υ. The torque on the stone is (a) 6.0 J (b) 5.0 J (c) 9.0 J (d) 4.0 J	
17	Four 2 kg masses are connected by $\frac{1}{4}$ m spokes to an axle. A force of 24 N acts on a level 1/2 m long to produce angular acceleration α. The magnitude of α in rad s^{-2} is (a) 24 (b) 12 (c) 6 (d) 3	
18	A gramophone turn table rotating at 75 rpm slow down uniformly and stops in 5 s after the motor is turned-off. Its angular acceleration (rad s^{-2}) (a) -0.42 (b) -0.89 (c) -1.57 (d) -1.96	
19	When a ceiling fan is switched off, its angular velocity fall to half while it makes 36 rotations. How many more rotations will it make before coming to rest? (Assume	

	uniform angular retardation) (a) 36 (b) 24 (c) 18 (d) 12	
20	A wheel starts from rest and acquires a rotational speed of 240 rps in 2 min. Its acceleration is (a) 5 rps^2 (b) 2 rps^2 (c) 8 rps^2 (d) 11 rps^2	
21	A particle of mass M moves along the line PC with velocity υ as shown. what is the angular momentum of the particle about O?  (a) mvL (b) mvl (c) mvr (d) Zero	
22	A particle starts from rest with an acceleration of 2 rad s^{-2} in a circle of radius 2 m. Its linear speed after 6 s is (a) 12 ms^{-1} (b) 24 ms^{-1} (c) 4 ms^{-1} (d) None of these	
23	A thin and circular disc of mass and radius R is rotating in a horizontal plane about axis passing through its centre and perpendicular of its plane with an angular velocity ω. If another disc of same dimensions but of mass $\frac{M}{4}$ is placed gently on the first disc coaxially, then the new angular velocity of the system is (a) $\frac{5}{4}\omega$ (b) $\frac{2}{3}\omega$ (c) $\frac{4}{5}\omega$ (d) $\frac{3}{2}\omega$	
24	A thin uniform rod AB of mass m and length L is hinged at one end A to the level floor. Initially, it stands vertically and is allowed to fall freely to the floor in the vertical plane. The angular velocity of the rod, when its end B strikes the floor is (g is acceleration due to gravity) (a) $\left(\frac{mg}{L}\right)$ (b) $\left(\frac{mg}{3L}\right)^{1/2}$ (c) $\left(\frac{g}{L}\right)$ (d) $\left(\frac{3g}{L}\right)^{1/2}$	
25	A ballet dancer spins with 2.8 rev s^{-1} with her arms out stretched. When the moment of inertia about the same axis becomes 0.7 I, the new rate of spin is	

	(a) 3.2 rev s^{-1} (b) 4.0 rev s^{-1} (c) 4.8 rev s^{-1} (d) 5.6 rev s^{-1}	
26	A Merry-go-round, made of a ring-like platform of radius R and mass M, is revolving with angular speed ω. A person of mass M is standing on it. At one instant. The person jumps off the round, radially away from the centre of the round (as seen from the round). The speed of the round afterward is (a) 2 ω (b) ω (c) $\frac{\omega}{2}$ (d) 0	
27	A particle performs uniform circular motion with an angular momentum L. If the frequency of a particle's motion is doubled and its kinetic energy is halved, the angular momentum becomes (a) 2 L (b) 4 L (c) L/2 (d) L/4	
28	A circular platform is mounted on a vertical friction less axle. Its radius is r = 2 m and its moment of inertia I = 200 kg-m^2. It is initially at rest. A 70 kg man stands on the edge of the platform and begins to walk along the edge at speed υ_0 = 1.0 ms^{-1} relative to the ground. The angular velocity of the platform is 0.7 rad s^{-1}. When the man has walked once around the platform, so that he is at his original position on it, his angular displacement relative to ground is (a) $\frac{6}{5}\pi$ (b) $\frac{5}{6}\pi$ (c) $\frac{4}{5}\pi$ (d) $\frac{5}{4}\pi$	
29	If earth where to shrink to half its present diameter without any change in its mass, the duration of the day will be (a) 48 h (b) 6 h (c) 12 h (d) 24 h	
30	Two discs of moment of inertia I_1 and I_2 about their respective axes and rotating with angular speed ω_1 and ω_2 are brought into contact face to face with their axes of rotation coincident. Then the loss of in kinetic energy of the system in the process is (a) $\frac{I_1 I_2}{2(I_1+I_2)}(\omega_1-\omega_2)^2$ (b) $-\frac{I_1 I_2}{2(I_1+I_2)}(\omega_1-\omega_2)^2$ (c) $\frac{I_1 I_2}{(I_1+I_2)}(\omega_1-\omega_2)^2$ (d) Zero	

31	A man of 80 kg mass is standing on the rim of a circular platform of mass 200 kg rotating about its axis. The mass of the platform with the man on it rotates at 12.0 rpm. If the man now moves to centre of the platform, the rotational speed would become (a) 16.5 rpm (b) 25.7 rpm (c) 32.3 rpm (d) 31.2 rpm	

CONCEPT-21: BASED ON LAW OF GRAVITATION

1	Two spheres of radius r and 2r are touching each other. The force of attraction between them is proportional to (a) r^6 (b) r^4 (c) r^2 (d) r^{-2}	
2	A solid sphere of uniform density and radius R applies a gravitational force of attraction equal to F_1 on a particle placed at P, distance 2R from the centre O of the sphere. A spherical cavity of radius R/2 is now made in the sphere as shown in figure. The sphere with cavity now applies an gravitational force F_2 on same particle placed at P. The ration F_2/F_1 will be  (a) 1/2 (b) 7/9 (c) 3 (d) 7	
3	A uniform ring of mass M and radius r is placed directly above a uniform sphere of mass 8 M and of same radius R. The centre of the sphere. The gravitational attraction between the sphere and the ring is (a) $\frac{GM^2}{R^2}$ (b) $\frac{3GM^2}{2R^2}$ (c) $\frac{2GM^2}{\sqrt{2}R^2}$ (d) $\frac{\sqrt{3}GM^2}{R^2}$	
4	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 $R^{-3/2}$, then T_2 is proportional to (a) R^3 (b) $R^{5/2}$ (c) $R^{3/2}$ (d) $R^{7/2}$	
5	If a planet of given density were made larger its force of attraction for an object on its surface would increase because of planet's greater mass but would decrease because of the greater distance from the object to the	

	centre of the planet. Which effect predominate? (a) Increase in mass (b) Increase in radius (c) Both affect attraction equally (d) None of the above	
6	Both earth and moon are subject to the gravitational force of the sun. As observed from the sun, the orbit of the moon (a) Will be elliptical (b) Will not be strictly elliptical because the total gravitational force on it is not central (c) Is not elliptical but will necessarily be a closed curve (d) Deviates considerably from being elliptical due to influence of planets other than earth	
7	Different points in earth are at slightly different distances from the sun and hence experience different forces due to gravitation. For a rigid body, we know that if various forces act at various points in it, the resultant motion is as if a net force acts on the CM (centre of mass) causing translation and a net torque at the CM causing rotation around an axis through the CM For the earth-sun system (approximating the earth as a uniform density sphere) (a) The torque is zero (b) The torque causes the earth to spin (c) The rigid body result is not applicable since the earth is not even approximately a rigid body (d) The torque causes the earth to move around the sun	
8	Two astronauts have deserted their space ships in a region of space far from the gravitational attraction of any other body. Each has a mass of 100 kg and they are 100 m apart. They are initially at rest relative to one another. How long will it be before the gravitational attraction brings them 1 cm closer together? (a) 2.52 days (b) 1.41 days (c) 0.70 days (d) 0.41 days	
9	If three particles each of mass M are placed at the three corners of an equilateral triangle of side a, the forces exerted by this system on another particle of mass M placed (i) at the mid point of a side and (ii) at the centre of the triangle are respectively (a) 0, 0 (b) $\frac{4GM^2}{3a^2}, 0$ (c) 0, $\frac{4GM^2}{3a^2}$ (d) $\frac{3GM^2}{a^2}, \frac{GM^2}{a^2}$	
10	The gravitational attraction between the two bodies increases when their masses are	

	(a) Reduced and distance is reduced (b) Increased and distance is reduced (c) Reduced and distance is increased (d) Increased and distance is increase	
11	A spherical hollow is made in a lead sphere of radius R such that its surface touches the outside surface of the lead sphere and passes through the centre. The mass of the lead sphere before hollowing was M. The force of attraction that this sphere would exert on a particle of mass m which lies at a distance d (> R) from the centre of the lead sphere on the straight line joining the centres of the sphere and the hollow is (a) $\frac{GM\,m}{d^2}$ (b) $\frac{GMm}{8d^2}$ (c) $\frac{GMm}{d^2}\left[1+\frac{1}{8\left(1+\frac{R}{2d}\right)}\right]$ (d) $\frac{GMm}{d^2}\left[1-\frac{1}{8\left(1-\frac{R}{2d}\right)^2}\right]$	

CONCEPT-22: BASED ON GRAVITY AND ACCELERATION DUE TO GRAVITY

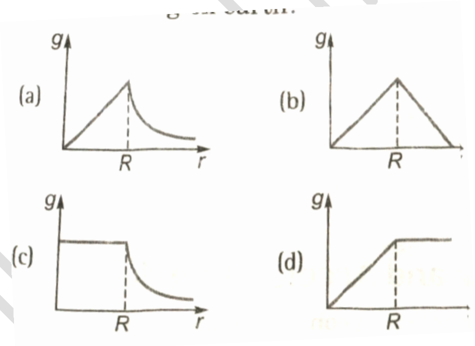
1	If suppose moon is suddenly stopped and then released (given radius of moon is one-fourth the radius of earth) and the acceleration of moon with respect to earth is 0.0027 ms^{-2}), then the acceleration of the moon just before striking the earth's surface is (Take g = 10 ms^{-2}) (a) 0.0027 ms^{-2} (b) 5.0 ms^{-2} (c) 6.4 ms^{-2} (d) 10 ms^{-2}	
2	The acceleration due to gravity on a planet is 1.96 ms^{-2}. If it is safe to jump from a height of 3m on the earth, the corresponding height on the planet will be (a) 3 m (b) 6 m (c) 9 m (d) 15 m	
3	The mass of the moon is 1/8 of the earth but the gravitational pull is 1/6 of the earth. It is due to the face that (a) Moon is the satellite of the earth (b) The radius of the earth is 8.6 the moon (c) The radius of the earth is $\sqrt{8/6}$ of the moon (d) The radius of the moon is 6/8 of the earth	

4	If different planets have the same density but different radii, then the acceleration due to gravity on the surface of the planet is related to the radius (R) of the planet as (a) $g \propto R^2$ (b) $g \propto R$ (c) $g \propto \frac{1}{R^2}$ (d) $g \propto \frac{1}{R}$	
5	A thief stole a box full of valuable articles of weight w and while carrying it on his head jumped down from a wall of height h from the ground. Before he reaches the ground, he experienced a load (a) Zero (b) w/2 (c) w (d) 2w	
6	Assuming the earth to be a sphere of uniform mass density, how much would body weigh half way down to the centre of earth if it weighed 250 N on the surface? (a) 225 N (b) 325 N (c) 100 N (d) 125 N	
7	The maximum vertical distance through which a full dressed astronaut can jump on the earth is 0.5 m. Estimate the maximum vertical distance through which he can jump on the moon, which has a mean density 2/3rd that of earth and radius one quarter that of the earth (a) 1.5 m (b) 3 m (c) 6 3 (d) 7.5 m	
8	In the above problem, the ratio of the time duration of his jump on the moon to that of his jump on the earth is (a) 1 : 6 (b) 6 : 1 (c) $\sqrt{6}$: 1 (d) 1 : $\sqrt{6}$	
9	Particles of masses 2M, m and M are respectively at points A, B and C with AB = $\frac{1}{2}$(BC). m is much-much smaller than M and at time t = 0, they are all at rest  (a) m will remain at rest (b) m will move towards M (c) m will move towards 2M (d) m will have oscillatory motion	

CONCEPT-23: BASED ON VARIATION IN THE ACCELERATION DUE TO GRAVITY

1	The earth is an approximate sphere. If the interior contained matter which is not of the same density everywhere, then on the surface of the earth, the acceleration due to gravity (a) Will be directed towards the centre but not the same everywhere	

	(b) Will have the same value everywhere but not directed towards the centre (c) Will be same everywhere in magnitude directed towards the centre (d) Cannot be zero at any point	
2	The masses and radii of the earth and moon are M_1, R_1 and M_2, R_2 respectively. Then centres are distance d apart. The minimum velocity with which a particle of mass M should be projected from a point midway between their centres so that it escapes to infinity is (a) $2\sqrt{\frac{G}{d}(M_1+M_2)}$ (b) $2\sqrt{\frac{2G}{d}(M_1+M_2)}$ (c) $2\sqrt{\frac{GM}{d}(M_1+M_2)}$ (d) $2\sqrt{\frac{GM(M_1+M_2)}{d(R_1+R_2)}}$	
3	At a given place where, acceleration due to gravity is g ms^{-2}, a sphere of lead of density d kgm^{-3} is gently released in a column of liquid of density ρ kgm^{-3}. If d > ρ, the sphere will (a) Fall vertically with an acceleration of g ms^{-2} (b) Fall vertically with no acceleration (c) Fall vertically with an acceleration g $\left(\frac{d-\rho}{d}\right)$ (d) Fall vertically with an acceleration ρ / d	
4	What is the height, the weight of body will be the same as at the same depth from the surface of the earth? Radius of earth is R? (a) $\frac{R}{2}$ (b) $\sqrt{5}$ R-R (c) $\frac{\sqrt{5}R-R}{2}$ (d) $\frac{\sqrt{3}R-R}{2}$	
5	There is a mine of depth about 2.0 km. In this mine the conditions as compared to those at the surface are (a) Lower air pressure, higher acceleration due to gravity (b) Higher air pressure, lower acceleration due to gravity (c) Higher air pressure, higher acceleration due to gravity (d) Lower air pressure, lower acceleration due to gravity	
6	A clock S is based on oscillation of a spring and a clock P is based on pendulum motion. Both clock run at the same rate on earth. On a planet having the same density as earth but twice the radius, (a) S will run faster than P (b) P will run faster than S (c) Both will run at the same rate as on the earth (d) Both will run at the same rate which will be different	

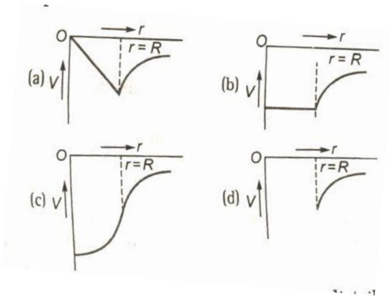
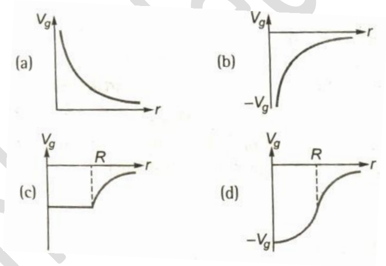
	from that on the earth	
7	If the radius of the earth were to shrink by 1% its mass remaining same, the acceleration due to gravity on the earth's surface would (a) Decrease by 2% (b) Remain unchanged (c) Increase by 2% (d) Become zero	
8	Two spherical planets A and B have same mass but densities in the ratio 8 : 1. For these planets, the ratio of acceleration due to gravity at the surface A to its value at the surface of B is (a) 1 : 4 (b) 1 : 2 (c) 4 : 1 (d) 8 : 1	
9	The height at which the acceleration due to gravity decreases by 36% of its value on the surface of the earth. (The radius of the earth is R). (a) $\frac{R}{6}$ (b) $\frac{R}{4}$ (c) $\frac{R}{2}$ (d) $\frac{2}{3}R$	
10	If the value of g acceleration due to gravity at earth surface is 10 ms^{-2}, its value in ms^{-2} at the centre of the earth, which is assumed to be a sphere of radius T metre and uniform mass density is (a) 5 (b) 10/R (c) 10/2R (d) Zero	
11	When of the following graphs correctly represents the variation of g on earth?  	
12	If the force inside the earth surface varies as x^n, where r is the distance of body from the centre of earth, then the value of n will be (a) – 1 (b) – 2 (c) 1 (d) 2	
13	320 km above the surface of earth, the value of acceleration due to gravity is nearly 90% of its value on the surface of the earth. Its value will be 95% of the value on the earth's surface (a) Nearly 160 km below the earth's surface (b) Nearly 80 km below the earth's surface	

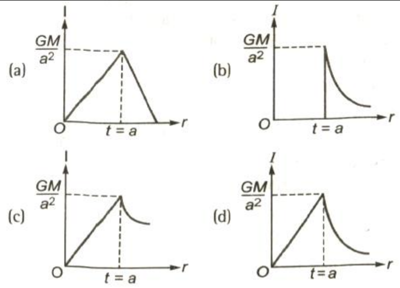
	(c) Nearly 640 km below the earth's surface (d) Nearly 320 km below the earth's surface	
14	The acceleration due to gravity at a height $1/20^{th}$ of the radius of the earth above the earth surface is 9 ms^{-2}. Its value at a point at an equal distance below the surface of the earth in ms^{-2} is about (a) 8.5 (b) 9.5 (c) 9.8 (d) 11.5	
15	At a distance 320 km above the surface of earth, the value of acceleration due to gravity will be lower than its value on the surface of the earth by nearly (radius of earth = 6400 km) (a) 2% (b) 6% (c) 10% (d) 14%	
16	The depth from the surface of the earth of radius R at which the acceleration due to gravity will be 75% of the value on the surface of the earth is (a) R/4 (b) R/2 (c) 3R/4 (d) R/8	
17	Two equal masses m and m are hung from a balance whose scale pans differ in height by h. If ρ is the mean density of earth, then the error in weighing machine is (a) Zero (b) $4\pi G\rho mh/3$ (c) $8\pi G\rho mh/3$ (d) $2\pi G\rho mh/3$	
18	One goes from the centre of the earth to a distance two-third the radius of the earth, where will the acceleration due to gravity be the greatest? (a) At the centre of the earth (b) At a height half the radius of the earth (c) At a height one-third the radius of the earth (d) At a height two-third the radius of the earth	
19	Mass of moon is 7.34×10^{22} kg. If the acceleration due to gravity on the moon is 1.4 ms^{-2}, the radius of the moon is ($G = 6.667 \times 10^{-11}$ Nm^2kg^{-2}) (a) 0.56×10^4 m (b) 1.87×10^6 m (c) 1.92×10^6 m (d) 1.01×10^8 m	
20	The ratio of acceleration due to gravity at a height h above the surface of the earth and at a depth h below the surface of the earth for h < radius of earth (a) Is constant (b) Increases linearly with h (c) Decreases linearly with h (d) Decreases parabolically with h	
21	At what height in km over the earth's pole the free fall acceleration decreases by one percent? (Assume the radius of the earth to be 6400 km)	

	(a) 32 (b) 64 (c) 80 (d) 1.253	
22	If a man weighs 90 kg on the surface of earth, the height above the surface of the earth of radius R, where the weight is 30 kg, is (a) 0.73 R (b) R / $\sqrt{3}$ (c) R / 3 (d) $\sqrt{3}$ R	
23	Two equal masses m and m are hung from a balance whose scale pan differs in vertical height by h/2. The error in weighing in terms of density of the earth ρ is (a) $\frac{1}{3}\pi G\rho mh$ (b) $\pi G \pi mh$ (c) $\frac{4}{3}\pi G \rho mh$ (d) $\frac{8}{3}G\rho mh$	
24	The radius of the earth is 6400 km and g = 10 m/s^2 in order that a body of 5 kg weight zero at the equator the angular speed of the earth is (a) 1/80 rad/s (b) 1/400 rad/s (c) 1/800 rad/s (d) 1/1600 rad/s	
25	What should be the angular speed of earth in rads^{-1} so that a body of 5 kg, weighs zero at the equator? (Take g = 10 ms^{-2} and radius of earth = 6400 km). (a) 1/1600 (b) 1/800 (c) 1/400 (d) 1/80	
26	The bodies situated on the surface of earth at its equator, becomes weightless, when the earth has KE about it axis (a) mgR (b) 2 mgR/5 (c) MgR/5 (d) 5 MgR/2	
27	At what height above the earth's surface, does the force of gravity decrease by 10%? The radius of the earth is 6400 km? (a) 345.60 km (b) 687.20 km (c) 1031.8 km (d) 12836.80 km	
28	The value of g on the earth's surface is 980 cms^{-2}. Its value at a height of 64 km from the earth's surface is (Radius of the earth R = 6400 km) (a) 960.40 cms^{-2} (b) 984.90 cms^{-2} (c) 982.45 cms^{-2} (d) 977.55 cms^{-2}	
29	The speed of earth's rotation about its axis is ω. Its speed is increased to x times to make the effective acceleration due to gravity equal to zero at the equator, then value of x is around (g = 10 ms^{-2}; R = 6400 km) (a) 1 (b) 8.5 (c) 17 (d) 34	

30	For a body lying on the equator to appear weightless, what should be the angular speed of the earth? (Take g = 10 ms^{-2}; radius of earth = 6400 km) (a) 0.125 $rads^{-1}$ (b) 1.25 $rads^{-1}$ (c) 1.25 x 10^{-3} $rads^{-1}$ (d) 1.25 x 10^{-2} $rads^{-1}$	

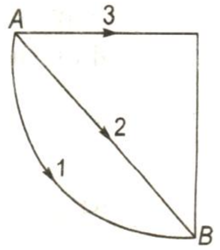
CONCEPT-24: BASED ON GRAVITATIONAL FIELD & GRAVITATIONAL POTENTIAL ENERGY

1	P is a point at a distance r from the centre of a solid sphere of radius r. the variation of gravitational potential at P(i.e., V) and distance r from the centre of sphere is represented by the curve. 	
2	The gravitational field due to a mass distribution is $I = k/x^3$ in the x-direction (k is a constant). Taking the gravitational potential to be zero at infinity, its value at a distance $x/\sqrt{2}$ is (a) k/x (b) k/2x (c) k/x^2 (d) $k/2x^2$	
3	Select the proper graph between the gravitational potential (V_g) due to hollow sphere and distance ® from its centre. 	
4	Which of the following graphs represents correctly the variation of the intensity of gravitational field (I) with the distance ® from the centre of a spherical shell of mass M and radius a ?	

		
5	A particle of mass m is placed side a spherical shell, away from its centre. The mass of the shell is M. (a) The particle will move towards the centre if m < M, and away from the centre is m > M (b) The particle will move towards the centre (c) The particle will oscillate about the centre of shell (d) The particle will remain stationary	
6	The distance between the earth and the moon is 3.85×10^8 m. at what distance from the earth's centre, the intensity of gravitational field will be zero? The masses of earth and moon are 5.98×10^{24} kg and 7.35×10^{22} kg respectively, (a) 3.47×10^8 m (b) 0.39×10^8 m (c) 1.82×10^8 m (d) None of these	
7	Two bodies of masses 100 kg and 1000 kg are separated by a distance of 1 m. What is the intensity of gravitational field at the mid point of the line joining them? (a) 6.6×10^{-11} N m^2 kg^{-2} (b) 2.4×10^{-8} Nkg^{-1} (c) 2.4×10^{-7} Nkg^{-1} (d) 2.4×10^{-6} Nkg^{-1}	
8	There are two bodies of masses 100000 kg and 1000 kg separated by a distance of 1 m. At what distance (in metre) from the smaller body, the intensity of gravitational field will be zero? (a) 1/9 (b) 1/10 (c) 1/11 (d) 10/11	
9	In a certain region of space, the gravitational field is given by –k / r, where r is the distance and k is a constant. If the gravitational potential at $r = r_0$ be V_0, then what is the expression for the gravitational potential V? (a) $k \log\left(\frac{r}{r_0}\right)$ (b) $k \log\left(\frac{r_0}{r}\right)$ (c) $V_0 + k \log\left(\frac{r}{r_0}\right)$ (d) $V_0 + k \log\left(\frac{r_0}{r}\right)$	

10	The depth d at which the value of acceleration due to gravity becomes $\frac{1}{n}$ times, the value at the surface is (R = radius of the earth) (a) $\frac{R}{n}$ (b) $R\left(\frac{n-1}{n}\right)$ (c) $\frac{R}{n^2}$ (d) $R\left(\frac{n}{n+1}\right)$	
11	A solid sphere if of density ρ and radius R. The gravitational field at a distance r from the centre of the sphere, where r < R, is (a) $\frac{\rho\pi GR^3}{r}$ (b) $\frac{4\pi G\rho r^2}{3}$ (c) $\frac{4\pi G\rho R^3}{3r^2}$ (d) $\frac{4\pi G\rho r}{3}$	
12	Two bodies of masses 2 kg and 8 kg are separated by a distance of 9 m. The point where the resultant gravitational field intensity is zero is at a distance of (a) 4.5 m from each mass (b) 6 m from 2 kg (c) 6 m from 8 kg (d) 2.5 m from 2 kg	
13	Gravitational potential on the surface of earth is (m = mass of the earth, R = radius of earth) (a) – GM / 2R (b) – gR (c) gR (d) GM / R	
14	A particle of mass m is placed at the centre of a uniform spherical shell of mass 3 m and radius R. The gravitational potential on the surface of the shell is (a) $-\frac{Gm}{R}$ (b) $-\frac{3Gm}{R}$ (c) $-\frac{4Gm}{R}$ (d) $-\frac{2Gm}{R}$	
15	The gravitational field due to a mass distribution is 1 = $\frac{C}{x^2}$ in x direction. Here C is constant. Taking the gravitational potential to be zero at infinity, potential at x is (a) $\frac{2C}{x}$ (b) $\frac{C}{x}$ (c) $\frac{2C}{x^2}$ (d) $\frac{C}{2x^2}$	
16	A space ship moves from earth to moon and back. The greatest energy required for the space ship is to overcome	

	the difficulty in (a) Entering the earth's gravitational field (b) Take off from earth's field (c) Take off from lunar surface (d) Entering the moon's lunar surface	
17	The mass of the earth is 6.00 x 10^{22} kg. The constant of gravitation G = 6.67 x 10^{-11} Nm^2 kg^{-2}. The potential energy of the system is -7.79 x 10^{28} J. The mean distance between earth and moon is (a) 3.80 x 10^8 m (b) 3.37 x 10^6 m (c) 7.60 x 10^4 m (d) 1.90 x 10^2 m	
18	The change in potential energy when a body of mass m is raised to a height nR from the centre of earth (R = radius of earth) (a) mgR $\frac{(n-1)}{n}$ (b) nmgR (c) mgR $\frac{n^2}{n^2+1}$ (d) mgR $\frac{n}{n+1}$	
19	A mass m is placed at a point B in the gravitational field of mass M. When the mass m is brought from B to near point A, its gravitational potential energy will (a) Remain unchanged (b) Increase (c) Decrease (d) Become zero	
20	The gravitational field in a region is given by $I = (4\hat{i} + \hat{j})$ Nkg^{-1}. Work done by this field is zero when a particle is moved along the line (a) x + y = 6 (b) x + 4y = 6 (c) y + 4x = 6 (d) x – y = 6	
21	A satellite orbits the earth at a height of 400 km above the surface. How much energy must be expended to rocket the satellite out of the earth's gravitational influence? Mass of the satellite = 200 kg, mass of the earth = 6.0 x 10^{24} kg, radius of the earth = 6.4 x 10^6 m, G = 6.67 x 10^{-11} N-m^2/kg^2. (a) 5.2 x 10^{10} J (b) 3 x 10^6 J (c) 4 x 10^6 J (d) 6 x 10^9 J	
22	A body of mass m rises to a height h = R/5 from the surface of earth, where R is the radius of earth. If g is the acceleration due to gravity at the surface of earth, the increase in potential energy is (a) (4/5) mgh (b) (5/6) mgh (c) (6/7) mgh (d) mgh	
23	The gravitational potential difference between the surface	

	of a planet and a point 20 m above it is 14 J kg^{-1}. The work done in moving a 2.0 kg mass by 8.0 m on a slope of 60^0 from the horizontal, is equal to (a) 7 J (b) 9.6 J (c) 16 J (d) 32 J	
24	If W_1, W_2, and W_3 represent the work done in moving a particle from A to B along three different paths 1, 2 and 3 respectively (as shown) in a gravitational field of point mass m, then  (a) $W_1 = W_2 = W_3$ (b) $W_1 > W_2 > W_3$ (c) $W_1 > W_2 < W_3$ (d) $W_1 < W_2 < W_3$	

CONCEPT-25: BASED ON SATELLITE, ESCAPE VELOCITY & KEPLER'S LAWS

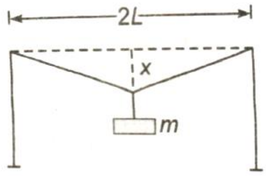
1	Out of the following, the only correct statement about satellites is (a) A satellite cannot move in a stable orbit in a plane passing through the earth's centre (b) Geostationary satellites are launched in the equatorial plane (c) We can use just one geostationary satellite for global communication around the globe (d) The speed of satellite increases with an increase in the radius of its orbit	
2	A satellite S is moving in an elliptical orbit around earth. The mass of the satellite is very small compared to the mass of the earth? (a) The acceleration of S is always directed towards the centre of the earth (b) The angular momentum of S about the centre of the earth changes in direction but its magnitude remains constant (c) The total mechanical energy of S varies periodically with time (d) The linear momentum of S remains constant in magnitude	
3	A satellite is placed in a circular orbit around earth at such a height that it always remains stationary with respect to earth surface. In such case, its height from the earth surface is (a) 32000 km (b) 36000 km (c) 6400 km (d) 4800 km	
4	Satellites orbiting the earth have finite life and sometimes debris of satellites fall to the earth. This is because,	

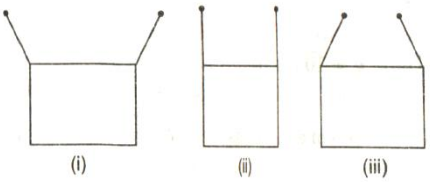
	(a) The solar cells and batteries in satellites run out (b) The laws of gravitation predict a trajectory spiralling inwards (c) Of viscous forces causing the speed of satellite and hence height to gradually decrease (d) Of collisions with other satellites	
5	The orbital velocity of an artificial satellite in a circular orbit just above the earth's surface is υ. For a satellite orbiting at an altitude of half of the earth's radius, the orbital velocity is (a) $\frac{3}{2}v$ (b) $\sqrt{\frac{3}{2}}v$ (c) $\sqrt{\frac{2}{3}}v$ (d) $\frac{2}{3}v$	
6	For a body to escape from earth, angle at which it should be fired is? (a) 45^0 (b) > 45^0 (c) < 45^0 (d) Any angle	
7	If the moon is to escape from the gravitational field of the earth forever, it will require a velocity (a) 11.2 kms^{-1} (b) Less than 11.2 kms^{-1} (c) Slightly more than 11.2 kms^{-1} (d) 22.4 kms^{-1}	
8	The escape velocity from the earth is 11 kms^{-1}. The escape velocity from a planet having twice the radius and the same mean density as the earth would be (a) 5.5 kms^{-1} (b) 11 kms^{-1} (c) 15.5 kms^{-1} (d) 22 kms^{-1}	
9	The escape velocity for a body projected vertically upwards from the surface of the earth is 11.2 kms^{-1}. If the body is projected in a direction making an angle of 45^0 with the vertical, the escape velocity will be (a) 11.2 kms^{-1} (b) 11.2 x $\sqrt{2}$ kms^{-1} (c) 11.2 x 2 kms^{-1} (d) 11.2/$\sqrt{2}$ kms^{-1}	
10	The ratio of the radii of the planets P_1 and P_2 is a. The ratio of their acceleration due to gravity is b. The ratio of the escape velocities from them will be (a) ab (b) $\sqrt{ab}$ (c) $\sqrt{a/b}$ (d) $\sqrt{b/a}$	
11	The mass of the moon is 1/81 of earth's mass and its radius 1/4th that of the earth. If the escape velocity from the earth's surface is 11.2 kms^{-1}, its value for the moon will	

	be (a) 0.15 kms^{-1} (b) 5 kms^{-1} (c) 2.5 kms^{-1} (d) 0.5 kms^{-1}	
12	If the radius of earth's orbit is made 1/4th, then duration of an year will become (a) 8 times (b) 4 times (c) 1/8 times (d) 1/4 times	
13	The period of revolution of planet A around the sun is 8 times that B. The distance of a from the sun is how many times greater than that of B from the sun? (a) 2 (b) 3 (c) 4 (d) 5	
14	The largest and the shortest distance of the earth from the sun are r_1 and r_2, its distance from the sun when it is perpendicular to the major axis of the orbit drawn from the sun, is (a) $\frac{r_1+r_2}{4}$ (b) $\frac{r_1r_2}{r_1+r_2}$ (c) $\frac{2r_1r_2}{r_1+r_2}$ (d) $\frac{r_1+r_2}{3}$	
15	In our solar system, the inter-planetary region has chunks of matter (much smaller in size compared to planets) called asteroids. They (a) Will not move around the sun since they have very small masses compared to sun (b) Will move in an irregular way because of their small masses and will drift away into outer space (c) Will move around the sun in closed orbits but not obey Kepler's laws (d) Will move in orbits like planets and obey Kepler's laws	
16	A comet of mass m moves in a highly elliptical orbit around the sun of mass M. The maximum and minimum distances of the comet from the centre of the sun are r_1 and r_2 respectively. The magnitude of angular momentum of the comet with respect to the centre of sun is (a) $\left[\frac{GMr_1}{r_1+r_2}\right]^{1/2}$ (b) $\left[\frac{GMmr_1}{(r_1+r_2)}\right]^{1/2}$ (c) $\left(\frac{2Gm^2r_1r_2}{r_1+r_2}\right)^{1/2}$ (d) $\left(\frac{2GMm^2r_1r_2}{(r_1+r_2)}\right)^{1/2}$	

CONCEPT-26: BASED ON YOUNG'S MODULUS OF ELASTICITY

1	When a certain weight is suspended from a long uniform wire, its length increases by 1 cm. If the same weight is suspended from another wire of the same material and	

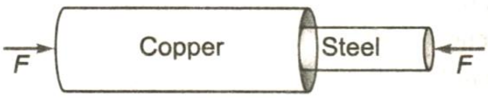
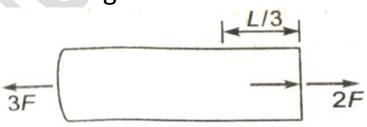
	length but having a diameter half of the first one, the increase in length will be (a) 0.5 cm (b) 2 cm (c) 4 cm (d) 8 cm	
2	The ratio of diameters of two wires of same materials in n : 1. The length of each wire is 4 m. On applying the same load, the increase in length of thin wire will be (n > 1) (a) n^2 times (b) n times (c) 2n times (d) (2n + 1) times	
3	A rigid bar of mass M is supported symmetrically by three wires each of length l. Those at each end are of copper and the middle one is of iron. The ratio of their diameter, if each is to have the same tension, is equal to (a) Y_{copper}/Y_{iron} (b) $\sqrt{\frac{Y_{iron}}{Y_{copper}}}$ (c) $\frac{Y_{iron}^2}{Y_{copper}^2}$ (d) $\frac{Y_{iron}}{Y_{copper}}$	
4	A thick rope of rubber of density 1.5 x 10^3 kgm^{-3} and Young's modulus 5 x 10^6 Nm^{-2}, 8 m in length is hung from the ceiling of a room, the increase in its length due to its own weight is (a) 9.6 x 10^{-2} m (d) 19.2 x 10^{-2} m (c) 9.6 x 10^{-3} m (d) 9.6 m	
5	A mild steel wire of length 2L and cross-sectional area A is stretched, well within elastic limit, horizontally between two pillars as shown in figure. A mass m is suspended from the mid point of the wire. Strain in the wire is  (a) $\frac{x^2}{2L^2}$ (b) $\frac{x}{L}$ (c) $\frac{x^2}{L}$ (d) $\frac{x^2}{2L}$	
6	A copper wire of negligible mass, 1 m length and cross-sectional area 10^{-6} is kept on a smooth horizontal table with one end fixed. A ball of mass 1 kg is attached to the other end. The wire and the ball are rotated with an angular velocity 20 rad s^{-1}. If the elongation in the wire is 10^{-3} m, then the Young's modulus is (a) 4 x 10^{11} Nm^{-2} (b) 6 x 10^{11} Nm^{-2} (c) 8 x 10^{11} Nm^{-2} (d) 10 x 10^{11} Nm^{-2}	
7	A uniform wire, fixed at its upper end, hangs vertically and supports a weight at its lower end. If its radius is r, its	

	length L and the Young's modulus for the material of the wire is E, the extension is 1. Directly proportional to E 2. Inversely proportional to r 3. Directly proportional to L (a) If only 3 is correct (b) If 1, 2 are correct (c) If 2, 3 are correct (d) If only 1 is correct	
8	The Young's modulus of a rubber string cm long and density 1.5 kg/m^3 is 5 x 10^8 N/m^2, is suspended on the ceiling in a room. The increase in length due to its own weight will be (a) 9.5 x 10^{-5} m (b) 9.6 x 10^{-11} m (c) 9.6 x 10^{-3} m (d) 9.6 m	
9	A steel cable with a radius of 1.5 cm supports a chair lift at a ski area. If the maximum stress is not to exceed 10^8 N/m^2, what is the maximum load the cable can support? (a) 7 x 10^5 N (b) 7 x 10^6 N (c) 7 x 10^4 N (d) 9 x 10^5 N	
10	A rectangular frame is to be suspended symmetrically by two strings of equal length on two supports (Fig). It can be done in one of the following three ways;  The tension in the strings will be (a) The same in all cases (b) Least in (i) (c) Least in (ii) (d) Least in (iii)	
11	A 1 m long wire is stretched without tension at 30^0 C between two rigid supports. What strain will be produced in the wire if the temperature falls to 0^0C? (Given, α = 12 x 10^{-6} K^{-1}) (a) 36 x 10^{-5} (b) 64 x 10^{-5} (c) 0.78 (d) 0.32	
12	If x is longitudinal strain produced in a wire of Young's modulus Y, then energy stored in the material of the wire per unit volume is (a) Yx^2 (b) $2Yx^2$ (c) $\frac{1}{2}Y^2x$ (d) $\frac{1}{2}Yx^2$	
13	Two identical wires are suspended from the same rigid support but one is of copper and the other is of iron. Young's modulus of iron is thrice that of copper. The	

	weights to be added on copper and iron wires so that the ends are on the same level must be in the ratio of (a) 1 : 3 (b) 2 : 1 (c) 3 : 1 (d) 4 : 1	
14	The temperature of a wire of length 1 m and area of cross-section 1 cm^2 is increased from 0^0C to 100^0C. If the rod is not allowed to increased in length, the force required will be ($\alpha = 10^{-5}/^0C$ and $Y = 10^{11}\ N/m^2$) (a) 10^3 N (b) 10^4 N (c) 10^5 N (d) 10^9 N	
15	A substance breaks down by a stress of $10^6\ Nm^{-2}$. If the density of the material of the wire is $3 \times 10^3\ kgm^{-3}$, then the length of the wire of that substance which will break under its own weight when suspended vertically is nearly (a) 3.4 m (b) 34 m (c) 340 m (d) 3400 m	
16	The dimensions of four wires of the same material are given below. In which wire the increase in length will be maximum? (a) Length 100 cm, Diameter 1 mm (b) Length 200 cm, Diameter 2 mm (c) Length 300 cm, Diameter 3 mm (d) Length 50 cm, Diameter 0.5 mm	
17	On increasing the length by 0.5 mm in a steel wire of length 2 m and area of cross-sectional 2 mm^2, the force required is [Y for steel = $2.2 \times 10^{11}\ Nm^{-2}$] (a) 1.1×10^5 N (b) 1.1×10^4 N (c) 1.1×10^3 N (d) 1.1×10^2 N	
18	Two wires of the same material and length are stretched by the same force. Their masses are in the ratio 3:2. Their elongations are in the ratio (a) 3 : 2 (b) 9 : 4 (c) 2 : 3 (d) 4 : 9	
19	A 100 N force stretches the length of a hanging wire by 0.5 mm. The force required to stretch a wire, of the same material and length but having four times the diameter, by 0.5 mm is (a) 100 N (b) 400 N (c) 1200 N (d) 1600 N	
20	Two wires of the same length and same material but radii in the ratio of 1 : 2 are stretched by unequal forces to produce equal elongation. The ratio of the two forces is (a) 1 : 1 (b) 1 : 2 (c) 2 : 3 (d) 1 : 4	
21	Two wires of the same material have lengths in the ration 1 : 2 and their radii are in the ratio $1 : \sqrt{2}$. If they are stretched by applying equal forces, the increase in their	

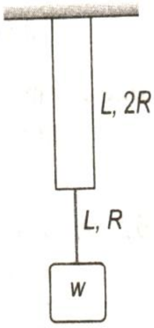
	lengths will be in the ratio of (a) $\sqrt{2}:2$ (b) $2:\sqrt{2}$ (c) 1 : 1 (d) 1 : 2	
22	A wire of length L and radius r is clamped rigidly at one end. When the other end of the wire is pulled by a force F its length increases by l. Another wire of the same material of length 4 L, radius 4r is pulled by a force 4F. The increase in length will be (a) $\frac{1}{2}$ (b) l (c) 2l (d) 4l	
23	When a weight of 5 kg is suspended from a copper wire of length 30 m and diameter 0.5 mm, the length of the wire increases by 2.4 cm. If the diameter is doubled, the extension produced is (a) 1.2 cm (b) 0.6 cm (c) 0.3 cm (d) 0.15 cm	
24	The length of a wire is increased by 1 mm on the application of a given load. In a wire of the same material, but of length and radius twice that of the first, on the application of the same load, extension is (a) 0.25 mm (b) 0.5 mm (c) 2 mm (d) 4 mm	
25	An aluminium rod, Young's modulus 7.0×10^9 Nm^{-2}, has a breaking strain of 0.2 %. The minimum cross-sectional area of the rod in m^2 in order to support a load of 10^4 N is (a) 1×10^{-2} (b) 1.4×10^{-3} (c) 1.0×10^{-3} (d) 7.1×10^{-4}	
26	A substance breaks down by a stress of 10^6 Nm^{-2}. If the density of the material of the wire is 3×10^3 kg m^{-3}, then the length of the wire of the substance which will break under its own weight when suspended vertically is (a) 66.6 m (b) 60.0 m (c) 33.3 m (d) 30.0 m	
27	A steel ring of radius r and cross-sectional area A is fitted on a wooden disc of radius R (R > r). If Young's modulus be E, then the force with which the steel ring is expanded is (a) $AE\frac{R}{r}$ (b) $AE\frac{(R-r)}{r}$ (c) $\frac{E}{A}\left(\frac{R-r}{A}\right)$ (d) $\frac{Er}{AR}$	
28	Find the extension produced in a copper of length 2 m and diameter 3 mm, when a force of 30 N is applied. Young's modulus for copper = 1.1×10^{11} Nm^{-2} (a) 0.2 mm (b) 0.04 mm (c) 0.08 mm (d) 0.68 mm	

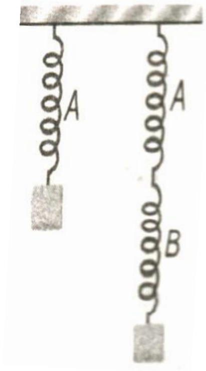
29	A wire extends by 1 mm when a force is applied. Double the force is applied to another wire of same material and length but half the radius of cross-section. The elongation of the wire in mm will be (a) 8 (b) 4 (c) 2 (d) 1	
30	A 1 m long steel wire of cross-sectional area 1 mm^2 is extended by 1 mm. If Y = 2 x 10^{11} Nm^{-2}, then the work done is (a) 0.1 J (b) 0.2 J (c) 0.3 J (d) 0.4 J	
31	A wire is stretched 1 mm by a force of 1 kN. How far would a wire of the same material and length but of four times that diameter be stretched by the same force? (a) $\frac{1}{2}mm$ (b) $\frac{1}{4}mm$ (c) $\frac{1}{8}mm$ (d) $\frac{1}{16}mm$	
32	Two bars A and B of circular cross-section and of same volume and made of the same material are subjected to tension. If the diameter of A is half that of B and if the force applied to both the rods is the same and it is in the elastic limit, the ratio of extension of A to that of B will be (a) 16 : 1 (b) 8 : 1 (c) 4 : 1 (d) 2 : 1	
33	A steel wire has length 2 m, radius 1 mm and Y = 2 x 10^{11} Nm^{-2}. A 1 kg sphere is attached to one end of the wire and whirled in a vertical circle with an angular velocity of 2 revolutions per second. When the sphere is at the lowest point of the vertical circle, the elongation of the wire is nearly (Take, g = 10 ms^{-2}) (a) 1 mm (b) 2 mm (c) 0.1 mm (d) 0.01 mm	
34	Two wires of equal cross-section but one made of steel and the other of copper are joined end to end. When the combination is kept under tension, the elongations in the two wires are found to be equal. What is the ratio of the lengths of the two wires? (Given, Y for steel = 2 x $10^{11}$$Nm^{-2}$) (a) 2 : 11 (b) 11 : 2 (c) 20 : 11 (d) 11 : 20	
35	The Young's modulus of brass and steel are 10 x 10^{10} Nm^{-2} and 2 x 10^{11} Nm^{-2} respectively. A brass wire and a steel wire of the same length are extended by 1 mm under the same force. The radii of the brass and steel wires are R_B and R_S respectively. Then (a) $R_S = \sqrt{2}R_B$ (b) $R_S = \frac{R_B}{\sqrt{2}}$ (c) $R_S = 4R_B$ (d) $R_S = \frac{R_B}{4}$	
36	When the tension in a metal wire is T_1, its length is l_1.	

	When the tension is T_2, its length is l_2. The natural length of wire is (a) $\frac{T_2}{T_1}(I_1+I_2)$ (b) $T_1I_1+T_2I_2$ (c) $\frac{I_1T_2-I_2T_1}{T_2-T_1}$ (d) $\frac{I_1T_2+I_2T_1}{T_2+T_1}$	
37	A rubber rope of length 8 m is hung from the ceiling of a room. What is the increase in length of the rope due to its own weight? (Given Young's modulus of elasticity of rubber = 5 x 10^6 Nm^{-2} and density of rubber = 1.5 x 10^6 kgm^{-3}. Take g = 10 ms^{-2}) (a) 1.5 mm (b) 6 mm (c) 24 mm (d) 96 mm	
38	Two identical wires of rubber and iron are stretched by the same weight, then the number of atoms in unit volume of iron wire will be (a) Equal to that of rubber (b) Less than that of the rubber (c) More than that of the rubber (d) None of the above	
39	Two wires, one made of copper and other of steel are joined end to end (as shown in figure). The area of cross-section of copper wire is twice that of steel wire.  They are placed under compressive force of magnitudes F. The ratio for their lengths such that change in lengths of both wires are same is (Y_S = 2 x 10^{11} Nm^{-2} and Y_C = 1.1 x 10^{11} Nm^{-2}) (a) 2.1 (b) 1.1 (c) 1.2 (d) 2	
40	A uniform slender rod of length L, cross-sectional area A and Young's modulus Y is acted upon by the forces shown in the figure. The elongation of the rod is  (a) $\frac{3FL}{5AY}$ (b) $\frac{2FL}{5FY}$ (c) $\frac{3FL}{8AY}$ (d) $\frac{8FL}{3AY}$	

CONCEPT-27: BASED ON BULK MODULUS, STRESS, STRAIN

1	Two wires of the same material (Young's modulus Y) and same length L but radii R and 2R respectively are joined end to end and a weight w is suspended from the	

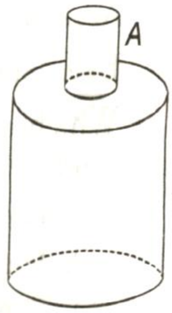
	combination as shown in the figure. The elastic potential energy in the system is  (a) $\frac{3w^2L}{4\pi R^2Y}$ (b) $\frac{3w^2L}{8\pi R^2Y}$ (c) $\frac{5w^2L}{8\pi R^2Y}$ (d) $\frac{w^2L}{\pi R^2Y}$	
2	A load suspended by a massless spring produces an extension of x cm, in equilibrium. When it is cut into two unequal parts, the same load produces an extension of 7.5 cm when suspended by the larger part of length 60 cm. When it is suspended by the smaller part, the extension is 5.0 cm. Then (a) x = 12.5 (b) x = 3.0 (c) The length of the original spring is 90 cm (d) The length of the original spring is 80 cm	
3	In the figure three identical springs are shown. from spring A, a mass of 4 kg is hung and spring shows elongation of 1 cm. But when a weight of 6 kg is hung ob B, the hook descends through	

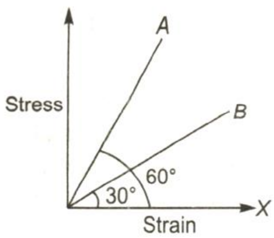
	 (a) 1 cm (b) 2 cm (c) 3 cm (d) 4 cm	
4	The length of an elastic string is α metre when the tension is 44 N, and b metre when the tension is 5 N. The length in metre when the tension is 9 N, is (a) 4a – 5b (b) 5b – 4a (c) 9b – 9a (d) a + b	
5	The ratio of two specific heats of gas C_p/C_v for argon is 1.6 and for hydrogen is 1.4. Adiabatic elasticity of argon at pressure p is E. Adiabatic elasticity of hydrogen will also be equal to E at the pressure (a) p (b) $\frac{8}{7}p$ (c) $\frac{7}{8}p$ (d) 1.4 p	
6	Consider two cylindrical rods of identical dimensions, one of rubber and the other of steel. Both the rods are fixed rigidly at one end to the roof. A mass M is attached to each of the free ends at the centre of the rods. (a) Both the rods will elongate but there shall be no perceptible change in shape (b) The steel rod will elongate and change shape but the rubber rod will only elongate (c) The steel rod will elongate without any perceptible change in shape, but the rubber rod will elongate and the shape of the bottom edge will change to an ellipse. (d) The steel rod will elongate, without any perceptible change in shape, but the rubber rod will elongate with the shape of the bottom edge tapered to a tip at the centre	
7	If the compressibility of water is σ per unit atmospheric pressure, then the decrease in volume (V) due to atmospheric pressure p will be (a) σ p/V (b) σ pV (c) σ /pV (d) σ V/p	
8	A cube is compressed at 0^0C equally from all sides by an external pressure p. By what amount should be	

	temperature be raise to bring it back to the size it has before the external pressure was applied? (Given K is bulk modulus of elasticity of the material of the cube and α is the coefficient of linear expansion.) (a) $\frac{p}{K\alpha}$ (b) $\frac{p}{3K\alpha}$ (c) $\frac{3\pi\alpha}{p}$ (d) $\frac{K}{3p}$	
9	When a 4 kg mass is ung vertically on a light spring that obeys Hooke's law, the sping stretches by 2 cm. The work required to be done by an external agent in stretching this spring by 5 cm will be (a) 4.9 J (b) 2.45 J (c) 0.495 J (d) 0.245 J	
10	A spring is extended by 30 mm when a force of 1.5 N is applied to it. Calculate the energy stored in the spring when hanging vertically supporting a mass of 0.20 kg is the spring was instructed before applying the mass? (a) 0.01 J (b) 0.02 J (c) 0.04 J (d) 0.08 J	
11	How much should the pressure on a litre of water be changed to compress it by 0.10%. Bulk modulus of elasticity of water = 2.2 x 10^9 N/m^2. (a) 2.2 x 10^{-6} N-m^2 (b) 4.2 x 10^{-6} N-m^{-2} (c) 2.2 x 10^6 N-m^2 (d) 4.2 x 10^4 N-m^2	
12	Compute the fractional change in volume of a glass slab, when subjected to a hydraulic pressure of 10 atm (a) 2.74 x 10^{-5} (b) 3.74 x 10^{-5} (c) 1.74 x 10^{-5} (d) None of these	
13	A height spring extends 40 mm when stretched by a force of 10 N, and for tensions upto this value the extension is proportional to the stretching force. Two such springs are joined end-to-end and the double-length spring is stretched 40 mm beyond its natural length. The total strain energy in (joule), stored in the double spring is (a) 0.05 (b) 0.10 (c) 0.80 (d) 0.40	
14	A cube is shifted to a depth of 100 m in a lake. The change in volume is 0.1%. the bulk modulus of the material is nearly (a) 10 Pa (b) 10^4 Pa (c) 10^7 Pa (d) 10^6 Pa	
15	A copper bar of length L and area of cross-section A is placed in a chamber at atmosphere pressure. If the chamber is evacuated, the percentage change in its	

	volume will be (compressibility of copper is 8 x $10^{12}$$m^2$N-1 and 1 atm = 10^5 n M^{-2}) (a) 8 x 10^{-7} (b) 8 x 10^{-5} (c) 1.25 x 10^{-4} (d) 1.25 x 10^{-5}	
16	An elastic material of Young's modulus Y is subjected to a stress S. The elastic energy stored per unit volume of the material is (a) $\frac{SY}{2}$ (b) $\frac{S^2}{2Y}$ (c) $\frac{S}{2Y}$ (d) $\frac{2S}{Y}$	
17	A ball falling in a lake of depth 200 m shows a decrease of 0.1% in its volume at the bottom. The bulk modulus of elasticity of the material of the ball is (Take g = 10 ms^{-2}) (a) 10^9 Nm^{-2} (b) 2 x 10^9 Nm^{-2} (c) 3 x 10^9 Nm^{-2} (d) 4 x 10^9 Nm^{-2}	
18	A spherical ball contracts in volume by 0.01% when subjected to a normal uniform pressure of 100 atmosphere. What is the bulk modulus of elasticity of the material of the ball? (Take, 1 atmosphere = 106 dyne cm^{-2}) (c) 10^9 dyne cm^{-2} (b) 10^{10} dyne cm^{-2} (c) 10^{12} dyne cm^{-2} (d) 10^{14} dyne cm^{-2}	
19	When a rubber cord is stretched, the change in volume with respect to change in its linear dimensions is negligible. The Poisson's ratio for rubber is (a) 1 (b) 0.25 (c) 0.5 (d) 0.75	
20	A cube is subjected to a uniform volume compression. If the side of the cube decreases by 1% the bulk strain is (a) 0.01 (b) 0.02 (c) 0.03 (d) 0.06	
21	For most materials is Young's modulus is n times, the rigidity modulus, where n is (a) 2 (b) 3 (d) 4 (d) 6	
22	A wire o Young's modulus 1.5 x 10^{12} Nm^{-2} is stretched by a force so as to produce a strain of 2 x 10^4. The energy stored per unit volume is (a) 3 x 10^8 Jm^{-3} (b) 3 x 10^3 Jm^{-3} (c) 6 x 10^3 Jm^{-3} (d) 3 x 10^4 Jm^{-3}	
23	In the three states of matter, the elastic coefficient can be (a) Young's modulus (b) Coefficient of volume elasticity (c) Modulus of rigidity (d) Poisson's ratio	

24	The force constant of a wire is k and that of another wire of the same material is 2k. When both the wires are stretched, then work done is (a) $W_2 = 1.5\ W_1$ (b) $W_2 = 2W_1$ (c) $W_2 = W_1$ (d) $W_2 = 0.5\ W_1$	
25	Modulus of rigidity of ideal liquids is (a) Infinity (b) Zero (c) Unity (d) Some finite small non-zero constant value	
26	One end of steel wire is fixed to ceiling of an elevator moving up with an acceleration 2 ms^{-2} and a load of 10 kg hangs from other end. Area of cross-section of the wire is 2 cm^2. The longitudinal strain in the wire is (Take g = 10 ms^{-2} and Y = 2 x 10^{11} Nm^{-2}) (a) 4 x 10^{11} (b) 3 x 10^{-6} (c) 8 x 10^{-6} (d) 2 x 10^{-6}	
27	A wire suspended vertically from one of its ends is stretched by attaching a weight of 200 N to the lower end. The weight stretches the wire by 1 mm. Then, the elastic energy stored in the wire is (a) 0.2 J (b) 10 J (c) 20 J (d) 0.1 J	
28	A body of mass m = 10 kg is attached to a wire of length 0.3 m. The maximum angular velocity with which it can be rotated in a horizontal circle is (Breaking stress of wire = 4.8 x 10^7 Nm^{-2} and area of cross-section of a wire = 10^{-2} m^2) (a) 4 $rads^{-1}$ (b) 8 $rads^{-1}$ (c) 1 $rads^{-1}$ (d) 2 $rads^{-1}$	
29	If the shear modulus of a wire material is 5.9 x 10^{11} dyne cm^{-2}, then the potential energy of a wire of 4 x 10^3 cm in diameter and 5 cm long twisted through an angle of 10' is (a) 1.253 x 10^{-12} J (b) 2.00 x 10^{-12} J (c) 1.00 x 10^{-12} J (d) 0.8 x 10^{-12} J	
30	Two cylinders of same material and of same length are joined to end as shown in figure. The upper end of A is rigidly fixed. Their radii are in ratio of 1 : 2. If the lower end of B is twisted by an angle θ, the angle of twist of cylinder A is	

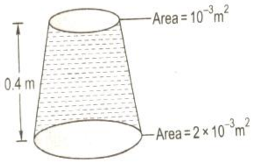
	 (a) $\frac{15}{16}\theta$ (b) $\frac{16}{15}\theta$ (c) $\frac{16}{17}\theta$ (d) $\frac{17}{16}\theta$	
31	In a wire stretched by hanging a weight from its end, the elastic potential energy per unit volume in terms of longitudinal strain σ and modulus of elasticity Y is (a) $\frac{Y\sigma^2}{2}$ (b) $\frac{Y\sigma}{2}$ (c) $\frac{2Y\sigma^2}{2}$ (d) $\frac{Y^2\sigma}{2}$	
32	Two wires of the same material and length but diameters in the ratio 1 : 2 are stretched by the same force. The potential energy per unit volume for the two wires when stretched will be in the ratio (a) 16 : 1 (b) 4 : 1 (c) 2 : 1 (d) 1 : 1	
33	A metal rod of Young's modulus 2 x 10^{10} Nm^{-2} undergoes an elastic strain of 0.06%. The energy per unit volume stored in Jm^{-3} is (a) 3600 (b) 7200 (c) 10800 (d) 14400	
34	One end of uniform wire of length L and of weight w is attached rigidly to a point in the roof and a weight w_1 is suspended from its lower end. If s is the area of cross-section of the wire, the stress in the wire at a height (3L/4) from its lower end is (a) $\frac{w_1}{s}$ (b) $\left[w_1+\frac{w}{4}\right]s$ (c) $\left[w_1+\frac{3w}{4}\right]/s$ (d) $\frac{w_1+w}{s}$	
35	Two rods A and B of the same material and length have their radii r_1 and r_2 respectively. When they are rigidly fixed at one end and twisted by the same couple applied at the other end, the ratio of the angle of twist at the end of A and the angle of twist at the end of B is	

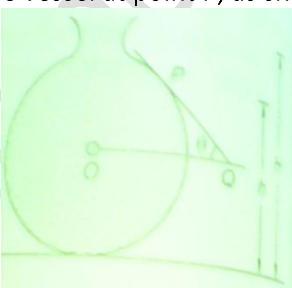
	(a) $\frac{r_2^4}{r_1^4}$ (b) $\frac{r_1^4}{r_2^4}$ (c) $\frac{r_2^2}{r_1^2}$ (d) $\frac{r_1^2}{r_2^2}$	
36	What among of work is done in increasing the length of a wire though unity? (a) $\frac{YL}{2A}$ (b) $\frac{YL^2}{2A}$ (c) $\frac{YA}{2L}$ (d) $\frac{YL}{A}$	
37	If the work done in stretching a wire by 1 mm is 2 J, the work necessary for stretching another wire of same material but with double radius of cross-section and half the length by 1 mm is (a) $\frac{1}{4}$ J (b) 4 J (c) 8 J (d) 16 J	
38	A wire (Y = 2 x 10^{11} Nm^{-2}) has length 1 m and cross-sectional area 1 mm^2. The work required to increase the length by 2 mm is (a) 0.4 J (b) 4 J (c) 40 J (d) 400 J	
39	In above question, the work done in the two wires is (a) 0.5 J, 0.03 J (b) 0.25 J, 0 J (c) 0.03 J, 0.25 J (d) 0 J, 0 J	
40	A copper wire 2 m long is stretched by 1 mm. If the energy stored in the stretched wire is converted to heat, calculate the rise in temperature of the wire. (Given, Y = 12 x 10^{11} dyne cm^{-2}, density of copper = 9 gcm^{-3} and specific heat of copper = 0.1 cal g^{-10} C^{-1}) (a) 252^{0}C (b) (1/252)^{0}C (c) 1000^{0}C (d) 2000^{0}C	
41	The stress versus strain graphs for wires of two materials A and B are as shown in the figure. If y_A and y_B are the Young's modulus of the materials, then  (a) $y_B = 2\, y_A$ (b) $y_A = y_B$ (c) $y_B = 3y_A$ (d) $y_A = 3y_B$	
42	The upper end of a wire of radius 4 mm and length 100 cm	

	is clamped and its other end is twisted through an angle of 30^0. Then angle of shear is (a) 12^0 (b) 0.12^0 (c) 1.2^0 (d) 0.012^0	
43	If E_θ and E_ϕ denote the isothermal and adiabatic elasticities respectively of a gas, then E_θ / E_ϕ (a) < 1 (b) > 1 (c) = 1 (d) = 3.2	
44	For a given material, the Young's modulus is 2.4 times that of modulus of rigidity. Its Poisson's ratio is (a) 0.1 (b) 0.2 (c) 0.3 (d) 0.4	
45	Forces of 100 N each are applied in opposite directions on the upper and lower faces of a cube of side 20 cm. The upper face is shifted parallel to itself by 0.25 cm. If the side of the cube were 10 cm, then the displacement would be (a) 0.25 cm (b) 0.5 cm (c) 0.75 cm (d) 1 cm	
46	The compressibility of water is 6×10^{-10} $N^{-1}m^2$. If one litre is subjected to a pressure of 4×10^7 Nm^{-2}. The decrease in its volume is (a) 2.4 cc (b) 10 cc (c) 24 cc (d) 15 cc	
47	The Young's modulus of the material of a wire is 6×10^{12} Nm^{-2} and there is no transverse strain in it, then its modulus of rigidity will be (a) 3×10^{12} Nm^{-2} (b) 2×10^{12} Nm^{-2} (c) 10^{12} Nm^{-2} (d) None of the above	
48	Equal torsional torques act on two rods x and y having equal length. The diameter of rod y is twice the diameter of rod x. If θ_x and θ_y are the angles of twist, then $\frac{\theta_x}{\theta_y}$ is equal to (a) 1 (b) 2 (c) 4 (d) 16	
49	The increase in length on stretching a wire is 0.05%. If its Poisson's ratio is 0.4, the diameter is reduced by (a) 0.01% (b) 0.02% (c) 0.03% (d) 0.04%	
50	A fore F is required to break a wire of length l and radius r. What force is required to break a wire, of the same material, having twice the length and six times the radius? (a) F (b) 3 F (c) 9 F (d) 36 F	
51	The following date were obtained when a wire was stretched within the elastic region Force applied to wire 100 N Area of cross-section of wire 10^{-6} m^2	

	Extension of wire 2×10^{-9}m Which of the following deductions can be correctly made from this date? 1. The value of Young's modulus is 10^{11} Nm^{-2} 2. The strain is 10^{-3} 3. The energy stored in the wire when the load is applied is 10 J (a) 1, 2, 3 are correct (b) 1, 2 are correct (c) 1 only (d) 3 only	

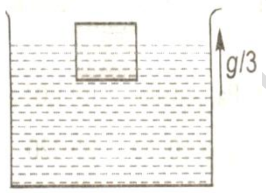
CONCEPT-28: BASED ON THRUST AND PRESSURE

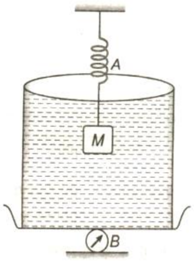
1	Density of ice is ρ and that of water is σ. What will be the decrease in volume when a mass M of ice melts? (a) $\frac{M}{\sigma-\rho}$ (b) $\frac{\sigma-\rho}{M}$ (c) $M\left(\frac{1}{\rho}-\frac{1}{\sigma}\right)$ (d) $\frac{1}{M}\left(\frac{1}{\rho}-\frac{1}{\sigma}\right)$	
2	A 50 kg girl wearing high heel shoes balances on a single heel. If the heel is circular with a diameter 1.0 cm. What is the pressure exerted on the horizontal floor? (a) 6.9×10^6 Pa (b) 6.2×10^6 Pa (c) 9.6×10^6 Pa (d) 9.0×10^6 Pa	
3	The surface area of air bubble increases four times when it rises from bottom to top of a water tank where the temperature is uniform. If the atmospheric pressure is 10 m of water, the depth of the water in the tank is (a) 30 m (b) 40 m (c) 70 m (d) 80 m	
4	A U-tube contains water and methylated spirit separated by mercury. The mercury columns in the two arms are in level with 10.0 cm of water in one arm and 12.5 cm of spirit in the other. The specific gravity of spirit would be (a) 0.70 (b) 0.80 (c) 0.90 (d) 0.60	
5	A uniform tapering vessel shown in figure is filled with liquid of density 900 kgm^{-3}. The force that acts on the base of the vessel due to liquid is (Take, g = 10 ms^{-2})  (a) 3.6 N (b) 7.2 N (c) 9.0 N (d) 12.0 N	
6	A U-tube contains water and methylated spirit separated by mercury. If the 15.0 cm of water and spirit each are further poured into the respective arms of the tube, what	

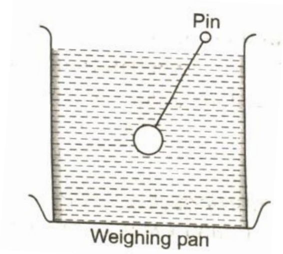
	is the difference in the levels of mercury in the two arms? (Specific gravity of mercury = 13.6) (a) 0.221 cm (b) 2.22 cm (c) 0.02 cm (d) None of these	
7	A cylindrical vessel is filled with equal amounts of weight of mercury on water. The overall height of the two layers is 29.2 cm, specific gravity of mercury is 13.6. Then the pressure of the liquid at the bottom of the vessel is (a) 29.2 cm of water (b) 29.2/13.6 cm of mercury (c) 4 cm of mercury (d) 15.6 cm of mercury	
8	The density ρ of water of bulk modulus B at a depth y in the ocean is related to the density at surface ρ_0 by the relation (a) $\rho = \rho_0\left(1 - \frac{\rho_0 gy}{B}\right)$ (b) $\rho = \left(\rho_0 1 + \frac{\rho_0 gy}{B}\right)$ (c) $\rho = \rho_0\left(1 + \frac{B}{\rho_0 hgy}\right)$ (d) $\rho = \rho_0\left(1 - \frac{B}{\rho_0 gy}\right)$	
9	An aquarium tank is in the shape of a cube with one side a 4m tall glass wall. When the tank is half filled and the water is 2 m deep, the water exerts on the wall when the tank is full and the water is 4 m drop? (a) 1/2 F (b) F (c) 2 F (d) 4 F	
10	Figure shows the vertical cross-section of a vessel filled with a liquid of density ρ. The normal thrust per unit area on the walls of the vessel at point P, as shown will be  (a) $h\rho g$ (b) $H\rho g$ (c) $(H-h)\rho g$ (d) $(H-h)\rho g\cos\theta$	

CONCEPT-29: BASED ON RELATIVE DENSITY OF SUBSTANCE, ARCHIMEDES' PRINCIPLE AND LAWS OF FLOATATION

1	A beaker containing water is balanced on the pan of a common balance. A solid of specific gravity 1 ad mass 5 g is tied to the arm of the balance and immersed in water contained in the beaker. The scale pan with the beaker (a) Goes down (b) goes up (c) Remains unchanged (d) None of these	

2	Torricelli's barometer used mercury. Pascal duplicated it using French wine of density 984 kg/m^3. Determine the height of the wine column for normal atmospheric pressure. (a) 9.5 cm (b) 5.5 cm (c) 10.5 cm (d) 11.5 cm	
3	An ice block floats in a liquid whose density is less than water. A part of block is outside the liquid. When whole of ice has melted, the liquid level will (a) Rise (b) Go down (c) Remain same (d) First rise then go down	
4	A tank 5m high is half filled with water and then is filled to the top with oil of density 0.85 gcm^{-3}. The pressure at the bottom of the tank, due to these liquids is (a) 1.85 g dyne cm^{-3} (b) 89.25 g dyne cm^{-3} (c) 462.5 g dyne cm^{-3} (d) 500 dyne cm^{-3}	
5	A balloon of volume 1500 m^3 and weighing 1650 kg with all its equipment is filled with He (density 0.2 kg m^{-3}). If the density of air be 1.3 kgm^{-3}, the pull on the rope tied to the balloon will be (a) 300 kg (b) 1950 kg (c) 1650 kg (d) Zero	
6	A cubic block is floating in a liquid with half of its volume immersed in the liquid. When the whole system accelerates upwards with acceleration of g/3 the fraction of volume immersed in the liquid will be  (a) $\frac{1}{2}$ (b) $\frac{3}{8}$ (c) $\frac{2}{3}$ (d) $\frac{3}{4}$	
7	Two cubes each weighing 22 g exactly are taken. One is of iron (d = 8 x 10^3 kgm^{-3}) and the other is of marble (D = 3 x 10^3 kgm^{-3}). They are immersed in alcohol and then weighed again (a) Iron cube weighs less (b) Iron cube weighs more (c) Both have equal weight (d) Nothing can be said	
8	The spring balance A reads 2 kg with a block of mass m suspended from it. A balance B reads 5 kg when a beaker with liquid is put on the pan of the balance. The two balances are now so arranged that the hanging mass is inside the liquid in a beaker as shown in figure.	

	 (a) The balance A will read more than 2 kg (b) The balance B will read less than 5 kg (c) The balance A will read less than 2 kg and B will read more than 5 kg (d) The balance A will read more than 2 kg and B will read less than 5 kg	
9	A cylinder of mass m and density ρ hanging from a string is lowered into a vessel of cross-sectional area A containing a liquid of density $\sigma(<\rho)$ until it is fully immersed. The increase in pressure at the bottom of the vessel is (a) Zero (b) $\frac{mg}{A}$ (c) $\frac{mg\rho}{\sigma A}$ (d) $\frac{m\sigma g}{\rho A}$	
10	A cubical block of wooden edge l and a density ρ floats in water of density 2ρ. The lower surface of cube just ouches the free end of a massless spring of force constant k fixed at the bottom of the vessel. The weight w put over the block so that it is completely immersed in water without wetting the weight is (a) $a(l\rho g+k)$ (b) $a(l^2\rho g+k)$ (c) $a\left(\frac{l\rho g}{2}+2k\right)$ (d) $l\left(l^2\rho g+\frac{k}{2}\right)$	
11	A rectangular plate 2m x 3m is immersed in water in such a way that its greatest and least depth are 6 m and 4 m respectively, from the water surface. The total thrust on the plate is (a) 294×10^3 N (b) 294 N (c) 100×10^3 N (d) 400×10^3 N	
12	A block of aluminium of mass 1 kg and volume $3.6 \times 10^{-4} m^3$ is suspended from a string and then completely immersed in a container of water. The decrease in tension in a container of water. The decrease in tension in the string after immersion is (a) 9.8 N (b) 6.2 N (c) 3.6 N (d) 1.0 N	
13	A vessel with water is placed on a weighing pan and it reads 0.8 gcc^{-1} is sunk into the water with a pin of negligible volume as shown in figure keeping it sunk. The weighing pan will show a reading	

	 (a) 600 g (b) 632 g (c) 642 g (d) 640 g	
14	A body of density ρ is dropped from rest at a height h into a lake of density σ, where $\sigma > \rho$. Neglecting all dissipative forces, calculate the maximum depth to which the body sinks before returning to float on the surface. (a) $\frac{h}{\sigma-\rho}$ (b) $\frac{h\rho}{\sigma}$ (c) $\frac{h\rho}{\sigma-\rho}$ (d) $\frac{h\sigma}{\sigma-\rho}$	
15	Two cylinders of same cross-section and length L but made of two material of densities ρ_1 and ρ_2 (in CGS units) are cemented together to form a cylinder of length 2L. If the combination floats in water with a length L/2 above the surface of water and $\rho_1 < \rho_2$, then (a) $\rho_1 > 1$ (b) $\rho_1 < 3/4$ (c) $\rho_1 > 1/2$ (d) $\rho_1 > 3/4$	
16	The density of ice is 0.9 gcc^{-1} and that of sea water is 1.1 gcc^{-1}. An ice berg of volume V is floating in sea water. The fraction of ice berg above water level is (a) 1/11 (b) 2/11 (c) 3/11 (d) 4/11	
17	A solid of density D is floating in a liquid of density d. If υ is the volume of solid submerged in the liquid and V is the total volume of the solid, then υ / V is equal to (a) $\frac{d}{p}$ (b) $\frac{D}{d}$ (c) $\frac{D}{(D+d)}$ (d) $\frac{D+d}{D}$	
18	The total weight of a piece of wood is 6 kg. In the floating state in water its $\frac{1}{3}$ part remains inside the water. On this floating solid, what maximum weight is to be put such that the whole of the piece of wood is to be drowned in the water? (a) 12 kg (b) 10 kg (c) 14 kg (d) 15 kg	
19	A hollow cylinder of mass m made heavy at its bottom is	

	floating vertically in water. It is tilled from its vertical position through an angle θ and is left. The restoring force acting on it is (a) mg cos θ (b) mg sin θ (c) $mg\left[\frac{1}{\cos\theta}-1\right]$ (d) $mg\left[\frac{1}{\cos\theta}+1\right]$	
20	A hemispherical bowl just floats without sinking in a liquid of density 1.2 x 10^3 kgm^{-3}. If outer diameter and the density of the bowl are 1 m and 2 x 10^4 kgm^{-3} respectively, then the inner diameter of the bowl will be (a) 0.94 m (b) 0.96 m (c) 0.98 m (d) 0.99 m	

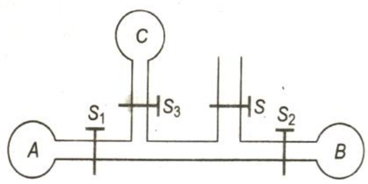
CONCEPT-30: BASED ON SURFACE TENSION AND SURFACE ENERGY

1	A thin metal disc of radius r float on water surface and bends the surface downwards along the perimeter making an angle θ with vertical edge of the disc. If the disc displaced a weight of water of metal disc is (a) $2\pi rT+W$ (b) $2\pi rT\cos\theta-W$ (c) $2\pi rT\cos\theta+W$ (d) $W-2\pi rT\cos\theta$	
2	A ring is cut from a platinum tube 8.5 cm internal diameter and 8.7 cm external diameter. It is supported horizontally from a pan of a balance so, that it comes in contact with the water is in glass vessel. If an extra 3.47 g-wt is required to pull it away from water, surface tension of water is (a) 72.07 dyne cm^{-1} (b) 70.80 dyne cm^{-1} (c) 65.35 dyne cm^{-1} (d) 60.00 dyne cm^{-1}	
3	What is the pressure inside the drop of mercury of radius 3.00 mm at room temperature? Surface tension of mercury at that temperature (20^0C) is 4.65 x 10^{-1}N/m. The atmospheric pressure is 1.01 x 10^5 Pa. Also give the excess pressure inside the drop. (a) 1.01 x 10^5 Pa, 320Pa (b) 1.01 x 10^5 Pa, 310Pa (c) 310 Pa, 1.01 x 10^5 Pa (d) 320 Pa, 1.01 x 10^5Pa	
4	What is the radius of the biggest aluminium coin of thickness, t and density ρ, which will still be able to float on the water surface of surface tension S? (a) $\frac{4S}{3\rho gt}$ (b) $\frac{3S}{4\rho gt}$ (c) $\frac{2S}{\rho gt}$ (d) $\frac{S}{\rho gt}$	
5	8000 identical water drops are combined to form a big drop then the ratio to the final surface energy to the initial surface energy, if all the drops together is (a) 1 : 10 (b) 1 : 15 (c) 1 : 20 (d) 1 : 25	

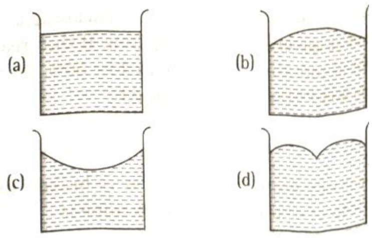
6	A frame made of a metallic wire enclosing a surface area A is covered with a soap fil. If the area of the frame of metallic wire is reduced by 50%, the energy of the soap film will be changed by (a) 100% (b) 75% (c) 50% (d) 25%	
7	A mercury drop of radius 1 cm is broken into 106 droplets of equal size. The work done is ($S = 35 \times 10^{-2}$ Nm^{-1}) (a) 4.35×10^{-2} J (b) 4.35×10^{-3} J (c) 4.35×10^{-6} J (d) 4.35×10^{-8} J	
8	Surface tension of a soap solution is able of 2.0 cm diameter will be (a) 7.6×10^{-6} πJ (b) 15.2×10^{-6} πJ (c) 1.9×10^{-6} πJ (d) 1×10^{-4} πJ	
9	A drop of water breaks into two droplets of equal size. In this process, which of the following statements is correct? (a) The sum of the temperatures of the two droplets together is equal to temperature of the original drop (b) The sum of the masses of the two droplets is equal to mass of drop (c) The sum of the radii of the two droplets is equal to the radius of the drop (d) The sum of the surface areas of the two droplets is equal to the surface area of the original drop	
10	Work done in splotting a drop of water of 1mm radius into 10^6 droplets is (surface tension of water 72×10^{-3} J / m^2) (a) 9.8×10^{-5} J (b) 8.95×10^{-5} J (c) 5.89×10^{-5} J (d) 5.98×10^{-6} J	
11	A drop of liquid of diameter 2.8 mm breaks up into 125 identical drops. The change in energy is nearly (S = 75 dyne cm^{-1}) (a) Zero (b) 19 erg (c) 46 erg (d) 74 erg	
12	The surface energy of a liquid drop u. It is sprayed into 1000 equal droplets. Then its surface energy becomes (a) u (b) 10 u (c) 100 u (d) 1000 u	
13	A water film is made between two straight parallel wires of length 10 cm separated by 5 mm from each other. If the distance between the wires is increased by 2 mm. How much work will be done? Surface tension for water is 72 dyne cm^{-1}. (a) 288 erg (b) 72 erg (c) 144 erg (d) 216 erg	
14	What change in surface energy will be noticed when a	

	drop of radius R splits up into 1000 droplets of radius r, surface tension T? (a) $4 \pi R^2 T$ (b) $7 \pi R^2 T$ (c) $16 \pi R^2 T$ (d) $36 \pi R^2 T$	
15	Let, W be the work done, when a bubble of volume V is formed from a given solution. How much work is required to be done to form a bubble of volume 2 V? (a) W (b) 2W (c) $2^{1/3}$ W (d) $4^{1/3}$ W	
16	What is the ratio of surface energy of 1 small drop and 1 large drop if 1000 drops combined to form 1 large drop? (a) 100 : 1 (b) 1000 : 1 (c) 10 : 1 (d) 1 : 100	
17	A bigger drop of radius R is converted into n smaller drops of radius r, the required energy is (a) $\left(4\pi r^2 n - 4\pi R^2\right)T$ (b) $\left(\frac{4}{3}\pi r^3 n - \frac{4}{3}\pi R^3\right)T$ (c) $\left(4\pi R^2 - 4\pi r^2\right)nT$ (d) $\left(n4\pi r^2 - 4\pi R^2\right)T$	

CONCEPT-31: BASED ON EXCESS OF PRESSURE, SHAPE OF MENISCUS AND CAPILLARITY

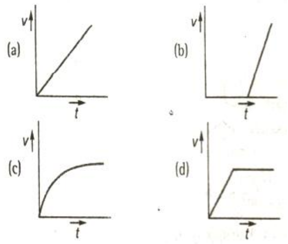
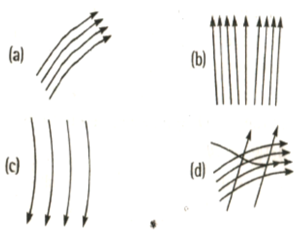
1	The angle of contact at the interface of water-glass is 0^0 Ethylalcohol-glass is 0^0, Mercury-glass is 140^0 and Methyliodide-glass is 30^0. A glass capillary is put in a trough containing one of these four liquids. It is observed that the meniscus is convex. The liquid in the trough is (a) Water (b) Ethylalcohol (c) Mercury (d) Methyliodide	
2	The diagram shows three soap bubbles A, B and C prepares by blowing the capillary tube fitted with stop cocks S, S_1, S_2 and S_3. With stop cock S closed and stop cocks S_1, S_2 and S_3 opened  (a) B will start collapsing with volumes of A and C increasing (b) C will start collapsing with volume of A and B increasing (c) Volume of A, B and C will become equal in equilibrium (d) C and A will both start collapsing with volume of B increasing	
3	The amount of work done in blowing a soap bubble such	

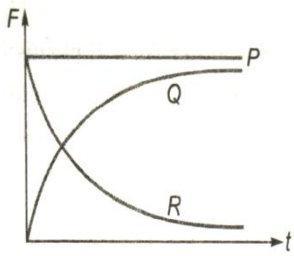
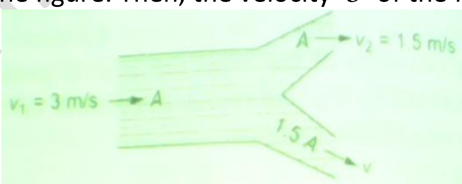
	that its diameter increases from d to D is (S = surface tension of solution) (a) $\pi(D^2 - d^2)$ S (b) $2\pi(D^2 - d^2)$ S (c) $4\pi(D^2 - d^2)$ S (d) $8\pi(D^2 - d^2)$ S	
4	If pressure at half the depth of a lake is equal to $\frac{2}{3}$ pressure at the bottom of the lake then what is the depth of the lake? (a) 10 m (b) 20 m (c) 60 m (d) 30 m	
5	In a test experiment on a model aeroplane in a wind tunnel, the flow speeds on the upper and lower surfaces of the wing are 70 m/s and 63 m/s respectively. What is the lift on the wing, if its area is 2.5 m^2? Take the density of air to be 1.3 kg/m^3. (a) 5.1×10^2 N (b) 6.1×10^2 N (c) 1.6×10^3 N (d) 1.5×10^3 N	
6	With the increase in temperature, the angle of contact (a) Decreases (b) Increases (c) Remains contact (d) Sometimes increases and sometimes decreases	
7	Water rises to a height of 10 cm in a capillary tube and mercury falls to a depth of 3.42 cm in the same capillary tube. If the density of mercury and water are 135^0 and 0^0 respectively, the ratio of surface tension of water and mercury is (a) 1 : 0.15 (b) 1 : 3 (c) 1 : 6.5 (d) 1.5 : 1	
8	Water rises to a height of 16.3 cm in a capillary of height 18 cm above the water level. If the tube is cut at a height of 12 cm in the capillary tube, (a) Water will come as a fountain from the capillary tube (b) Water will stay at a height of 12 cm in the capillary tube (c) the height of water in the capillary tube will be 10.3 cm (d) Water height flow down the sides of the capillary tube	
9	Water rises in a capillary tube to a height h. It will rise to a height more than h (a) On the surface of sun (b) In a lift moving down with an acceleration (c) At the poles (d) In a lift moving up with an acceleration	
10	If a liquid is placed in a vertical cylindrical vessel and the vessel is rotated about its axis, the liquid will take the shape of figure.	

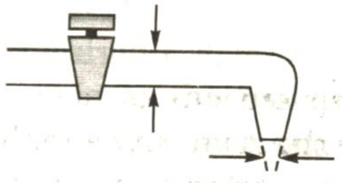
	 	
11	By inserting a capillary tube upto a depth l in water, the water rises to a height h. If the lower end of the capillary tube is closed inside water and the capillary is taken out and closed end opened, to what height the water will remain in the tube, when l > h? (a) Zero (b) l + h (c) 2 h (d) h	
12	Two capillary tubes of radii 0.2 cm and 0.4 cm are dipped in the same liquid. The ratio of heights through which liquid will rise in the tubes is (a) 1 : 2 (b) 2 : 1 (c) 1 : 4 (d) 4 : 1	
13	Water rises in a capillary tube to a height h. Choose the false statement regarding rise from the following. (a) On the surface of Jupitor, height will be less than h. (b) In a lift, moving up with constant acceleration, height is less than h. (c) On the surface of the moon, the height is more than h. (d) In a lift moving down with constant acceleration, height is less than h.	

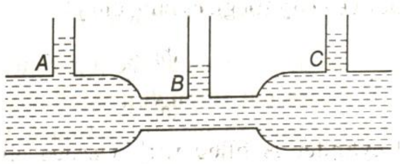
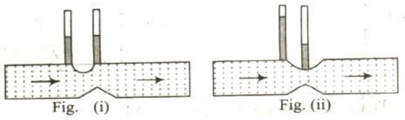
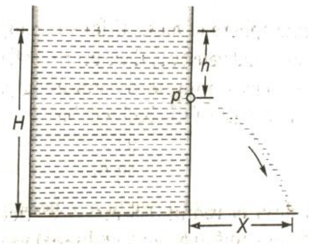
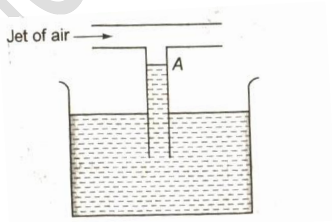
CONCEPT-32: BASED ON STOKES' LAW, TERMINAL VELOCITY AND VARIATION OF VISCOSITY & LIQUID FLOW

1	The terminal velocity υ of a spherical ball of lead of radius R falling through a viscous liquid varies with R such that (a) $\frac{V}{R}$ = constant (b) VR = constant (c) V = constant (d) $\frac{V}{R^2}$ = constant	
2	The rate of steady volume flow of water through a capillary tube of length l and raius r under a pressure difference of p, is V. This tube is connected with another tube of the same length but half the radius in series. Then the rate of steady volume flow through them is (The pressure difference across the combination is p) (a) $\frac{V}{16}$ (b) $\frac{V}{17}$ (c) $\frac{16V}{17}$ (d) $\frac{17V}{16}$	
3	A small spherical ball of steel falls through a viscous medium with terminal velocity υ. If a ball of twice the	

	radius of the first one but of the same mass is dropped through the same method, it will fall with a terminal velocity (neglect buoyancy) (a) $\frac{v}{2}$ (b) $\frac{v}{\sqrt{2}}$ (c) v (d) 2 v	
4	A tall cylinder is filled with viscous oil. A round pebble is dropped from the top with zero initial velocity. From the plot shown in figure, indicate the one that represents the velocity (υ) of the pebble as a function of time (t). 	
5	A rain drop of radius 0.3 mm has a terminal velocity in air = 1 ms^{-1}. The viscous force on it is (a) 101.73 x 10^{-4} dyne (b) 101.73 x 10^{-5} dyne (c) 16.95 x 10^{-4} dyne (d) 16.95 x 10^{-5} dyne	
6	A metallic sphere of mass M falls through glycerine with a terminal velocity υ. If we drop a ball of mass 8 M of same metal into a column of glycerine, the terminal velocity of the ball will be (a) 2 v (b) 4 v (c) 8 v (d) 16 v	
7	A rain drop of radius 1.5 mm, experiences a drag force F = (2 x 10^{-5} υ)N, while falling through air from a height 2 km, with a velocity υ. The terminal velocity of the rain drop will be nearly (use g = 10 ms^{-2}) (a) 200 ms^{-1} (b) 80 ms^{-1} (c) 7 ms^{-1} (d) 3 ms^{-1}	
8	Which of the following diagrams (figure) does not represent a streamline flow? 	
9	A marble of mass x and diameter 2 r is gently released a tall cylinder containing honey. If the marble displaces mass y (< x) of the liquid, then the terminal velocity is proportional to (a) (x + y) (b) (x – y)	

	(c) $\frac{x+y}{r}$ (d) $\frac{(x-y)}{r}$	
10	A small iron sphere is dropped from a great height. It attains its terminal velocity after having fallen 32 m. Then, it covers the rest of the path with terminal velocity only. The work done by air friction during the first 32 m of fall is W_1. The work done by air friction during the subsequent 32 m fall is W_2. Then (a) $W_1 > W_2$ (b) $W_1 < W_2$ (c) $W_1 = W_2$ (d) $W_2 = 32W_1$	
11	A spherical ball is dropped in a long column of viscous liquid. Which of the following graphs represent the variation of (i) Gravitational force with time (ii) Viscous force with time (iii) Net force acting on the ball with time?  (a) Q, R, P (b) R, Q, P (c) P, Q, P (d) R, P, Q	
12	A large tank is filled with water to a height H. A small hole is made at the base of the tank if taken T_1 time to decrease the height of water to $\frac{H}{l}(\eta > 1)$ and if takes T_2 time to take out the rest of water if $T_1 = T_2$ then the value of η is (a) 2 (b) 3 (c) 4 (d) $2\sqrt{2}$	
13	An incompressible liquid flows through a horizontal tube as shown in the figure. Then, the velocity υ of the fluid is  (a) 3 m/s (b) 1.5 m/s (c) 1.0 m/s (d) 2.25 m/s	
14	Water flowing out of the mouth of a tap and falling vertically in streamline flow forms a tapering column, i.e., the area of cross-section of the liquid column decreases as it moves down. Which of the following is the most accurate explanation for this?	

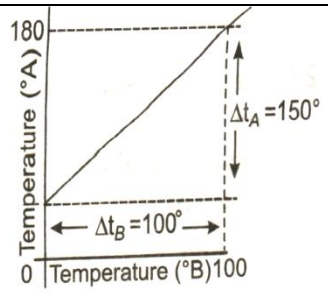
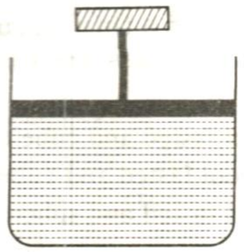
	 (a) Falling water tries to reach a terminal velocity and hence, reduces the area of cross-section to balance upward and downward forces (b) As the water moves down, its speed increases and hence, its pressure decreases. It is then compressed by atmosphere (c) The surface tension causes the exposed surface area of the liquid to decrease continuously (d) The mass of water flowing out per second through any cross-section must remain constant. As the water is almost incompressible, so the volume of water flowing out per second must remain constant. As this is equal to velocity x area, the area decreases as velocity increases	
15	If two ping pong balls are suspended near each other and a fast stream of air is produce within the space of the balls, the balls (a) Come nearer to each other. (b) Move away from each other. (c) Remain in their original positions. (d) Move far away.	
16	Along a streamline (a) The velocity of a fluid particle remains constant (b) The velocity of all fluid particles crossing a given position is constant (c) The velocity of all fluid particles at a given instant is constant (d) The speed of a fluid particle remains constant	
17	An ideal fluid flows through a pipe of circular cross-section made of two sections with diameters 2.5 cm and 3.75 cm. The ratio of the velocities in the two pipes is (a) 9 : 4 (b) 3 : 2 (c) $\sqrt{3}:\sqrt{2}$ (d) $\sqrt{2}:\sqrt{3}$	
18	Air is streaming past a horizontal air plane wing such that its speed is 120 ms^{-1} over the upper surface and 90 ms^{-1} at the lower surface. If the density of air is 1.3 kgm^{-3}, what will be the gross lift on the wing? If the wing is 10 m long and has an average width of 2 m, (a) 81.9 N (b) 8.19 kN (c) 81.9 kN (d) 819 kN	
19	Three tubes A, B and C are connected to a horizontal pipe	

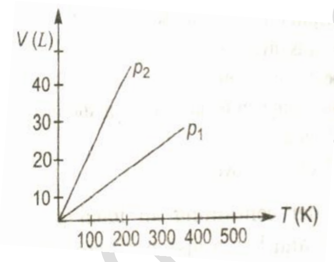
	in which liquid is flowing. The radii of pipe at the joints of A, B and C are 2 cm, 1 cm and 2 cm respectively. The height of liquid  (a) In A is maximum (b) In A and B is equal (c) Is same in all three (d) In A and C is same	
20	Figs. (i) and (ii) refer to the steady flow of a (non-viscous) liquid. Which of the two figures is/are incorrect?  Fig. (i) Fig. (ii) (a) Fig. (i) (b) Fig. (ii) (c) Both (i) and (ii) (d) None of these	
21	A tank is filled with water upto a height H. Water is allowed to come out of a hole P in one of the walls at a depth h below the surface of water (see figure). Express the horizontal distance X in terms of H and h.  (a) X = $\sqrt{h(H-h)}$ (b) X = $\sqrt{\frac{h}{2}(H-h)}$ (c) X = $2\sqrt{h(H-h)}$ (d) X = $4\sqrt{(H-h)}$	
22	Water stands level A in the arrangement shown in the figure. What will happen if a jet of air is gently blown into the horizontal tube in the direction shown in the figure?  (a) Water will rise above A in the capillary tube (b) Water will fall below A in the capillary tube (c) There will be no effect on the level of water in the capillary tube (d) Air will emerge from end B in the form of bubbles	
23	A cylindrical drum, open at the top, contains 15 L of water. It drains out through a small opening at the bottom. 5 L of	

	water comes out in time t_1, the next 5 L in further time t_2 and the last 5 L in further time t_3. Then (a) $t_1 < t_2 < t_3$ (b) $t_1 > t_2 > t_3$ (c) $t_1 = t_2 = t_3$ (d) $t_2 > t_1 = t_3$	
24	The level of water in a tank is 5 m high. A hole of area 10 cm^2 is made in the bottom of the tank. The rate of leakage of water from the hole is (a) 10^{-2} m^3s^{-1} (b) 10^2 m^3s^{-1} (c) 10 m^3s^{-1} (d) 10^{-1} m^3s^{-1}	
25	A fluid flows through a horizontal pipe having two different cross-sections of area A and 2 A. If the pressure at the thin cross-section is p and fluid velocity is υ, the velocity and pressure at the thicker cross-section is (take the density of fluid as ρ) (a) $\frac{v}{2}, p+\frac{1}{2}\rho v^2$ (b) $\frac{v}{4}, p+\frac{3}{8}\rho v^2$ (c) $\frac{v}{2}, p+\frac{3}{8}\rho v^2$ (d) $v, p+\frac{3}{4}\rho v^2$	

CONCEPT-33: BASED ON THERMOMETRY AND CALORIMETRY

1	Two absolute scales A and B have triple point of water defined to be 200 A and 350 B. What is the relation between T_A and T_B? (a) $\frac{T_A}{T_B} = \frac{4}{7}$ (b) $\frac{T_A}{T_B} = \frac{3}{7}$ (c) $\frac{T_A}{T_B} = \frac{7}{3}$ (d) $\frac{T_A}{T_B} = \frac{7}{4}$	
2	A faulty thermometer has its fixed points marked 5 and 95. When this thermometer reads 68, the correct temperature in Celsius is (a) 68^0C (b) 70^0C (c) 66^0C (d) 72^0C	
3	The Fahrenheit and Kelvin scales of temperature will give the same reading at (a) – 40 (b) 313 (c) 574.25 (d) 732.75	
4	An amount of water of mass 20 g at 0^0C is mixed with 40 g of water at 10^0C, final temperature of the mixture is (a) 5^0C (b) 0^0C (c) 20^0C (d) 6.66^0C	
5	The graph between two temperature scales A and B is shown in figure. Between upper fixed point and lower point there are 150 equal division on scale A and 100 on scale B. The relationship for conversion between the two scales is given by	

	 (a) $\frac{t_A - 180}{100} = \frac{t_B}{150}$ (b) $\frac{t_A - 30}{150} = \frac{t_B}{100}$ (c) $\frac{t_B - 180}{150} = \frac{t_A}{100}$ (d) $\frac{t_B - 40}{100} = \frac{t_A}{180}$	
6	One gram of ice is mixed with one gram of steam. At thermal equilibrium the temperature of mixture is (a) 0^0C (b) 100^0C (c) 55^0C (d) 80^0C	
7	If the ratio densities of two substances is 5 : 6 and that of the specific heats is 3 : 5. Then, the ratio between heat capacities per unit volume is (a) 1 : 1 (b) 2 : 1 (c) 1 : 2 (d) 1 : 3	
8	Heat capacity of a substance is infinite. It means (a) Heat is given out (b) Heat is taken in (c) No change in temperature whether heat is taken in or given out (d) All of the above	
9	A cylinder containing an ideal gas is in vertical position and has a piston of mass M that is able to move up or down without friction. If the temperature is increased.  (a) Both p and V of the gas will change (b) Only p will increases according to Charles' law (c) V will change but not p (d) p will change but not V	
10	Water falls from a height of 500 m. What is the rise in temperature of water at the bottom if whole energy is used up in heating water ? (a) 0.96^0C (b) 1.02^0C (c) 1.16^0C (d) 0.23^0C	
11	540 g of ice at 0^0C is mixed with 540 g of water at 80^0C.	

	The final temperature of the mixture is (a) 0^0C (b) 53^0C (c) 80^0C (d) Less than 0^0C	
12	Which one of the following would raise the temperature of 20 g of water at 30^0C most when mixed with it? (a) 20 g of water at 40^0C (b) 40 g of water at 35^0C (c) 10 g of water at 50^0C (d) 4 g of water at 80^0C	
13	A metal sphere of radius r and specific hear c is rotated about an axis passing through its centre at a speed of η rotations per second. It is suddenly stopped and 50% of its energy is used in increasing its temperature. Then the rise in temperature of the sphere is (a) $\frac{2}{5}\frac{\pi^2 n^2 r^2}{c}$ (b) $\frac{1}{10}\frac{\pi^2 n^2}{r^2 c}$ (c) $\frac{7}{8}\pi r^2 n^2 c$ (d) $5\left[\frac{\pi rn}{14c}\right]^2$	
14	Volume versus temperature graphs for a mass of an ideal gas are shown in figure at two different values of constant pressure. What can be inferred about relation between P_1 and P_2?  (a) $p_1 > p_2$ (b) $p_1 = p_2$ (c) $p_1 < p_2$ (d) Data is insufficient	
15	A sphere, a cube and a thin circular plate, all of same material and same mass are initially heated to same high temperature. (a) Plate will cool fasted and cube the slowest (b) Sphere will cool fasted and cube the slowest (c) Plate will cool fasted and sphere the slowest (d) Cube will cool fastest and plate the slowest	
16	When the room temperature becomes equal to the dew point the relative humidity of the room is (a) 100% (b) 0% (c) 70% (d) 85%	
17	An aluminium sphere is dipped into water. Which of the following is true? (a) Buoyancy will be less in water at 0^0 C than that is water at 4^0 C	

	(b) Buoyancy will be more in water at 0^0 C than that is water at 4^0 C (c) Buoyancy in water at 0^0 C will be same as that in water at 4^0 C (d) Buoyancy may be more or less in water at 4^0C depending on the radius of the sphere	
18	As the temperature is increased, the time period of a pendulum (a) Increases as its effective length increases even though its centre of mass still remains at the centre of the bob (b) Decrease as its effective length increases even though its centre of mass still remains at the centre of the bob (c) Increases as its effective length increases due to shifting of centre of mass below the centre of the bob (d) Decreases as its effective length increases remains same but the centre of mass shifts above the centre of the bob	

CONCEPT-34: BASED ON THERMAL EXPANSION OF SOLIDS AND LIQUIDS

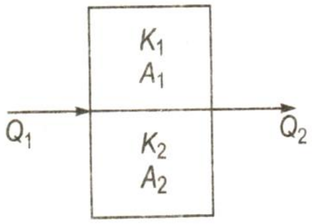
1	What should be the lengths of a steel and copper rod at 0^0C so that the length of the steel rod is 5 cm longer than the copper rod at any temperature? α(Steel) = $1.1 \times 10^{-5}\ {}^0C^{-1}$ α(Copper) = $1.7 \times 10^{-5}\ {}^0C$ (a) 14.17 cm; 9.17 cm (b) 9.17 cm, 14.17 cm (c) 28.34 cm; 18.34 cm (d) 14.17 cm, 18.34 cm	
2	When a liquid in a glass vessel is heated, its apparent expansion is $10.30 \times 10^{-4}\ C^{-1}$. When the same liquid is heated in a metal vessel, its apparent expansion is $10.06 \times 10^{-4}\ {}^0C^{-1}$. If the coefficient of linear expansion of glass = $9 \times 10^{6}\ {}^0C^{-1}$, what is the coefficient of linear expansion of metal? (a) $51 \times 10^{-6}\ {}^0C^{-1}$ (b) $17 \times 10^{-6}\ {}^0C^{-1}$ (c) $25 \times 10^{-6}\ {}^0C^{-1}$ (d) $43 \times 10^{-6}\ {}^0C^{-1}$	
3	A steel wire of uniform area 2 mm^2 is heated upto 50^0C and is stretched by tying its ends rigidly. The change in tension when the temperature falls from 50^0C to 30^0C is (Take Y = $2 \times 10^{11}\ Nm^{-2}$, $\alpha = 1.1 \times 10^{-5}\ {}^0C^{-1}$) (a) 1.5×10^{10} N (b) 5 N (c) 88 N (d) 2.5×10^{10} N	
4	Density of substance at 0^0C is 10 g/cc and at 100^0C, its density is 9.7 g/cc. The coefficient of linear expansion of the substance is (a) $1.03 \times 10^{-4}\ {}^0C^{-1}$ (b) $3 \times 10^{-4}\ {}^0C^{-1}$ (c) $19.7 \times 10^{-3}\ {}^0C^{-1}$ (d) $10^{-3}\ {}^0C^{-1}$	
5	A rectangular block is heated from 0^0C to 100^0C. The percentage increase in its length is 0.2%. what is the	

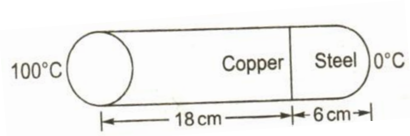
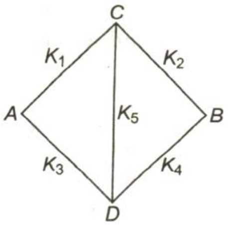
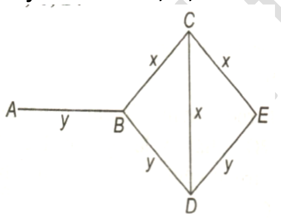
	percentage increase in its volume? (a) 0.6 % (b) 0.10% (c) 0.2% (d) 0.4%	
6	A cubic vessel (with faces horizontal + vertical) contains an ideal gas at NTP. The vessel is being carried by a rocket which is moving at a speed of 500 ms^{-1} in vertical direction. The pressure of the gas inside the vessel as observed by us on the ground (a) Remains the same because 500 ms^{-1} is very much smaller than V_{rms} of the gas (b) Remains the same because motion of the vessel as a whole does not affect the relative motion of the gas molecules and the walls (c) Will increase by a factor equal to (v_{rms}^2 + $(500)^2$ / v_{rms}^2 where v_{rms} was the original mean square velocity of the gas (d) Will be different on the top wall and bottom wall of the vessel	
7	A metal rod having linear expansion coefficient 2 x 10^{-5} $^0C^{-1}$ has a length of 1 m at 20^0C. The temperature at which it is shortened by 1 mm is (a) - 20^0C (b) -15^0C (c) - 30^0C (d) - 25^0C	
8	A bimetallic strip is made of aluminium and steel ($\alpha_{A1} > \alpha_{steel}$). On heating, the strip will (a) Remain straight (b) Get twisted (c) Will bend with aluminium on concave side (d) Will bend with steel on concave side	
9	A bimetallic is made of two strops A and B having coefficients of linear expansion α_A and α_B. If $\alpha_A < \alpha_B$, then on heating, the strip will (a) Bend with A on outer side (b) Bend with B on outer side (c) Not bend at all (d) one of the above	
10	A clock with an iron pendulum keeps correct time at 15^0C. What will be the error in second per day, if the room temperature is 20^0C? (The coefficient of linear expansion of iron is 0.000012^0C^{-1}.) (a) 2.6 s (b) 6.2 s (c) 1.3 s (d) 3.1 s	
11	A uniform metallic rod rotates about its perpendicular bisector with constant angular speed. If it is heated uniformly to raise its temperature slightly (a) Its speed of rotation increases (b) Its speed of rotation decreases (c) Its speed of rotation remains same (d) Its speed increases because its moment of inertia increases	
12	A uniform metal rod is used as a bar pendulum. If the	

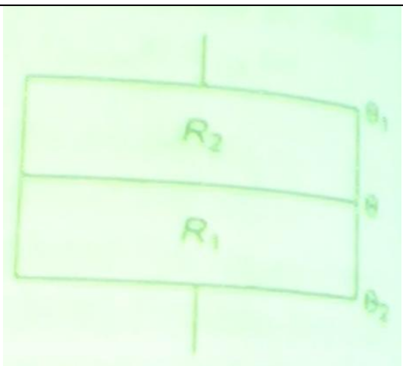
	room temperature rises by 10^0C and coefficient of linear expansion of the metal of the rod is 2 x 10^{6} $^0C^{-1}$ the period of pendulum will increase by (a) 1 x 10^{-3}% (b) -1 x 10^{-3} % (c) 2 x 10^{-3}% (d) -2 x 10^{-3} %	
13	A vertical column 50 cm long at 50^0C balances another column of same liquid 60 cm along at 100^0C. The coefficient of absolute expansion of the liquid is (a) 0.005/^{0}C (b) 0.0005/^{0}C (c) 0.002/^{0}C (d) 0.0002/^{0}C	
14	A bar of iron is 10 cm at 20^0C. At 19^0C it will be (α of iron = 11 x 10^{-6} /^{0}C) (a) 11 x 10^{-6} cm longer (b) 11 x 10^{-6} cm shorter (c) 11 x 10^{-5} cm shorter (d) 11 x 10^{-5} cm longer	
15	The radius of a metal sphere at room temperature T is R, and the coefficient of linear expansion of the metal is α. The sphere is heated a little by a temperature ΔT so that its new temperature is T + ΔT. The increase in the volume of the sphere is approximately (a) 2π Rα ΔT (b) π R^2 α ΔT (c) 4π R^3 α ΔT /3 (d) 4πR^3α ΔT	
16	The volume of a metal sphere increases by 0.24% when its temperature is raised by 40^0C. The coefficient of linear expansion of the metal is...^{0}C. (a) 2 x 10^{-5} per^{0}C (b) 6 x 10^{-5} per^{0}C (c) 2.1 x 10^{-5} per^{0}C (d) 1.2 x 10^{-5} per^{0}C	

CONCEPT-35: BASED ON THERMAL CONDUCTION AND CONVECTION

1	A wall has two layers A and B, made of two different materials. The thermal conductivity of material A is twice that of B. If the two layers have same thickness and under thermal equilibrium, the temperature difference across the wall is 48^0C, the temperature difference across layer B is (a) 40^0C (b) 32^0C (c) 16^0C (d) 24^0C	
2	Two plates of same thickness, of coefficients of thermal conductivity K_1 and K_2 and areas of cross section A_1 and A_2 are connected as shown in figure. The common coefficient of thermal conductivity K will be	

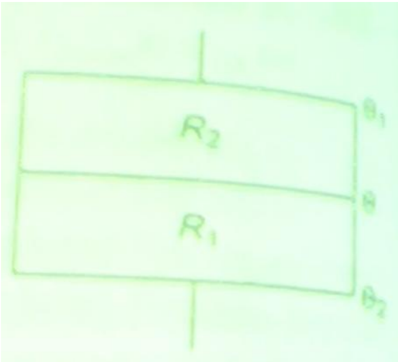
	 (a) $K_1A_1 + k_2A_2$ (b) $\frac{K_1A_1}{k_2A_2}$ (c) $\frac{K_1A_1 + k_2A_2}{A_1 + A_2}$ (d) $\frac{K_1A_2 + k_2A_1}{K_1 + K_2}$	
3	Ice starts forming in a lake with water at 0^0C, when the atmospheric temperature is -10^0C. If time taken for 1 cm of ice to be formed is 7 h, the time taken for the thickness of ice to increase from 1 cm to 2 cm is (a) 7 h (b) Less than 7 h (c) More than 7 h but less than 14 h (d) More than 14 h	
4	When a bimetallic strip is heated, is (a) Does not bend at all (b) Gets twisted in the form of an helix (c) Bend in the form of an arc with the more expandable (d) Bends in the form of an arc with the more expandable metal inside	
5	Four rods of different radii r and length l are used to connect two reservoirs of heat at different temperatures. Which one will conduct heat fastest? (a) r = 2 cm, l = 0.5 m (b) r = 1 cm, l = 0.5 m (c) r = 2 cm, l = 2 m (d) r = 1 cm, l = 1 m	
6	Two rods of equal length and area of cross-section are kept parallel and lagged between temperatures 20^0C and 80^0C. The ratio of the effective thermal conductivity to that of the first rod is $\left[the\,ratio \left(\frac{K_1}{K_2} \right) = \frac{3}{4} \right]$ (a) 7 : 4 (b) 7 : 6 (c) 4 : 7 (d) 7 : 8	
7	Two rods of same length and material transfer a given amount of heat in 12 s, when they are joined end to end(i.e., in series). But when they are joined in parallel, they will transfer same heat under same conditions in (a) 24 s (b) 3 s (c) 48 s (d) 1.5 s	
8	The coefficient of thermal conductivity of copper is nine times that of steel. In the composite cylindrical bar shown	

	in figure, what will be the temperature at the junction of copper and steel?  (a) 75^0C (b) 67^0C (c) 33^0C (d) 25^0C	
9	Five rods of some dimensions are arranged as shown in figure. They have thermal conductivities K_1, K_2, K_3, K_4 and K_5. When points A and B are maintained at different temperatures, no heat would flow through central rod, if  (a) $K_1K_4 + K_2 K_3$ (b) $K_1 = K_4$ and $K_2 = K_3$ (c) $\frac{K_1}{K_4} = \frac{K_2}{K_3}$ (d) $K_1K_2 = K_3K_4$	
10	Three rods of material X and three rods of material Y are connected as shown in figure. All are identical in length and cross-sectional area. If end A is maintained at 60^0C, end E at 10^0C, thermal conductivity of X is 0.92 $cals^{-1}\ cm^{-1}\ {}^0C^{-1}$ and that of Y is 0.46 $cals^{-1}\ cm^{-1}\ {}^0C^{-1}$, then find the temperatures of junctions B, C, D.  (a) $20^0C, 30^0C, 20^0C$ (b) $30^0C, 20^0C, 0^0C$ (c) $20^0C, 20^0C, 30^0C$ (d) $20^0C, 20^0C, 20^0C$	
11	A cylindrical rod with one end in a steam chamber and the other end in ice results in melting of 0.1 g of ice per second. If the rod is replaced by another with half the length and double the radius of the first and if the thermal conductivity of the material of the second rod is 1/4 that of the first, the rate at which ice melts in gs^{-1} will be	



(a) 3.2 (b) 1.6 (c) 0.2 (d) 0.1

12 Consider two insulating sheets with thermal resistances R_1 and R_2 as shown in figure. The temperature θ is



(a) $\frac{\theta_1 R_2 + \theta_2 R_1}{R_1 + R_2}$ (b) $\frac{(\theta_1 + \theta_2) R_1 R_2}{R_1^2 + R_2^2}$

(c) $\frac{\theta_1 R_1 + \theta_2 R_2}{R_1 + R_2}$ (d) $\frac{\theta_1 \theta_2 R_1 R_2}{(\theta_1 + \theta_2)(R_1 + R_2)}$

13 Two rods P and Q have equal lengths. Their thermal conductivities are K_1 and K_2 and cross-sectional areas are A_1 and A_2. When the temperature at ends of each rod are T_1 and T_2 respectively, the rate of flow of heat through P and Q will be equal, if

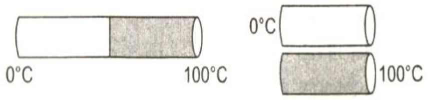
(a) $\frac{A_1}{A_2} = \frac{K_2}{K_1}$ (b) $\frac{A_1}{A_2} = \frac{K_2}{K_1} x \frac{T_2}{T_1}$

(c) $\frac{A_1}{A_2} = \sqrt{\frac{K_1}{K_2}}$ (d) $\frac{A_1}{A_2} = \left(\frac{K_2}{K_1}\right)^2$

14 If l is length, A is the area of cross-section and K is thermal conductivity, then the thermal resistance of the block is given by

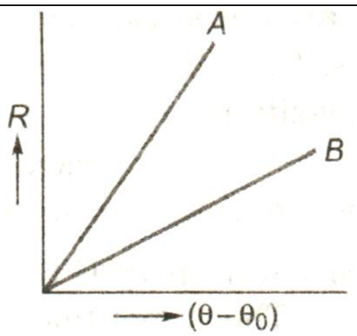
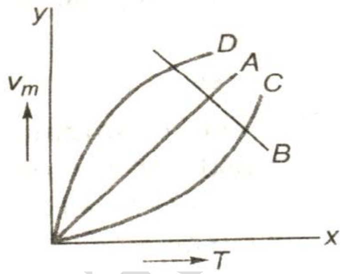
(a) K l A (b) l / K l A (c) l + KA (d) l / KA

15 The amount if heat conducted out per second through a window, when inside temperature is 10^0C and outside temperature is -10^0C, is 1000 J. Same heat will be conducted in through the window, when outside

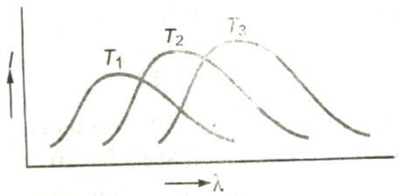
	temperature is -23^{0}C and inside temperature is (a) 23^{0}C (b) 230 K (c) 270 K (d) 296 K	
16	Two identical square rods of metal are welded end to end as shown in figure (i) 20 cal of heat flows through it in 4 minutes. If the rods are welded as shown in figure (ii) the same amount of heat will flow through the rods in  (a) 1 min (b) 2 min (c) 4 min (d) 16 min	
17	The ratio of thermal conductivity of two rods is 5 : 4. The ratio of their cross-sectional areas is 1 : 1 and they have the same thermal resistances. The ratio of their lengths, must will be (a) 4 : 5 (b) 9 : 1 (c) 1 : 9 (d) 5 : 4	
18	In heat transfer which method is based on gravitation (a) Natural convection (b) Conduction (c) Radiation (d) Stirrling of liquid	
19	If a liquid is heated in weightlessness the heat is transmitted through (a) Conduction (b) Convection (c) Radiation (d) Neither because the liquid cannot be heated in weightlessness	

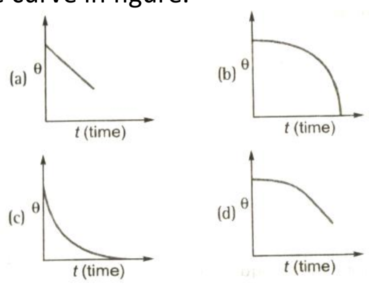
CONCEPT-36: BASED ON THERMAL RADIATION; STEFAN'S LAW, WIEN'S LAW AND NEWTON'S LAW OF COOLING

1	wavelength of maximum intensity of radiation emitted by a star is 289.8 nm and the radiation intensity for the star is (Stefan's constant = 5.67 x 10^{-8} Wm^{-2}K^{-2}, Wien's constant b = 2878 μK). (a) 5.67 x 10^8 Wm^{-2} (b) 5.67 x 10^{-12} Wm^{-2} (c) 10.67 x 10^7 Wm^{-2} (d) 10.67 x 10^{14} Wm^{-2}	
2	A polished metal plate with a rough black spot on it is heated to about 1400 K and quickly taken to a dark room. The spot will appear (a) Darker than plate (b) Brighter than plate (c) Equally bright (d) Equally dark	
3	The rate of radiation of a black body at 0^{0}C is E watt. The rate of radiation of this body at 273^{0}C will be (a) 16 E (b) 8 E (c) 4 E (d) E	
4	Two circular discs A and B with equal radii are blackened. They are heated to same temperature and are cooled under identical conditions. What inference do you draw from their cooling curves, shown below?	

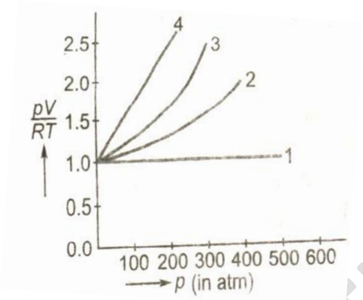
	 (a) A and B have same specific heats (b) Specific heat of A is less (c) Specific heat of B is less (d) Nothing can be said	
5	The temperature of a black body is increases by 50%, then the percentage of increase of radiation is approximately (a) 100% (b) 25% (c) 400% (d) 500%	
6	A body cools from 80^0C to 50^0C in 5 min. Calculate the time it takes to cool from 60^0C to 30^0C. The temperature of the surroundings is 20^0C. (a) 9 min (b) 7 min (c) 8 min (d) 10 min	
7	The frequency (v_m) corresponding to which energy emitted by a black body is maximum may vary with temperature T of the body as shown in figure. Which of the curves represents correct variation?  (a) A (b) B (c) C (d) D	
8	If temperature of a black body increases from 7^0C to 287^0C, then the rate of energy radiation increases by (a) $(287/7)^4$ (b) 16 (c) 4 (d) 2	
9	A black body is at a temperature of 2880 K. The energy of radiation emitted by this object with wavelength between 499 nm and 500 nm is U_1 and between 999 nm and 1000 nm is U_2. The Wien constant = 2.88 x 10^6 nm K. Then (a) $U_1 = 0$ (b) $U_3 = 0$ (c) $U_1 > U_2$ (d) $U_2 = U_1$	
10	If wavelength of maximum intensity of radiation emitted by sun and moon are 0.5 x 10^{-6}m and 10^{-4} m respectively, the ratio of their temperatures is (a) 1 : 100 (b) 1 : 200	

	(c) 200 : 1 (d) 400 : 1	
11	The maximum energy in the thermal radiation from a hot source occurs at λ = 11 x 10^{-5} cm. If temperature of another source is n times, for which wavelength of maximum energy is 5.5 x 10^{-5} cm, then n is (a) 2 (b) 4 (c) $\frac{1}{2}$ (d) 1	
12	A black body radiates at two temperatures T_1 and T_2, such that $T_1 < T_2$. The frequency corresponding to maximum intensity is (a) Less at T_1 (b) More at T_1 (c) Equal in the two cases (d) Cannot say	
13	An object is cooled from 75^0C to 65^0C in 2 min in a room at 30^0C. The time taken to cool another identical object from 55^0C to 45^0C in the same room, in minutes is (a) 4 (b) 5 (c) 6 (d) 7	
14	A black body at 1373^0C emits maximum energy corresponding to a wavelength of 1.78 micron. The temperature of moon for which λ_m = 14 micron would be (a) 62.6^0C (b) -58.9^0C (c) 63.7^0C (d) 64.2^0C	
15	A planet is at an average distance d from the sun and its average surface temperature is T. Assume that the planet receives energy only from the sun, and loses energy only through radiation from its surface. Neglect atmospheric effects. If T $\propto$ d^{-n}, the value of n is (a) 2 (b) 1 (c) 1/2 (d) 1/4	
16	The rectangular surface of area 8 cm x 4 cm of a black body at a temperature of 127^0C emits energy at the rate of E per second. If the length and breadth of the surface are each reduced to half of its initial value, and the temperature is raised to 327^0C, the rate of emission of energy will become (a) $\frac{3}{8}E$ (b) $\frac{81}{16}E$ (c) $\frac{9}{16}E$ (d) $\frac{81}{64}E$	
17	The plots for intensity versus wavelength for three black bodies at temperature T_1, T_2, T_3 respectively are shown in figure. Their temperatures are such that	

	 (a) $T_1 > T_2 > T_3$ (b) $T_1 > T_3 > T_2$ (c) $T_2 > T_3 > T_1$ (d) $T_3 > T_2 > T_1$	
18	A metallic sphere cools from 50^0C to 40^0C in 300 s. If the room temperature is 20^0C, then its temperature in next 5 min will be (a) 38^0C (b) 33.3^0C (c) 30^0C (d) 36^0C	
19	A black body radiates heat energy at the rate of 2×10^5 $Js^{-1}m^{-2}$ at a temperature 127^0C. The temperature of black body, at which the rate of heat radiation is 32×10^5 $Js^{-1}m^{-2}$ is (a) 273^0C (b) 527^0C (c) 873^0C (d) 927^0C	
20	A liquid is filled in a container which is kept in a room whose temperature is 20^0C. When temperature of liquid is 80^0C, it emits heat at the rate of 45 $cals^{-1}$. When temperature of liquid falls to 40^0C, its rate of heat loss will be (a) 15 $cals^{-1}$ (b) 30 $cals^{-1}$ (c) 45 $cals^{-1}$ (d) 60 $cals^{-1}$	
21	The maximum wavelength of radiation emitted at 2000 K is 4 μm. What will be the maximum wavelength emitted at 2400 K? (a) 3.3 μm (b) 0.66 μm (c) 1 m (d) 1 μm	
22	Two bodies A and B are placed in an evacuated vessel maintained at a temperature of 27^0C. The temperature of A is 327^0C and that of B is 227^0C. The ratio of heat loss from A and B is about (a) 2 : 1 (b) 4 : 1 (c) 1 : 2 (d) 1 : 4	
23	The reflectance and emittance of a perfectly black body are respectively (a) 0, 1 (b) 1, 0 (c) 0.5, 0.5 (d) 0, 0	
24	The rate of emission of radiation of a black body at temperature 27^0C is E_1. If its temperature is increased to 327^0C, the rate of emission of radiation is E_2. The relation between E_1 and E_2 is (a) $E_2 = 24\ E_1$ (b) $E_2 = 16\ E_1$ (c) $E_2 = 8\ E_1$ (d) $E_2 = 4\ E_1$	
25	The rates of heat radiation from two patches of skin each of area A, on a patient's chest differ by 2%. If the patch of the lower temperature is at 300 K and emissivity of both the patches is assumed to be unity, the temperature of	

	other patch would be (a) 306 K (b) 312 K (c) 308.5 K (d) 301.5 K	
26	The rays of sun are focussed on a piece of ice through a lens of diameter 5 cm, as a result of which 10 g ice melts in 10 min. The amount of heat received from sun, per unit area per min is (a) 4 cal cm^{-2} min^{-1} (b) 40 cal cm^{-2} min^{-1} (c) 4 Jm^{-2} min (d) 400 cal cm^{-2} min^{-1}	
27	Solar radiation emitted by sun resembles that emitted by a black body at a temperature of 6000 K. Maximum intensity is emitted at a wavelength of about 4800 $\overset{0}{A}$. If the sun were cooled down from 6000 K to 3000 K, then the peak intensity would occur at a wavelength of (a) 4800 $\overset{0}{A}$ (b) 9600 $\overset{0}{A}$ (c) 2400 $\overset{0}{A}$ (d) 19200 $\overset{0}{A}$	
28	When the temperature of a black body increases, it is observed that the wavelength corresponding of maximum energy changes from 0.26 μm to 0.13 μm to a body at the respective temperature. Then ratio of the emissivities $\frac{E_2}{E_1}$ is (a) 16/1 (b) 4/1 (c) 1/4 (d) 1/16	
29	The energy emitted per second by a black body at 27^0C is 10 J. If the temperature of black body is increased to 327^0C, the energy emitted per second will be (a) 20 J (b) 40 J (c) 80 J (d) 160 J	
30	A black body at a temperature of 327^0C radiates 4 cal $cm^{-2}s^{-1}$. At a temperature of 927^0C, the rate of heat radiated per unit area in cal $cm^{-2}s^{-1}$ will be (a) 16 (b) 32 (c) 64 (d) 128	
31	The temperature of coffee in a cup with time is most likely given by the curve in figure. 	
32	A solid cube and a solid sphere have equal surface areas.	

	Both are at the same temperature of 12^0C. Then (a) Both of them will cool down at the same rate (b) The cube will cool down faster than the sphere (c) The sphere will cool down faster than the cube (d) Whichever of the two is heavier will cool down faster	
33	A surface at temperature T_0 K receives power P by radiation from a small sphere at temperature $T > T_0$ and at a distance d. If both T and d are doubled, the power received by the surface will become (a) P (b) 2 P (c) 4 P (d) 16 P	
34	If a given mass of gas occupies a volume of 100 cc at 1 atm pressure and temperature of 100^0C (373.15 K). What will be its volume at 4 atm pressure; the temperature being the same? (a) 100 cc (b) 400 cc (c) 25 cc (d) 104 cc	
35	1 mole of H_2 gas is contained in a box of volume V = 100 m^3 at T = 300 K. The gas is heated to a temperature of T = 3000 K and the gas gets converted to a gas of hydrogen atoms The final pressure would be (considering all gases to be ideal) (a) Same as the pressure initially (b) 2 times the pressure initially (c) 10 times the pressure initially (d) 20 times the pressure initially	
36	Two gases A and B having the same temperature T, same pressure p and same volume V are mixed. If the mixture is at same temperature T and occupies a volume V, the pressure of the mixture is (a) 2 p (b) p (c) p/2 (d) 4 p	
37	When a gas filled in a closed vessel is heated through 1^0C, its pressure increases by 0.4%. The initial temperature of the gas was (a) 250 K (b) 2500 K (c) 250^0C (d) 25^0C	
38	A vessel of volume V contains a mixture of 1 mole of hydrogen and 1 mole of oxygen (both considered as ideal). Let $f_1(\upsilon)\,d\upsilon$, denote the fraction of molecules with speed between υ and $(\upsilon + d\upsilon)$ with $f_2(\upsilon)\,d\upsilon$, similarly for oxygen. Then (a) $f_1(v) + f_2(v) = f(v)$ obeys the Maxwell's distribution law (b) $f_1(v)$, $f_2(v)$ will obey the Maxwell's distribution law separately (c) Neither $f_1(v)$, not $f_2(v)$ will obey the Maxwell's distribution law (d) $f_2(v)$ and $f_1(v)$ will be the same	
39	An inflated rubber balloon contains one mole of an ideal gas, has a pressure p, volume V and temperature T. If the temperature rises to 1.1T, and the volume is increases to 1.05 V. The final pressure will be	

	(a) 1.1 p (b) p (c) Less than p (d) Between p and 1.1 p	
40	The air density at Mount Everest is less than that at the sea level. It is found by mountaineers that for one trip lasting few hours, the extra oxygen needed by them corresponds to 30000 cc at sea level (pressure 1 atm, temperature 27^0C). Assuming that the temperature around Mount Everest is -73^0C and that the pressure cylinder has capacity of 5.2 L, the pressure at which oxygen be filled (at site) in the cylinder is (a) 3.86 atm (b) 5.00 atm (c) 5.77 atm (d) 1 atm	
41	A fixed amount of nitrogen gas (1 mole) is taken and is subjected to pressure and temperature variation. The experiment is performed at high pressures as well as high temperature. The result obtained are shown in the figure. The correct variation of $\frac{pV}{RT}$ with p will be exhibited by  (a) Curve (4) (b) Curve (3) (c) Curve (2) (d) Curve (1)	
42	How much should the pressure be increases in order to decrease the volume of a gas by 5% at a constant temperature? (a) 5% (b) 5.26% (c) 10% (d) 4.26%	
43	An ideal gas is found to obey an additional law pV^2 = constant. The gas is initially at temperature T and volume V. Then it expands to a volume 2 V, the temperature becomes (a) $T/\sqrt{2}$ (b) 2 T (c) 2T / 2 (d) 4 T	
44	The rms velocity of gas molecules is $300 ms^{-1}$. The rms velocity of molecules of gas with twice the molecular weight and half the absolute temperature is (a) $300\ ms^{-1}$ (b) $600\ ms^{-1}$ (c) $75\ ms^{-1}$ (d) $150\ ms^{-1}$	
45	If C_S is the velocity of sound in air and c is the rms velocity, then (a) $c_S < c$ (b) $c_S = c$	

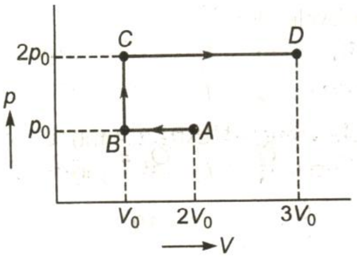
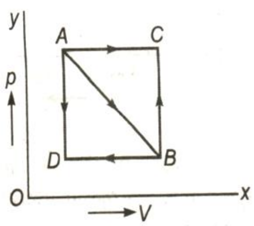
	(c) $c_S = c\left(\frac{\lambda}{3}\right)^{1/2}$ (d) None of these	
46	N molecules, each of mass m, of gas m, of gas A and 2 N molecules, each of mass 2 m, of gas B are contained in the same vessel which is maintained at a temperature T. The mean square velocity of molecules of B type is denoted by V_2 and the mean square velocity of A type is denoted by V_1, then $\frac{V_1}{V_2}$ is (a) 2 (b) 1 (c) 1/3 (d) 2/3	
47	At room temperature, the rms speed of the molecules of a certain diatomic gas is found to be 1930 ms^{-1}. The gas is (a) H_2 (b) F_2 (c) O_2 (d) Cl_2	
48	Calculate the rms speed of smoke particles each of mass 5 x 10^{-17} kg in their Brownian motion in air at NTP (k = 1.38 x 10^{-23} JK^{-1}) (a) 1.5 mm s^{-1} (b) 1.5 ms^{-1} (c) 1.5 cms^{-1} (d) 1.5 kms^{-1}	
49	At a certain temperature, the ratio of the rms velocity of H_2 molecules to O_2 molecule is (a) 1 : 1 (b) 1 : 4 (c) 4 : 1 (d) 16 : 1	
50	An oxygen cylinder of volume 30 L has an initial gauge pressure of 15 atm and a temperature of 27^0C. After some oxygen is withdrawn from the cylinder the gauge pressure drops to 11 atm and its temperature drops to 17^0C. The mass of oxygen taken out of the cylinder (R = 8.31 $Jmol^{-1}K^{-1}$). (a) 0.14 g (b) 0.02 g (c) 0.14 kg (d) 0.14 kg	
51	RMS velocity of a particle is c at pressure p. If pressure is increased two times, then rms velocity becomes (a) 0.5 c (b) c (c) 2 c (d) 3 c	
52	If the molecular weight of two gases are M_1 and M_2, then at a temperature the ratio of rms velocity c_1 and c_2 will be (a) $\left(\frac{M_1}{M_2}\right)^{1/2}$ (b) $\left(\frac{M_2}{M_1}\right)^{1/2}$ (c) $\left(\frac{M_1-M_2}{M_1+M_2}\right)^{1/2}$ (d) $\left(\frac{M_1+M_2}{M_1-M_2}\right)^{1/2}$	
53	The root mean square velocity of the molecules in a sample of helium is 5/7th that of the molecules in a sample of hydrogen. If the temperature of the hydrogen as is 0^0C, that of helium sample is about (a) 0^0C (b) 4 K (c) 273^0C (d) 100^0C	

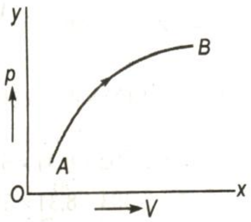
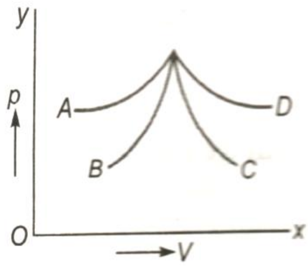
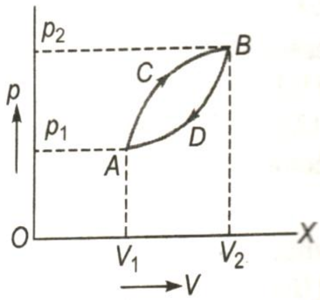
54	The average translatory energy and rms speed of molecules in a sample of oxygen gas at 300 K are 6.21 x 10^{-21} J and 484 ms^{-1} respectively. The corresponding values at 600 K are nearly (assuming ideal gas behaviour) (a) 12.42 x 10^{-21} J, 968 ms^{-1} (b) 7.78 x 10^{-21} J, 64 ms^{-1} (c) 6.21 x 10^{-21} J, 968 ms^{-1} (d) 12.42 x 10^{-21} J, 684 ms^{-1}	
55	The average energy and the rms speed of molecules in a sample of oxygen gas at 400 K are 7.21 x 10^{-21} J and 524 ms^{-1} respectively. The corresponding values at 800 K are nearly (a) 14.42 x 10^{-21} J, 1048 ms^{-1} (b) 10.18 x 10-21 J, 741 ms^{-1} (c) 7.21 x 10^{-21} J, 1048 ms^{-1} (d) 14.42 x 10^{-21} J, 741 ms^{-1}	
56	The average kinetic energy of a gas molecules at 27^0C is 6.21 x 10^{-21} J. Its average kinetic energy at 127^0C will be (a) 12.2 x 10^{-21} J (b) 8.28 x 10^{-21} J (c) 10.35 x 10^{-21} J (d) 11.35 x 10^{-21} J	
57	The value of molar specific heat at constant volume for 1 mole of polyatomic gas having n number of degrees of freedom at temperature T K is (R = universal gas constant) (a) $\frac{nR}{2T}$ (b) $\frac{nR}{2}$ (c) $\frac{nRT}{2}$ (d) 2 nRT	
58	For a gas, if the ratio of specific heats at constant pressure and constant volume is γ, then the value of degrees of freedom is (a) $\frac{\gamma+1}{\gamma-1}$ (b) $\frac{\gamma-1}{\gamma+1}$ (c) $\frac{(\gamma-1)}{2}$ (d) $\frac{2}{\gamma-1}$	
59	The value of molar specific heat at constant pressure for one mole of triatomic gas (triangular arrangement) at temperature T K is (R = universal gas constant) (a) 3R (b) $\frac{2}{7}R$ (c) $\frac{5}{2}R$ (d) 4 R	
60	The diameter of a gas molecule is 2.4 x 10^{-10} m. The mean free path of gas molecule at NTP is (k = 1.38 x 10^{-23} JK^{-1}) (a) 1.46 x 10^{-7} m (b) 2.46 x 10^{-6} m	

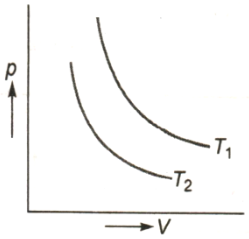
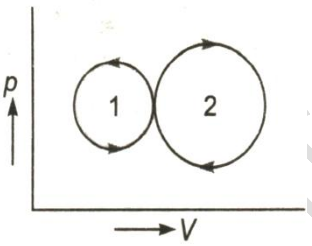
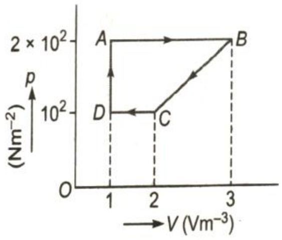
	(c) 1.46×10^{-6} m (d) 2.46×10^{-7} m	
61	The value of γ for gas X is 1.33, the X is (a) Ne (b) O_3 (c) N_2 (d) NH_3	
62	There is a rough black spot on a polished metallic plate. It is heated upto 1400 K. Approximately and then at once taken in a dark room which of the following statements is true? (a) In comparison with the plate the spot will shine more (b) In comparison with the plate the spot will appear were black (c) The spot and the plate will be equally bright (d) The plate and the black spot can not be seen in the dark room	
63	The thermal radiation from a hot body travels with a velocity of (a) 330 ms^{-1} (b) 2×10^8 ms^{-1} (c) 3×10^8 ms^{-1} (d) 230×10^8 ms^{-1}	
64	Assuming the sun to have a spherical outer surface of radius r radiating like a black body at temperature t^0C, the power received by a unit surface (normal to the incident rays) at a distance R from the centre of the sun is (σ is Stefan's constant) (a) $4\pi r^2 \sigma t^4$ (b) $\frac{r^2\sigma(t+273)^4}{4\pi R^2}$ (c) $\frac{16\pi^2 r^2 \sigma t^4}{R^2}$ (d) $\frac{r^2\sigma(1+273)^4}{R^2}$	
65	The temperature of sun is 5500 K and it emits maximum intensity radiation in the yellow region (5.5×10^{-7} m). The maximum radiation from a furnace occurs at wavelength 11×10^{-7} m. The temperature of furnace is (a) 2550 K (b) 2750 K (c) 2650 K (d) 2850 K	
66	The temperature of a liquid drops from 365 K to 361 K in 2 minutes. Find the time during which temperature of the liquid drops from 344 K to 342 K. Temperature of room is 292 K (a) 84 s (b) 72 s (c) 66 s (d) 60 s	

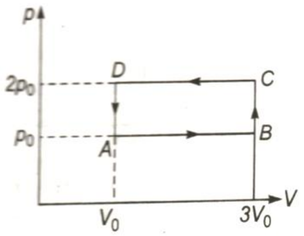
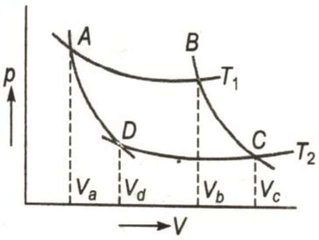
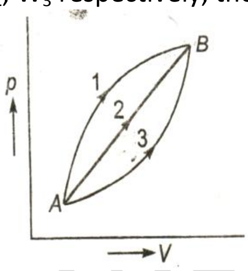
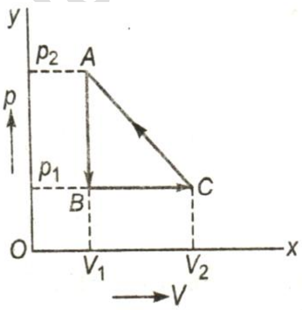
CONCEPT-37: BASED ON THERMODYNAMIC PROCESSES

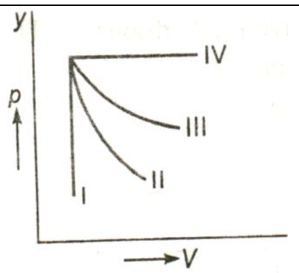
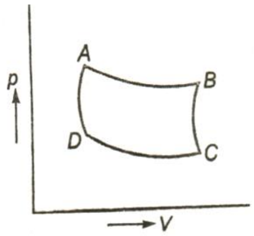
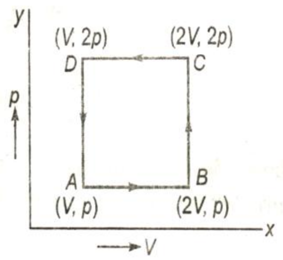
1	The ratio of the slopes of p-V graphs of adiabatic and isothermal is (a) $\frac{\gamma-1}{\gamma}$ (b) $\gamma-1$ (c) $\gamma/1$ (d) γ	
2	N ideal gas at a pressure 1 atm and temperature of 27^0C is	

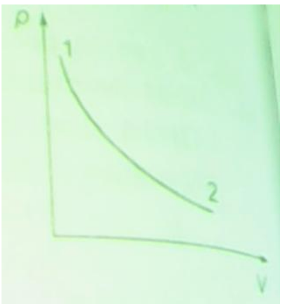
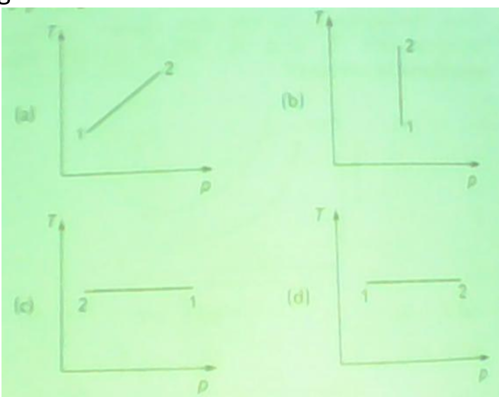
	compressed adiabatically until its pressure becomes 8 times, the initial pressure. Then, the final temperature is $\left(\gamma = \frac{3}{2}\right)$ (a) 627^0C (b) 527^0C (c) 427^0C (d) 327^0C	
3	A cylinder with a movable piston contains 3 moles of hydrogen at standard temperature and pressure. The walls of the cylinder are made of heat insulator, and the piston is insulated by having a pile of sand on it/ By what factor does the pressure of the gas increase, if the gas is compressed to half its original volume? (a) 1.40 (b) 1.60 (c) 2.64 d) 1.94	
4	p-V diagram of an ideal gas is as shown in figure. Work done by the gas in the process ABCD is  (a) $4pV_0$ (b) $2p_0V_0$ (c) $3p_0V_0$ (d) p_0V_0	
5	if for hydrogen $C_p - C_V = m$ and for the nitrogen $C_p - C_V = n$, where C_p, C_V refer to specific heats per unit mass respectively at constant pressure and constant volume, the relation between m and n is (a) m = 14 n (b) n = 7 n (c) m = 7 n (d) n = 14 n	
6	If an average person jogs, hse produces 14.5×10^3 cal/min. This is removed by the evaporation of sweat. The amount of sewat evaporated per minute (assuming 1 kg requires 580×10^3 cal for evaporation) is (a) 0.25 kg (b) 2.25 kg (c) 0.05 kg (d) 0.20 kg	
7	An ideal gas is taken from state A to state B following three different paths as shown in p-V diagram. Which one of the following is true?  (a) Work done is maximum along AB (b) Work done is minimum along AB	

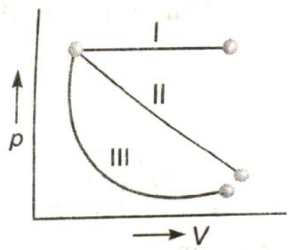
	(c) Work done along ACB = work done along ADB (d) Work done along ADB is minimum	
8	Figure shows a thermodynamic process on one mole of a gas. How does the work done in the process changes with time?  (a) Decreases continuously (b) Increases continuously (c) Remains constant (d) First increases and then decreases	
9	During an adiabatic process, the pressure p of a fixed mass of an ideal gas changes by Δp and its volume V changes by ΔV. If γ = C_p/C_V, then ΔV / V is given by (a) $-\frac{\Delta p}{p}$ (b) $-\gamma\frac{\Delta p}{p}$ (c) $-\frac{\Delta p}{\gamma p}$ (d) $\frac{\Delta p}{\gamma^2 p}$	
10	Figure shows four p-V diagrams. Which of these curves represent isothermal and adiabatic process?  (a) D and C (b) A and C (c) A and B (d) B and D	
11	A thermodynamic system is taken from state A to state B along ACB and is brought back to A along BDA as shown in figure. Net work done during one complete cycle is given by area  	

	(a) ACBDA (b) $ACBp_2p_1A$ (c) AV_1V_2 BDA (d) BD Ap_1p_2 B	
12	A gas at pressure p is adiabatically compressed so that its density becomes twice that of initial value. Given that γ = C_p/C_V = 7/5, what will be the final pressure of the gas? (a) 2p (b) $\frac{7}{5}p$ (c) 2.63 p (d) p	
13	Two isothermal curves are shown in figure at temperature T_1 and T_2. Which of the following relations is correct?  (a) $T_1 > T_2$ (b) $T_1 < T_2$ (c) $T_1 = T_2$ (d) $T_1 = \frac{1}{2}T_2$	
14	In the indicator diagram, net amount of work done will be  (a) Positive (b) Zero (c) Infinity (d) Negative	
15	A cyclic process is shown in figure. Work done during isobaric expansion is  (a) 1600 J (b) 100 J (c) 400 J (d) 600 J	
16	In a p-V diagram for an ideal gas (where symbols have their usual meanings). (a) 1 (b) 2 (c) C_p/C_V (d) C_V/C_p	
17	An ideal gas undergoes cyclic process ABCDA as shown in given p-V diagram. The amount of work done by the gas is	

	 (a) $6p_0V_0$ (b) $-2p_0V_0$ (c) $+2p_0V_0$ (d) $+4p_0V_0$	
18	In the following p-V diagram figure two adiabates cut two isothermals at T_1 and T_2. The value of V_b / V_c is  (a) $= V_a / V_d$ (b) $< V_a / V_d$ (c) $> V_a / V_d$ (d) Cannot say	
19	In figure a certain mass of gas traces paths 1, 2, 3 from state A to state B. If work done by the gas along three paths are W_1, W_2, W_3 respectively, then  (a) $W_1 < W_2 < W_3$ (b) $W_1 = W_2 = W_3$ (c) $W_1 > W_2 > W_3$ (d) Cannot say	
20	Work done by the system in closed path ABCA, is  (a) Zero (b) $(V_1 - V_2)(p_1 - p_2)$ (c) $\frac{(p_2 - p_1)(V_2 - V_1)}{2}$ (d) $\frac{(p_2 + p_1)(V_2 - V_1)}{2}$	
21	Figure shows four thermodynamic process to which a gas sample may be subjected. The isobaric and isothermal curves are	

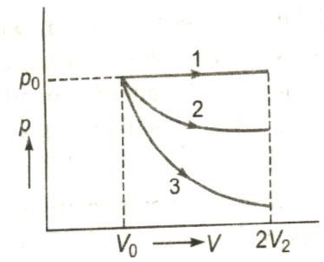
	 (a) IV and III (b) II and IV (c) I and III (d) II and III	
22	In the indicator diagram, T_a, T_b, T_c,T_d represents temperature of gas at A, B, C, D respectively. Which of the following is correct relation?  (a) $T_a = T_b = T_c = T_d$ (b) $T_a \neq T_b \neq T_c \neq T_d$ (c) $T_a = T_b$ and $T_c = T_d$ (d) None of these	
23	An ideal monoatomic gas is taken around the cycle ABCD as shown in p versus V diagram. Work done during the cycle is  (a) pV (b) 0.5 pV (c) 2 pV (d) 3 pV	
24	By what percentage should the pressure of the given mass of gas be increased so to decrease its volume by 10% at a constant temperature? (a) 5% (b) 7.2% (c) 12.5% (d) 11.1%	
25	One mole of an ideal gas expands adiabatically from an initial temperature T_1 to a final temperature T_2. The work done by the gas would be (a) $(C_p - C_V)(T_1 - T_2)$ (b) $C_p(T_1 - T_2)$ (c) $C_V(T_1 - T_2)$ (d) $(C_p - C_V)(T_1 + T_2$	
26	A gas at pressure 6×10^5 Nm^{-2} and volume 1 m^3 and its pressure falls to 4×10^5 Nm^{-2}. When its volume is $3m^3$. Given that the indicator diagram is a straight line, work done by the system is (a) 6×10^5 J (b) 3×10^5 J (c) 4×10^5 J (d) 10×10^5 J	

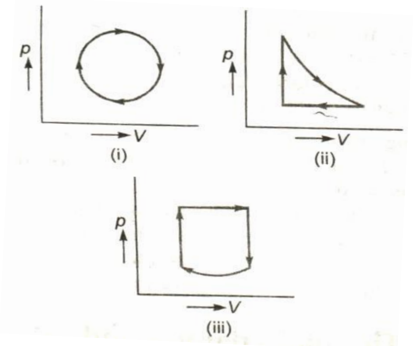
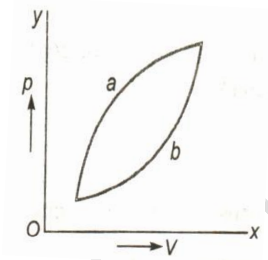
27	A thermodynamic system goes from state (i) (p, V) to (2 p, V) and (ii) (p, V) to (p, 2V). Work done in the two cases is (a) Zero, zero (b) Zero, pV (c) pV, zero (d) pV, pV	
28	Consider p-V diagram for an ideal gas shown in figure $P = \frac{constant}{V}$  Out of the following diagrams (figure), which represents the T-p diagram? 	
29	The pressure inside a tyre is 4 atm at 27^0C. If the tyre bursts suddenly, new temperature will be (γ = 7/5) (a) $300\ (4)^{7/2}$ (b) $300\ (4)^{2/7}$ (c) $300\ (2)^{7/2}$ (d) $300\ (4)^{-2/7}$	
30	A monoatomic ideal gas, initially at temperature T_1 is enclosed in a cylinder fitted with a frictionless piston. The gas is allowed to expand adiabatically to a temperature T_2 by releasing the piston suddenly. If L_1, L_2 are the lengths of the gas column before and after expansion respectively, then T_1/T_2 is given by (a) $(L_1 / L_2)^{2/3}$ (b) (L_1 / L_2) (c) L_1 / L_2 (d) $(L_2 / L_1)^{2/3}$	
31	For adiabatic expansion of a perfect monoatomic gas, when volume increases by 24%, what is the percentage decreases by 24%, what is the percentage decrease in pressure? (a) 24% (b) 30% (c) 48% (d) 71%	

32	Starting with the same initial conditions, an ideal gas expands from volume V_1 to V_2 in three different ways. The work done by the gas is W_1 if the process is purely isothermal, W_2 if purely isobaric and W_3 if purely adiabatic. Then, (a) $W_2 > W_1 > W_3$ (b) $W_2 > W_3 > W_1$ (c) $W_1 > W_2 > W_3$ (d) $W_1 > W_3 > W_2$	
33	A litre of dry air at STP is allowed to expand to a volume of 3 L under adiabatic conditions. If γ = 1.40, the work done is ($3^{1.4}$ = 4.6555) (a) 48 J (b) 60.7 J (c) 90.5 J (d) 100.8 J	
34	As shown in figure three p-V diagrams. In which case, work done is minimum  (a) I (b) II (c) III (d) Cannot say	
35	An ideal gas is heated at constant pressure and absorbs amount of heat Q. If the adiabatic exponent is γ then the fraction of heat absorbed in raising the internal energy and performing the work, is (a) $1-\frac{1}{\gamma}$ (b) $1+\frac{1}{\gamma}$ (c) $1-\frac{2}{\gamma}$ (d) $1+\frac{2}{\gamma}$	
36	A thermo dynamical system is changed from state (p_1V_1) to (p_2V_2) by two different process. The quantity which will remain same is (a) ΔQ (b) ΔW (c) $\Delta Q+W$ (d) $\Delta Q-\Delta W$	
37	In a thermodynamic process pressure of a fixed mass of a gas is changed in such a manner that the gas molecules gives out 20 J of heat ad 10 J of work is done on the gas. If the internal energy of gas 40 J then the final internal energy will be (a) 30 J (b) 20 J (c) 60 J (d) 40 J	
38	In changing the state of a gas adiabatically from an equilibrium state A to another equilibrium state B, an amount of work equal t 22.3 J is done on the system. If the gas is taken from state A to B via a process in which the net heat absorbed by the system is 9.35 cal, how much is	

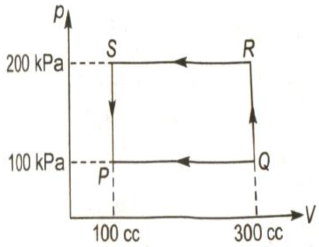
	the net work done by the system in the latter case? (a) 15.6 J (b) 11.2 J (c) 14.9 J (d) 16.9 J	
39	During an isothermal expansion, a confined ideal gas does-150 J of work against its surrounding. This implies that (a) 150 J of heat has been added of the gas (b) 150 J heat has been removed from the gas (c) 300 J of heat has been added to the gas (d) No heat is transferred because the process is isothermal	

CONCEPT-38: BASED ON LAWS OF THERMODYNAMICS AND INTERNAL ENERGY

1	In a certain process, 400 cal of heat are supplied to a system and at the same time 105 J of mechanical work was done on the system. The increase in its internal energy is (a) 20 cal (b) 303 cal (c) 404 cal (d) 425 cal	
2	If the heat of 110 J is added to a gaseous system and it acquires internal energy of 40 J, then the amount of internal work done is (a) 40 J (b) 70 J (c) 150 J (d) 110 J	
3	A gas is expanded from volume V_0 to $2V_0$ under three different processes shown in figure. Process 1 is isobaric process, process 2 is isothermal and process 3 is adiabatic. Let ΔU_1, ΔU_2 and ΔU_3 be the change in internal energy of the gas in these three process. Then,  (a) $\Delta U_1 > \Delta U_2 > \Delta U_3$ (b) $\Delta U_1 < \Delta U_2 < \Delta U_3$ (c) $\Delta U_2 < \Delta U_1 > \Delta U_3$ (d) $\Delta U_2 < \Delta U_3 < \Delta U_1$	
4	In a thermodynamic process, pressure of affixed mass of gas is changed in such a manner that the gas releases 20 J of heat and 8 J of work is done on the gas. If internal energy of the gas was 30 J, then the final internal energy	

	will be (a) 42 J (b) 18 J (c) 12 J (d) 60 J	
5	What is the nature of change in internal energy in the following three thermodynamic processes shown in figure?  (a) ΔU is positive in all the three cases (b) ΔU is negative in all the three cases (c) ΔU is positive for (i), negative for (ii), zero for (iii) (d) ΔU = 0, in all the cases	
6	Figure shows two processes a and b for a given sample of a gas, if ΔQ_1, ΔQ_2 are the amounts of heat absorbed by the system in the two cases and ΔU_1, ΔU_2 are changes in internal energies respectively, then  (a) $\Delta Q_1 = \Delta Q_2; \Delta U_1 = \Delta U_2$ (b) $\Delta Q_1 > \Delta Q_2; \Delta U_1 > \Delta U_2$ (c) $\Delta Q_1 < \Delta Q_2; \Delta U_1 < \Delta U_2$ (d) $\Delta Q_1 > \Delta Q_2; \Delta U_1 = \Delta U_2$	
7	1 cm^3 of water at its boiling point absorbs 540 cal of heat to become steam with a volume = 1.013 x 10^5 Nm^{-2} and the mechanical equivalent of heat = 4.19 $Jcal^{-1}$. The energy spend in this process in overcoming intermolecular forces is (a) 540 cal (b) 40 cal (c) 500 cal (d) Zero	
8	During adiabatic expansion of 10 moles of a gas, the internal energy decreased by 50 J. Work done during the process is (a) + 50 J (b) – 50 J (c) Zero (d) Cannot say	

9	If amount of heat given to a system be 50 J and work done on the system be 15 J, then change in internal energy of the system is (a) 35 J (b) 50 J (c) 65 J (d) 15 J	
10	In an isothermal change of an ideal gas, ΔU = 0. The change in heat energy ΔQ is equal to (a) 0.5 W (b) W (c) 1.5 W (d) 2 W	
11	5 mole of an ideal gas with (γ = 7/5) initially at STP are compressed adiabatically so that its temperature becomes 400^0C. The increases in the internal energy of gas in kJ is (a) 21.55 (b) 41.55 (c) 65.55 (d) 50.55	
12	Which one of the following statements is true in respect of usual quantities represented by ΔQ, ΔU and ΔW ? (a) ΔU and ΔW are path dependent (b) ΔQ and ΔU are path dependent (c) ΔU does not depend on path (d) ΔQ does not depend upon path	
13	When an ideal monoatomic gas is heated at constant pressure, fraction of heat energy supplied which increases the internal energy of gas is (a) 2/5 (b) 3/5 (c) 3/7 (d) 3/4	
14	Consider two containers A and B containing identical gases at the same pressure, volume and temperature. The gas in container A is compressed to half of its original volume isothermally while the gas in container B is compressed to half of its original value adiabatically. The ratio of final pressure of gas in B to that of gas in A is (a) $2^{\gamma-1}$ (b) $\left(\frac{1}{2}\right)^{\gamma-1}$ (c) $\left(\frac{1}{1-\gamma}\right)^2$ (d) $\left(\frac{1}{\gamma-1}\right)^2$	
15	Three copper blocks of masses M_1, M_2 and M_3 kg respectively are brought into thermal contact till they reach equilibrium. Before contact, they were at T_1, T_2,T_3 (T_1 > T_2 > T_3). Assuming there is no heat loss to the surroundings, the equilibrium temperature T is (s is specific heat of copper) (a) T = $\frac{T_1+T_2+T_3}{3}$ (b) T = $\frac{M_1T_1+M_2T_2+M_3T_3}{M_1+M_2+M_3}$	

	(c) T = $\frac{M_1T_1 + M_2T_2 + M_3T_3}{3(M_1 + M_2 + M_3)}$ (d) T = $\frac{M_1T_1s + M_2T_2s + M_3T_3s}{M_1 + M_2 + M_3}$	
16	In which of processes does the internal energy of the system remains constant (a) Isobaric (b) Isothermal (c) Adiabatic (d) Isochoric	
17	A thermodynamic system is taken through the cycle PQRSP process. The net work done by the system is  (a) 20 J (b) -20 J (c) 400 J (d) -374 J	

CONCEPT-39: BASED ON CARNOT ENGINE AND REFRIGERATOR

1	The efficiency of a Carnot engine working between 800 K and 500 K is (a) 0.4 (b) 0.625 (c) 0.375 (d) 0.5	
2	A Carnot engine whose sink is at 300 K has an efficiency of 40%. By how much should the temperature of source be increased so as to increase its efficiency by 50% of original efficiency? (a) 280 K (b) 275 K (c) 325 K (d) 250 K	
3	An ideal Carnot engine whose efficiency is 40% receives heat at 500 K. If its efficiency were 50%, then in take temperature for same exhaust temperature would be (a) 700 K (b) 900 K (c) 800 K (d) 600 K	
4	A Carnot's engine works between a source at a temperature of 27^0C and a sink at - 123^0C. Its (a) 0.5 (b) 0.25 (c) 0.75 (d) 0.4	
5	Four engines are working between the given temperatures ranges given below. For which temperature range the efficiency is maximum? (a) 100 K, 80 K (b) 40 K, 20 K (c) 60 K, 40 K (d) 120 K, 100 K	
6	An engine has an efficiency of 1/3. The amount of work this engine can perform per kilocalorie of heat input is (a) 1400 cal (b) 700 cal (c) 700 J (d) 1400 J	

7	A Carnot engine works between 600 K and 300 K. In each cycle of operation, the engine draws 1000 J of heat energy from the source. The efficiency of the engine is (a) 50% (b) 70% (c) 20% (d) 80%	
8	In a refrigerator, the low temperature coil of evaporator is at -23^{0}C and the compressed gas in the condenser has a temperature of 77^{0}C. How much electrical energy is spend in freezing 1 kg of water already at 0^{0}C? (a) 134400 J (b) 1344 J (c) 80000 J (d) 3200 J	
9	A refrigerator absorbs 2000 cal of heat from ice trays. If the coefficient of performance is 4, then work done by the motor is (a) 2100 J (b) 4200 J (c) 8400 J (d) 500 J	
10	A Carnot engine has same efficiency between (i) 100 K and 500 K, (ii) T K and 900 K. The value of T is (a) 180 K (b) 90 K (c) 270 K (d) 360 K	
11	A refrigerator works between temperature of melting ice and room temperatures (17^{0}C). The amount of energy in kWh that must be supplied to freeze 1 kg of water at 0^{0}C is (a) 1.4 (b) 1.8 (c) 0.058 (d) 2.5	
12	A Carnot engine has an efficiency of 1/6. When temperature of sink is reduced by 62^{0}C, its efficiency is doubled. Temperature of source and sink are, (a) 99^{0}C, 37^{0}C (b) 124^{0}C, 62^{0}C (c) 37^{0}C, 99^{0}C (d) 62^{0}C, 124^{0}C	
13	A Carnot engine whose low temperature reservoir is at 27^{0}C has an efficiency 37.5%. The high temperature reservoir is at (a) 480^{0}C (b) 327^{0}C (c) 307^{0}C (d) 207^{0}C	
14	The coefficient of performance of a refrigerator working between 10^{0}C and 20^{0}C is (a) 28.3 (b) 29.3 (c) 2 (d) Cannot be calculated	
15	A reversible heat engine converts $\frac{1}{6}$th of heat it absorbs from source into work. When temperature of source is 600 K, temperature at which heat exhausts is (a) 500 K (b) 100 K (c) 0 K (d) 600 K	

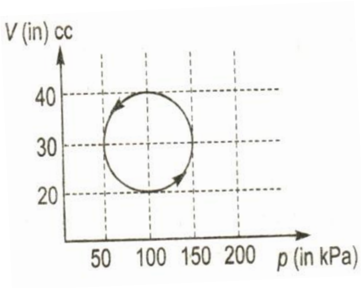
16	A Carnot engine used first ideal monoatomic gas and then an ideal diatomic gas, if the source and sink temperatures are 411^{0}C and 69^{0}C, respectively and the engine extracts 1000 J of heat from the source in each cycle, then (a) Area enclosed by the p-V diagram is 10 J (b) Heat energy rejected by engine is 1st case is 600 J while that in 2nd case in 113 J (c) Area enclosed by the p-V diagram is 500 J (d) Efficiencies of the engine in both the cases are in the ration 21 : 25	
17	A Carnot engine whose source is at 400 k takes 200 cal of heat and rejects 150 cal to the sink. What is the temperature of the sink? (a) 800 K (b) 400 K (c) 300 K (d) Cannot say	
18	An ideal gas heat engine operates in Carnot cycle between 227^{0}C and 127^{0}C. It absorbs 6 x 10^4 cal of heat at higher temperature. Amount of heat converted into work is (a) 1.2 x 10^4 cal (b) 2.4 x 10^4 cal (c) 6 x 10^4 cal (d) 4.8 x 10^4 cal	
19	Two heat engines A and B have their sources at 1000 K and 1100 K and their sinks are at 500 K and 400 K respectively. What is true about their efficiencies? (a) $\eta_A = \eta_B$ (b) $\eta_A > \eta_B$ (c) $\eta_A < \eta_B$ (d) Cannot say	
20	An engine takes compressed steam at 127^{0}C and rejects it at 47^{0}C. Efficiency of the engine is (a) 60% (b) 35% (c) 20% (d) 40%	
21	A Carnot engine has the same efficiency between 800 K to 500 K and x K to 600 K. The value of x is (a) 100 K (b) 960 K (c) 846 K (d) 754 K	
22	What is the temperature of source in Carnot cycle of 10% efficiency when heat exhausts at 270 K? (a) 400 K (b) 500 K (c) 300 K (d) 600 K	
23	Even Carnot engine cannot give 100% efficiency because we cannot (a) Prevent radiation (b) Final ideal sources (c) Reach absolute zero temperature (d) Eliminate friction	
24	A Carnot engine take 3 x 10^6 cal of heat from a reservoir at 627^{0}C and gives it to a sink at 27^{0}C. The work done by the	

	engine is (a) 4.2×10^6 J (b) 8.4×10^6 J (c) 16.8×10^6 J (d) Zero	
25	A Carnot engine has the same efficiency between 800 K to 500 K and x K to 600 K. The value of x is (a) 100 K (b) 960 K (c) 846 K (d) 754 K	
26	What is the value of sink temperature when efficiency of engine is 100%? (a) 0 K (b) 300 K (c) 273 K (d) 400 K	

CONCEPT-40: BASED ON SPECIFIC HEAT OF GASES AND DEGREES OF FREEDOM

1	For a gas the difference between the two specific heats is 4150 J/kg-K. What is the specific heats at constant volume of gas it the ratio of the specific heat is 1.4? (a) 8475 J/kg-K (b) 5186 J/kg-K (c) 1660 J/kg-K (d) 10375 J/kg-K1	
2	For a gas if the ratio of specific heats at constant pressure and volume is γ, then value of degree of freedom is (a) $\frac{3\gamma-1}{2\gamma-1}$ (b) $\frac{2}{\gamma-1}$ (c) $\frac{9}{2}(\gamma-1)$ (d) $\frac{25}{2}(\gamma-1)$	
3	If 70 cal of heat is required to raise the temperature of 2 moles of an ideal gas at constant pressure from 30^0C to 35^0C, then the amount of heat required to raise the temperature of same gas through same range at constant volume is (a) 50 cal (b) 70 cal (c) 60 cal (d) 65 cal	
4	One mole of an ideal gas requires 207 J heat to raise the temperature by 1 K, when heated at constant pressure. If the same gas is heated at constant volume to raise the temperature by the same range, the heat required will be (Take R = 8.3 $Jmol^{-1} K^{-1}$) (a) 215.3 J (b) 198.7 J (c) 207 J (d) None of these	
5	One mole of a gas enclosed in a vessel is heated at constant pressure 1 K. Work done by the gas is (a) 1 J (b) $\frac{1}{R}J$ (c) R J (d) None of these	
6	One mole of a mono atomic gas is heated at a constant pressure of 1 atm from 0 K to 100 K. If the gas constant R = 8.32 $Jmol^{-1} K^{-1}$, the change in internal energy of the gas is approximately (a) 2.3 J (b) 46 J (c) 8.67×10^3 J (d) 1.25×10^3 J	

7	Which one of the following gases possesses the largest internal energy? (a) 2 moles of helium occupying 1 m^3 at 300 K (b) 56 g of nitrogen at 107 N m^{-2} at 300 K (c) 8 g of oxygen at 8 atm at 300 K (d) 6 x 10^{26} molecules of argon occupying 40 m^3 at 900 K	
8	For the same rise in temperature of one mole of gas at constant volume, heat required for a non linear tri atomic gas is K times that required for mono atomic gas. The value of K is (a) 1 (b) 0.5 (c) 2 (d) 2.5	
9	Value of two principal specific heats of a gas ib cal (mol K)$^{-1}$ determined by different students are given. Which is most reliable? (a) 5, 2 (b) 6, 5 (c) 7, 5 (d) 7, 4	
10	In the above question, if λ = 1.5, the gas may (a) Mono atomic (b) Diatomic (c) A mixture of mono atomic and diatomic gases (d) A mixture of diatomic and tri atomic gases	
11	Calculate change in internal energy when 5 mole of hydrogen is heated to 20^0C from 10^0C, specific heat of hydrogen at constant pressure is 8 cal (mol^{0}C)$^{-1}$ (a) 200 cal (b) 350 cal (c) 300 cal (d) 475 cal	
12	A gas expands with temperature according to the relation V = $kT^{2/3}$, Calculate work done when the temperature changes by 60 K. (a) 10 R (b) 30 R (c) 40 R (d) 20 R	
13	A gaseous mixture contains equal number of hydrogen and nitrogen molecules. Specific heat measurements on this mixture at temperature below 150 K would indicate the value of $\gamma = C_p/ C_V$ for the mixture as (a) 3/2 (b) 4/3 (c) 5/3 (d) 7/5	
14	For a gas, the difference between the two principal specific heats is 4150 $Jkg^{-1}K^{-1}$. What is the specific heat of the gas at constant volume if, the ratio of specific heat is 1.4? (a) 5186 $Jkg^{-1}K^{-1}$ (b) 10375 $Jkg^{-1}K^{-1}$ (c) 1660 $Jkg^{-1}K^{-1}$ (d) 8475 $Jkg^{-1}K^{-1}$	
15	If the degrees of freedom of a gas molecule be f, then the ratio of two specific heat C_p/ C_V is given by	

	(a) $\frac{2}{f}+1$ (b) $1-\frac{2}{f}$ (c) $1+\frac{1}{f}$ (d) $1-\frac{1}{f}$	
16	During an adiabatic process the pressure of a gas is found to be proportional to the cube of its absolute temperature. The ratio C_p / C_V for the gas is (a) $\frac{3}{2}$ (b) $\frac{4}{3}$ (c) 2 (d) $\frac{5}{3}$	
17	The adiabatic elasticity of hydrogen gas (γ = 1.4) at NTP is (a) 1×10^5 N/m^2 (b) 1×10^{-8} N/m^2 (c) 1.4 N/m^2 (d) 1.4×10^5 N/m^2	
18	A system is taken through a cyclic process represented by a circle as shown. The heat absorbed by the system is  (a) $\pi \times 10^3$ J (b) $\frac{\pi}{2} J$ (c) $4\pi \times 10^2$ J (d) π J	

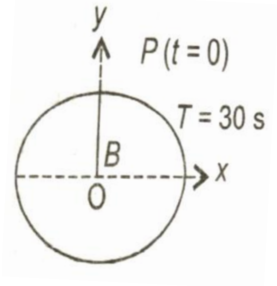
CONCEPT-41: BASED ON OSCILLATORY MOTION AND SIMPLE HARMONIC MOTION WITH ITS CHARACTERISTICS

1	The displacement of two particles executing SHM are represented by equations $y_1 = 2\sin(10t + \theta)$, $y_2 = 3\cos 10t$. The phase difference between the velocity of these particle is (a) θ (b) - θ (c) $\theta + \pi/2$ (d) $\theta - \pi/2$	
2	Two pendulum of length 121 cm and 100 cm start vibrating. At same instant the two are in the mean position in the same phase. After how many vibrations of the shorter pendulum, the two will be in phase at the mean position? (a) 10 (b) 11 (c) 20 (d) 21	
3	The displacement of the particle varies with time according to the relation. $y = \alpha\sin\omega t + b\cos\omega t$, then (a) The motion is oscillating but not SHM (b) The motion is SHM with amplitude a + b	

	(c) The motion is SHM with amplitude $a^2 + b^2$ (d) The motion is SHM with amplitude $\sqrt{a^2 + b^2}$	
4	Two pendulums have time period T and 5T/4. They start SHM at the same time from the mean position. What will be the phase difference between them after the bigger pendulum completed one oscillation? (a) 45^0 (b) 90^0 (c) 60^0 (d) 30^0	
5	The displacement of a particle is represented by the equation y = 3cos $\left(\frac{\pi}{4} - 2\omega t\right)$. The motion of the particle is (a) Simple harmonic with period 2p/ ω (b) Simple harmonic with period π/ ω (c) Periodic but not simple harmonic (d) Non-periodic	
6	Starting from y = Asin ωt and y = Acos ωt (a) Acceleration lags the displacement by a phase π/4 (b) Acceleration lags the displacement by a phase π/2 (c) Acceleration leads the displacement by a phase π/2 (d) Acceleration leads the displacement by a phase π	
7	The displacement of a particle is represented by the equation y = $\sin^3 \omega$t. The motion is (a) Non-periodic (b) Periodic but not simple harmonic (c) Simple harmonic with period 2π/ ω (d) Simple harmonic with period π/ ω	
8	A simple harmonic oscillator has and amplitude α and time period T. The time required by it to travel from x = α to x = $\frac{\alpha}{2}$ is (a) $\frac{T}{6}$ (b) $\frac{T}{4}$ (c) $\frac{T}{3}$ (d) $\frac{T}{2}$	
9	The piston in the cylinder head of a locomotive has a stroke (twice the amplitude) of 1.0 m. If the piston moves with simple harmonic motion with an angular frequency of 200 rad/min, what is its maximum speed? (a) 100 m/min (b) 200 m/min (c) 300 m/min (d) 50 m/min	
10	Two points are located at a distance of 10 m and 15 m from the source of oscillation. The period of oscillation is 0.05 s and the velocity of the wave is 300 m/s. What is the phase difference between the oscillations of two points? (a) π (b) $\frac{\pi}{6}$ (c) $\frac{\pi}{3}$ (d) $\frac{2\pi}{3}$	

11	A horizontal plank has a rectangular block placed on it. The plank starts oscillating vertically and simple harmonically with an amplitude of 40 cm. The block just loses contact with the plank when the later is momentarily at rest. Then (a) The period of oscillation is $2\pi/5$ s (b) the block weighs double its weight when the plank is at one of the positions of momentary at rest (c) The block weighs 1.5 times its weight on the plank half way down (d) The block weighs its true weight on the plank, when the latter moves fastest	
12	A body has a time period T_1 under the action of one force and T_2 under the action of another force, the square of the time period when both the forces are acting in the same direction is (a) $T_1^2T_2^2$ (b) $T_1^2T_2^2$ (c) $T_1^2+T_2^2$ (d) $T_1^2T_2^2(T_1^2+T_2^2)$	
13	Motion of an oscillating liquid column in a U-tube is (a) Periodic but not simple harmonic (b) Non-periodic (c) Simple harmonic and time period is independent of the density of the liquid (d) Simple harmonic and time-period is directly proportional to the density of the liquid	
14	A particle is acted simultaneously by mutually perpendicular simple harmonic motions x = α cos ω t and y = α sin ω t. The trajectory of motion of the particle will be (a) An ellipse (b) A parabola (c) A circle (d) A straight line	
15	This time period of a particle undergoing SHM is 16 s. It starts motion from the mean position. After 2 s, its velocity is 0.4 ms^{-1}. The amplitude is (a) 1.44 m (b) 0.72 m (c) 2.88 m (d) 0.36 m	
16	A particle is performing simple harmonic motion along x-axis with amplitude 4 cm and time period 1.2 s. The minimum time taken by the particle to move from x = + 2 to x = 4 cm and back again is given by (a) 0.4 s (b) 0.3 s (c) 0.2 s (d) 0.6 s	
17	The acceleration of a particle performing SHM is 12 cms^{-2} at a distance of 3 cm from the mean position. Its time period is (a) 2.0 s (b) 3.14 s (c) 0.5 s (d) 1.0 s	
18	The acceleration d^2x / dt^2 of a particle varies with	

	displacement x as $\frac{d^2x}{dt^2}$ = - kx Where k is a constant of the motion. The time period T of the motion is equal to (a) 2πk (b) $2\pi\sqrt{k}$ (c) $2\pi/\sqrt{k}$ (d) 2 π / k	
19	Two linear SHMs of equal amplitude A and angular frequencies ω and 2ω are impressed on a particle along the axes x and y respectively. If the initial phase difference between them is π/2, the resultant path followed by the particle is (a) $y^2 = x^2(1 - x^2/A^2)$ (b) $y^2 = 2x^2(1 - x^2/A^2)$ (c) $y^2 = 4x^2(1 - x^2/A^2)$ (d) $y^2 = 8x^2(1 - x^2/A^2)$	
20	A coin is placed on a horizontal platform, which undergoes horizontal SHM about a mean position O. The coin placed on platform does not slip, coefficient of friction between the coin and the platform is μ. The amplitude of oscillation is gradually increased. The coil will begin to slip on the platform for the first time (a) At the mean position (b) At the extreme position of oscillations (c) For an amplitude of $\mu g/\omega^2$ (d) For an amplitude of $g/\mu\omega^2$	
21	A block is resting on a piston which is moving vertically with SHM of period 1.0 s. At what amplitude of motion will the block and piston separate? (a) 0.2 m (b) 0.25 m (c) 0.3 m (d) 0.35 m	
22	A particle moves according to the law, x = rcos $\frac{\pi t}{2}$. The distance covered by it in the time interval between t = 0 to t = 3 s is (a) r (b) 2r (c) 3r (d) 4r	
23	A particle is executing SHM of period 24s and of amplitude 41 cm with O as equilibrium position. The minimum time in seconds taken by the particle to go from P to Q, where OP = - 9 cm and OQ = 40 cm is (a) 5 (b) 6 (c) 7 (d) 9	
24	Figure shows the circular motion of a particle. The radius of the circle, the period, sense of revolution and the initial position are indicated on the figure. The simple harmonic motion of the x-projection of the radius vector of the rotating particle P is	

	 (a) x(t) = $B\sin\left(\frac{2\pi t}{30}\right)$ (b) x(t) = $B\cos\left(\frac{\pi t}{15}\right)$ (c) x(t) = $B\sin\left(\frac{\pi t}{15}+\frac{\pi}{2}\right)$ (d) x(t) = $B\left(\frac{\pi t}{15}+\frac{\pi}{2}\right)$	
25	1.00 x 10^{-20} kg particle is vibrating with simple harmonic motion with a period of 1.00 x 10^{-5} s and a maximum speed of 1.00 x 10^{3} m/s. The maximum displacement of the particle is (a) 1.59 mm (b) 1.00 cm (c) 10 m (d) None of these	
26	Which one of the following equations does not represent SHM, x = displacement and t = time. Parameters a, b and c are the constants of motion? (a) x = a sin bt (b) x = a cos bt + c (c) x = a sin bt + c cos bt (d) x = a sec bt + c cosec bt	
27	A particle executing SHM has a maximum speed of 30 cm/s and a maximum acceleration of 60 cm/s^2. The period of oscillation is (a) π s (b) $\frac{\pi}{2}s$ (c) 2π s (d) $\frac{\pi}{t}s$	
28	The bob of a simple pendulum of length L is released at time t = 0 from a position of small angular displacement. Its linear displacement at time t is given by (a) X = a sin 2π $\sqrt{\frac{L}{g}}xt$ (b) X = acos 2π $\sqrt{\frac{g}{L}}xt$ (c) X = a sin $\sqrt{\frac{g}{L}}xt$ (d) X = a cos $\sqrt{\frac{g}{L}}xt$	
29	Displacement-time equation of a particle executing SHM is, x = 4 sin ωt + 3 sin $(\omega t+\pi/3)$. Here x is in centimetre and t in second. The amplitude of oscillation of the particle is approximately (a) 5 cm (b) 6 cm (c) 7 cm (d) 9 cm	
30	A particle SHM is described by the displacement function	

	x(t) = A cos $(\omega t+\phi)$, ω = 2π/T. If the initial (t = 0) position of the particle is 1 cm, its initial velocity is π cm s^{-1} and its angular frequency is πs^{-1}, then the amplitude of its motion is (a) π cm (b) 2 cm (c) $\sqrt{2}$ cm (d) 1 cm	
31	A particle moves in xy-plane according to the rule x = α sin ωt and y = α cos ωt. The particle follows (a) An elliptical path (b) A circular path (c) A parabolic path (d) A straight line path inclined equally to x and y-axis	
32	Out the following functions representing motion of a particle which represents SHM (1) y = sin ωt - cos ωt (2) y = $\sin^3$ ωt (3) y = 5 cos $\left(\frac{3\pi}{4}-3\omega t\right)$ (4) y = 1 + ωt + $\omega^2 t^2$ (a) Only (1) and (2) (b) Only (1) (c) Only (4) does not represent SHM (d) Only (1) and (2)	
33	A large horizontal surface moves up and down in SHM with an amplitude of 1 cm. If a mass of 10 kg (which is placed on the surface) is to remain continuously is in contact with it, the maximum frequency of SHM will be (a) 5 Hz (b) 0.5 Hz (c) 1.5 Hz (d) 10 Hz	
34	The composition of two simple harmonic motions of equal periods at right angle to each other and with a phase difference of π results in the displacement of the particle along (a) Circle (b) Figure of eight (c) Straight line (d) Ellipse	
35	A horizontal platform vibrates with simple harmonic motion in the horizontal direction with a period 2 s. A body of mass 0.5 kg is placed on the platform. The coefficient of static friction between the body and platform is 0.3. what is the maximum frictional force on the body when the platform is oscillating with an amplitude 0.2 m? Assume π^2 = 10 = g. (a) 0.5 N (b) 1 N (c) 1.5 N (d) 2 N	

CONCEPT-42: BASED ON ENERGY IN SHM

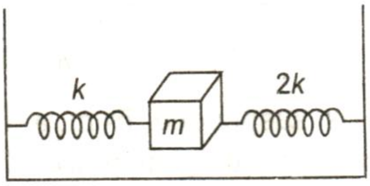
1	The angular velocity and the amplitude of a simple pendulum is ω and α respectively. At a displacement x from the mean position it its kinetic energy is T and	

	potential energy is V, then the ratio of T to V is (a) $(a^2 - x^2\omega^2)/x^2\omega^2$ (b) $x^2\omega^2/(a^2 - x^2\omega^2)$ (c) $(a^{2-}x^2)/X$ (d) $x^2/(a^2 - x^{2)}$	
2	A particle of mass m is executing oscillations about the origin on the x-axis with amplitude A. Its potential energy is given as $U(x) = \alpha x^4$, where α is positive constant. The x-coordinate of mass where potential energy is one-third of the kinetic energy of particle, is (a) $\pm\frac{A}{\sqrt{3}}$ (b) $\pm\frac{A}{\sqrt{2}}$ (c) $\pm\frac{A}{3}$ (d) $\pm\frac{A}{2}$	
3	A particle starts SHM from the mean position. Its amplitude is α and total energy E. at one constant its kinetic energy is 3E/4 its displacement at this instant is (a) y = a / $\sqrt{2}$ (b) y = $\frac{a}{2}$ (c) y = $\frac{a}{\sqrt{3/2}}$ (d) y = a	
4	A point particle of mass 0.1 kg is executing SHM of amplitude 0.1 m. When the particle passes through the mean position, its kinetic energy is 8 x 10^{-3} J. The equation of motion of this particle, if its initial phase of oscillation is 45^0, is (a) y = 0.1sin $\left(\frac{r}{4}+\frac{\pi}{4}\right)$ (b) y = 0.1sin $\left(\frac{t}{2}+\frac{\pi}{4}\right)$ (c) y = 0.1sin $\left(4t-\frac{\pi}{4}\right)$ (d) y = 0.1sin $\left(4t+\frac{\pi}{4}\right)$	
5	A particle is vibrating in a simple harmonic motion with and amplitude of 4cm. At what displacement from the equilibrium position is its energy half potential and half kinetic? (a) 1 cm (b) $\sqrt{2}$ cm (c) 3 cm (d) $2\sqrt{2}$ cm	
6	When the potential energy of a particle executing simple harmonic motion is one-fourth of its maximum value during the oscillation, the displacement of the particle from the equilibrium position in terms of its amplitude α is	

	(a) $\frac{a}{4}$ (b) $\frac{a}{3}$ (c) $\frac{a}{2}$ (d) $\frac{2a}{3}$	
7	The potential energy of a particle (U_X) executing SHM is given by (a) $U_X = \frac{k}{2}(x-a)^2$ (b) $U_X = k_1x + k_2x^2 + k_3x^3$ (c) $U_X = Ae^{-bx}$ (d) U_X = constant	
8	If a simple pendulum of length l has maximum angular displacement θ, then the maximum kinetic energy of bob of mass m is (a) $\frac{1}{2}x\left(\frac{l}{g}\right)$ (b) $\frac{1}{2}x\frac{mg}{l}$ (c) $mglx(1-\cos\theta)$ (d) $\frac{1}{2}xmgl\sin\theta$	
9	When the displacement is half of the amplitude, then what fraction of the total energy of a simple harmonic oscillator is kinetic? (a) 2/7th (b) 3/4th (c) 2/9th (d) 5/7th	
10	For a particle executing SHM, the kinetic energy K is given by K = $K_0 \cos^2 \omega t$. The equation of its displacement can be (a) $\left(\frac{k_0}{m\omega^2}\right)^{1/2}\sin\omega t$ (b) $\left(\frac{2k_0}{m\omega^2}\right)^{1/2}\sin\omega t$ (c) $\left(\frac{2\omega^2}{mk_0}\right)^{1/2}\sin\omega t$ (d) $\left(\frac{2k_0}{m\omega}\right)^{1/2}\sin\omega t$	

CONCEPT-43: BASED ON SPRINGS AND THEIR OSCILLATIONS

1	A body of mass 500 g is attached to a horizontal spring of spring constant 8 π^2 Nm^{-1}. If the body is pulled to a distance of 10 cm from its mean position then its frequency of oscillation is (a) 2 Hz (b) 4 Hz (c) 8 Hz (d) 0.5 Hz (e) 4 π Hz	
2	A simple spring has length l and force constant k. It is cut into two springs of length l_1 and l_2 such that l_1 = n l_2 (n = an integer). The force constant of the spring of length l_2 is (a) k(1 + n) (b) $\frac{(n+1)k}{n}$ (c) k (d) k / (n + 1)	
3	Two springs of force constants k and 2 k are connected to a mass as shown below. The frequency of oscillation of the mass is	



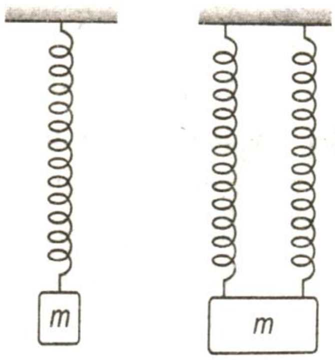
(a) $\frac{1}{2\pi}\sqrt{k/m}$ (b) $\frac{1}{2\pi}\sqrt{2k/m}$

(c) $\frac{1}{2\pi}\sqrt{\frac{3k}{m}}$ (d) $\frac{1}{2\pi}\sqrt{\frac{m}{k}}$

4 A weightless spring which has a force constant k oscillates with frequency n when a mass m is suspended from it. The spring is cut into two equal halves and a mass 2 m is suspended from one part of spring. The frequency of oscillation will now become

(a) n (b) 2n (c) $\frac{n}{\sqrt{2}}$ (d) $n(2)^{1/2}$

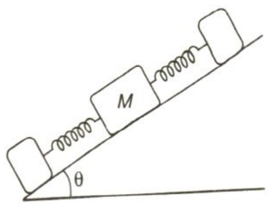
5 An object suspended from a spring exhibits oscillations of period T. Now, the spring is cut in two halves and the same object is suspended with two halves as shown in figure. The new time period of oscillation will become



(a) $\frac{T}{2\sqrt{2}}$ (b) $\frac{T}{2}$

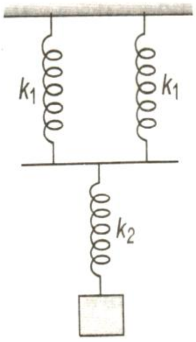
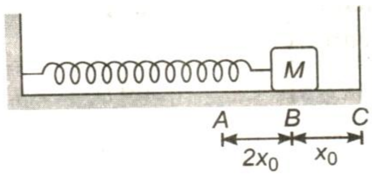
(c) $\frac{T}{\sqrt{2}}$ (d) 2T

6 On a smooth inclined plane, a body of mass M is attached between two springs. The other ends of the springs are fixed to firm support. If each spring has force constant k, the period of oscillation of the body (assuming the springs as massless) is



(a) $2\pi[M / 2K]^{1/2}$ (b) $2\pi[2M / K]^{1/2}$

	(c) $2\pi[Mg \sin \theta / 2k]^{1/2}$ (d) $2\pi[2Mg / k]^{1/2}$	
7	A mass M, attached to a spring, oscillates with a period of 2 s. If the mass is increased by 4 kg, the time period increases by 1 s. Assuming that Hooke's law is obeyed, the initial mass M was (a) 3.2 kg (b) 1 kg (c) 2 kg (d) 8 kg	
8	A mass M is suspended from a light spring. An additional mass m added displaces the spring further by a distance X. Now the combined mass will oscillate on the spring with period (a) $T = 2\pi \sqrt{\frac{mg}{X(M+m)}}$ (b) $T = 2\pi \sqrt{\frac{(M+m)X}{mg}}$ (c) $T = \pi / 2 \sqrt{\frac{mg}{X(M+m)}}$ (d) $T = 2\pi \sqrt{\frac{(M+m)}{mg}}$	
9	Time period of mass m suspended by a spring is T. If the spring is cut to one-half and made to oscillate by suspending double mass, the time period of the mass will be (a) 8T (b) 4T (c) $\frac{T}{2}$ (d) T	
10	Two blocks with masses m_1 = 1 kg and m_2 = 2 kg are connected by a spring of spring constant k = 24 Nm^{-1} and placed on a frictionless horizontal surface. The block m_1 is imparted an initial velocity υ_0 = 12 cms^{-1} to the right, the amplitude of oscillation is (a) 1 cm (b) 2 cm (c) 3 cm (d) 4 cm	
11	A mass 1 kg suspended from a spring whose force constant is 400 Nm^{-1}, executes simple harmonic oscillation. When the total energy of the oscillator is 2 J, the maximum acceleration experienced by the mass will be (a) 2 ms^{-2} (b) 4 ms^{-2} (c) 40 ms^{-2} (d) 400 ms^{-2}	
12	A uniform spring of force constant k is cut into two pieces, the lengths of which are in the ratio 1 : 2. The ratio of the force constants of the shorter and longer piece is (a) 1 : 2 (b) 2 : 1 (c) 1 : 3 (d) 2 : 3	
13	What will be the force constant of the spring system shown in figure?	

	 (a) $\frac{k_1}{2}+k_2$ (b) $\left[\frac{1}{2k_1}+\frac{1}{k_2}\right]^{-1}$ (c) $\frac{1}{2k_1}+\frac{1}{k_2}$ (d) $\left[\frac{2}{k_1}+\frac{1}{k_2}\right]^{-1}$	
14	One end of a spring of force constant k is fixed to a vertical wall and the other to a block of mass m resting on a smooth horizontal surface. There is another wall at a distance x_0 from the block. The spring is then compressed by $2x_0$ and then released. The time taken to strike the wall is  (a) $\frac{1}{6}\pi\sqrt{\frac{k}{m}}$ (b) $\sqrt{\frac{k}{m}}$ (c) $\frac{2\pi}{3}\sqrt{\frac{m}{k}}$ (d) $\frac{\pi}{4}\sqrt{\frac{k}{m}}$	

CONCEPT-44: BASED ON WAVE MOTION, SPEED OF SOUND

1	Velocity of sound wave in air is 330 m/s for a particular sound in air ; a path difference of 40 cm is equivalent to a phase difference of 1.6 π. The frequency of this wave is (a) 165 Hz (b) 150 Hz (c) 660 Hz (d) 330 Hz	
2	The equation of wave is represented by Y = 10^{-4} sin $\left[100t-\frac{x}{10}\right]$m, then the velocity of wave will be (a) 100 ms^{-1} (b) 4 ms^{-1} (c) 1000 ms^{-1} (d) Zero	
3	A steel rod 100 cm long is clamped at its middle. The fundamental frequency of longitudinal vibrations of the rod are given to be 2.53 kHz. What is the speed of sound in steel? (a) 5 km/s (b) 6 km/s (c) 7 km/s (d) 4 km/s	

4	From a point source, if amplitude of waves at a distance r is A, its amplitude at a distance 2r will be (a) A (b) 2 A (c) A/2 (d) A/4	
5	A simple harmonic progressive wave is represented by the equation $y = 8 \sin 2\pi(0.1x - 2t)$ Where x and y are in cm and t is in seconds. At any instant, the phase difference between two particles separated by 2.0 cm in the x-direction is (a) 18^0 (b) 54^0 (c) 36^0 (d) 72^0	
6	In a sinusoidal wave, the time required for a particular point to move from maximum displacement to zero displacement is 0.170 s. The frequency of the wave is (a) 1.47 Hz (b) 0.36 Hz (c) 0.73 Hz (d) 2.94 Hz	
7	υ_1 and υ_2 are the velocities of sound at the same temperature in two monoatomic gases of densities ρ_1 and ρ_2 respectively. If $\frac{\rho_1}{\rho_2} = \frac{1}{4}$, then the ratio of velocities υ_1 and υ_2 will be (a) 1 : 2 (b) 4 : 1 (c) 2 : 1 (d) 1 : 4	
8	A 1000 Hz sound wave in air strikes the surface of a lake and penetrates into water. If speed of sound in water is 1500 ms^{-1}, the frequency and wavelength of waves in water are (a) 1500 Hz, 1m (b) 1000 Hz, 1.5 m (c) 1000 Hz, 1m (d) 1500 Hz, 1.5 m	
9	Sound waves of wavelength λ travelling in a medium with a speed of υ m/s enter into another medium where its speed is 2 υ m/s. Wavelength of sound waves in the second medium is (a) λ (b) $\frac{\lambda}{2}$ (c) 2 λ (d) 4 λ	
10	The displacement x (in metre) of a particle performing simple harmonic motion is related to time t (in second) as $x = 0.05 \cos\left(4\pi t + \frac{\pi}{4}\right)$. The frequency of the motion will be (a) 0.5 Hz (b) 1.0 Hz (c) 1.5 Hz (d) 2.0 Hz	
11	The temperature at which the speed of sound in air becomes double of its value at 0^0C is (a) 273 K (b) 546 K (c) 1092 K (d) 0 K	
12	A wave length of frequency 500 Hz has a velocity 360 ms^{-1}.	

	The phase difference between two displacements at a certain point at time 10^{-3} s apart will be (a) π rad (b) π/2 rad (c) π/4 rad (d) 2 π rad	
13	The phase difference between two points separated by 0.8 m in a wave of frequency 120 Hz is 0.5 π. The wave velocity is (a) 144 ms^{-1} (b) 384 ms^{-1} (c) 256 ms^{-1} (d) 720 ms^{-1}	
14	Two sitar strings A and B playing the note 'Ga' are slightly out of tune and produce beats of frequency 6 Hz. The tension in the string A is slightly reduced and the beat frequency is found to reduce to 3 Hz. If the original frequency of A is 324 Hz, what is the frequency of B? (a) 218 Hz (b) 518 Hz (c) 418 Hz (d) 318 Hz	
15	A stone dropped from the top of a tower of height 300 m high splashes into the water of a pond near the base of the tower. When is the splash heard at the top given that the speed of sound in air is 340 m/s? (g = 9.8 m/s^2) (a) 8.7 s (b) 9.7 s (c) 6.7 s (d) 10 s	
16	Speed of sound in mercury at a certain temperature is 1450 m/s. Given the density of mercury as 13.6 x 10^3 kg/m^3, the bulk modulus for mercury is (a) 2.86 x 10^{10} N/m^3 (b) 3.86 x 10^{10} N/m^3 (c) 4.86 x 10^{10} N/m^3 (d) 5.86 x 10^{10} N/m^3	
17	If the temperature is raised by 1 K from 300 K, the percentage change in the speed of sound in the gaseous mixture is (R = 8.31 J/mol-K) (a) 0.167% (b) 0.334% (c) 1% (d) 2%	
18	The path difference between two waves $y_1 = a_1 \sin\left(\omega t - \frac{2\pi x}{\lambda}\right)$ and y2 = $a_2 \cos\left(\omega t - \frac{2\pi x}{\lambda} + \phi\right)$ is (a) $\frac{\lambda}{2\pi}(\phi)$ (b) $\frac{\lambda}{2\pi}\left(\phi + \frac{\pi}{2}\right)$ (c) $\frac{2\pi}{\lambda}\left(\phi - \frac{\pi}{2}\right)$ (d) $\frac{2\pi}{\lambda}(\phi)$	
19	The amplitude of a wave is given by A = $\frac{c}{(a+b-c)}$ Resonance will occur when	

	(a) b = $-\frac{c}{2}$ (b) b = $-\frac{a}{2}$ (c) b = 0, a = c (d) None of these	
20	Which of the following equations represents a wave? (a) y = A sin ωt (b) y = A cos kx (c) y = A sin (at – bx + c) (d) y = A(ωt - kx)	
21	Ultrasonic waves are produced by (a) Piezoelectric effect (b) Pettiro's effect (c) Doppler's effect (d) Coulomb's law	
22	A transverse wave is described by the equation y = $y_0$sin 2π $\left[ft - \frac{x}{\lambda}\right]$. The maximum particle velocity is equal to four times the wave velocity, if (a) λ = π y_0/ 4 (b) λ = 2 π y_0 (c) λ = π/ y_0 (d) λ = π y_0/ 2	
23	The wavelength of infrasonics in air is of the order of (a) 10^0 m (b) 10^1 m (c) 10^{-1} m (d) 10^{-2} m	
24	Which of the following statements are true for wave motion? (a) Mechanical transverse waves can propagate through all mediums. (b) Longitudinal waves can propagate through solids only. (c) Mechanical transverse waves can propagate through solids only. (d) Longitudinal waves can propagate through vacuum.	
25	The speed of sound in a mixture of 1 mole of helium and 2 moles of oxygen at 27^0C is (a) 800 ms^{-1} (b) 400.8 ms^{-1} (c) 600 ms^{-1} (d) 1200 ms^{-1}	
26	A wave is represented by the equation y = 0.5sin (10t + x)m It is a travelling wave propagating along +X direction with velocity (a) 40 ms^{-1} (b) 20 ms^{-1} (c) 5 ms^{-1} (d) None of these	
27	Under identical conditions of pressure and density, the speed of sound is highest in a (a) Monoatomic gas (b) Diatomic gas (c) Triatomic gas (d) Polyatomic gas	
28	A sound absorber attenuates the sound level by 20 dB. The intensity decreases by a factor of	

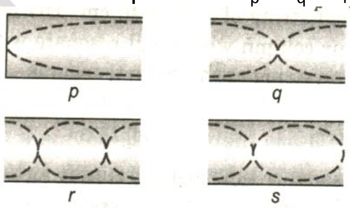
	(a) 100 (b) 1000 (c) 10000 (d) 10	
29	The velocity of sound in air is 330 ms^{-1} and the velocity of light in air is 3 x 10^8 ms^{-1}. What frequency, in Hz dies a BBC station which transmits at 1500 m broadcast? (a) 2 x 10^5 Hz (b) 595 x 10^3 Hz (c) 0.22 Hz (d) 5 x 10^{-6} Hz	
30	Walls of auditorium should be (a) Good absorber (b) Reflector (c) Amplifier (d) Modifier	
31	The velocity of sound in air is 330 ms^{-1}. The rms velocity of air molecules (λ = 1.4 is approximately equal to (a) 400 ms^{-1} (b) 471.4 ms^{-1} (c) 231 ms^{-1} (d) 462 ms^{-1}	
32	The ratio of intensities between two coherent sound sources is 4 : 1. The difference of loudness in decibels (dB) between maximum and minimum intensities, on their interference in space is (a) 20 log 2 (b) 10 log 2 (c) 20 log 3 (d) 10 log 3	
33	A sine wave has an amplitude A and a wavelength λ. Let υ be the wave velocity, and V be maximum velocity of a particle in the medium. (a) V cannot be equal to v (b) V = v, if A = λ / 2π (c) V = v, if A = 2π λ (d) V = v, if λ = A / π	
34	Two identical sounds A and B reach a point in the same phase. The resultant sound is C. The loudness of C is ndB higher than the loudness of A. (a) 2 (b) 3 (c) 4 (d) 6	
35	The velocity of sound hydrogen is 1224 ms^{-1}. Its velocity in mixture of hydrogen and oxygen containing 4 parts by volume of hydrogen and 1 part oxygen is (a) 1224 ms^{-1} (b) 612 ms^{-1} (c) 2448 ms^{-1} (d) 306 ms^{-1}	

CONCEPT-45: BASED ON STATIONARY WAVES IN STRINGS AND IN ORGAN PIPES

1	A wave represented by the given equation y = αcos(kx - ωt) is superposed with another wave to form a stationary wave such that the point x = 0 is a node. The equation for the other wave is (a) y = a sin (kx + ωt) (b) y = -a cos (kx + ωt) (c) y = -a cos (kx - ωt) (d) y = -a sin (kx - ωt)	

2	A string of mass 2.5 kg is under a tension of 200 N. The length of the stretched string is 20.0 m. If the transverse jerk is struck at one end of the string, the disturbance will reach the other end in (a) 1 s (b) 0.5 s (c) 2 s (d) Data is insufficient	
3	A wavelength 2 m is reflected from a surface if a node is formed at 3 m from the surface, then at what distance from the surface another node will be formed? (a) 3 m (b) 2 m (c) 3 m (d) 4 m	
4	Two wires made up of same material are of equal lengths but their radii are in the ratio 1 : 2. On stretching each of these two strings by the same tension, the ratio between the fundamental frequencies is (a) 1 : 2 (b) 2 : 1 (c) 1 : 4 (d) 4 : 1	
5	n waves are produced on a string in one second. When the radius of the string is doubled and the tension is maintained the same, the number of waves produced in one second for the same harmonic will be (a) $\frac{n}{2}$ (b) $\frac{n}{3}$ (c) 2n (d) $\frac{n}{\sqrt{2}}$	
6	a sound wave is passing through air column in the form of compression and rarefaction. In consecutive compressions and rarefactions, (a) Density remains constant (b) Boyle's law is obeyed (c) Bulk modulus of air oscillates (d) There is no transfer of heat	
7	A string in a musical instrument is 50 cm long and its fundamental frequency is 800 Hz. If a frequency of 1000 Hz is to be produced, then required length of string is (a) 62.5 cm (b) 50 cm (c) 40 cm (d) 37.5 cm	
8	The tension in a wire is decreased by 19%. The percentage decrease in frequency will be (a) 19% (b) 10% (c) 0.19% (d) None of these	
9	An echo repeats two syllables. If the velocity of sound is 330 ms^{-1}, then the distance of the reflecting surface is (a) 66.0 m (b) 33.0 m (c) 99.0 m (d) 16.5 m	
10	A tuning fork of frequency 512 Hz is used to produce vibrations in a sonometer wire of natural frequency 256 Hz. The wire will vibrate in (a) One segment (b) Two segments	

	(c) Four segments (d) Three segments	
11	The following equations represent progressive transverse waves Z_1 = A cos (ωt - kX), Z_2 = A cos (ωt + kX) Z_3 = A cos (ωt - kY), Z_4 = A cos (2 ωt - 2kY) A stationary wave will be formed by superposing (a) Z_1 and Z_2 (b) Z_1 and Z_4 (c) Z_2 and Z_3 (d) Z_3 and Z_4	
12	The equation of a stationary wave along a stretched string is given by y=4sin $\frac{2\pi x}{2}$ cos 40πt Where x and y are in cms and t is in sec. The separation between two adjacent nodes is (a) 3 cm (b) 1.5 cm (c) 6 cm (d) 4 cm	
13	The length of a sonometer wire AB is 110 cm. Where should the two bridges be placed from A to divide the wire in three segments whose fundamental frequencies are in the ratio of 1 : 2 : 3. (a) 30 cm, 90 cm (b) 60 cm, 90 cm (c) 40 cm, 70 cm (d) None of these	
14	If n_1, n_2 and n_3 are the fundamental frequencies of three segments into which a string is divided, then the original fundamental frequency n of the string is given by (a) $\frac{1}{n}=\frac{1}{n_1}+\frac{1}{n_2}+\frac{1}{n_3}$ (b) $\frac{1}{\sqrt{n}}=\frac{1}{\sqrt{n_1}}+\frac{1}{\sqrt{n_2}}+\frac{1}{\sqrt{n_3}}$ (c) $\sqrt{n}$ = $\sqrt{n_1}$ + $\sqrt{n_2}$ + $\sqrt{n_3}$ (d) n = n_1 + n_2 + n_3	
15	An organ pipe open at one end is vibrating in first overtone and is in resonance with another pipe open at both ends and vibrating in third harmonic. The ratio of length of two pipes is (a) 3 : 8 (b) 8 : 3 (c) 1 : 2 (d) 4 : 1	
16	In Melde's experiment, three loops are formed by putting a weight of 8 g in a massless pan. The weight required to form two loops is (a) 18 g (b) 8 g (c) 36 g (d) 24 g	
17	A stretched string of length l fixed at both ends can sustain stationary waves of wavelength λ given by (a) λ = 2/n (b) λ = 2l / n (c) λ = l^2 / 2n (d) λ = n^2 / 2l	

18	In Melde's experiment, the string vibrates in 4 loops when a 50 kg-wt weight is placed in the pan of weight 15 kg-wt. To made the string vibrate in 6 loops, the weight that has to be removed from the pan is approximately (a) 7 kg-wt (b) 36 kg-wt (c) 21 kg-wt (d) 29 kg-wt	
19	Equation of a plane progressive wave is given by y = 0.6sin $2\pi\left(t-\frac{x}{2}\right)$. On reflection from a denser medium its amplitude becomes 2/3 of the amplitude of the incident wave. The equation of the reflected wave is (a) y = 0.6 sin $2\pi\left(t+\frac{x}{2}\right)$ (b) y = - 0.4 sin $2\pi\left(t+\frac{x}{2}\right)$ (c) y = 0.4 sin $2\pi\left(t+\frac{x}{2}\right)$ (d) y = - 0.4 sin $2\pi\left(t-\frac{x}{2}\right)$	
20	A wave of frequency 100 Hz is sent along a string towards a fixed end. When this wave travels back, after reflection, a node is formed at a distance of 10 cm from the fixed end of the string. The speeds of incident (and reflected) waves are (a) 5 ms^{-1} (b) 10 ms^{-1} (c) 20 ms^{-1} (d) 40 ms^{-1}	
21	An open pipe is suddenly closed at one end with the result that the frequency of third harmonic of the closed pipe is found to be higher at 100 Hz. The fundamental frequency of the open pipe is (a) 200 Hz (b) 480 Hz (c) 240 Hz (d) 300 Hz	
22	The vibrating of four air columns are represented in the figure. The ratio of frequencies $n_p : n_q : n_r : n_s$ is  (a) 12 : 6 : 3 : 5 (b) 1 : 2 : 4 : 3 (c) 4 : 2 : 3 : 1 (d) 6 : 2 : 3 : 4	
23	In a resonance column first and second resonance are obtained at depths 22.7 cm and 70.2 cm. The third resonance will be obtained at a depth of	

	(a) 117.7 cm (b) 92.9 cm (c) 115.5 cm (d) 113.5 cm	
24	A cylindrical tube open at both ends, has a fundamental frequency f_0 in air. The tube is dipped vertically into water such that half of its length inside water. The fundamental frequency of the air column now is (a) $3f_0/4$ (b) f_0 (c) $f_0/2$ (d) $2f_0$	
25	A metre-long tube open at one end, with a movable piston at the other end, shows resonance with a fixed frequency source (a tuning fork of frequency 340 Hz) when the tube length is 25.5 cm or 79.3 cm. Estimate the speed of sound in air at the temperature of the experiment. The edge effect may be neglected. (a) 336 m/s (b) 331 m/s (c) 356 m/s (d) 366 m/s	
26	If $\lambda_1, \lambda_2, \lambda_3$ are the wavelengths of the waves giving resonance with the fundamental, first and second overtones respectively of a closed organ pipe, then the ratio of $\lambda_1, \lambda_2, \lambda_3$ is (a) 1 : 3 : 5 (b) 1 : 2 : 3 (c) 5 : 3 : 1 (d) $1 : \frac{1}{3} : \frac{1}{5}$	
27	In a resonance tube, the first resonance with a tuning fork occurs at 16 cm and second at 49 cm. If the velocity of sound is 330 m/s, the frequency of tuning fork is (a) 500 (b) 300 (c) 330 (d) 165	
28	An open organ pipe has fundamental frequency 100 Hz. What frequency will be produced it its one end is closed? (a) 100, 200, 300.... (b) 50, 150, 250.... (c) 50, 100, 200, 300... (d) 50, 100, 150, 200...	
29	An open pipe is suddenly closed at one end with the result that the frequency of third harmonic of the closed pipe is found to be higher by 100 Hz. Then the fundamental frequency of open pipe is (a) 480 Hz (b) 300 Hz (c) 240 Hz (d) 200 Hz	
30	A column of air of length 50 cm resonates with a stretched string of length 40 cm. The length of the same air column which will resonate with 60 cm of the same string at the same tension is (a) 100 cm (b) 75 cm (c) 50 cm (d) 25 cm	
31	In a resonance tube, using a tuning fork of frequency 325 Hz, two successive resonance length are observed as 25.4 cm and 77.4 cm respectively. The velocity of sound in air is (a) 338 ms^{-1} (b) 328 ms^{-1}	

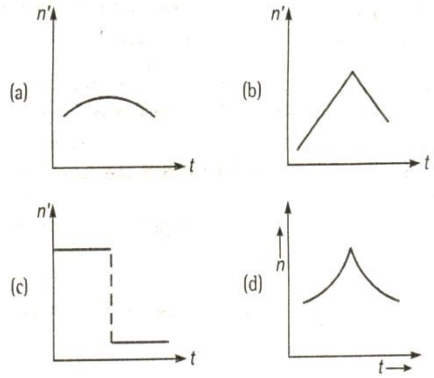
	(c) 330 ms^{-1} (d) 320 ms^{-1}	
32	An organ pipe P_1 closed at one end vibrating in its first harmonic and another pipe P_2 open at both ends vibrating in its third harmonic are in resonance with a given tuning fork. The ratio of the length of P_1 to that of P_2 is (a) 1/3 (b) 1/6 (c) 3/8 (d) 8/3	
33	The tones that are separated by three octaves have a frequency ratio of (a) 3 (b) 4 (c) 8 (d) 16	
34	Air is blown at the mouth of a tube of length 25 cm and diameter equal to 2 cm open at both ends. If velocity of sound in air is 330 ms^{-1}, the sound emitted will have all the frequencies in the group (a) 330, 990, 1690 Hz (b) 302, 664, 1320 Hz (c) 660, 1320, 1980 Hz (d) 660, 100, 3300 Hz	
35	A pipe closed at one end and open at the other end, resonates with sound waves of frequency 135 Hz and also 165 Hz, but not with any wave of frequency intermediate between these two. Then the frequency of the fundamental note is (a) 30 Hz (b) 15 Hz (c) 60 Hz (d) 7.5 Hz	

CONCEPT-46: BASED ON BEATS & DOPPLER'S EFFECT

1	In two similar wires of tensions 16 N and T, 3 beats are heard, then T = (a) 49 N (b) 25 N (c) 64 N (d) None of these	
2	When 2 tuning forks (fork 1 and fork 2) are sounded simultaneously, 4 beats s^{-1} are heard. Now, some tape is attached on the prong of fork 2. When the tuning the forks are sounded again, 6 beats s^{-1} are heard if the frequency of fork 1 is 200 Hz, then what was the original frequency of fork 2? (a) 196 Hz (b) 200 Hz (c) 202 Hz (d) 204 Hz	
3	A wire stretched between two rigid supports vibrates in its fundamental mode with a frequency of 45 Hz. The mass of the wire is 3.5 x 10^{-2} kg and its linear mass density is 4.0 x 10^{-2} kg/m. What is (i) the speed of a transverse wave on the string and (ii) the tension in the string? (a) (i) 80 m/s (ii) 250 N (b) (i) 88 m/s (ii) 208 N (c) (i) 90 m/s (ii) 249 N (d) (i) 78.75 m/s (ii) 248 N	

4	Ten tuning forks are arranged in increasing order of frequency in such a way that any two nearest tuning forks produce 4 beats s^{-1}. The highest frequency is twice that of the lowest. Possible highest and lowest frequencies are (a) 80 and 40 (b) 100 and 50 (c) 44 and 32 (d) 72 and 36	
5	A source of frequency n gives 5 beats s^{-1}, when sounded with a source of frequency 200 s^{-1}. The second harmonic (2n) gives 10 beats s^{-1}, when sounded with a source of frequency 420 s^{-1}. n is equal to (a) 200 s^{-1} (b) 205 s^{-1} (c) 195 s^{-1} (d) 210 s^{-1}	
6	Two forks A and B when sounded together produce four beats s^{-1}. The fork A is in unison with 30 cm length of a sonometer wire and B is in unison with 25 cm length of the same wire at the same tension. The frequencies of the forks are (a) 24 Hz, 28 Hz (b) 20 Hz, 24 Hz (c) 16 Hz, 20 Hz (d) 26 Hz, 30 Hz	
7	Beats are produced by two travelling waves each of loudness I and nearly equal frequencies n_1 and n_2. The beat frequency will be...and maximum loudness hard will be (a) $(n_1 - n_2)$, 2 I (b) $(n_1 - n_2)$, 4 I (c) $(n_1 - n_2)$, 3 I (d) $(n_1 - n_2)$, I	
8	A tuning fork of frequency 200 Hz is in unison with a sonometer wire. The number of beats heard per second when the tension is increased by 1% is (a) 1 (b) 2 (c) 4 (d) 1/2	
9	Two organ pipes both closed at on end have length l ad ($l+\Delta l$). Neglect end correction. If velocity of sound in air is υ, the number of beats s^{-1} is (a) V / 4 l (b) V / 2 l (c) $\frac{V}{4l^2}(\Delta l)$ (d) $\frac{V}{2l^2}(\Delta l)$	
10	A fork of unknown frequency gives four beats s^{-1} when sounded with another of frequency 256. The fork is now loaded with a piece of wax and again four beats s^{-1} are heard. Then the frequency of the unknown fork is (a) 256 Hz (b) 252 Hz (c) 264 Hz (d) 260 Hz	
11	When two waves of almost equal frequencies n_1 and n_2 are produced simultaneously, then the time interval between successive maxima is (a) $\frac{1}{n_1 - n_2}$ (b) $\frac{1}{n_1} - \frac{1}{n_2}$	

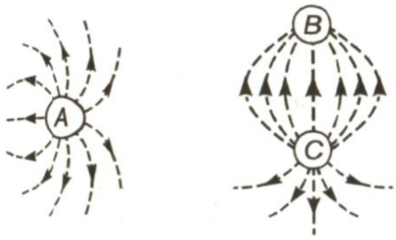
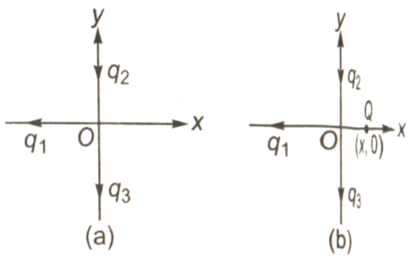
	(c) $\frac{1}{n_1}+\frac{1}{n_2}$ (d) $\frac{1}{n_1+n_2}$	
12	A tuning fork of frequency 480 Hz produces 10 beats^{-1} when sounded with a vibrating sonometer string. What must have been the frequency of string is slight increase in tension produces fewer beats s^{-1} than before? (a) 490 Hz (b) 470 Hz (c) 460 Hz (d) 480 Hz	
13	Two organ pipes, each closed at one end, give 5 beats s^{-1} when emitting their fundamental notes. If their lengths are in the ratio 50 : 51, their fundamental frequencies are (a) 250, 225 (b) 255, 260 (c) 260, 265 (d) 265, 270	
14	A source of sound gives 5 beats s^{-1} when sounded with another source of frequency 100 Hz. The second harmonic of the source together with a source of frequency 205 Hz gives 5 beats s^{-1}. What is the frequency of the source? (a) 105 Hz (b) 205 Hz (c) 95 Hz (d) 100 Hz	
15	Two uniform wires are vibrating simultaneously in their fundamental notes. The tension, lengths diameters and the densities of the two wires are in the ratio 8 : 1, 36 : 35, 4 : 1 and 1 : 2 respectively. If the note of the higher pitch gas a frequency 360 Hz, the number of beats produced per second is (a) 5 (b) 15 (c) 10 (d) 20	
16	Two sound sources emitting sound each of wavelength λ are fixed at a given distance apart. A listener moves with a velocity u along the line joining the two sources. The number of beats heard by him per second is (a) $2u/\lambda$ (b) u/λ (c) $\frac{u}{3\lambda}$ (d) $\frac{2\lambda}{u}$	
17	A bus is moving with a velocity of 5 ms^{-1} towards a huge wall. The driver sounds a horn of frequency 165 Hz. If the speed of sound in air is 335 ms^{-1}, the number of beats heard per second by the passengers in the bus will be (a) 3 (b) 4 (c) 5 (d) 6	
18	A train whistling at constant frequency is moving towards a station at a constant speed υ. The train goes past a stationary observer on the station. The frequency n' of the sound as heard by the observer is plotted as a function of time t (figure). Identify the expected curve.	

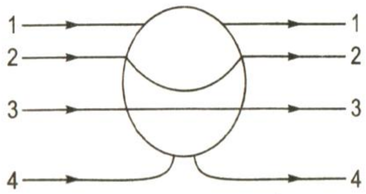
		
19	A rocket is receding away from earth with velocity = 0.2 c. The rocket emits signal of frequency 4 x 10^7 Hz. The apparent frequency of the signal produced by the rocket observed by the observer on earth will be (a) 3 x 10^6 Hz (b) 4 x 10^6 Hz (c) 2.4 x 10^7 Hz (d) 5 x 10^7 Hz	
20	A source of sound of frequency 256 Hz is moving towards a wall with a velocity of 5 ms^{-1}. Velocity of sound is 330 ms^{-1}. The number of beats s^{-1} heard by an observer standing between the source and the wall is nearly (a) $\frac{256x330}{325} - \frac{256x330}{325}$ (b) $256 - \frac{256x330}{325}$ (c) $\frac{256x330}{325} - \frac{256x330}{325}$ (d) $\frac{256x330}{325} - 256$	
21	A bat flies at a steady speed of 4 m/s emitting a sound of f = 90 x 10^3 Hz. It is flying horizontally towards a vertical wall. The frequency of the reflected sound as detected by the bat will be (Take velocity of sound in air as 330 m/s) (a) 88.1 x 10^3 Hz (b) 87.1 x 10^3 Hz (c) 92.1 x 10^3 Hz (d) 89.1 x 10^3 Hz	
22	A source of sound emitting a tone of frequency 200 Hz moves towards an observer with a velocity υ equal to the velocity of sound. If the observer also moves away from the source with the same velocity υ, the apparent frequency heard by the observer is (a) 50 Hz (b) 100 Hz (c) 150 Hz (d) 200 Hz	
23	A source and an observer move away from each other with a velocity of 10 m/s with respect to ground. If the observer finds the frequency of sound coming from the source as 1950 Hz, then actual frequency of the source is (velocity of sound in air = 340 m/s) (a) 1950 Hz (b) 2068 Hz (c) 2132 Hz (d) 2486 Hz	
24	A sound wave of frequency n travels horizontally to the	

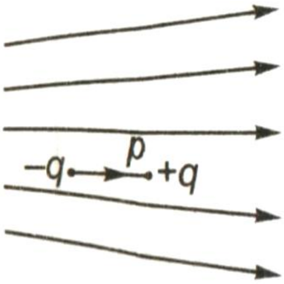
	right. It is reflected from a large vertical plane surface moving to the left with speed υ. The speed of the sound in the medium is c. Then, (a) The frequency of the reflected wave is $\left[\frac{c+v}{c-v}\right]$ (b) The wavelength of the reflected wave is $\left[\frac{c}{n}\right]\left[\frac{c+v}{c-v}\right]$ (c) The number of waves striking the surface per second is $\left[\frac{c+v}{c}\right]$ (d) The number of beats heard by a stationary listener to the left to the reflecting surface is $\frac{nv}{c-v}$	
25	A whistle giving out 450 Hz approaches a stationary observer at a speed of 33 ms^{-1}. The frequency heard by the observer in Hz is [velocity of sound in air = 333 ms^{-1}] (a) 409 (b) 429 (c) 517 (d) 500	
26	A train moves towards a stationary observer with speed 34 ms^{-1}. The train sounds a whistle and its frequency registered by the observer is f_1. If the train's speed is reduced to 17 ms^{-1}, the frequency registered is f_2. If the speed of sound is 340 ms^{-1}, then the ratio f_1/f_2 is (a) 18/19 (b) 1/2 (c) 2 (d) 19/18	
27	A racing car moving towards a cliff sounds its horn. The driver observes that the sound reflected from the cliff has a pitch one octave higher than the actual sound of the horn. If υ = the velocity of sound, the velocity of the car is (a) $v/\sqrt{2}$ (b) v/2 (c) v/3 (d) v/4	
28	A source of sound S is moving with a velocity of 50 ms^{-1} towards a stationary observer. The observer measures the frequency of the source as 1000 Hz. What will be the apparent frequency of the source when it is moving away from the observer after crossing him? The velocity of the sound in medium is 350 ms^{-1}. (a) 750 Hz (b) 857 Hz (c) 1143 Hz (d) 1333 Hz	
29	A source of sound of frequency 500 Hz is moving towards an observer with velocity 30 ms^{-1}. The speed of sound is 300 ms^{-1}. The frequency heard by the observer will be (a) 545 Hz (b) 580 Hz (c) 558.3 Hz (d) 550 Hz	

CONCEPT-47: ELECTRIC CHARGE, ELECTRIC FIELD AND DIPOLE

1	Figure shows the electric field lines around three point	

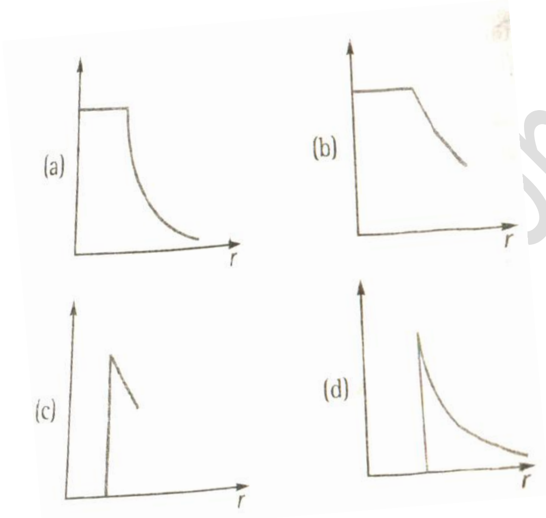
	charges A,B and C. Which charge has the largest magnitude?  (a) Charge A (b) Charge B (c) Charge A and B (d) Charge C	
2	If charge q is placed at the centre of the line joining two equal charges Q, the system of these charges will be in equilibrium if q is (a) $-4Q$ (b) $-\frac{Q}{4}$ (b) $-\frac{Q}{2}$ (d) $+\frac{Q}{2}$	
3	Two point charges repel each other with a force of 100N. One of the charges is increased by 10% and other is reduced by 10%. The new force of repulsion at the same distance would be (a)100N (b)121N (c)99N (d)None of these	
4	A point charge q produces an electric field of magnitude $2NC^{-1}$ at a point distance 0.25m from it. What is the value of charge? (a)1.39×10^{-11}C (b) 1.39×10^{11}C (c) 13.9×10^{-11}C (d) 13.9×10^{11}C	
5	In figure two positive charge q_2 and q_3 fixed along the y-axis, exert a net electric force in the +x direction on a charge q_1 fixed along the x-axis. If a positive charge Q is added at (x,0), the force on q+1  (a) shall increase along the positive x-axis (b) shall decrease along the positive x-axis (c) shall point along the negative x-axis (d) shall increase but the direction changes because of the intersection of Q with q_2 and q_3	
6	A hollow metallic sphere of radius 10cm is given a charge of 3.2×10^{-9} C . The electric intensity at a point 4 cm from the	

	centre is (a)9×10^{-9} NC^{-1} (b)288 NC^{-1} (c)2.88 NC^{-1} (d)zero	
7	Charges+2Q and –Q are placed as shown in the figure. The point at which electric intensity is zero will be  (a) somewhere between –Q and +2Q (b) somewhere on the left of –Q (c) somewhere on the right of +2Q (d) somewhere on the right bisector of line joining –Q and +2Q	
8	A charged particle of mass m and charge q is released from rest in an electric field of constant magnitude E. The kinetic energy of the particle after time t is (a) $\frac{E^2q^2t^2}{2m}$ (b) $\frac{2E^2t^2}{qm}$ (c) $\frac{Eqm}{2t}$ (d) $\frac{Eq^2m}{2t^2}$	
9	A metallic solid sphere is placed in a uniform electric field. The lines of force follow the paths shown in figure  (a)1 (b)3 (c)3 (d)4	
10	There are two charged identical metal spheres A and B repel each other with a force 3×10^{-5} N. Another identical uncharged sphere C is touched with A and then placed at the mid- point between A and B. Net force on C is (a)1×10^{-5} N (b) 2×10^{-5} N (c) 1.5×10^{-5} N (d) 3×10^{-5} N	
11	Two small conducting sphere of equal radius have charges + 10μC and -20μC respectively and placed at a distance T from each other experience force F_1. If they are brought in contact and separated to the same distance, they experience force F_2. The ratio of F_1 to F_2 is (a)1 : 2 (b)-8 : 1 (c)1 : 8 (d)-2 : 1	
12	The electric strength of air is $2 \times 10^7 NC^{-1}$. The maximum charge that a metallic sphere of diameter 6 mm can hold is	

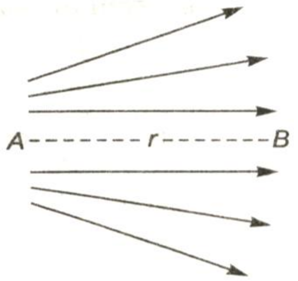
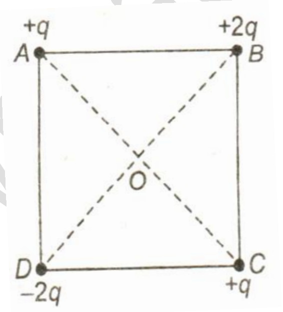
	(a) 3 nC (b) 20 nC (c) 1.5 nC (d) 2 nC	
13	Figure shows electric field lines in which an electric dipole P is placed as shown. Which of the following statement is correct?  (a) The dipole will not experience any force (b) The dipole will experience a force towards left (c) The dipole will experience a force towards right (d) The dipole will experience a force upwards	
14	A point charge +q is placed at a distance d from an isolated conducting plane. The field at a point P on the other side of the plane is (a) directed perpendicular to the plane and away from the plane (b) directed perpendicular to the plane but towards the plane (c) directed radially away from the point charge (d) directed radially towards the point charge	
15	in infinite parallel plane sheet of a metal is charged to charge density σ coulomb per square metre in a medium of dielectric constant K. Intensity of electric field near the metallic surface will be (a) $\frac{\sigma}{\varepsilon_0 \kappa}$ (b) $E = \frac{\kappa}{3\varepsilon_0}$ (c) $E = \frac{\sigma}{2\varepsilon_0 \kappa}$ (d) $E = \frac{\kappa}{2\varepsilon_0}$	
16	A semi-circular arc of radius a is charged uniformly and the charge per unit length is λ. The electric field at its centre is (a) $\frac{\lambda}{2\pi\varepsilon_0 a^2}$ (b) $\frac{\lambda}{4\varepsilon_0 a}$ (c) $\frac{\lambda^2}{4\pi\varepsilon_0 a}$ (d) $\frac{\lambda^2}{2\pi\varepsilon_0 a}$	
17	Three charges each of +1μC are placed at the corners of equilateral triangle. If the force between any two charges be F, then the net force on either charge will be (a) $\sqrt{2F}$ (b) $F\sqrt{2}$	

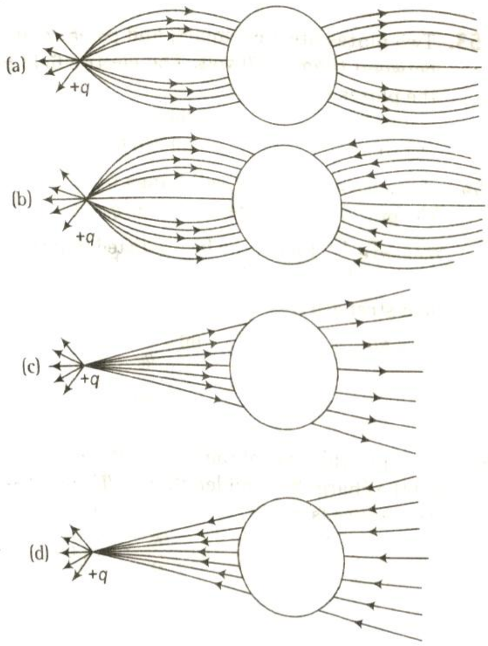
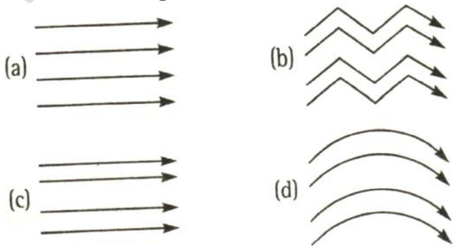
	(c) $2F$ (d) $2F$	
18	A point Q lies on the perpendicular bisector of an electrical dipole moment p. if the distance of Q from the dipole is r (much larger than the size of the dipole), then the electric field intensity E at Q is proportional to (a) r^{-2} (b) r^{-4} (c) r^{-1} (d) r^{-3}	
19	Charge q_1 =+6.0 nC is on Y-axis at y = -3 cm. calculate force on a test charge q_0 = 2 nC placed on X-axis at x = 4 cm. (a)-51.8 $\hat{j}$ μN (b)+51.8 $\hat{j}$ μN (c)- 5.18 $\hat{j}$ μN (d) 5.18 $\hat{j}$ μN	
20	An electric dipole consists of two opposite charges, each of magnitude 1.0μC separated by a distance of 2.0 cm. The dipole is placed in an external electric field of 10^5 NC^{-1}. The maximum torque on the dipole is (a)0.2 x 10^{-3} N-m (b) 1 x 10^{-3} N-m (c) 2 x 10^{-3} N-m (d) 4 x 10^{-3} N-m	
21	The electrostatic force of repulsion between two positively charged ions carrying equal charge is 3.7 x 10^{-9}N, when they are separated by a distance of 5 A. what are the number of electrons are missing from each ion? (a)2 (b)4 (c)0 (d)10	
22	The electric field in the space between the plates of a discharge tube is 3.25 x 10^{-4} NC^{-1}. If mass of proton is 1.67 x 10^{-27} kg and its charge is 1.6 x 10^{-19} C, the force often the proton in the field is (a)10.4 x 10^{-15}N (b) 2.0 x 10^{-23}N (c) 5.40 x 10^{-15}N (d) 5.20 x 10^{-15}N	
23	The electric field that can balance a deuteron of mass 3.2x10^{-27} kg is (a) 19.6x 10^{-10} NC^{-1} (b) 19.6x 10^{-8} NC^{-1} (c) 19.6x 10^{10} NC^{-1} (d) 19.6x 10^{8} NC^{-1}	
24	The dimensional formula of absolute permittivity of air or free space (ε_0) is (a) $\left[M^{-1}L^{-3}T^{4}A^{2}\right]$ (b) $\left[M^{0}L^{-3}T^{3}A^{3}\right]$ (c) $\left[M^{-1}L^{-3}T^{-3}A\right]$ (d) $\left[M^{1}L^{-3}TA^{2}\right]$	
25	Two point charges +3μC and +8μC repel each other with a force of 40N. If a charge of -5μC is added to each of them, then the force between them will become (a)-10 N (b)+10 N	

	(c)+20 N (d)-20 N	
26	A polythene piece, rubbed with wool, is found to have negative charge of $4x10^{17}$ C. the number of electrons transferred from wool to polythene is (a)$1.5x10^{12}$ (b) $2.5x10^{12}$ (c) $2.5x10^{13}$ (d) $3.5x10^{13}$	
27	An electron of mass M_e, initially at rest, moves through a certain distance in a uniform electric field in time t_1. A proton of mass M_p also initially at rest, takes time t_2 to move through an equal distance in this uniform electric field. Neglecting the effect of gravity, the ratio t_2/t_1 is nearly equal to (a)1 (b) $\sqrt{M_p / M_e}$ (c) $\sqrt{M_e / M_p}$ (d)1836	
28	A charged spherical conductor of radius R carries a charge q_0. A point test charge q_0 is placed at a distance x from the surface of the conductor. The force experienced by the test charge will be proportional to (a)$(R + x)^2$ (b) $(R - x)^2$ (c) $\frac{1}{(R-x)^2}$ (d) $\frac{1}{(R+x)^2}$	
29	An insulated sphere of radius R has charge density ρ. The electric field at a distance r from the centre of the sphere (r < R) (a) $\frac{\rho r}{3\varepsilon_0}$ (b) $\frac{\rho R}{3\varepsilon_0}$ (c) $\frac{\rho r}{\varepsilon_0}$ (d) $\frac{\rho R}{\varepsilon_0}$	
30	A spherical charged conductor has σ as the surface density of charge. The electric field on its surface is E. If the radius of the sphere is doubled, keeping the surface density of the charge unchanged, what will be the electric field on the surface of the new sphere? (a) $\frac{E}{4}$ (b) $\frac{E}{2}$ (c)E (d)2E	
31	A hemisphere is uniformly charged positively. The electric field at a point on a diameter away from the centre is directed (a) Perpendicular to the diameter (b) Parallel to the diameter (c) At an angle tilted towards the diameter (d) At an angle titled away from the diameter	

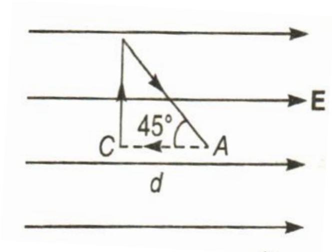
32	A given charge situated at a certain distance from an electric dipole in the end on position, experiences a force F. If the distance of charge is doubled, the force acting from the charge will be (a)2F (b)F/2 (c)F/4 (d)F/8	
33	Two point charges of 1μC and -1μC are separated by a distance of 100 $\overset{0}{A}$. A point P is at a distance of 10 cm from the mid-point and on the perpendicular bisector of the line joining the two charges. The electric field at P will be (a) 9 NC^{-1} (b) 0.9 Vm^{-1} (c)90 Vm^{-1} (d) 0.09NC^{-1}	
34	The distance between two point charges as increased by 10%. The force of interaction between them (a) increased by 10% (b) decreased by 10% (c) decreased by 17% (d) decreased by 21%	
35	Which one of the following graphs, shows the variation of electric field strength E with distance d from the centre of the hollow conducting sphere? 	
36	Two point charges exert on each other a force F when they are placed r distance apart in air. If they are placed R distance apart in a medium of dielectric constant K, they exert the same force. The distance R equals (a) $\frac{r}{k}$ (b) rk (c) $r\sqrt{k}$ (d) $\frac{r}{\sqrt{k}}$	
37	Two point charges of +2 μC and +6μC repel each other with a force of 12 N. If each of is given an additional charge of -4 μC. What will be the new force? (a)-6 N (b) 0 (c)-2 N (d) -4N	

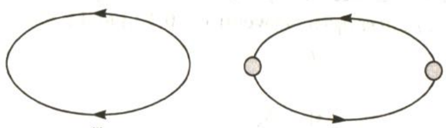
38	A neutral water molecule (H_2O) in its vapour state has an electric dipole moment of $6x10^{-30}$ Cm. if the molecule is placed in an electric field of $1.5x10^{4}$ NC^{-1}, the maximum torque that the field can exert on it is nearly (a)4.5×10^{-26}N-m (b) 4×10^{-34}N-m (c) 9×10^{-26}N-m (d) 6×10^{-26}N-m	
39	If E_α be the electric field strength of a short dipole at a point on its axial line and E_e that on equatorial line at the same distance, then (a)$E_e = 2E_a$ (b) $E_a = 2E_e$ (c) $E_a = E_e$ (d) none of these	
40	Two conducting sphere of radii, r_1 and r_2 are charged to the same surface charge density. The ratio of electric field near their surface is (a) r_1^2 / r_2^2 (b) r_2^2 / r_1^2 (c) r_1 / r_2 (d)1 :1	
41	If two charges are placed at a distance of 5 cm. If a bras sheet is placed between them. The force between two charges will be (a)decrease to 0 (b)increase to ∞ (c)increase to 0 (d)decrease to ∞	
42	Three concentric spherical shells have radii a, b and c (a < b < c) and have surface charge densities $\sigma, -\rho$ and ρ , respectively. If V_A, V_B and V_C denote the potentials of the three shell, then for c = a+b, we have (a) $V_C \neq V_B \neq V_A$ (b) $V_C = V_A \neq V_B$ (c) $V_C = V_B = V_A$ (d) $V_C \neq V_A = V_B$	
43	A long charged cylinder of liner charged density λ is surrounded by a hollow co-axial conducting cylinder. What is the electric field in the space between the two cylinders? (a) $\frac{\lambda}{2\pi\varepsilon_0 r}$ (b) $\frac{\lambda r}{\sqrt{2}\pi\varepsilon_0}$ (c) $\frac{\lambda}{\sqrt{2}\pi\varepsilon_0 r}$ (d) None of these	
44	Figure shows the electric lines of force energy from a charged body. If the electric field at A and B are E_A and E_B, respectively and if the Displacement between A and B	

	 (a) $E_A < E_B$ (b) $E_A > E_B$ (c) $E_A = E_B$ (d) $E_A = 2E_B$	
45	Two charges 5×10^{-8} C and -3×10^{-8} C are located 16 cm apart. At what point(s) on the line joining the two charges is the electric potential zero? Take the potential at infinity to be zero. (a) 6 cm from the charge -3×10^{-8} C (b) 6 cm from the charge 5×10^{-8} C (c) 9 cm from the charge -3×10^{-8} C (d) 9 cm from the charge 5×10^{-8} C	
46	Two identical spheres carrying charges -9μC and 5μC , respectively are kept in contract and then separated from each other. Point out true statement from the following in each sphere. (a)1.25×10^{13} electrons are in excess (b) 1.25×10^{13} electrons are in deficit (c) 4.15×10^{12} electrons are in excess (d)None of the above	
47	Four charges are arranged at the corners of a square ABCD as shown in the figure. The force on the charge kept at the centre O is  (a)zero (b)along the diagonal AC (c)along the diagonal BD (d)along perpendicular to the side AB	
48	A point positive charge brought near an isolated conducting sphere (figure. The electric field is best given by	

		
49	A charge 5μC is placed a point. What is the work required to carry IC of charge once round it in circle of 12 cm radius? (a)100 (b)0 (c)1 (d) ∞	
50	Two metallic spheres A and B of same radii one solid and other hollow are charged to the same potential. Which of the two will hold more charge? (a)sphere A (b)sphere B (c)Both spheres (d)none of these	
51	The tangential component of electrostatic field is continuous from one side of a charged surface to another is (a) $\frac{1}{4\pi\varepsilon_0}\left(\frac{1}{r_A}+\frac{1}{r_B}-\frac{1}{r_C}\right)$ (b)zero (c) $\frac{1}{4\pi\varepsilon_0}\left(\frac{1}{r_A}-\frac{1}{r_B}+\frac{1}{r_C}\right)$ (d) $\frac{1}{4\pi\varepsilon_0}\left(\frac{1}{r_A}+\frac{1}{r_B}+\frac{1}{r_C}\right)$	
52	Which of the following lines of force is uniform field? 	
53	Two plates are 1 cm apart, and potential difference between them is 10 volt. The electric field between the plates is	

	(a)10 N/C (b)500 N/C (c)10^3 N/C (d)250 N/C	
54	A positively charged ball hags from a silk thread. We put a positive test charge q_0 at a point and measure $\frac{F}{q_0}$ then it can be predicted that the electric field strength E is (a)>F/q_0 (b) $\frac{F}{q_0}$ (c)< $\frac{F}{q_0}$ (d)cannot be estimated	
55	A semi-circular are of radius a is charged uniformly and the charge per unit length is λ. The electric field at its centre is (a) $\frac{\lambda}{2\pi\varepsilon_0 a^2}$ (b) $\frac{\lambda}{4\varepsilon_0 a}$ (c) $\frac{\lambda^2}{2\pi\varepsilon_0 a}$ (d) $\frac{\lambda}{2\pi\varepsilon_0 a}$	
56	An electric dipole is placed at the centre of a hollow conducting sphere. Which of the following option is correct? (a) Electric field is non-zero anywhere on the sphere (b) The flux of electric field is zero through the sphere (c) Options (a) and (b) both are true (d) No option is correct	
57	A glass rod rubbed with silk is used to charged a gold leaf electroscope and the leaves are observed to diverse. The electroscope thin, charged is exposed to X-rays for short period. Then, (a) the leaves will diverge further (b) the leaves will melt (c) the leaves will not be affected (d) none of the above	

58	A uniform electric field of 100 N/C exist in the vertically downward direction. The increase in the electric potential as one goes up the through a height of 50 cm is (a)10 V (b)5 V (c)0 V (d)0.5 V	
59	A test charge q_0 is moved without acceleration from A to C and covers the path ABC as shown in figure. The potential difference between A and C is  (a)Ed (b)E/d (c) 2Ed (d)Ed/2	
60	A charge Q and q is placed at each of the diagonally opposites corners of a square of a square. If the net electrical force on Q is zero, then Q/q equals to (a) $-2\sqrt{2}$ (b)-1 (c)1 (d)r = C_1 $e^{C_{2x}}$	
61	A charge +q if fixed at each of the points x = x_0, x = $3x_0$, x = $5x_0$.... ∞, on the x-axis and a charge –q is fixed at each of the point x = $2x_0$, x = $6x_0$ .... ∞. Here, x_0 is the constant. Take the electric potential at a point due to a charge Q at a distance r from it to be Q/4 $\pi\varepsilon_0 r$. Then, the potential at the origin due to the above system of charges is (a) $\frac{q}{4\pi\varepsilon_0 x_0}\log_e 2$ (b) $\frac{q}{8\pi\varepsilon_0 x_0}\log_e 2$ (c)0 (d) ∞	
62	The charge of $\frac{10}{3}\times10^{-9}C$ are placed at each of the four	

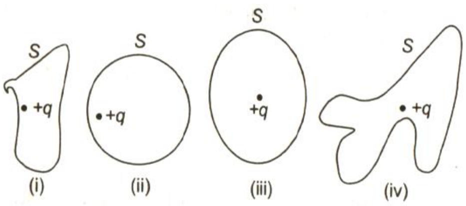
	corners of a square of side 8 cm. The potential at the point of intersection of the diagonals, is (a)1500 $\sqrt{2}V$ (b)1800 $\sqrt{2}V$ (c)600 $\sqrt{2}V$ (d)900 $\sqrt{2}V$	
63	Below figures. (i) and (ii) represent field lines. Which of the following correct statement?  (i) (ii) (a) Fig. (i) represents magnetic lines of force (b) Fig. (ii) represents magnetic lines of force (c) Fig. (i) represents electric lines of force (d) Fig. (ii) represents electric lines of force	
64	An alpha particle of energy 5 Me V is scattered through 180° by a fixed uranium nucleus. The distance of closest approach is of the order of (a)1 $\overset{0}{A}$ (b)10^{-10} cm (c)10^{-12} (d)10^{-15} cm	

CONCEPT-48: BASED ON ELECTRIC FLUX AND GAUSS'S THEOREM

1	A cylinder of radius, R and length, L is placed in a uniform electric field, E parallel to the cylinder axis. The total flux for the surface of the cylinder is given by (a)zero (b)$\pi R^2/E$ (c)$2\pi R^2 E$ (d)10^{-15}cm	

2

The electric flux through the surface



(a)in figure (iv) is the largest

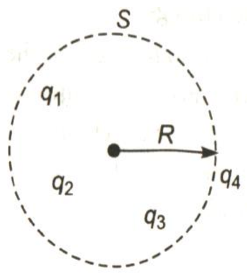
(b)in figure (iii) is the least

(c)in figure (ii) is same as figure (iii) but is smaller than figure (iv)

(d)is the same for all the figures

3

Q_1, q_2, q_3 and q_4 are point charges located at points as shown in figure and S is the spherical Gaussian surface of radius, R. Which of the following is true according to the Gauss's law?



(a) $\oint (E_1 + E_2 + E_3).dA = (q_1 + q_2 + q_3) / \varepsilon_0$

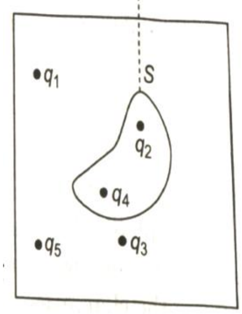
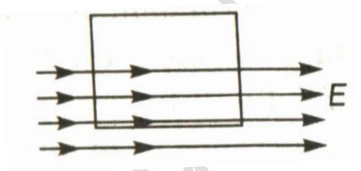
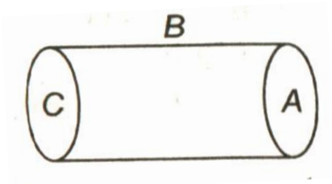
(b) $\oint (E_1 + E_2 + E_3).dA = (q_1 + q_2 + q_3 + q_4) / \varepsilon_0$

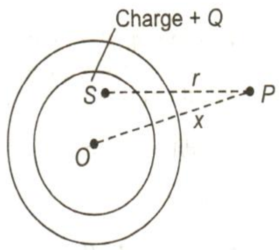
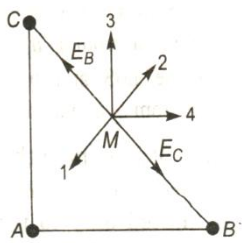
(c) $\oint (E_1 + E_2 + E_3).dA = q_1 + q_2 + q_3 / 2\varepsilon_0$

(d) None of the above

4

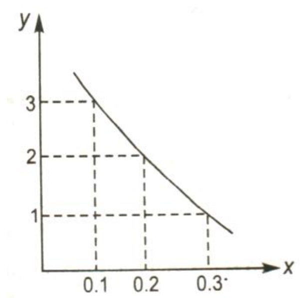
Five charges q_1, q_2, q_3, q_4 and q_5 are fixed at their positions as shown in figure S is a Gaussian surface. The Gauss's law is given by $\oint E.ds = \frac{q}{\varepsilon_0}$ Which of the following statements is correct?

	 (a) E on the LHS is the above equation will have a contribution fromq_1, q_5 and q_3 on the RHS will have a contribution from q_2 and q_4 only (b) E on the LHS is the above equation will have a contribution fromq_1, q_2 and q_3 only (c) E on the LHS is the above equation will have a contribution from all charges while q on the RHS will have a contribution from q_1, q_2 and q_5 only (d) Both E on the LHS and q on the RHS will have contributions from q_2 and q_4 only.	
5	A square surface of side lm in the plane of the paper. A uniform electric field E (V/m) also in the plane of the paper, is limited only to the lower half of the square surface, the electric flux (in SI units) associated with the surface is  (a)zero (b)El^2 (c)$El^2/2$ (d)EL/2	
6	A hollow cylinder has a charge q coulomb within it. If ϕ is the electric flux in unit is V-m, associated with the curved surface B, the electric flux linked with the plane surface A in unit of V-m, will be 	

	(a) $\left(\frac{q}{\varepsilon_0}-\phi\right)$ (b) $\frac{1}{2}\left(\frac{q}{\varepsilon_0}-\phi\right)$ (c) q/ε_0 (d) $q/\varepsilon_0/\phi$	
7	The adjacent diagram shows a charge +Q held on an insulating support S and enclosed by a hollow spherical conductor, O represents the centre of the spherical conductor and p is a point such that OP=x and SP=r. The electric field at point, P will be  (a)zero (b) $\frac{Q}{4\pi\varepsilon_0 x^2}$ (c) $\frac{Q}{\varepsilon_0 x^2}$ (d)None of these	
8	Three electrostatic potential inside a charged spherical ball is given by ϕ = ar^2+b, where, r is the distance from the centre, a and b are constants. Then the charge density inside the ball is (a) $-24\pi a\varepsilon_0 r$ (b) $-6a\varepsilon_0$ (d) $-24\pi a\varepsilon_0$ (d) $-6a\varepsilon_0 r$	
9	Three identical point charges as shown in figure, are placed the vertices of an isosceles right angled triangle. Which of the numbered vectors coincides in direction with the electric field at the mid-point M of the hypotaneous?  (a)4 (b)3 (c)2 (d)1	

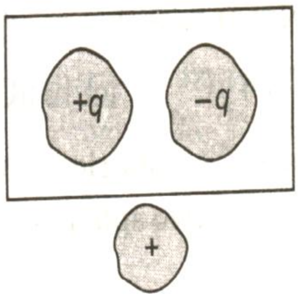
10	Two electric dipoles of moment P and 64 P are placed in opposite direction on a line at a distance of 25 cm. the electric field will be zero at point between the dipoles whose distance from dipole of moment P is (a)10 cm (b)5 cm (c)8 cm (d)20 cm	

CONCEPT-49: BASED ON ELECTRIC POTENTIAL, ELECTRIC FLUX AND CAPACITOR

1	The electrostatic potential on the surface of a charged conducting sphere is 100 V. Two statements are made in this regard. S_1: At any point inside the sphere, electric intensity is zero S_2: At any point inside the sphere, the electrostatic potential is 100 V Which of the following is a correct statement. (a)S_1 is true but S_2 is false (b)Both S_1 and S_2 are false (c)S_1 is true S_2 is also true and S_1 is the cause of S_2 (d)S_1 is true S_2 is also true the statements are independent.	
2	Two insulated metal spheres of radii 10 cm and 15 cm charged to a potential of 150 V and 100 v respectively, are connected by means of a metallic wire. What is the charge on the first sphere? (a)2 esu (b) 4 esu (c)6 esu (d)8 esu	
3	The variation of potential V with distance x from a fixed point charge is shown in figure. The electric field strength between x = 0.1 m and 0.3 m is  (a)+0.4 Vm^{-1} (b) -0.4 Vm^{-1}	

	(c)+10 Vm^{-1} (d)- 10 Vm^{-1}	
4	The electric potential V at any point (x, y, z) in space is given by $V = 4x^2$. The electric field at (1, 0, 2) m in Vm^{-1} is (a) 8, along negative X-axis (b) 8, along positive X-axis (c) 16, along negative X-axis (d) 16, along positive Z-axis	
5	A hollow conducting sphere of radius, R has a charge (+Q) on its surface. What is the electric potential within the sphere at a distance, r = R/3 from its centre? (a) $\frac{1}{4\pi\varepsilon_0}.\frac{Q}{r}$ (b) $\frac{1}{4\pi\varepsilon_0}.\frac{Q}{r^2}$ (c) $\frac{1}{4\pi\varepsilon_0}.\frac{Q}{R}$ (d)Zero	
6	Two point charges –q and +q/2 are situated at the origin and at the point (a, 0, 0), respectively. The point along the X-axis, whereas the electric field centre? (a) $x=\frac{\sqrt{2a}}{\sqrt{2}-1}$ (b) $x=\sqrt{2a}-\sqrt{2}-1$ (c) $x=(\sqrt{2}-1)\sqrt{2a}$ (d)None of these	
7	A positively charged particle is released from rest in an uniform electric field. The electric potential energy of the charge (a) Remains a constant because the electric field is uniform (b) Increase because the charge moves along the electric field (d) Decreases because the charge moves along the electric	

	field (d) Decreases because the charge moves opposite to the electric field	
8	A ball of mass 1 kg carrying a charge 10^{-8} C moves from a point A at potential 600 V to a point B at zero potential. The change in its kinetic energy is (a)-6 x 10^{-6} erg (b))-6 x 10^{-6} J (c))6 x 10^{-6} J (d) 6 x 10^{-6} erg	
9	A charge (-q) and another charge (+Q) are kept at two points A and B, respectively. Keeping the charge (+Q) fixed at B, the charge (-q) at A is moved to another point C such that ABC forms an equilateral triangle of side l. The net work done in moving the charge (-q) is (a) $\frac{1}{4\pi\varepsilon_0}\cdot\frac{Qq}{l}$ (b) $\frac{1}{4\pi\varepsilon_0}\cdot\frac{Qq}{l^2}$ (c) $\frac{1}{4\pi\varepsilon_0}\mathrm{Qq}\,l$ (d)Zero	
10	The flux entering and leaving a closed surface are 5 x 10^{5} and 4 x 10^{5} in MKS unit respectively, then the charge inside the surface will be (a)-8.886 x 10^{-7} C (b)7.86 x 10^{-7} C (c)6.85 x 10^{7} C (d)6.85 x 10^{-7} C	
11	The potential difference applied to an X-ray tube is 5 kV and current through it is 3.2 mA. Then, the number of electrons striking the target per second is (a)2 x 10^{10} (b)3 x 10^{18} (c)2 x 10^{16} (d)5 x 10^{15}	
12	Equipotentials at a great distance from a collection of charges whose total sum is not zero are approximately. (a)spheres (b)planes (c)paraboloids (d)ellipsoids	

13	The work done in carrying an electron from point A to a point B in an electric is 10 MJ. The potential difference (V_A – V_B) is then (a)+2 kV (b)-2 kV (c)+200 V (d)None of these	
14	Shown below is a distribution of charges. The flux of electric field due to these charges through the surface is  (a)3q/ε_0 (b)zero (c)2q/ε_0 (d)q/ε_0	
15	An electric field is given by E = $(y\hat{i}+x\hat{j})\,\mathrm{NC}^{-1}$. The work done in moving a 1 C charge from r_A = $(2\hat{i}+2\hat{j})$ m to r_B = $(4\hat{i}+2\hat{j})$ m is (a)2 y (b)3 y (c)zero (d)infinity	
16	The work done by electric field done during the displacement of a negatively charged particle towards a fixed positively charged particle is 9 J. As a results the distance between the charges has been decreased by half. What work is done by the electric field over the first half of this distance? (a)3 J (b)6 J (c)1.5 J (d)9 J	
17	A parallel plate capacitor is connected to a battery. A metal sheet of negligible thickness is placed between the plates at their centre. Which of the following is correct? (a) Equal and opposite charges will appear in the low these faces of metal sheet (b) Capacity remain same	

(c) Potential difference between the plates increases

(d) Battery supplies more charge

18

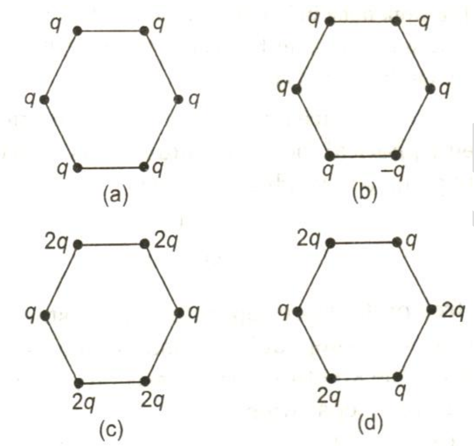
A sphere of radius r is charged to a potential V. the outward pull per unit area of its surface is given by

(a) $\frac{4\pi\varepsilon_0 V^2}{r^2}$ (b) $\frac{\varepsilon_0 V^2}{2r^2}$

(c) $\frac{2\pi\varepsilon_0 V^2}{r^2}$ (d) $\frac{\varepsilon_0 V^2}{4r^2}$

19

Figures shown below regular hexagons, with charges at the vertices. In which of the following cases the electric field at the centre is not zero?



20

n small drops of same size are charged to V volt each. If theycoalesced to form a single large drop, then its potential will be

(a)Vn (b)Vn^{-1} (c)$Vn^{1/3}$ (d)$Vn^{2/3}$

21

A cube of side b has a charge q at each of its vertices. Determine the potential and electric field due to this charge array at the centre of the cube.

(a) $\frac{4q}{\sqrt{3}\pi\varepsilon_0 b}$ (b) $\frac{3q}{\sqrt{2}\pi\varepsilon_0 b}$

(c) $\frac{3q}{\sqrt{2}\pi\varepsilon_0 b^2}$ (d) $\frac{2q}{\sqrt{3}\pi\varepsilon_0 b}$

22

Potential energy of two equal negative point charges 2 μC each held 1 m apart in air is

(a)2 J (b)2 eV (c)4J (d)0.036 J

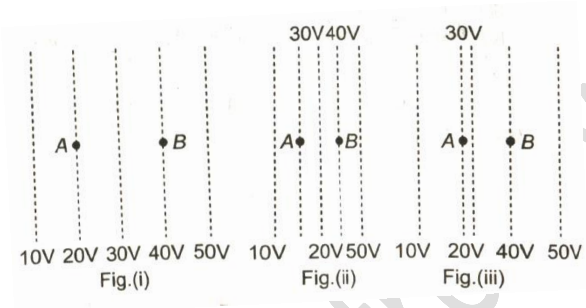
23

In a region of space, the electric field is given by $E = 8\hat{i} + 4\hat{j} + 3\hat{k}$. The electric flux through a surface of area of 100 unit xy-plane is

(a)800 units (b)300 units
(c)400 units (d)1500 units

24

Figures shows some equipotential lined distributed in space. A charged object is moved from point A to point B.



(a) The work done in fig. (i) is the greatest

(b) The work done in fig.(ii) is least

(c) The work done in fig.(i), fig. (ii) and fig.(iii)

(d) The work done in fig.(iii) is greater than fig. (ii) but equal to that in fig. (i)

25

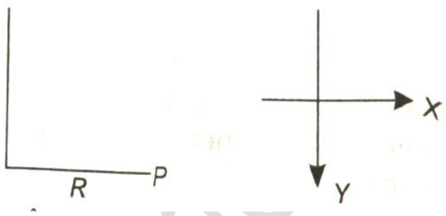
In a region of space having a uniform electric field E, a hemispherical bowl of radius r is placed. The electric flux ϕ through the bowl is

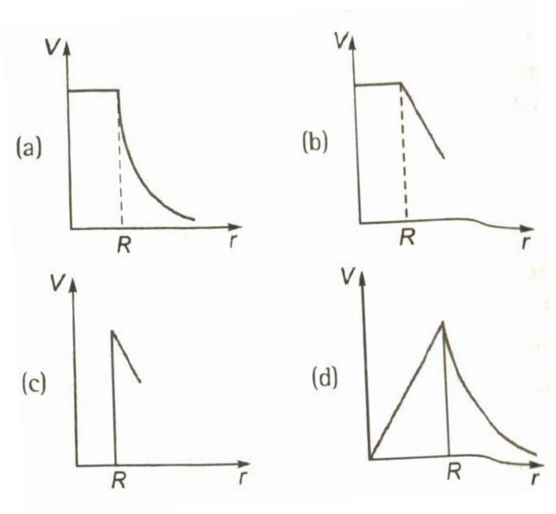
(a)$2\pi rE$ (b)$4\pi r^2E$ (c)$2\pi r^2E$ (d)πr^2E

26

Two free protons are separated by a distance is 1 $\dot{A}$. If one proton is kept at least distance and the other is released, the kinetic energy of second proton when it is at infinite separation is

(a)23.0×10^{-19} J (b) 11.5×10^{-19} J

	(c) 2.3×10^{-19} J (d)zero	
27	A regular hexagon of side 10 cm has a charge 5μC at each of its vartices. The potential at the centre of the hexagon is? (a)3.7×10^6 V (b) 2.7×10^6 V (c) 4×10^6 V (d) 5×10^6 V	
28	27 identical drops of mercury are charged simultaneously to the same potential of 10 V each. Assuming drops to be spherical, if all the charged drops are made to combine to form one larger drop, then the potential of larger drop would be (a)45 V (b)135 V (c)270 V (d) 90 V	
29	The electric field intensity at a point P due to long uniformly charged wire as shown in figure (charge per unit length is λ)  (a) $\frac{\lambda}{2\sqrt{2}\pi\varepsilon_0 R}$ (b) $\frac{\lambda}{\sqrt{2}\pi\varepsilon_0 R}$ (c) $\frac{2\lambda}{\sqrt{2}\pi\varepsilon_0 R}$ (d) $\frac{\lambda}{4\sqrt{2}\pi\varepsilon_0 R}$	
30	Which one of the following graphs figure shows the variation of electric potential V with distance r from the centre of a hollow charged sphere of radius R?	



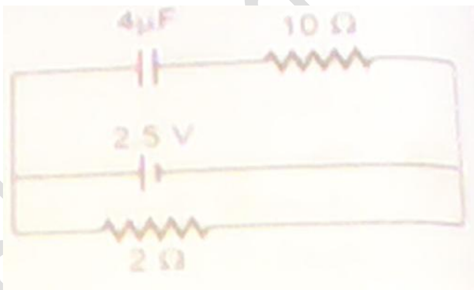
31

A capacitor connected to a 10 V battery collects a charge of 40 μC with air as dielectric and 100μC with a given oil as dielectric. The dielectric constant of the is

(a)1.5 (b)2.0 (c)2.5 (d)3.0

32

A capacitor of 4μF is connected as shown in the circuit. The internal resistance of the battery is 0.5 Ω the amount of charge on the capacitor plates will be



(a)0 (b)4μC (c)16μC (d)8 μC

33

The capacitance of a spherical condensers is 1μF. if the spacing between two spheres is 1 mm, the radius of the outer sphere is

(a)3 m (b)7 m (c)8 m (d)9 m

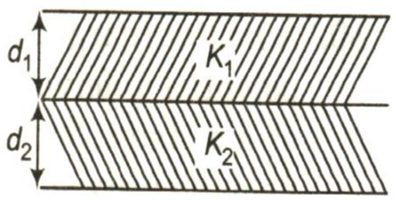
34

A parallel plate capacitor has a capacitance of 50μF in air and 100μF when immersed in an oil. The dielectric constant K of the oil is

(a)2.2 (b)1.1 (c)0.45 (d)5.0

35

A parallel plate capacitor is made of two dielectric blocks in series. One of the blocks has thickness d_1 and dielectric constant K_1 and the other has thickness d_2 and dielectric constant K_2 as shown in figure. This arrangement can be thought as a dielectric slab of thickness d(= d_1 + d_2) and effective dielectric constant K. the K is

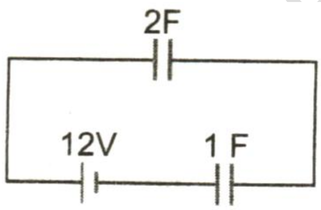


(a) $\dfrac{k_1d_1+k_2d_2}{d_1+d_2}$ (b) $\dfrac{k_1d_1+k_2d_2}{k_1+k_2}$

(c) $\dfrac{k_1k_2(d_1+d_2)}{(k_1d_1+k_2d_2)}$ (d) $\dfrac{2k_1k_2}{k_1+k_2}$

36

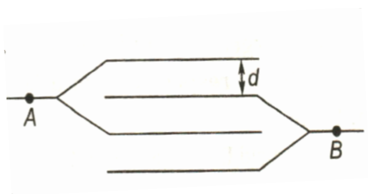
In a circuit shown in figure, the potential difference across the capacitor of 2 F is



(a)8 V (b)4 V (c)12 V (d) 6 V

37

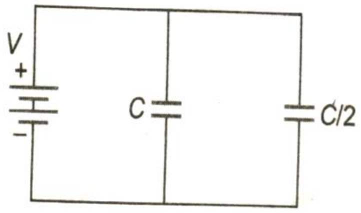
The equivalent capacity between points A and B in figure will be, while capacitance of each capacitor is 3μF.



(a)2 μF (b)4μF (c)7μF (d)9μF

38

Two condenser one of capacity C and other of capacity C/2 are connected to 9V battery, as shown in figure. The work done in charging fully both condenser is



(a)1/4 CV^2 (b)2 CV^2

(c)3/4 CV^2 (d)1/2 CV^2

39

The force on each plate of parallel plate capacitor has a magnitude equal to $\frac{1}{2}$ QE, where Q is the charge on the capacitor and E is the magnitude of electric field between the plates. Then

(a) $\frac{E}{2}$ contributes to the force against which the plates are moved

(b) $\frac{E}{3}$ contributes to the force against which the plates are moved

(c) E contributes force against which the plates are moved

(d) None of the above

40

An electric technician requires a capacitance of 2µF in a circuit across a potential difference of 1 kV. A large number of 1 µF capacitors are available to him each of which can withstand a potential difference of not more than 400 V. suggest a possible arrangement that requires the minimum number of capacitors.

(a) Six rows having 3 capacitors in each row

(b) Three rows having 6 capacitors in each row

(c) Nine rows having 2 capacitors in each row

(d) Two rows having 9 capacitors in each row

41

A 600 pF capacitor is charged by a 200 V supply. Then, it is disconnected from the supply and is connected to another

	uncharged 600 pF capacitor. How much electrostatic energy is lost in the process? (a)4 x 10^{-6} J (b) 6 x 10^{-6} J (c) 5 x 10^{-6} J (d) 8 x 10^{-6} J	

CONCEPT-50: BASED ON ELECTRIC CURRENT AND DRIFT VELOCITY, ELECTROMOTIVE FORCE

1	The current flowing through a wire depends on time as I = $3t^2$+2t+5. The charge flowing the cross section of the wire in time from t = 0 to t = 2 s in (a)21 C (b)10C (c)22C (d)1C	
2	In a region, 10^{19} α-particles and 10^{19} protons move to the left, while 10^{19} electrons move to the right per second. The current is (a)3.2A towards left (b) 3.2A towards right (c)6.4A towards left (d) 6.4A towards right	
3	Every atom makes one free electron in copper. If 1.1A current is flowing in the wire of copper having 1 mm diameter, then the drift velocity (approx) will be (density of copper = 9 x 10^3 kgm^{-3} and atomic weight of copper = 63) (a)0.1 mms^{-1} (b)0.2 mms^{-1} (c)0.3 mms^{-1} (d)0.2 cms^{-1}	
4	Consider a current carrying wire (current I) in the shape of a circle. Note that as the current progresses along the wire, the direction of j (current density) changes in an exact manner, while the current I remain unaffected. The agent that is essentially responsible for is (a) Source of emf (b) Electric filed produced by charges accumulated on the surface of wire (c) The charges just behind a given segment of wire which push them just the right way by repulsion (d) The charges ahead	

5

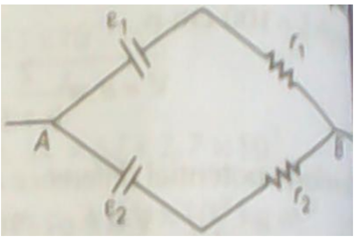
The electron of hydrogen atom is considered to be revolving round a proton in circular orbit of radius h^2/me^2 with velocity e^2/h where h = h/2π. The current I is

(a) $\frac{4\pi^2 me^5}{h^2}$ (b) $\frac{4\pi^2 me^2}{h^3}$

(c) $\frac{4\pi^2 m^2 e^2}{h^3}$ (d) $\frac{4\pi^2 me^5}{h^3}$

6

Two batteries of emf ε_1 and $\varepsilon_2 (\varepsilon_2 > \varepsilon_1)$ and internal resistances r_1 and r_2 respectively are connected parallel as shown in figure.



(a) The equivalent emf ε_{eq} of the two cells is between ε_1 and ε_2, i.e., $\varepsilon_1 < \varepsilon_{eq} < \varepsilon_2$

(b) The equivalent emf ε_{eq} is smaller than ε_1

(c) The e_{eq} is given by $\varepsilon_{eq} = \varepsilon_1 + \varepsilon_2$ always

(d) ε_{eq} is independent of internal resistance r_1 and r_2

7

Two wires of the same material but of different diameters carry the same current i. if the ratio of their diameters is 2:1 then the corresponding ratio of their mean drift velocities will be

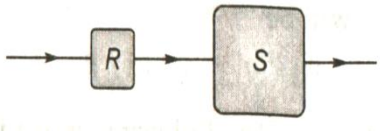
(a)4 : 1 (b)1 : 1 (c)1 : 2 (d)1 : 4

8

A straight conductor of uniform cross-section carries a current i. If s is the specific charge of an electron, the momentum of all the free electrons per unit length of the conductor, due to their drift velocity only is

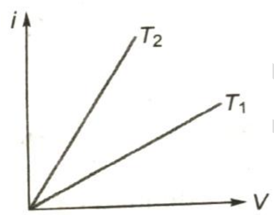
(a)is (b) $\sqrt{i/s}$ (c) i/s (d) $(i/s)^2$

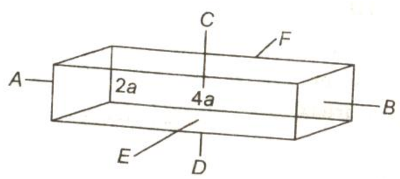
9	In a neon gas discharge tube Ne^{+} ions moving through a cross-section of the tube each second to the right is 2.9 x 10^{18} electrons move towards left in the same time. The electronic charge being 1.6 x 10^{-19} C, the net electric current is (a)0.27 A to the right (b)0.66 A to the right (c)0.66 A to the left (d)zero	
10	A metallic resistor is connected across a battery. If the number of collisions of the free electrons with the lattice is some how decreased in the resistor (for example by cooling it), the current will (a)remains constant (b)increase (c)decrease (d)become zero	
11	A capacitor of 10μF has a potential difference of 40 V across it. If it is discharged in 0.2 s, the average current during discharge is (a)2 mA (b)4 mA (c)1 mA (d)0.5 mA	
12	There is a current of 0.21 A in a copper wire whose area of cross –section is s10-^{6} m^{2}. if the number of free electrons per m^{3} is s8.4 x 10^{28}, then find the drift velocity, (e = 1.6 x 10^{-19} C) (a)2 x 10^{-5} ms^{-1} (b) 1.56x 10^{-5} ms^{-1} (c) 1 x 10^{-5} ms^{-1} (d) 0.64 x 10^{-5} ms^{-1}	
13	The alloys constant and managing are used to make standard resistance became they have (a) high resistivity (b) low temperature coefficient of resistance (c) low resistivity (d) both (a) and (b)	
14	All the edges of a block with parallel faces are unequal. Its tangent edge is twice its shortest edge. The ratio of the maximum to minimum resistance between parallel faces is (a)8 (b)4 (c)2 (d) none of these	

15	The resistance of a 10 m long wire is 10Ω. Its length is increased by 25% by stretching the wire uniformly. The resistance of wire will charge to (approximately) (a)12.5Ω (b)14.5Ω (c)15.6Ω (d)16.6Ω	
16	Two plates R and S are in the form of a square and have the same thickness. A side of S is twice the side of R. compare their resistances. The direction of current is shown by an arrow head in figure.  (a) The resistance of R is twice that of S (b) Both have the same resistance (c) The resistance of S is four times that of R (d) The resistance of R is half that of S	
17	Masses of the three wires of same material are in the ratio of 1 : 2 : 3 and their lengths in the ratio of 3 : 2 : 1. Electrical resistance of these wires will be in the ratio of (a)1 : 1 : 1 (b)1 : 2 : 3 (c)9 : 4 : 1 (d)27 : 6 : 1	

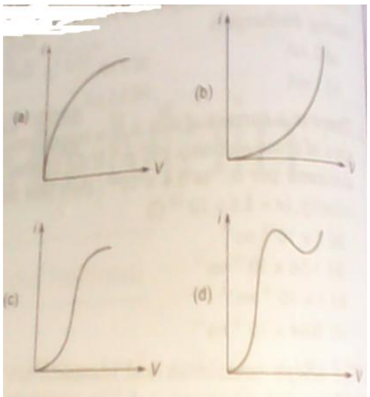
CONCEPT-51: BASED ON SPECIFIC RESISTANCE, CURRENT DENSITY, ELECTRICAL CONDUCTIVITY AND EFFECT OF TEMPERATURE

1	A silver wire has a resistance of 2.1 Ω at 27.5 ^{o}C. Determine the temperature coefficient of resistivity of silver. (a)0.049/^{0}C (b)0.0049/^{0}C (c)0.0039/^{0}C (d)0.039/^{0}C	
2	Two wires of same dimensions but resistivity's ρ_1 and ρ_2	

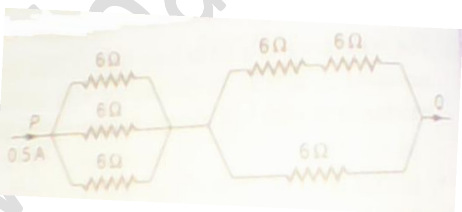
	are connected in series. The equivalent resistivity of the combination is (a) $\sqrt{\rho_1\rho_2}$ (b) $(\rho_1+\rho_2)$ (c) $\frac{(\rho_1+\rho_2)}{2}$ (d)None of these	
3	In cosmic rays 0.15 protons cm^{-2} sec^{-1} are entering the earth's atmosphere. If the radius of the earth is 6400 km, the current received by the earth in the form of cosmic rays is nearly. (a)0.12A (b)1.2A (c)12A (d)120A	
4	The temperature coefficient of resistance for a wire is 0.00125^0C^{-1}. At 300 K its resistance is 1 Ω. The temperature at which the resistance becomes 1.5 Ω is? (a)450 K (b)727 K (c)454 K (d)900 K	
5	The current I and voltage V graphs for a given metallic wire at two different temperatures T_1 and T_2 are shown in figure. It is concluded that  (a)$T_1 > T_2$ (b) $T_1 < T_2$ (c) $T_1 = T_2$ (d) $T_1 = 2T_2$	
6	There are two concentric spheres of radius a and b respectively. If the space between them is filled with medium of resistivity ρ, then the resistance of the inter gap between the two spheres will be (a) $\frac{\rho}{4\pi(b+a)}$ (b) $\frac{\rho}{4\pi}\left(\frac{1}{b}-\frac{1}{a}\right)$ (c) $\frac{\rho}{4\pi}\left(\frac{1}{a^2}-\frac{1}{b^2}\right)$ (d) $\frac{\rho}{4\pi}\left(\frac{1}{a}-\frac{1}{b}\right)$	

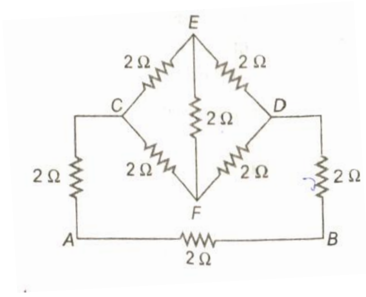
7	A copper wire of length 1 m and radius 1 mm is joined in series with an iron wire of length 2 m and radius 3 mm and a current is passed through the wires. The ratio of the current density in the wires. The ratio of the current density in the copper and iron wires is (a)2 : 3 (b)6 : 1 (b)9 : 1 (d)18 : 1	
8	A conductor with rectangular cross-section has dimensions (ax2ax4a) as shown in figure. Resistance across AB is R+1+., across CD isR_2 and across EF is R_3. Then  (a)$R_1 = R_2 = R_3$ (b) $R_1 > R_2 > R_3$ (c) $R_2 > R_3 > R_1$ (d) $R_1 > R_3 > R_2$	
9	A resistance of 2Ω is to be made from a copper wire (specific resistance = $1.7\text{x}10^{-8}\Omega$) using a wire of length 50 cm. The radius of the wire is (a)0.0116 mm (b)0.367 mm (c)0.116 mm (d)0.267 mm	
10	A metal rod of length 10 cm and a rectangular cross-section of 1 cm x $\frac{1}{2}$ cm is connected to a battery across opposite faces. The resistance will be (a) Maximum when the battery is connected across 1 cm x $\frac{1}{2}$ cm (b) Maximum when the battery is connected across 10 cm x 1 cm faces (c) Maximum when the battery is connected across 10 cm x $\frac{1}{2}$ cm	

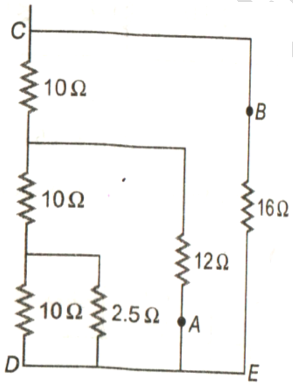
	(d) Same irrespective of the three faces	
11	Two conductors are made of the same material and have the same length. Conductor A is a slid wire of diameter 1 mm. conductor B is a hollow tube of outer diameter 2 mm and inner diameter 1 mm. What is the ration of resistance R_A to R_B? (a)1 : 3 (b)3 : 1 (c)2 : 3 (d)3 : 2	
12	Resistance of a resistor at temperature t^o C is $R_t = R_0 (1 + \alpha t + \beta t^2)$ Here R_0 is the resistance at 0^o C. The temperature coefficient of resistance at temperature t^o C is (a) $\frac{(1 + \alpha t + \beta t^2)}{\alpha + 2\beta t}$ (b) $(\alpha + 2\beta t)$ (c) $\frac{(\alpha + 2\beta t)}{(1 + \alpha t + \beta t^2)}$ (d) $\frac{(\alpha + 2\beta t)}{2(1 + \alpha t + \beta t)}$	
13	A given resistor has the following colour scheme of the various strips on it, brown, black, green and silver. Its value in ohm is (a)1.0 x $10^4 \pm$ 10% (b) 1.0 x $10^5 \pm$ 10% (c) 1.0 x $10^6 \pm$ 10% (d) 1.0 x $10^7 \pm$ 10%	
14	The variation between V and I has been shown by V-I graph for heater filament is represented by	

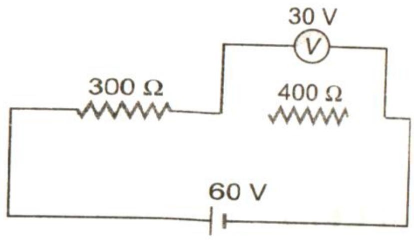
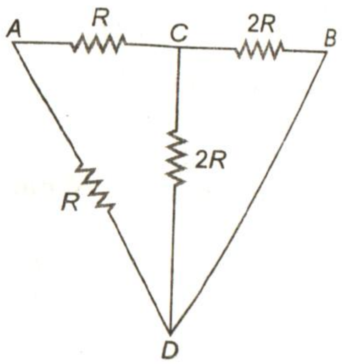
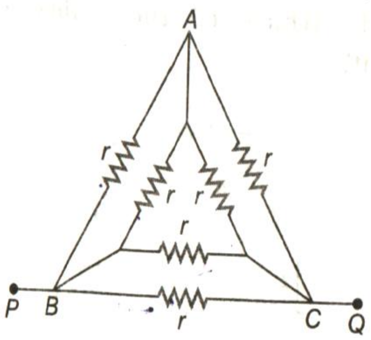
CONCEPT-52: BASED ON GROUPING OF RESISTORS & CELLS

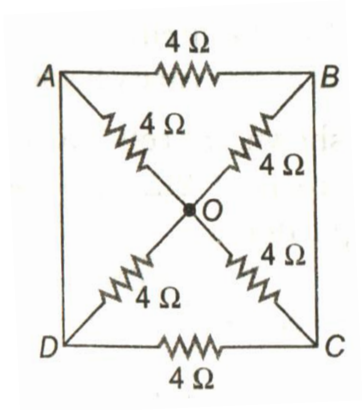
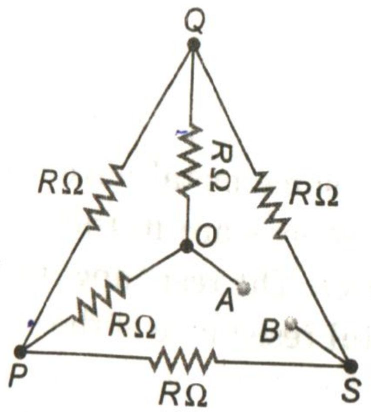
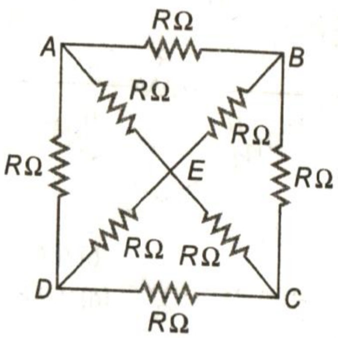
1	An electric cable of copper has just one wire of radius 0 mm. Its resistances are 5Ω. This single copper wire of cable is replaced by 6 different well insulated copper wires each of radius 3 mm. the total resistance of the cable will now be equal to (a)7.5Ω (b)45Ω (c)90Ω (d)270Ω	
2	Resistance of 6Ω each are connected in the manner shown in figure with the correct 0.5A as shown in figure, the potential difference, $V_P - V_Q$ is  (a)3 V (b)5 V (c)4 V (d)3.9V	
3	The equivalent resistance of n resistors each of same resistance when connected in series is R. If the same resistance are connected in parallel, the equivalent resistance will be (a)R/n^2 (b)R/n (c)n^2/R (d)nR	

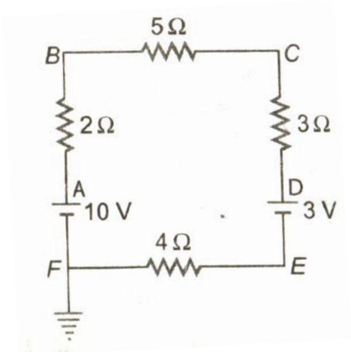
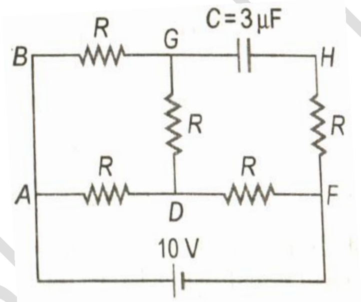
<table>
<tr><td>4</td><td>The resistance of the following circuit between A and B is


(a) (3/2) Ω (b)2 Ω (c)4 Ω (d)8 Ω</td><td></td></tr>
<tr><td>5</td><td>What is the equivalent resistance across the points A and B in the circuit given below?


(a)8 Ω (b)12 Ω (c)16 Ω (d)32 Ω</td><td></td></tr>
<tr><td>6</td><td>Three resistance each of 4 Ω are connected in the form of an equilateral triangle. The effective resistance between any two corners is
(a)(3/8) Ω (b)(8/3) Ω (c)8 Ω (d)12 Ω</td><td></td></tr>
<tr><td>7</td><td>In the circuit figure, the voltmeter reads 30V. What is the resistance of the voltmeter?</td><td></td></tr>
</table>

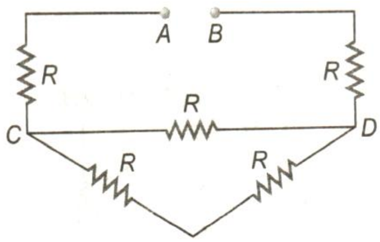
	 (a)1200Ω (b)700Ω (c0400Ω (d)300Ω	
8	The effective resistance between points A and B is  (a)R (b) $\frac{R}{3}$ (c) $\frac{2R}{3}$ (d) $\frac{3R}{5}$	
9	The resistance across R and Q in the figure  (a)r/3 (b)r/2 (c)2r (d)6r	
10	Six equal equal resistances each of 4Ω are connected to form a figure. The resistance between two corners A and B is	

	 (a)4Ω (b)4/Ω (c)12Ω (d)2Ω	
11	If each of the resistances in the network in figure. R, the equivalent resistance between terminals A and B is  (a)5R (b)2R (c)4R (d)R	
12	The resistance between the points A and C in the figure below is 	

	(a)RΩ (b)$\frac{4}{3}$RΩ (c)$\frac{2}{3}$RΩ (d)$\frac{8R}{3}$	
13	In the circuit shown in the figure, the point F is grounded. Which of the following is wrong statement?  (a) D is at 5V (b) E is at zero potential (d) the current in the circuit will be 0.5A (d) The potential at E is same whether or not F is rounded	
14	In the circuit shown, the cell is ideal, which emf = 10 V. Each resistance is of 2Ω the potential difference across the capacitor is  (a)12V (b)10V (c)8V (d)zero	
15	Two wires of same metal have the same length but their cross-sections are in the ratio 3 : 1. They are joined in series. The resistance of the thicker wire is 10Ω the total resistance of the combinations is (a)5/2Ω (b)40/3Ω (c)40Ω (d)100Ω	

16

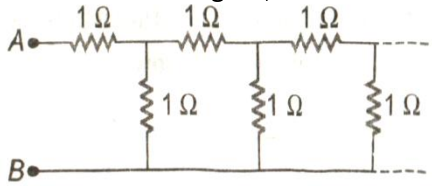
What is the equivalent resistance between point A and point B in the circuit of figure, if R = 3 Ω ?



(a)8 Ω (b)9 Ω (c)2 Ω (d)15 Ω

17

The equivalent resistance between points A and B of an infinite network of resistance each of 1 Ω connected as shown in figure, is

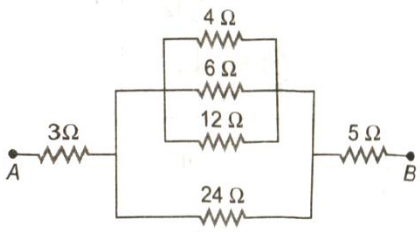


(a)infinite (b)zero

(c)2 Ω (d) $\left(1+\sqrt{5}\right)/2\Omega$

18

The effective resistance between points A and B in figure



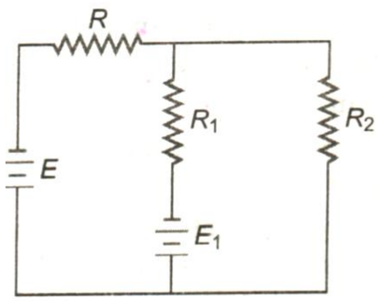
(a)10 Ω (b)12 Ω (c)9.85 Ω (d)10.85 Ω

19

A cell supplies a current i_1 through a resistance R_1 and a current I_2 through a resistance R_2. The internal resistance of a cell is

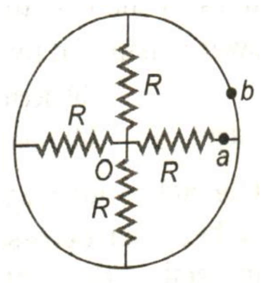
(a) $R_2 - R_1$ (b) $\frac{(i_1+i_2)}{i_1+i_2}R_1R_2$

(c) $\frac{i_1R_2 - i_2R_1}{i_1 - i_2}$ (d) $\frac{i_2R_2 - i_1R_1}{i_1 - i_2}$

20	To get a maximum current through a resistance of 2.5Ω, one can use m rows of cells each row having n cells. The internal resistance of each cell is 0.5Ω.what are the values of m and n, if the total number of cells are 2f0? (a)m = 2, n = 10 (b)m =4, n = 5 (c)m = 5, n = 4 (d)n = 2, m = 10	
21	Two identical cells connected in series send 1.0 A current through a 5Ω resistor. When they are connected in parallel, they send 0.8A current through the same resistor. What is the internal resistance of the cell? (a)0.5Ω (b)1.0Ω (c)1.5Ω (d)2.5Ω	
22	Figure shows a circuit with known resistances R_1 and R_2. Neglect the internal resistance of the connecting wire. The magnitude of electromotive force E_1 such that the current through the resistance R is zero will be  (a)ER_1/R_2 (b)ER_2/R_1 (c)$E(R_1+R_2)R_2$ (d) $ER_1(R_1+R_2)$	
23	Under what condition will the strength of current in a wire of resistance R be the same for connection is n series or in parallel of n identical cells each of the internal resistance r, when (a)R = nr (b)R = r/n (c)R = r (d)$R \to \infty, r \to 0$	
24	n identical cells, each of emf E and internal resistance r, are connected in series a cell A is joined with reverse polarity. The potential difference across each cell, except A is (a) $\frac{2nF}{n-2}$ (b) $\frac{(n-2)E}{n}$ (c) $\frac{(n-1)E}{n}$ (d) $\frac{2E}{n}$	

25

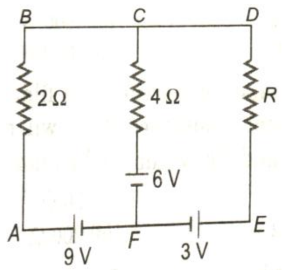
The equivalent resistance between points a and b of a network shown in figure is given by



(a) $\frac{3}{4}R$ (b) $\frac{4}{3}R$ (c) $\frac{5}{6}R$ (d) $\frac{5}{4}R$

26

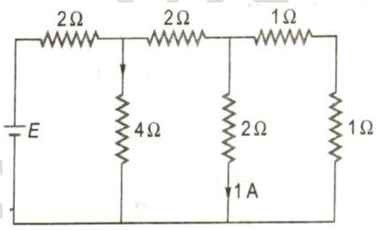
For what value of R in the circuit as shown in figure, current passing through 4 Ω resistance will be zero.



(a)1 Ω (b)2 Ω (c)3 Ω (d)4 Ω

27

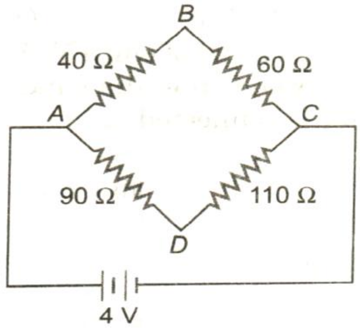
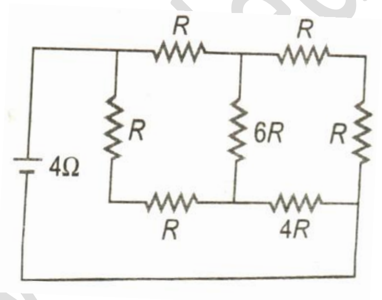
The emf of the battery shown in figure, is



(a)12 V (b)13V (c)16V (d)18V

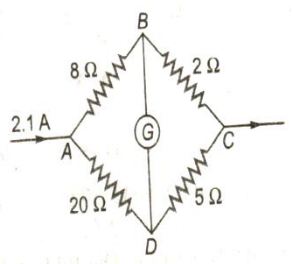
28

Four resistances 40 Ω, 60 Ω, 90 Ω and 110 Ω make the arms of a quadrilateral ABCD. Across AC is the battery circuit, the emf of the battery being 4V and internal resistance negligible. The potential difference across BD is

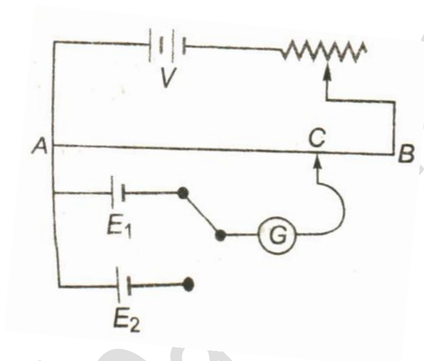
	 (a)1V (b)-1V (c)-0.2V (d)0.2V	
29	A store battery of emf 8.0 V and internal resistance 0.5 Ω is being charged by a 120 V DC supply using a series resistor of 15.5 Ω. What is the terminal voltage of the battery during charging? (a)11.5 V (b)13.5 (c)8 Ω (d)3 Ω	
30	A,B,C and D are four resistances of 2 Ω, 2 Ω, 2 Ω and 3 Ω respectively. They are used to form a Wheatstone bridge. The resistance D is short circuited with a resistance R will be (a)4 Ω (b)6 Ω (c) 8 Ω (d)3 Ω	
31	A battery of internal resistance 4 Ω is connected to the network of resistances as shown. In order given the maximum power to the network, the value of R (in Ω) should be  (a)4/9 (b)8/9 (c)2 (d)18	

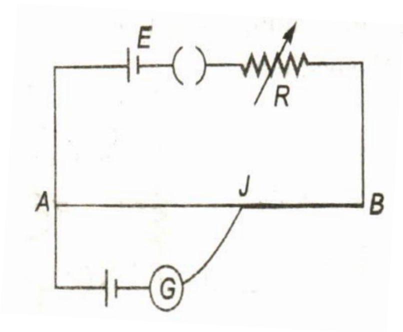
CONCEPT-53: BASED ON EFFECT OF CURRENT

1	In the given figure when galvanometer shows no deflection current flowing through 5 Ω resistance will be	

	 (a)0.5 A (b)0.6 A (c)1.5 A (d)2.0 A	
2	In a Wheatstone bridge, P = 90 Ω, Q = 110 Ω, R = 40 Ω and S = Ω and cell of emf 4 V. Then the potential difference between the diagonal along which a galvanometer is connected, is (a)-0.2 V (b)+0.2 V (c)-1 V (d)+1 V	

CONCEPT-54: BASED ON POTENTIOMETER

1	The circuit shown here is used to compare the emf of two cells E_1 and E_2 ($E_1 > E_2$). The null point is at C when the galvanometer is connected to E_2, the null point will be  (a) To the left of C (b) To the right of C (c) At C itself (d) None where on AB	
2	AB is a potentiometer wire (figure), if the value of R is increased, in which direction will the balance point J shift?	

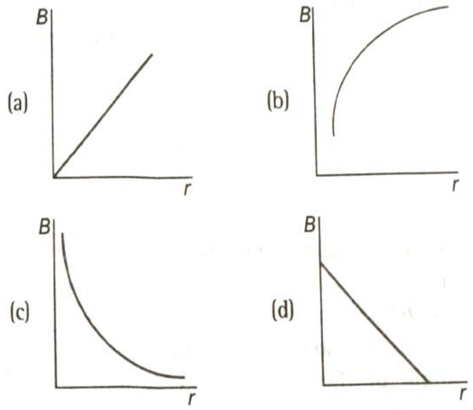
	 (a) Towards B (b) Towards A (c) No circuit flowing in circuit (d) None of the above	
3	Two cells of emf's approximately 5 V and 10 V are to be accurately compared using a potentiometer of length 400 cm. (a) The battery that runs the potentiometer should have voltage of 8V (b) The battery of potentiometer can have a voltage of 15V and R adjusted so that the potential drop across the wire slightly exceeds 10 V (c) The first portion of 50 cm of wire itself should have a potential drop of 10V (d) Potentiometer is usually used for comparing resistances and not voltages	
4	A resistance R is to be measured using a meter bridge. Student chooses the standard resistance S to be 100Ω. He finds the null point at l_1 = 2.9 cm. He is told to attempt to improve the accuracy. Which of the following is a useful way? (a) He should measure l_1 more accurately (b) He should measure S to 1000 Ω and repeat the experiment (c) He should change S to 3Ω and repeat the experiment (d) He should give up hope of a more accurate measurement with a meter bridge	

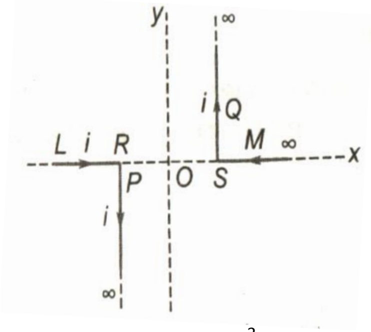
CONCEPT-55: BASED ON THERMAL EFFECT OF CURRENT

1	A resistor R_1 dissipates power P, when connected to a certain generators. If the resistor R_2 is put in series with R_1, the power dissipated by R_1 (a)increases (b)decreases (c)remains constant (d)None of these	
2	An electric kettle boils some water in 16 min. Due to some defect, it becomes necessary to remove 10% turns of heating coil of the kettle. Now, how much time will it take to boil the same of water? (a)17.7 min (b)14.4 min (c)20.9 min (d)13.7 min	
3	If two identical heaters each rated as (1000W-220V) are connected in parallel to 220 V, then the total power consumed is (a)200 W (b)2500 W (c)250 W (d)2000 W	
4	The resistance of hot tungsten filament is about 10 times the cold resistance. What will be the resistance of 100 W and 200 V lamp, when not in use? (a)40Ω (b)20Ω (c)400Ω (d)200Ω	
5	A 4μF conductor is charged to 400 VD and then its plates are joined through a resistance of 1 kΩ. The heat produced in the resistance is (a)0.18 J (b)0.21 J (c)0.25 J (d)0.32 J	

CONCEPT-56: BASED ON BIOT-SAVART LAW AND MAGNETIC FIELD

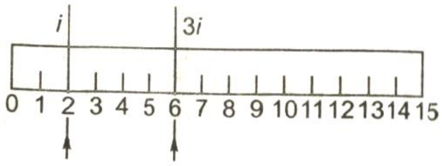
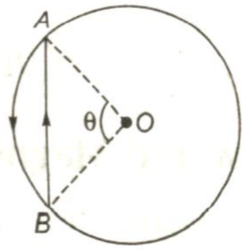
1	Two charged particles traverse identical helical paths in a completely opposite sense in a uniform magnetic field B = B_0k. (a) They have equal z- components of moments (b) They must have equal charges (c) They necessarily represent a particle-antiparticle pair (d) The charge to mass ratio satisfy: $\left(\frac{e}{m}\right)_1 + \left(\frac{e}{m}\right)_2 = 0$	
2	A horizontal overhead power line carries a current of 90 A	

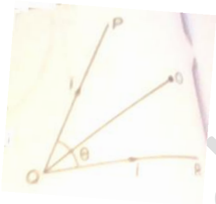
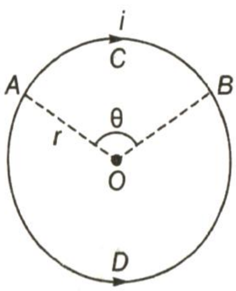
	in east to west direction. What are the magnitude and direction of the magnetic field due to the current 1.5 m below the line? (a) 1.2 x 10^{-5}T, perpendicularly outward to the plane of paper (b) 1.9 x 10^{-5}T, perpendicularly outward to the plane of paper (c) 2.6 x 10^{-5}T, perpendicularly inward to the plane of paper (d) 2.6 x 10^{-5}T, perpendicularly inward to the plane of paper	
3	Which of the following graph represents the variation of magnetic flux density B with distance r for a straight long wire carrying an electric current?  	
4	Biot-savart law indicates that the moving electrons (velocity V) produce a magnetic field B such that (a) B $\perp$ v (b) B $\parallel v$ (c) It obeys inverse cube law (d) it is along the line joining the electron and point of observation	
5	a pair of stationary and infinite long bent wires are placed in the xy-plane. The wires carrying currents of 10 A each as shown in figure. The segments L and M are parallel to x-axis. The segments P and Q are parallel to y-axis, such that Os = OR =0.02 m. the magnetic field induction at the origin O is	

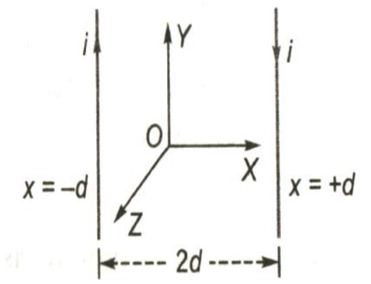
	 (a) 10^{-1} T (b) 4×10^{-3} T (c) 2×10^{-4} T (d) 10^{-4}T	
6	A uniform electric and magnetic fields are produced pointing in the same direction. If an electron is projected with its velocity pointing in the same direction. (a) The electron velocity will decrease in magnitude (b) The electron velocity will increase in magnitude (c) Neither (a) nor (b) (d) None of the above	
7	Two long and parallel straight wires A and B carrying current of 8.0 A and 5.0 A in the same direction are separated by a distance of 4.0 cm. Estimate the force on a 10 cm section of wire A? (a)1.5×10^{-5} N (b)2×10^{-5} N (c)4×10^{-5} N (d)3.2×10^{-5} N	
8	A length l of wire carries a steady current i. It is bent first to form a circular plane coil of one turn. The same length is now bent more sharply to give three loops of smaller radius. The magnetic field at the centre caused by the same current is (a) One-third of its value (b) Unaltered (c) Three times of its initial value (d) Nine times of its initial value	
9	The magnetic field normal to the plane of a wire of n turns and radius r which carries a current I is measured on the axis of the coil at a small distance h from the centre of the coil. This is smaller than the magnetic field at the centre by the fraction (a)$(2/3)r^2/h^2$ (b)$(3/2)\ r^2/h^2$ (c)$(2/3)\ h^2/\ r^2$ (d)$(3/2)\ h^2/\ r^2$	
10	The magnetic field of the earth can be modeled by that of a point dipole placed at the centre of the earth. The dipole axis makes an angle of 11.3^o with the axis of the earth. At Mumbai declination is nearly zero. Then (a) The declination varies between 11.3W to 11.3^oE (b) The least declination is 0^o (c) The plane defined by dipole and the earth axis posses through Greenwich	

	(d) Declination average over the earth must be always negative	
11	An element, dl = dx$\hat{i}$ (where dx = 1 cm) is placed at the origin and carries a large current I = 10 A. What is the magnetic field on the y-axis at a distance of 0.5 cm? (a)$2 \times 10^{-8}\hat{k}$ T (b) $4 \times 10^{-8}\hat{k}$ T (c)$-2 \times 10^{-8}\hat{k}$ T (d)$-4 \times 10^{-8}\hat{k}$ T	
12	A circular coil A of radius r carries current i. Another circular coil B of radius 2r carries current of i. the magnetic fields at the centres of the circular coils are in the ration of (a)3 : 1 (b04 : 1 (c)1 : 1 (d)2 : 1	

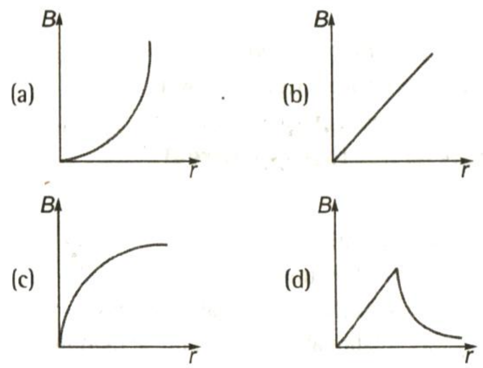
CONCEPT-57: BASED ON MAGNETIC FIELD DUE TO VARIOUS CURRENT CARRYING CONDUCTORS

1	Two parallel long straight conductors are placed at right angle to the meter scale at the 2 cm and d6 cm marks as shown in the figure. If they carry currents I and 3i respectively in the same direction, then they will produce zero magnetic field at  (a)zero mark (b)9 cm mark (c)3 cm mark (d)7 cm mark	
2	Net magnetic field at the centre of the circle O due to a current through a loop as shown in figure ($\theta < 180^o$)  (a) zero (b) Perpendicular to paper inwards (c) Perpendicular to paper outwards (d) Perpendicular to paper outwards if $90^o \leq \theta < 180^o$	
3	A current carrying circular loop of radius R is placed in the x-y plane with centre at the origin. Half of the loop with x>0 is now bent so that it now lies in the y-z plane. (a) The magnitude of magnetic moment now diminishes (b) The magnetic moment does not change (c) The magnitude of B at (0, 0, z), z>>R increases	

	(d) The magnitude of B at (0, , z), z>>R I unchanged	
4	Two parallel long wires A and B carry currents i_1 and i_2 ($<i_2$). When i_1 and i_2 are in the same direction, the magnetic field at a point mid way between the wires is 10μT. If i_2 is reversed, the field becomes 30μT. The ratio, i_1/i_2 is (a)1 (b)2 9c)3 (d)4	
5	Two straight long conductors AOB and COD are perpendicular to each other and carry currents i_1 and i_2. The magnitude of the magnetic induction at a perpendicular to the plane ABCD, is (a) $\frac{\mu_0}{2\pi a}(i_1+i_2)$ (b) $\frac{\mu_0}{2\pi a}(i_1-i_2)$ (c) $\frac{\mu_0}{2\pi a}(i_1-i_2)$ (d) $\frac{\mu_0}{2\pi a}\frac{i_1 i_2}{(i_1+i_2)}$	
6	Two wires PQ and QR, carry equal currents I as shown in figure. One end of both the wires extends to infinity $\angle PQR = \theta$. The magnitude of the magnetic field at O on the bisector angle of these two wires at a distance r from point Q, is  (a) $\frac{\mu_0}{4\pi}\frac{i}{r}\sin\frac{\theta}{2}$ (b) $\frac{\mu_0}{4\pi}\frac{i}{r}\cot\theta$ (c) $\frac{\mu_0}{4\pi}\frac{i}{r}\tan\frac{\theta}{2}$ (d) $\frac{\mu_0}{4\pi}\frac{i}{r}\left(\frac{1+\cos\theta/2}{(\sin\theta/2)}\right)$	
7	Equal current I flows in two segments of a circular loop in the direction shown in figure. Radius of the loop is r. The magnitude of magnetic field induction at the centre of the loop is  (a)zero (b) $\frac{\mu_0 i\theta}{3\pi r}$	

	(c) $\frac{\mu_0}{2\pi}\frac{i}{r}(\pi-\theta)$ (d) $\frac{\mu_0}{2\pi}\frac{i}{r}(2\pi-\theta)$	
8	In the given diagram two long parallel wires carry equal currents in opposite direction. Point O is situated midway between the wires and the XY—plane contains the two wires and the positive Z-axes comes normally out of the plane of paper. The magnetic field, B at O is non-zero along  (a)X,Y and Z-axes (b)X-axis (c)Y-axis (d)Z-axis	
9	An electron is projected with uniform velocity along the axis of a current carrying long solenoid. Which of the following is true? (a) The electron will be accelerated along the axis (b) The electron will be circular about the axis (c) The electron will experience a force at 45^o to the axis and hence execute a helical path (d) The electron will continue to move with uniform velocity along the axis of the solenoid	

CONCEPT-58: BASED ON AMPERE'S CIRCUITAL LAW AND SOLENOID

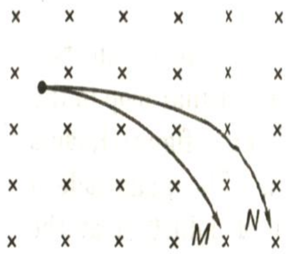
1	The magnetic flux density B at a distance r from a long straight rod carrying a steady current varies with r as shown in figure. 	
2	A closely wound solenoid 80 cm long has 5 layers of windings of 400 turns each. The diameter of the solenoid is 1.8 cm. If the current carried is 8.0 A, estimate the magnitude of B inside the solenoid near its centre (a) 1.5 x 10^{-2}T, opposite to the axis of solenoid	

	(b) 2.5 x 10^{-2}T, along the axis of solenoid (c) 3.5 x 10^{-2}T, along the axis of solenoid (d) 1.5 x 10^{-2}T, opposite the axis of solenoid	
3	Let the magnetic field on the earth be modeled by that of a point magnetic dipole at the centre of the earth. The angle of dip at a point the geographical equator (a) Is always zero (b) Can be zero at specific points (c) Can be positive or negative (d) Is bounded	
4	A long straight, solid metal wire of radius 2 mm carries a current uniformly distributed over its circular cross-section. The magnetic field induction at a distance 2 mm from its axis is B. Then, the magnetic field induction at distance 1 mm from axis will be (a)B (b)B/2 (c)2B (d)B	
5	A current of I ampere flows along an infinitely long straight thin walled tube, then the magnetic induction at any point inside tube is (a)infinite (b) zero (c) $\frac{\mu_0 2i}{4\pi r}T$ (d) $\frac{\mu_0 i}{2r}T$	

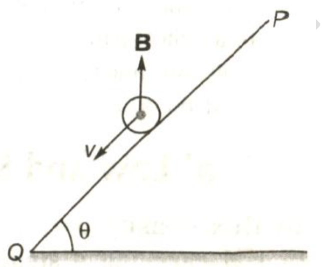
CONCEPT-59: BASED ON FORCES ON CHARGED PARTICLE IN ELECTRIC AND MAGNETIC FIELDS

1	A circular current loop of magnetic moment M is in an arbitrary orientation in an external magnetic field B. the work done to rotate the loop by 30° about an axis perpendicular to its plane is (a)MB (b) $\sqrt{3}\frac{MB}{2}$ (c) $\frac{MB}{2}$ (d)zero	
2	A deuteron of kinetic energy 50 ke V is describing a circular orbit of radius 0.d m, is plane perpendicular to magnetic field B. The kinetic energy of proton that describes a circular orbit 0.5 m in the same plane with the same magnetic field B, is (a)200 keV (b)50 keV (c)100 keV (d)25 keV	
3	A proton, a deuteron and an α-particle enter a magnetic field perpendicular to field with same velocity. What is the ratio of the radii of circular paths? (a)1 : 2 : 2 (b)2 : 1: 1	

	(c)1 : 1 : 2 (d)1 : 2: 1	
4	A particle of charge q and mass m starts moving from the origin under the action of an electric field, E = $E_0\ \hat{i}$ and B = B $\hat{i}$ with a velocity, $v = v_0\ \hat{j}$. The speed of the particle will becomes $\frac{\sqrt{5}}{2}\ v_0$ after a time (a) $\frac{mv_0}{qE}$ (b) $\frac{mv_0}{2qE}$ (c) $\frac{\sqrt{3}mv_0}{2qE}$ (d) $\frac{\sqrt{5}mv_0}{2qE}$	
5	A proton, a deuteron and an α-particle with the same kinetic energy enter a region of uniform magnetic field, moving at right angle to B. What is the ratio of the radius of their circular paths? (a)1 : $\sqrt{2}$: 1 (b)1 : $\sqrt{2}$: $\sqrt{2}$ (c) $\sqrt{2}$: 1 : 1 (d) $\sqrt{2}$; $\sqrt{2}$: 1	
6	A proton of mass 1.67 x 10^{-27}kg and charge 1.6 x 10^{-19} C is projected with a speed of 2 x 10^6 ms^{-1} at an angle of 60^o to the x-axis. If a uniform magnetic field of 0.104 T is applied along y-axis, the path of proton is (a) A circle of radius = 0.2 m and time period = 2π x 10^{-7} S (b) A circle of radius = 0.1 m and time period = 2π x 10^{-7} S (c) A helix of radius = 0.1 m and time period = 2π x 10^{-7} S (d) A helix of radius = 0.2 m and time period = 2π x 10^{-7} S	
7	An electron and a proton enter a magnetic field perpendicularly. Both have same kinetic energy. Which of the following is true? (a) Trajectory of electron is true (b) Trajectory of proton is less curved (c) Both trajectories are equally curved (d) Both more on straight line path	
8	A uniform magnetic field, B = $B_0\ \hat{j}$ exists in space. A particle of mass m and charge, q is projected towards x-axis with speed, v from a point (a, 0, 0). The maximum value of v for which the particle does not hit the yz-plane is (a) $\frac{Bqa}{m}$ (b) $\frac{Bqa}{2m}$ (c) $\frac{Bq}{am}$ (d) $\frac{Bq}{2am}$	
9	Two charged particles M and N enter a space of uniform magnetic field. The paths are as shown in figure. The possible reason (s) is/are	

	 (a) The charge of M is greater than that of N (b) The momentum of M is greater than of N (c) Specific charge of M is greater than that of N (d) The speed of M is greater than that of N	
10	A particle of mass, m and charge, q is placed at a rest in a uniform electric field, E and then released. The kinetic energy attained by the particle after moving a distance, y is (a)qEy^2 (b)qE^2y (c)qEy (d)q^2Ey	
11	A been of protons is moving parallel to a beam of electrons. Both the beams will tend to (a)repel each other (b)come closer (c)move more apart (d)either (b) or (c)	

CONCEPT-60: BASED ON FORCE AND TORQUE ON A CURRENT CARRYING CONCUCVTOR/COIL IN A MAGNETIC FIELD

1	A conducting rod of length, l and mass, m is moving down a smooth inclined plane of inclination, θ with constant speed, v. A vertically upward magnetic field B exists in space there. The magnitude of magnetic field, B is  (a) $\frac{mg}{il}\sin\theta$ (b) $\frac{mg}{il}\cos\theta$ (c) $\frac{mg}{il}\tan\theta$ (d) $\frac{mg}{il\sin\theta}$	
2	A current i_1 carrying wire AB is placed near an another long wire CD carrying current i_2 as shown un figure. If free to move, wire AB will have	

(a) Rotational motion only
(b) Translational motion only
(c) Rotational as well as translational motion
(d) Neither rotational nor translational motion

3 A wire of length, l is bent in the form of circular coil of some turns. A current, I flows through the coil. The coil is placed in a uniform magnetic field, B. The maximum torque on the coil can be

(a) $\frac{iBl^2}{2\pi}$ (b) $\frac{iBl^2}{4\pi}$ (c) $\frac{iBl^2}{\pi}$ (d) $\frac{2iBl^2}{\pi}$

4 A square coil of side 10 cm consist of 20 turns and carries a current of 12 A. The coil is suspended vertically and the normal to the plane of the coil makes an angle of 30^o with the direction of a uniform horizontal magnetic field of magnetic 0.80 T. what is the magnitude of torque experienced by the coil?

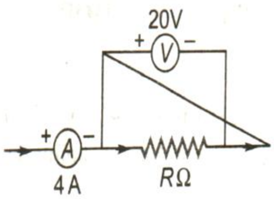
(a)0.96 N-m (b)2.06 N-m
(c)0.23 N-m (d)1.36 N-m

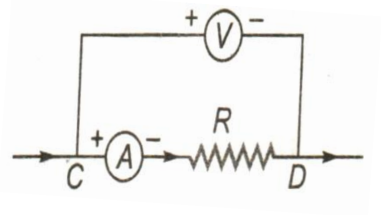
5 Two very long straight parallel wires carry currents I and 2i in opposite directions. The distance between the wires is r. At a certain instant of time a point charge, q is at a point equidistant from the two wires in the plane of the wires. Its instantaneous velocity v is perpendicular to this plane. The magnitude of the force due to the magnetic field acting on the charge at this instant is

(a)zero (b) $\frac{3\mu_0}{2\pi}\frac{iqv}{r}$
(c) $\frac{\mu_0}{\pi}\frac{iqv}{r}$ (d) $\frac{\mu_0}{2\pi}\frac{iqv}{r}$

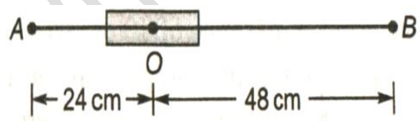
6 A metal wire of mass m slides without friction on two rails placed at a distance l apart. The track lies in a uniform vertical magnetic field B. A constant current I flows along the rails across the wire and brack down the other rail. The acceleration of the wire is

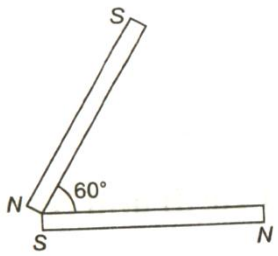
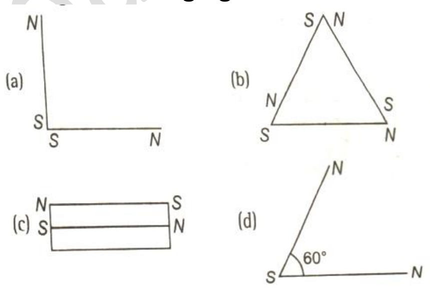
(a) $\frac{Bmi}{l}$ (b)mBi l (c) $\frac{Bil}{m}$ (d) $\frac{mil}{B}$

7	A moving coil galvanometer gives full scale deflection, when a current o 0.005 A is passed through its coil. It is converted into a voltmeter reading upto 5 V by using an external resistance of 975 Ω. What is the resistance of the galvanometer coil? (a)30 Ω (b)25 Ω (c)50 Ω (d)40 Ω	
8	A candidate connects a moving coil ammeter A and a moving coil voltmeter, V and a resistance, R as shown in figure. If, the voltmeter reads 20 V and the ammeter reads 4A, then R is  (a) equal to 5 Ω (b) greater than 5 Ω (c) less than 5 Ω (d) greater or less than 5 Ω depending upon its material	
9	A voltmeter has resistance of 2000 Ω and it can measure upto 2 V. If we want to increase its range by 8 V, then required resistance in series will be (a)4000 Ω (b)6000 Ω (c)7000 Ω (d)8000 Ω	
10	A galvanometer has a resistance of 100 Ω and full scale range of 50μA. it can be used as a voltmeter or as a higher range ammeter provided a resistance is added to it. Pick the correct range and resistance combinations (a)1 Ω in parallel (b)10^{-3} in parallel (c)10^{5} in series (d)100 Ω in series	
11	A microammeter has a resistance of 100 Ω and full scale range of 50μA. it can be used as a voltmeter or as a higher range ammeter provided a resistance is added to it. Pick the correct range and resistance combinations (a) 50 V range with 10 kΩ resistance in series (b) 10 V range with 200 kΩ resistance in series (c) 10 mA range with 1 Ω resistance in parallel (d) 10 mA range with 0.1 Ω resistance in parallel	
12	A candidate connects a moving coil voltmeter V and a moving coil ammeter A and resistor R as shown in figure? If the voltmeter reads 10 V and the ammeter reads 2 A, then R is	

	 (a) Equal to 5Ω (b) Greater than 5Ω (c) Less than 5Ω (d) Greater or less than 5Ω depending upon its material	
13	An ammeter has resistance R_0 and range I. what resistance should be connected in parallel with it to increase its range by nI ? (a)R_0/(n-1) (b) R_0/(n+1) (c) R_0/n (d)None of these	

CONCEPT-61: BASED ON FIELDS DUE TO MAGNETIC DIPOLE, TORQUE ON DIPOLE AND ITS POTENTIAL ENERGY

1	A magnet of magnetic moment μ and pole strength m is divided in two equal parts, the magnetic moment of each part will be (a)M (b)M/2 (c)M/4 (d)2M	
2	The magnetic potential due to a magnetic dipole at a point on its axis distant 40 cm from its centre is found to be 2.4 x $10^{-5}JA^{-1}m^{-1}$. The magnetic moment of the dipole will be (a)28.6 Am^2 (b)32.2 Am^2 (c)38.4 Am^2 (d)None of these	
3	A magnetic needle lying parallel to a magnetic field required W units of work to turn it through 60^o. the torque required to maintain the needle in this position will be (a) $\sqrt{3}W$ (b)W (c) $\sqrt{3}\frac{W}{2}$ (d) $2W$	
4	A bar magnet of length 3 cm has a point A and B along axis at a distance of d24 cm and 48 cm on the opposite ends. Ratio of magnetic fields at these points will be  (a) 8 (b)3 (c)4 (d)1/2 $\sqrt{2}$	
5	Rate of change of torque τ with deflection q is maximum for a magnet suspended freely in a uniform magnetic field of induction B, when (a) $\theta = 0^o$ (b) $\theta = 45^o$ (c) $\theta = 60^o$ (d) $\theta = 90^o$	

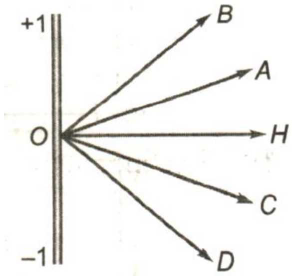
6	Two short bar magnets with magnetic moments 400 ab-amp cm^2 are placed with their axis in the same straight line with similar poles facing each other and with their centres at 20 cm from each other. Then the force of repulsion is (a)12 dyne (b)6 dyne (c)800 dyne (d)150 dyne	
7	Two magnets have the same length and the same pole strength. But one of the magnets has a smell hole at its centre. Then (a) Both the equal magnetic moment (b) One with hole has smaller magnetic moment (c) One with hole has large magnetic moment (d) One with hole loses magnetism through the hole	
8	Two magnets of equal magnetic moments M each are placed as shown in figure. The resultant magnetic moment is  (a)M (b) $\sqrt{3}M$ (c) $\sqrt{2}M$ (d) $M/2$	
9	A short bar magnet placed with its axis at 30^o with a uniform external magnetic field of 0.25 T experiences a torque of magnitude equal to 4.5 x 10^{-2}J, then the magnitude of magnetic moment of the magnet is? (a)0.36 J/T (b)3.6 J/T (c)8. 6 J/T (d)0.86 J/T	
10	In which orientation the resultant magnetic of two magnets, will be zero, if magnetic moment of each magnets is M in the following figures? 	
11	A closely wound solenoid of 800 turns and area of cross-section 2.5 x 10^{-4} m^2 carries a current of 3.0 A. Explain the sense in which the solenoid acts like a bar magnet. What is its associated magnetic moment? (a)6 J/T (b)0.9 J/T (c)9 J/T (d)0.6 J/T	
12	A bar magnet is cut into two equal halves by a plane	

	parallel to the magnetic axis. Of the following physical quantities, the one which remains unchanged is (a) pole strength (b) magnetic moment (c) intensity of magnetization (d) moment of inertia	
13	A toroid of n turns, mean radius R and cross-sectional radius carries current I. It is placed on a horizontal table taken as x-y plane. Its magnetic moment M (a) Is non-zero and points in the z-direction by symmetry (b) Points along the axis of the toroid (**m** = m) (c) Is zero, otherwise there would be a field falling as $\frac{1}{r^3}$ at large distances outside the toroid (d) Is pointing radially outwards	

CONCEPT-62: BASED ON MAGNETISM OF EARTH AND NEUTRAL POINTS

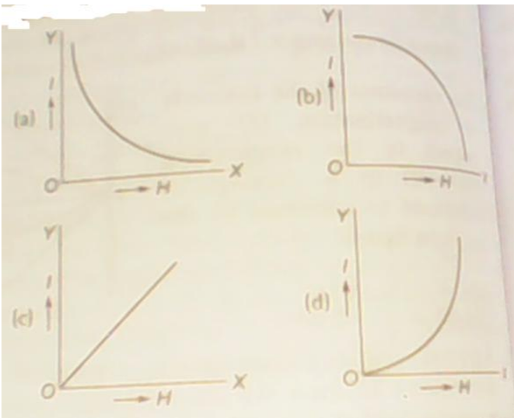
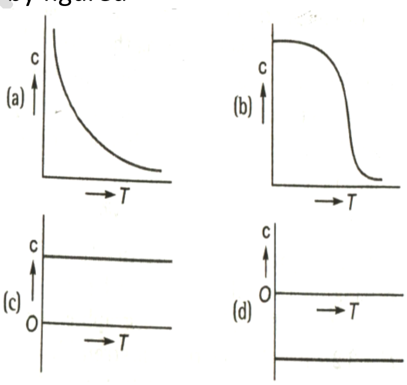
1	The vertical component of earth's magnetic field always has a vertical component except at the (a)magnetic poles (b)geographic poles (c)every place (d)magnetic equator	
2	The earth's magnetic field at a certain place has a horizontal component of 0.3G and total strength 0.5G. Find angle of dip in tan^{-1}. (a) $\delta = \tan^{-1}\frac{4}{3}$ (b) $\delta = \tan^{-1}\frac{3}{4}$ (c) $\delta = \tan^{-1}\frac{5}{3}$ **(d)** $\delta = \tan^{-1}\frac{3}{5}$	
3	A short bar magnet with the north pole facing north forms a neutral point a P in the horizontal plane the magnet is rotated by 90^o in the horizontal plane, the net magnetic induction at P is (Horizontal component of earth's magnetic field = B_H) (a)zero (b) $2B_H$ (c) $\frac{\sqrt{5}}{2}B_H$ (d) $\sqrt{5}B_H$	
4	The earth magnetic induction at a certain point is 7 x 10^{-1} Wbm^{-2}. This is to be annulled by the magnetic induction at the centre of a circular conducting loop of radius 15 cm. The required current in the loop is (a)0.56A (b)5.6A (c)0.28A (d)2.8A	
5	A bar magnet is placed north-south with its north pole	

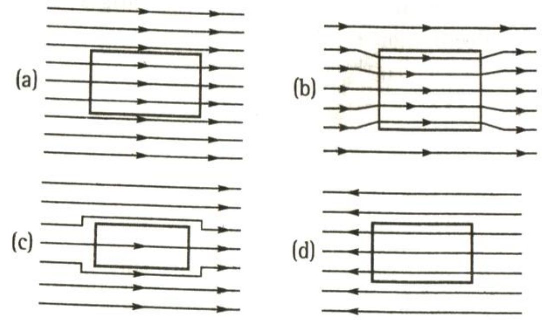
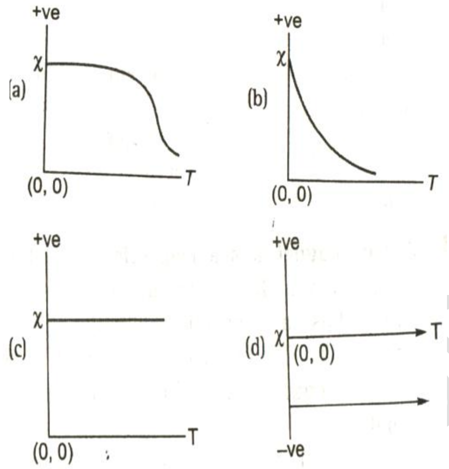
	due north. The points of zero magnetic field will be in which direction from centre of magnet (a) North and south (b) East and west (c) North-east and south-west (d) North-east and south-east	
6	The magnetic field of the earth can be modelled by that of a point dipole placed at the centre of the earth. The dipole axis makes an angle of 11.3^o with the axis of the earth. At Mumbai, declination is nearly zero. Then (a) The declination varies between 11.3^o W to 11.3^o E (b) The least declination is 0^o (c) The plane defined by dipole axis and Earth axis passes through Greenwich (d) Declination averaged over Earth must be always negative	
7	A magnetic placed on a paper in a horizontal plane for locating neutral points. A dip needle placed at the neutral point will be horizontal at the (a)magnetic poles (b)magnetic equator (c)latitude angle 45^o (d)latitude angle of 60^o	
8	A bar magnet 20 cm in length is placed with its south pole towards geographic north. The neutral points are situated at a distance of 40 cm from centre of the magnet. If horizontal component of earth's field 3.2 x 10^{-5}T, then pole strength of magnet is (a)5 Am (b)10 Am (c)45 Am (d)20 Am	
9	In a permanent magnet at room temperature (a) Magnetic moment of each molecule is zero (b) The individual molecules have non-zero magnetic moment which are all perfectly aligned (c) Domains are partially aligned (d) Domains are all perfectly aligned	
10	At a certain place, the horizontal component of the earth's magnetic field is B_0 and the angle of dip is 45^0. The total intensity of the field at that place will be (a) B_0 (b) $\sqrt{2}B_0$ (c) $2B_0$ (d) B_0^2	
11	Consider the two idealized systems : (i) a parallel plate capacitor with large plates and small separation and (ii) a long solenoid of length $L \gg R$, radius of cross-section. In (i) E is ideally treated as a constant between plates and zero outside. In (ii) magnetic field is constant inside the solenoid and zero outside. These idealized assumptions, however, contract fundamental laws as below (a) Case (i) contradicts Gauss's law for electrostatic fields. (b) Case (i) contradicts Gauss's law for magnetic fields (c) Case (i) agrees with $\int \mathbf{E}.d\mathbf{l} = 0.$	

	(d) Case (ii) contradicts $\int H.d\mathbf{l} = I_{en}$	
12	The variation of the intensity of magnetization (I) with respects to the magnetizing field (H) in a diamagnetic substance is described by the graph in figure.  (a)OD (b)OC (c)OB (d)OA	
13	A rod of ferromagnetic material with dimensions 10 cm x 0.5 cm x 0.2 cm is placed in a magnetic field of strength 0.5 x 10^4 Am^{-1} as a result of which a magnetic moment of 5 $A\text{-}m^{-2}$ is produced in the rod. The value of magnetic induction will be (a)0.54 T (b)6.28 T (c)0.358 T (d)2.591 T	
14	The space inside a toroid is filled with tungusten shoes susceptibility is 6.8 x 10^{-5}. The percentage increase in the magnetic field will be (a)0.0068% (b)0.068% (c)0.68% (d)None of these	
15	The horizontal component of flux density of earth's magnetic field is 1.7 x 10^{-5}T. the value of horizontal component of intensity of earth's magnetic field will be (a)24.5 Am^{-1} (b)13. 5 Am^{-1} (c)1.55 Am^{-1} (d)0.35 Am^{-1}	
16	A loop of area $0.5m^{-2}$ is placed in a magnetic field of strength 2 T in direction making an angle of 30^o with the field. The magnetic flux linked with the loop will be (a) $\frac{1}{2}Wb$ (b) $\sqrt{\frac{3}{2}}Wb$ (c) $2Wb$ (d) $\frac{\sqrt{3}}{2}Wb$	
17	The time period of a thin bar magnet in earth's magnetic field is T. if the magnet is cut into four equal parts perpendicular to its length, the time period of each part in the same field will be (a)T/2 (b)T/4 (c) $\sqrt{2T}$ (d)2 T	
18	a magnet freely suspended in a vibration magnetometer makes 40 oscillations per minute at a place A and 20 oscillations per minute a place B. If the horizontal component of earth's magnetic field at A is 36 x 10^{-6} T,	

	then its value at B is (a)36×10^{-6}T (b)9×10^{-6}T (c)144×10^{-6}T (d)228×10^{-6}T	
19	Two magnet held together in earth's magnetic field with same polarity together make 12 vib-min^{-1} and when opposite poles together make 4 vib-min^{-1}. The ratio of magnetic moments is (a)9 :1 (b)1 : 3 (c)1 : 9 (d)5 : 4	
20	A magnet performs 10 oscillations per minute in a horizontal plane at a place where the angle of dip is 45^o and the total intensity is 0.707 CGS units. The number of oscillations per minute at a place where dip angle is 60^o and total intensity is 0.5 CGS units will be (a)5 (b)7 (c)9 (d)11	
21	A circular coil of 16 turns and radius 10 cm carrying a current of 0.75 A rests with its plane normal to an external field of magnitude 5.0×10^{-2} T. The coil is free to turn about an axis in its plane perpendicular to the field direction. When the coil is turned slightly and released, it oscillates about its stable equilibrium with a frequency of 2.0/s. What is the moment of inertia of the coil about its axis of rotation? (a)1.2×10^{-4} g-cm^2 (b)3×10^{-4} g-cm^2 (c)0.3×10^{-4} g-cm^2 (d)1.2×10^{-4} g-cm^2	
22	At a certain place a magnet makes 30 oscillations per minute. At another place where the magnetic field is double, its time period will be (a) $\sqrt{2}s$ (b)2s (c)4 s (d) $\frac{1}{2}s$	
23	Two bar magnets having same geometry with magnetic moments M and 2M are firstly placed in such a way that their similar poles are same side. Time period of oscillations is T_1. Now the polarity of one of the magnets is reversed, and time period of oscillations is T_1. Now the polarity of one of the magnets is reversed and time period of oscillation is T_2 (a) $T_1 < T_2$ (b) $T_1 = T_2$ (c) $T_1 > T_2$ (d) $T_2 = \infty$	
24	The magnetic needle of a tangent galvanometer is deflected at an angle 30^o due to a magnet. The horizontal component of earth's magnetic field 0.34×10^{-4}T is along the plane of the coil. The magnetic intensity is (a)1.96×10^{-4}T (b) 1.96×10^{4}T (c) 1.96×10^{-5}T (d) 1.96×10^{-5}T	
25	The period of oscillation of a freely suspended bar magnet is 4 s. If it is cut two equal parts in length, then the time period of each part will be (a)4 s (b)2 s (c)0.5 s (d)0.25 s	

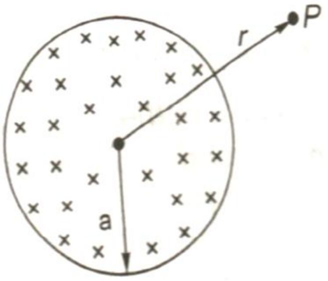
26	Two tangent galvanometers having coils of the same radius are connected in series. A current flowing in them produces deflections of 60° and 45° respectively. The ratio of the number of turns in the coils is (a)4/3 (b) $\left(\sqrt{3}+1\right)/1$ (c) $\frac{\sqrt{3}+1}{\sqrt{3}-1}$ (d) $\frac{\sqrt{3}}{1}$	
27	A paramagnetic sample shows a net magnetization of 8 Am^{-1} when placed in an external magnetic field of 0.6 T at a temperature of 4 K. When the same sample is placed in an external magnetic field of 0.2T at a temperature of16 K, the magnetization will be (a) $\frac{32}{3}Am^{-1}$ (b) $\frac{2}{3}Am^{-1}$ (c) $6Am^{-1}$ (d) $2.4Am^{-1}$	
28	A tangent galvanometer has a coil of 25 turns and a radius of 15 cm. The horizontal component of the earth's magnetic field is 3 x 10^{-5}T. the current required to produce a deflection of 45° in it is (a)0.29 A (b)0.14 A (c)1.2 A (d)3.6 x 10^{-5}A	
29	A bar magnet is oscillating in the Earth's magnetic field with a period T. What happens to its period of motion if its mass is quadrupled? (a) Motion remains SHM with time period = T/2 (b) Motion remains SHM and period remains nearly constant (c) Motion remains SHM with time period = 2T (d) Motion remains SHM with time period = 4T	
30	A vibration magnetometer consists of two identical bar magnets placed one over the other such that they are perpendicular and bisect each other. The time period of oscillation in a horizontal magnetic field is $2^{5/4}$s. one of the magnets is removed and if the other magnet oscillates in the same field, then the time period in second is (a) $2^{1/4}$ (b) $2^{1/2}$ (c) 2 (d)4	
31	The time of vibration of a dip needle vibrating in the vertical plane is 3s. When magnetic needle is made to vibrate in the horizontal plane, the time of vibration is $3\sqrt{2}$ s. Then the angle of dip is (a)30° (b)45° (c)60° (d)90°	
32	A compass needle placed at a distance r from a short magnet in tan A position shows a deflection of 60°. if the	

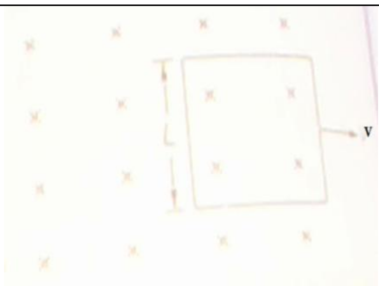
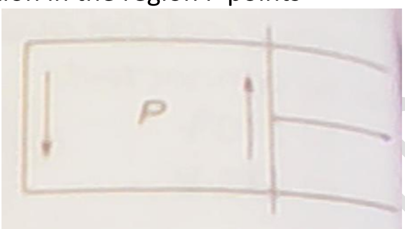
	distance is increased to r $(2)^{1/3}$, the deflection of compass needle is (a)30^o (b)60^o (c)45^o (d) 0^o	
33	The correct I-H curve for a paramagnetic material is represented by, figure. 	
34	A circular current loop of magnetic moment is in an arbitrary orientation in an external magnetic field B. The work done to rotate the loop by 30^o about an axis perpendicular to is planers (a) MB (b) $\sqrt{3}\dfrac{MB}{2}$ (c) $\dfrac{MB}{2}$ (d)0	
35	Two bar magnets of the same mass, same length and breadth but having magnetic moments M and 3M are joined together pole and suspended by a string. The time period of assembly in a magnetic field of strength H is 3 s. If now the polarity of one of the magnets is reversed and the combination is again made to oscillate in the same field, the time of oscillation is (a)3 s (b)3$\sqrt{3}$ s (c)3/$\sqrt{3}$ s (d)6s	
36	The variation of magnetic susceptibility (χ) with temperature for a diamagnetic substance is best represented by figured 	

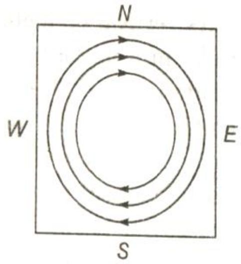
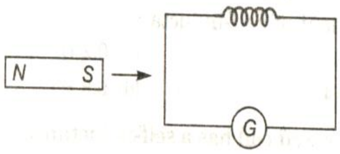
37	A uniform magnetic field parallel to the plane of paper, existed in space initially directed from left to right. When a bar of soft iron is placed in the field parallel to it, the lines of force passing through it will be represented by figure. 	
38	The variation of magnetic susceptibility (χ) with absolute temperature T for a ferromagnetic is given in figure, by 	
39	A copper rod is suspended a non-homogeneous magnetic field region. The rod when in equilibrium will align itself (a) In the region where magnetic field is strongest (b) In the region where magnetic field is weakest and parallel to direction of magnetic field there (c) In the direction in which it was originally suspended (d) In the region where magnetic field is weakest and perpendicular to the direction of magnetic field there	
40	The relative permeability of a substance X is slightly less than unity and that of substance Y is slightly more than unity, then (a) X is paramagnetic and Y is ferromagnetic (b) X is diamagnetic and Y is ferromagnetic (c) X and Y both are paramagnetic (d) X is diamagnetic and Y is paramagnetic	
41	The magnetizing field required to be applied in opposite direction to reduce residual magnetism to zero is called (a)coercivity (b)retentivity (c)hysteresis (d)None of the above	
42	The hysteresis cycle for the material of a transformer core is	

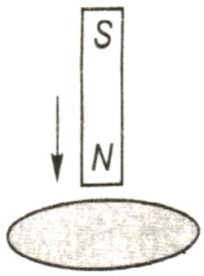
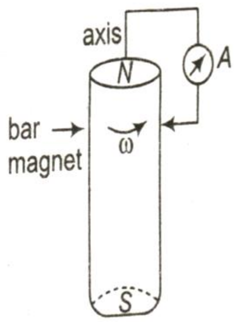
	(a)short and wide (b)tall and narrow (c)tall and wide (d)short and narrow	

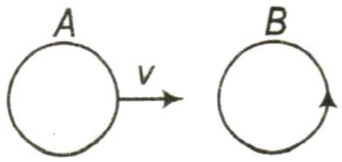
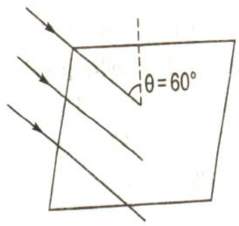
CONCEPT-63: BASED ON ELECTRO MAGNETIC INDUCTION, ALTERNATING CURRENT

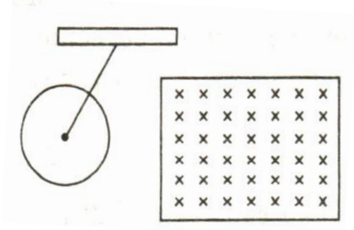
1	A cylindrical bar magnet is kept along the axis of a circular coil. The magnet is rotated about its axis such that north pole faces the coil. The induced current in the coil (a) is zero (b) is clockwise from magnet side (c) may be clockwise or anti-clockwise (d) is anti-clockwise from magnet side	
2	A uniform but time varying magnetic field B(t) exists in a circular region of radius a and is directed into the plane of e paper as shown in figure. The magnitude of induced electric field at point P at a distance r from the centre of the circular region  (a)is zero (b)decreases as 1/r (c)increases as r (d)decreases as $1/r^2$	
3	A jet plane is travelling towards west at a speed of 1800 km/h. What is the voltage difference developed between the ends of the wing having a span of 25 n, if the earth's magnetic field fat the location has a magnitude of 5 x 10^{-4} T and the dip angle is 30^o. (a)2.1V (b)3.1V (c)4.1 V (d)5.2V	
4	The wing span of an aeroplane is 36 m. if the plane is flying at 400 kmh^{-1}, the emf induced between the wings tips is (Assume V = 4 x 10^{-5} T) (a)16 v (b)1.6 V (c)4.1 V (d)0.016 V	
5	A conducting square loop of side LO and resistance R moves in its plane with a uniform velocity u perpendicular to one of its sides. A magnetic induction B constant in time and space pointing perpendicular and into the plane of the loop outside the field, as shown in figure. The induced emf is	

	 (a)BvR (b)vBL/R (c)vBL (d)BLv/2	
6	A square of side L metres lies in the x-y plane in a region. Where the magnetic field is given by $B = B_0(2\hat{i} + 3\hat{j} + 4\hat{k})\text{T}$, where B_0 is constant. The magnitude of flux passing through the square is (a) $2B_0L^2wb$ (b) $3B_0L^2wb$ (c) $4B_0L^2wb$ (d) $\sqrt{29}B_0L^2wb$	
7	A movable wire is moved to the right crossing an anti-clockwise induced current, figure. The direction of magnetic induction in the region P points  (a)to the right (b)to the left (c)up the paper (d)down into the paper	
8	A copper ring is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring. The acceleration of the falling magnet while it is passing through the ring is (a) More than that due to gravity (b) Less than that due to gravity (c) Depends on the diameter of the ring and the length of the magnet (d) None of the above	
9	An aeroplane in which the distance between the tips of the wings in 50 m is flying horizontally with a speed of 360 kmh^{-1} over a place where the vertical component of earth's magnetic field is 2 x 10^{-4} Wbm^{-2}. The potential difference between the tips of the wings would be (a)0.1 V (b)1.0 V (c)0.2 V (d)0.01 V	
10	A loop, made of straight edges has six corners at $A(O,O,O), B(L,O,O), C(L,L,O), D(O,L,O), E(0,L,L,)$ and $F(0,0,\text{L})$. A magnetic field B = B_o = $\left(\hat{i} + k\right)$ T is present in the region. The flux passing through the loop ABCDEFA (in that order)is	

	(a) B_0L^2wb (b) $4B_0L^2wb$ (c) $\sqrt{2}B_0L^2wb$ (d) $2B_0L^2wb$	
11	When a sheet of metal is placed in a magnetic field, which changes from zero to a maximum value, the induced currents are set up in the direction of magnetic field?  (a) Into the plane of the paper (b) Out of the plane of the paper (c) West to east (d) South to north	
12	As shown in the figure, a magnet s moved with a fast speed towards a coil at rest. Due to this induced electromotive force, induced current and induced charge in the coil is E, I and Q respectively. If the speed of the magnet is doubled, the incorrect statement is  (a)E increases (b)I increases (c) Q remain same (d)Q increases	
13	The two rails of a railways track insulated from each other and the ground are connected to a milli-voltmeter. What is the reading of the mV, when a train travels at a speed of 180 kmh^{-1} along the track, given that the horizontal component of earth's magnetic field is 0.2 x 10^{-4} Wbm^{-2} and the rails are separated by 1m. (a)10^{-2} mV (b)10 mV (c) 10^{2} mV (d)1 mV	
14	A copper ring having a cut such as not to form a complete loop is held horizontally and a bar magnet is dropped through the ring with its length the ring with its length along the axis of the ring, figure. The acceleration of the falling magnet is	

	 (a)g (b)less than g (c)more than g (d)zero	
15	An axle of truck is 2.5 m long. If the truck is moving due north at 30ms^{-1} at a place where the vertical component difference between the two ends of the axle is d (a) 6.75 mV with west end positive (b) 6.75 mV with East end positive (c) 6.75 mV with North end positive (d) 6.75 mV with south end positive	
16	A cylindrical bar magnet is rotated about its axis. A wire and is made to touch the cylindrical surface through a contact. Then  (a) A direct current flows in the ammeter A. (b) No current flows through the ammeter A. (c) An alternating sinusoidal current flows through the ammeter A with a time period $T = \frac{2\pi}{\omega}$. (d) A time varying non-sinosoidal current flows through the ammeter A.	
17	A circular ring of diameter 20 cm has a resistance of 0.01 Ω. The charge that will flow through the ring if it is turned from a position perpendicular to a uniform magnetic field of 2.0T to a position parallel to the field is about (a)63 C (b)0.63 C (c)6.3 C (d)0.063 C	
18	There are two coils A and B as shown in figure. A current starts flowing in B as shown, when A is moved towards B and stops when A stops moving. The current in A is counterclockwise. B is kept stationary when A moves. We can infer that	

	 (a) There is a constant current in the clockwise direction in A. (b) There is a varying current in A. (c) There is no current in A. (d) There is constant current in the counterclockwise direction in A	
19	The charge which will flow through a 200Ω galvanometer connected to a 400Ω circular coil of 1000 turns wound on a wooden stick 20 mm in diameter, if a magnetic field B = 0.012T parallel to the axis of the stick decreased suddenly to zero is (a)6.3μC (b)63μC (c)0.63μC (d)630μC	
20	Same as problem 4 except the coil A is made to rotate about a vertical axis. No current flows in B if A is at rest. The current in coil A, when the current in B(at t = 0) is counterclockwise and the coil A is as shown at this instant, t = 0, is (a) Constant current clockwise (b) Varying current clockwise (c) Varying current counterclockwise (d) Constant current counterclockwise	
21	A square loop of wire of side 5 cm is lying on a horizontal table. An electromagnet above and to one side of the loop is turned on, causing a uniform magnetic field downwards at an angle of 60^{o} to the vertical as shown in the figure. The magnetic induction is 0.50 T. the average induced emf in the loop, if the field increase from zero to its final value in 0.2 s is  (a)5.4×10^{-3}V (b)312×10^{-3}V (c)0 (d)0.25×10^{-3}V	
22	A metallic ring connected to a rod oscillates freely like a pendulum. If now a magnetic field is applied in horizontal direction so that the pendulum now. Swings through the field, the pendulum will be	

	 (a) Keep oscillating with a smaller time period (b) Come to rest very soon (c) Keep oscillating with a larger time period (d) Keep oscillating with the now time period	
23	A coil as an area of 0.05 cm^2 and it has 800 turns. It is placed perpendicularly in a magnetic field of strength 4 x 10^{-5} Wb/m^2, it is rotated through 90^o in 0.1 s. The average emf induced in the coil is (a)0.016 V (b)0.032 V (c)0.064 V (d)0.029 V	
24	Two coils of self-inductances 2 mH and 8 mH are placed so close together that the effective. Flux in one coil is completely linked with the other. The mutual inductance between these coils is (a)16 mH (b)10 mH (c)4 mH (c)6 mH	
25	A coil is wound on a core of rectangular cross-section. If all the linear dimensions of core are increased by a factor 2 and number of turns per unit length of coil remains same, the self-inductance increases by a factor of (a)16 (b)8 (c)4 (d)2	
26	Two coils X and Y are placed in a circuit such that a current change by 2 A in coil X and magnetic flux change of 0.4 Wb occurs in Y. The value of mutual inductance of the coils is (a)0.8 H (b)0.2 W (c)0.2 H (d)5 H	
27	A circular coil of radius 8.0 cm and 20 turns is rotated about its vertical diameter with an angular speed of 50 rad/s in a uniform horizontal magnetic field of magnitude 3.0 x 10^{-2} T. Obtain the maximum and average emf induced in the coil. If the coil forms a closed-loop of resistance 10Ω, calculate the maximum value of current in the coil. Calculate the average power loss due to Joule heating. (a)2 W (b)0.2 W (c)0.49 W (d)0.018 W	
28	Two coils A and B have 200 and 400 turns respectively. A current of A in coil A causes a flux per turn of 10^{-3} Wb to link with A through B and a flux per turn of 0.8 x 10^{-3} Wb. The ratio of mutual inductance of A and B is (a)0.625 (b)1.25 (c)1d.5 (d)1.625	
29	When current in a coil changes from 2 A to -2 A in 0.05 s, an emf of 8 V is induced in the coil. The coefficient of self-inductance of the coil is (a)0.1 H (b)0. H (c)0.4H (d)0.8 H	

30	An air cored coil has a self-inductance of 0.1.H.A soft iron core of relative permeability 1000 is 1/10th. The value of self-inductance of the coil is (a)1 mH (b10 m H (c)1H (d)10 H	
31	What is self-inductance of a coil which produces 5 V when current in it changes from 3 A to 2A in one millisecond? (a)5000 H (b)5 mH (c)50 H (d)5 H	
32	The self inductance L of a solenoid of length l and area of cross-section A, with a fixed number of turns N increases as (a) L and A increase (b) L decreases and A increases (c) L increases and A decreases (d) Both l and A decreases	
33	What is the self induction of an air core solenoid 1 m long, diameter 0.05m, if it has 500 turns? Take $\pi^2 = 10$ (a)3.15×10^{-4}H (b)4.8×10^{-4}H (c)5×10^{-4}H (d)6.25×10^{-4}H	
34	A coil of wire of certain radius has 100 turns and a self-inductance of 15 mH. The self-inductance of a second similar coil of 500 turns will be (a)75 mH (b)375 mH (c)15 mH (d)None of these	
35	Two circuits have mutual inductance of 0.09 H. average emf induced in the secondary by a change of current from 0 to 2.0A in 0.006 s in primary will be (a)120 V (b)200 V (c)180V (d)30 V	
36	Obtain the resonant frequency ω of a series L-C-R circuit with L = 2.0 H, C = 32μF and R = 10Ω. What is the Q-value of this circuit? (a)25 (b)18 (c) 17 (d)23	
37	If number f turns in primary and secondary coils is increased to two times each, the mutual inductance (a) Becomes 4 times (b) Becomes 2 times (c) Becomes ¼ times (d) Remains unchanged	
38	The expression for magnetic induction inside a solenoid of length L, carrying a current I and having N number of turns is (a) $\frac{\mu_0}{4\pi}\frac{N}{L}i$ (b) $\mu_0 NLi$	

	(c) $\frac{\mu_0}{4\pi} NLi$ (d) $\mu_0 \frac{N^2}{L} i$	
39	Two coils have mutual inductance 0.005 H. The current changes in the first coil according to equation $i = i_0 \sin \omega t$, where i_0 = 10 A and ω = 100π rads^{-1}. The maximum value of emf in second coil is (a)2 π (b)5 π (c)π (d)4 π	
40	A Current of 10 A in the primary coil of a circuit is reduced to zero. If the coefficient of mutual inductance is 3 H and emf induced in secondary coil is 30 kV, time taken for the change of current is (a)10^3 s (b) 10^2 s (c) 10^{-3} s (d) 10^{-2} s	
41	A .0 m long metallic rod is rotated with an angular frequency of 400 rad/s about an axis normal to the rod passing through its one end. The other end of the rod is in contact and uniform magnetic field of 0.5 T parallel to the axis exists everywhere. Calculate the emf developed between the centre and the ring. (a)95 V (b)85 V (c)100 V (d)105 V	
42	A coil of inductance 0.2 H and 1.0 W resistance is connected in the coil grow at the instant the coil is connected to the source? (a)450 As^{-1} (b)4.5 As^{-1} (c)45 As^{-1} (d)0.45 As^{-1}	
43	If the rms current in a 50 Hz AC circuit is 5 A, the value of the current 1/300 seconds after its value becomes zero is (a) $5\sqrt{2}A$ (b) $5\sqrt{3/2}A$ (c) $5/6$ (D) $5/\sqrt{2}A$	
44	Two inductors of inductance L each are connected in series with opposite magnetic fluxes. What is the resultant inductance? (a)zero (b)L (c) 2 L (d)3 L	
45	The number of turns of primary and secondary coils of a transformer are 5 and 10 respectively and mutual inductance of the transformer is 25 H. Now, number of turns in primary and secondary are made 10 and 5 respectively mutual inductance of transformer will be (a)25 H (b)12.5 H (c)50 H (b)6.25 H	
46	A uniformly wound solenoidal coil of self-inductance 1.8 x 10^{-4} H and resistance 6Ω is broken up into two identical coils. These identical coils are then connected in parallel across a 12 V battery of negligible resistance. The time constant of the current in the circuit and the steady state current through battery is (a)3 x 10^{-5} s, 8 A (b)1.5 x 10^{-5} s, 8 A (c)0.75 x 10^{-4} s, 4 A (d)6 x 10^{-5} s, 2 A	
47	An alternating current generator has an internal resistance R_g and an internal reactance X_g. it is used to supply power	

	to a passive load consisting of a resistance R_g and a reactance X_L. For maximum power to e delivered from the generator to the load, the value of X_L is equal to (a)zero (b) X_g (c)- X_g (d) R_g	
48	When a voltage measuring device is connected to AC mains, the meter shows the steady input voltage of 220 V. This means (a) Input voltage cannot be AC voltage but a DC voltage. (b) Maximum input voltage is 220 V (c) The meter reads not v but $<V^2>$ and is calibrated to read $\sqrt{<V^2>}$ (d) The pointer of the meter is struck by some mechanical defect.	
49	An emf of 15 V is applied in a circuit coil containing 5 H inductance and 10Ω, the ratio of current s at time $t=\infty$ and t = 1 s is (a) $\frac{e^{1/2}}{e^{1/2}-1}$ (b) $\frac{e^2}{e^2-1}$ (c) $1-e^{-1}$ (d) e^{-1}	
50	A 60μF capacitor is connected to a 110 V, 60 Hz AC supply. Determine the rms value of the current in the circuit. (a)2.5 A (b)2.1 A (c)3.1 A (d)3.5 A	
51	In step-up transformer, relation between number of turns in primary (N_P) and number of turns in secondary (N_S) coils is (a) $N_s > N_p$ (b) $N_p > N_s$ (c) $N_s = N_p$ (d) $N = 2N_s$	
52	The turns ratio of transformer is given as 2 : 3. If the current passing through the primary coil is 3 A. Find the current through the load resistance. (a)4.5 A (b)1.5 A (c)2 A (d)1 A	
53	The number of turns in the primary coil of a transformer is 200 and the number of turns in secondary coil is 10. If 240 V AC is applied to the primary, the output from secondary will be (a)48 V (b)24 V (c)12 V (d)6 V	
54	The primary winding of a transformer has 200 terms and its secondary winding has 50 turns, if the current in the secondary winding is 40 A, the current in the primary is (a)10 A (b)80 A (c)160 A (d)800 A	
55	The number of turns in a secondary coil is twice the number of turns in primary. A leclanche cell of 1.5 V is	

	connected across the primary. The voltage across secondary is (a)1.5 V (b)3.0 V (c)240 V (d)zero	
56	A step-up transformer is used on a 120V line to provide a potential difference of f2400 V. If the primary coil has 75 turns, the number of turns in the secondary coil is (a)150 (b)1200 (c)1500 (d)1575	
57	The ratio of turns in primary and secondary coils of a transformer is 1 : 20. The ratio of currents in primary and secondary coil will be (a)1 : 20 (b)20 : 1 (c)1 : 400 (d)400 : 1	
58	A low-loss transformer has 230 V applied to the primary and gives 4.6 V in the secondary. Secondary is connected to a load, which draws 5 A of current. The current (in ampere) in the primary is (a)0.1 (b)1.0 (c)10 (d)250	
59	The armature of a DC motor has resistance of 200Ω. It draws a current of 1.5 A when run by 220 V of DC. The value of peak emf induced in it will be (a)150 V (b)170 V (c)190 V (d)180 V	
60	In an induction coil, the coefficient of mutual inductance is 4 H. If current of 5 A in the primary coil is cut-off I 1/1500 s, the emf at the terminals of the secondary coil will be (a)15 kV (b)60 kV (c)10 kV (d)30 kV	
61	In an ideal transformer, the voltage is stepped-down from 11 kV to 220 V. If the primary current be 100 A, the current in the secondary coil will be (a)5 kA (b)1 kA (c)0.5 kA (d)0.1kA	
62	A transformer is used to light 140 W, 24 V lamp from 240 V AC mains. The current in the mains is 0.7 A. the efficiency of transformer is nearest to (a)90 % (b)80 % (C)70 % (d)60 %	
63	The reduce the resonant frequency in an L-C-R series circuit with a generator (a) The generator frequency should be reduced (b) Another capacitor should be added in parallel to the first (c) The iron core of the inductor should be removed (d|) Dielectric in the capacitor should be removed	
64	The armature of a shunt wound motor can with stand current up to 8 A before it overheats and it damaged. If the armature resistance is 0.5Ω, minimum back emf that	

	must be motor is connected to a 120 V line is (a)120 V (b)116 V (c)124 V (d)4 V	
65	A transformer is having 2100 turns in primary and 4200 turns in secondary. An AC source of f120 V, 10 A is connected to its primary. The secondary voltage and current are (a)240 V, 5 A (b)120 V, 10 A (c)240 V, 10 A (d)120 V, 20 A	
66	Which of the following combinations should be selected for better tuning of an L-C-R circuit used for communication? (a) R = 20Ω, L = 1.5 H, C = 35 µF (b) R = 25Ω, L = 2.5 H, C = 45 µF (c) R = 10Ω, L = 3.5 H, C = 30 µF (d) R = 25Ω, L = 1.5 H, C = 45 µF	
67	A motor having an armature of resistance 2Ω is designed to operate at 220 V mains. At full speed, it develops a back emf of 210 V when the motor is running at full speed, l the current in the armature is (a)5 A (b)10 A (c)120 A (d)110 a	
68	A transformer is used to light a 100 W-110 V lamp from 220 V mains. If main current is 0.5 A, efficiency of transformer is (a)90% (b)95% (c)96% (d)99%	

CONCEPT-64: BASED ON DISPLACEMENT CURRENT AND MAXWELL'S EQUATIONS

1	Consider the following two statements regarding a linearly polarized plane electromagnetic wave. (i) Electric field and the magnetic field have equal average values. (ii) Electric energy and the magnetic energy have equal average values. (a) (i) is true (b) (ii) is true (c) both are true (d)both are false	
2	One requires 11 eV of energy to dissociate a carbon monoxide molecule into carbon and oxygen atoms. The minimum frequency of the appropriate electromagnetic radiation to achieve the dissociation lies in (a)visible (b)infrared region (c)ultraviolet region (d)microwave region	
3	The Maxwell's four equations are written as (a) $\int E.ds = q/\varepsilon_0$ (b) $\int_s \mathrm{B}.ds = q/\varepsilon_0$ (c) $\int_s \mathrm{B}.dI = -\frac{d}{dt}\int_s B.ds$	

	(d) $\int B.dI = \mu_0 I + \mu_0\varepsilon_0 \frac{d}{dt}\int_s E.ds$ The equation which have sources of and are (a)(i),(ii),(iii) (b)(i),(ii) (c)(i)and (ii) only (d)(i) and (iv) only	
4	The magnetic field between the plates of a capacitor where r>R is given by (where r is the distance from the axis of plates and R is the radius of each plate of capacitor) (a) $\frac{\mu_0 i_D}{2\pi R^2}$ (b) $\frac{\mu_0 i_D}{2\pi R}$ (c) $\frac{\mu_0 i_D}{2\pi r}$ (d)zero	
5	An expression for the magnetic field strength Bat the point between the capacitor plates indicates in figure express B in terms of the rate of change of the electric field strength i.e., dE/dt between the plates (a) $\frac{\mu_0 i}{2\pi r}$ (b) $\frac{\varepsilon_0\mu_0 r}{2} dE/dt$ (c)zero (d) $\frac{\mu_0 i}{2\pi}$	
6	A linearly polarized electromagnetic wave given as $E_r = -E_0\hat{i}\cos(\kappa z - \omega t)$ is incident normally on a perfectly reflecting infinite wall at z = a. Assuming that the material of the wall is optically inactive, the reflected wave will be given as (a) $E_r = -E_0\hat{i}\cos(\kappa z + \omega t)$ (b) $E_r = -E_0\hat{i}\cos(\kappa z - \omega t)$ (c) $E_r = -E_0\hat{i}\sin(\kappa z + \omega t)$ (d) $E_r = -E_0\hat{i}\sin(\kappa z - \omega t)$	
7	The charge of a parallel plate capacitor is varying as q = q_0 sin 2πft. The plates are very large and close together (area = A, separation = d). Neglecting edge effects, the displacement current through the capacitor is (a) $\frac{d}{A\varepsilon_0}$ (b) $\frac{d}{\varepsilon_0}\sin 2\pi ft$ (c) $2\pi q_0 \cos 2\pi ft$ (d) $\frac{2\pi q_0}{\varepsilon_0}\cos 2\pi ft$	

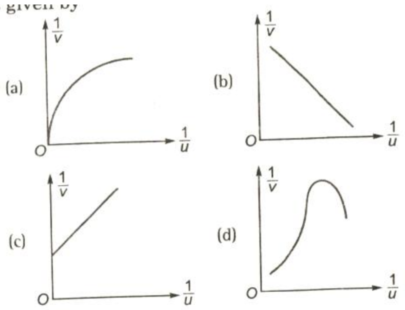
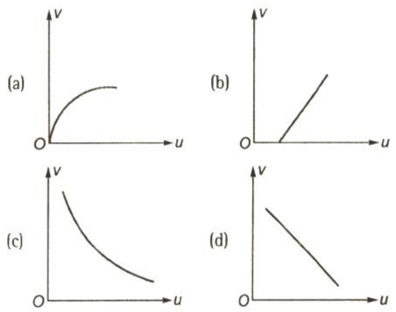
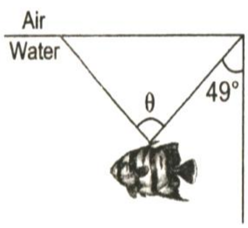
CONCEPT-65: BASED ON ELECTROMAGNETIC SPECTRUM AND ITS USES

1	If, u_s , u_x and u_m are the speeds of gamma rays, X-rays and microwaves respectively in vacuum, then (a) $v_s > v_x > v_m$ (b) $v_s < v_x < v_m$ (c) $v_s > v_x < v_m$ (d) $v_s = v_x = v_m$	
2	The wavelength of X-rays lies between (a) Maximum to finite limits (b) Minimum to certain limits (c) Minimum to infinite limits (d) Infinite to finite limits	
3	Hydrogen atom does not emit X=rays because (a) It has single electron (b) It has no neutron (c) it has single neutron (d) its energy levels are too close to each other	
4	The correct sequence of the increasing wavelength of the given radiation sources is (a) Radioactive sources, X-ray tube, crystal oscillator, sodium vapour lamp (b) Radioactive sources, X-ray tube, sodium vapour lamp, crystal oscillator (c) X-ray tube, radioactive source, crystal oscillator, sodium vapour lamp (d) X-rays tube, crystal oscillator, radioactive source, sodium vapour lamp	
5	The voltage applied across an X-ray tube is nearly equal to (a)10 V (b)100V (c)1000V (d)10000V	
6	X-rays are produced by jumping of (a) Electrons from lower to higher energy orbit of atom (b) Electrons from higher to lower energy orbit of atom (c) Protons from lower to higher energy orbit of nucleus (d) Proton from higher to lower energy orbit of nucleus	
7	The wavelength of infrared rays is of the order of (a)5 x 10^{-7}m (b) 10^{-3}m (c) 10^{-7}m to 10^{-7}m (d) 10^{11}m to 10^{9}m	
8	Which of the following rays is emitted by a human body? (a)X-rays (b)UV rays (c)visible rays (d)IR rays	
9	Molybdenum is used as a target element for the production of X-rays because it is (a) Light and can easily deflect electrons (b) Light and can absorb electrons (c) A heavy element with a high melting point (d) An element having high thermal conductivity	
10	X-rays are not used for radar purposes, because they are not (a) Reflected by target	

	(b) Partly absorbed by target (c) Electromagnetic waves (d) Completely absorbed by target	
11	Which of the following electromagnetic waves have the longest wavelength? (a)heat waves (b)light waves (c)radiowaves (d)ultraviolet waves	
12	The shortest wavelength of X-rays mitted from an X-rays tube depends upon (a) Nature of the gas in the tube (b) Voltage applied to tube (c) Current in the tube (d) Nature of target of the tube	
13	If a source is transmitting electromagnetic wave of frequency 8.2 x 20^6 Hz, then wavelength of the electromagnetic waves transmitted from the source will be (a)36.6 m (b)40.5 m (c)42.3 m (d)50.9 m	
14	If the wavelength of light is 4000 $\overset{o}{A}$, the number If wavelength in 1 mm length will be (a)2.5 x10^5 (b)0.25 x 10^4 (c)2.5 x 10^4 (d)0	

CONCEPT-66: BASED ON REFLECTION OF LIGHT

SL NO	PROBLEMS	SOLUTIONS
1	A dentist has a small mirror of focal length 16 mm. He views the cavity in the tooth of a patient by holding the mirror at a distance of 8 mm from the cavity. The magnification is (a)1 (b)1.5 (c)2 (d)3	
2	Given width of aperture = 3 mm man and λ =500nm. For what distance ray optics is good approximation? (a)18 m (b)18 mm (c)18 $\overset{o}{A}$ (d)18 light years	
3	The separation between the screen and a plane mirror is 2r. An isotopic point source of light is placed exactly mid ways between the mirror and the screen. Assume that mirror reflects 100% of incident light. Then the ratio of illuminance on the screen with and without the mirror is (a)10 :1 (b)2 : 1 (c)10 : 9 (d)9 : 1	
4	An object is placed a symmetrically between two plane mirrors inclined at an angle of 72°. the number of	

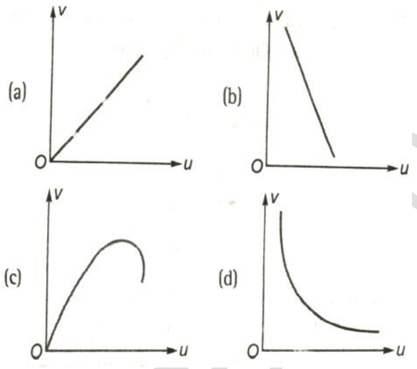
	image formed is (a)5 (b)4 (c)2 (d)infinite	
5	From a spherical mirror, the graph of 1/v versus 1/u is given by 	
6	for a convex mirror, the variation of u versus v is given by 	
7	A fish is a little away below the surface of a lake. If the critical angle is 49o, then the fish cold see things above water surface within an angular range of θ° where  (a) $\theta = 49^o$ (b) $\theta = 98^o$ (c) $\theta = 24\frac{1}{4}^o$ (d) $\theta = 90^o$	
8	A car is fitted with a convex mirror of focal length 20 cm. A second car 2m broad and 1.6 m height is 6 cm away from the first car. The position of the second car	

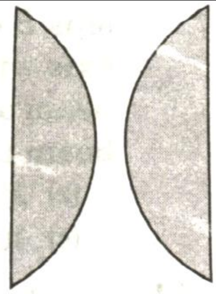
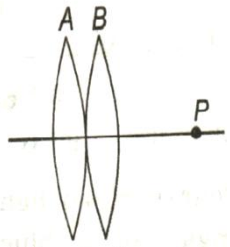
	as seen in the mirror of the first car is (a)19.35 cm (b)17.45 cm (c)21.48 cm (d)15.49 cm	
9	A convex mirror forms an image one-fourth the size of the object. If object is at a distance of 0.5 m from the mirror, the focal length of mirror is (a)0.17 m (b)-1.5 m (c)0.4 (d)-0.4 m	
10	A person of 6 feet in length can see his full size erect image in a mirror 2 feet in height. This mirror has to be (a)plane or convex (b)plane or concave (c)necessarily convex (d)necessarily concave	
11	A point object is placed at a distance of 30 cm from a convex mirror of a focal length 30 cm. The image will form at (a) Infinity (b) Pole (c) 15 cm behind the mirror (d) No image will be formed	
12	A plane mirror is reflecting a ray of incident light is rotated through an angle of about an axis through the point of incidence in the plane of the mirror perpendicular to the plane of incident, then (a) The reflected ray rotates through a angle 2θ (b) The reflected ray rotates through and angle of θ (c) The reflected ray does not rotate (d) None of the above	
13	With a concave mirror, an object is placed at a distance x_1 from the principal focus, on the principal axis. The image is formed at a distance x_2 from the principal focus. The focal length of the mirror is (a) x_1x_2 (b) $\frac{x_1+x_2}{2}$ (c) $\sqrt{\frac{x_1}{x_2}}$ (d) $\sqrt{x_1x_2}$	
14	A man has a concave shaving mirror or focal length 0.2 m. How far should the mirror be held from his face in order to give an image of two fold magnification? (a)-0.1 m (b)0.2 m (c)0.3 m (d)0.4 m	
15	To focal length of a concave mirror is 12 cm. where should an object of length should an object of length 4 cm be placed so that an image 1 cm long is formed? (a)48 cm (b)3 cm (c)-60 cm (d)15 cm	
16	The focal length of a concave mirror is 20 cm. where an object must be placed to form an image magnified to times when the image is real? (a) -30 cm from the mirror (b) 10 cm from the mirror (c) 20 cm from the mirror (d) 15 cm from the mirror	

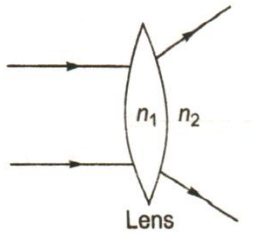
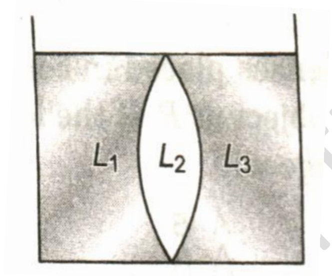
17	A spherical mirror forms diminished visual image of magnification 1/3. Focal length is 18cm. the distance of the object is (a)18 cm (b)-36 cm (c)48 cm (d)infinite	
18	Sun subtends an angle of 0.5^{o} at the centre of curvature of a concave mirror of radius of curvature 15 m. The diameter of the image of the sun formed by the mirror is (a)8.55 cm (b)7.55 cm (c)6.55 cm (d)6.55 cm	
19	A small candle, 2.5 cm in size is placed at 27 cm in front of a concave mirror of radius of curvature 36 cm. at what distance from the mirror should a screen be placed in order to obtain a sharp image? Describe the nature and size of the image. If the candle is moved closer to the mirror, how would the screen have to be moved? (a)54 cm (b)27 cm (c)28 cm (d)475 cm	
20	An object 5 cm tall is placed 1 m from a concave spherical mirror which has a radius of curvature of 20 cm the size of the image is (a)0.11 cm (b)-0.55 cm (c)0.55 cm (d)0.60 cm	
21	An convex mirror of radius of curvature 1.6 cm has an object placed at a distance of 1 m from it. The image is formed at a distance of (a) 8/13 m in front of the mirror (b) 8/13 m behind of the mirror (c) 4/9 m in front of the mirror (d) 4/9 m behind the mirror	
22	A short linear object of length b lies along the axis of a concave mirror. The size of the image is equal to (a) $b\left(\frac{u-f}{f}\right)^{1/2}$ (b) $b\left(\frac{f}{u-f}\right)^{1/2}$ **(c)** $b\left(\frac{u-f}{f}\right)$ **(d)** $b\left(\frac{f}{u-f}\right)$	
23	Two plane mirrors are inclined to each other at an angle θ. A ray of light is reflected first at one mirror and then at the other. The total deviation of the ray is (a)2θ (b)240^{o}-2θ (c)360^{o}-2θ (d)180^{o}-θ	
24	A plane mirrors is approaching you at 10 cms^{-1}. Your image shall approach you with a speed of (a)+10 cms^{-1} (b)-10 cms^{-1} (c)+20 cms^{-1} (d)-20 cms^{-1}	

25	A candle is placed before a thick plane mirror. When looked obliquely in the mirror, a number of images are seen from the surfaces of the plane mirror. Then (a) First image is brightest (b) Second image is brightest (c) Third image is brightest (d) All images beyond second are brightest	
26	An object is approaching a plane mirror at 10 cms^{-1}. a stationary observe3r sees the image. At what speed will the image approach the stationary observer? (a) 10 cms^{-1} (b) 5 cms^{-1} (c) 20 cms^{-1} (d) 15 cms^{-1}	
27	A small object is placed 10 cm in front of a plane mirror. If you stand behind the object, 30 cm from the mirror and look at its image, for what distance must you focus your eyes? (a)20 cm (b)60 cm (c)80 cm (d)40 cm	
28	When a convergent beam of light is incident on a plane mirror, the image formed is (a) Upright and real (b) Upright and virtual (c) Inverted and virtual (d) Inverted and real	
29	It is necessary to illuminate the bottom of a well by reflected solar beam when the light is incident at angle of $\alpha= 40^o$ to the vertical. At what angle β to the horizontal should a plane mirror be placed? (a)70^o (b)20^o (c)50^o (d)40^o	
30	The sun (diameter d) subtends an angle θ radian at the pole of a concave mirror of focal length f. the diameter of the image of sun formed by mirror (a) θf (b) $\frac{\theta}{2} f$ (c) $2\theta f$ (d) $\frac{\theta}{\pi} f$	
31	At what angle should a ray of light be incident on the face of a prism of refracting angle 60^o so that it just suffers total internal reflection at the other face? The refractive index of the material of the prism is 1.524. (a)16^o (b)29^o (c)45^o (d)58^o	
32	A spherical mirror forms an image of magnification m = $\pm$3. The object distance, if focal length of mirror is 24 cm, may be (a)32 cm, 24 cm (b)32 cm, 16cm (c)32 cm only (d)16 cm only	

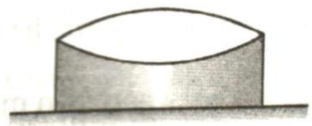
CONCEPT-67: BASED ON REFRACTION OF LIGHT

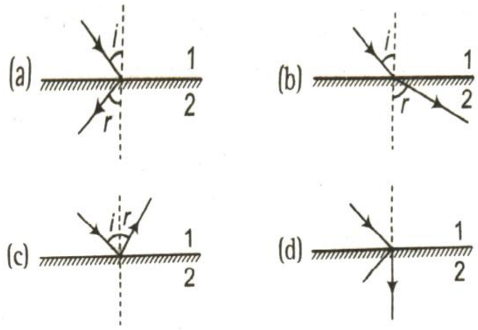
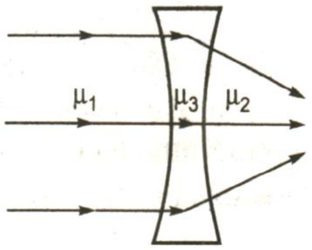
1	How will the image formed by a convex lens be affected, if the central portion of the lens is wrapped in blank paper, as shown in the figure.  (a) No image will be formed (b) Full image will be formed but is less bright (c) Full image will be formed but without the central portion (d) Two image will be formed , one due to each exposed half	
2	The distance v of the real image formed by a convex lens is measured for various object distance u. A graph is plotted between v and u. Which one of the following graphs is correct 	
3	If the space between the lenses in the combination shows were filled with water, what would happen to the focal length and power of the lens combination?	

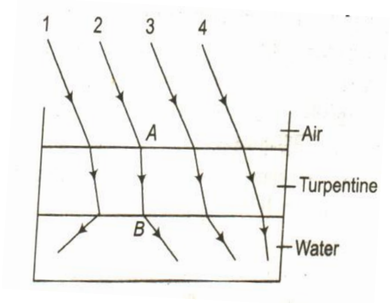
	 **focal length** **power** (a) Decreased increased (b) Decreased unchanged (c) Increased unchanged (d) Increased decreased	
4	Two convex lenses placed in contact form the image of a distance object at P. if the lens B is moved to the right, the image will  (a) Move to the left (b) Move to the right (c) Remain at P (d) Move either to the left or right, depending upon focal length of the lenses	
5	A layered lens as shown in figure is made of two types of transparent materials indicated by different shades. A point object is placed on its axis. The object will form  (a)1 image (b)2 images (c)3 image (d)9 images	
6	A small bulb is placed at the bottom of a tank containing water to a depth of 80 cm. What is the area of the surface of water through which light from the bulb can emerge out? Refractive index of water is 1.33. (consider the bulb to be a point source.)	

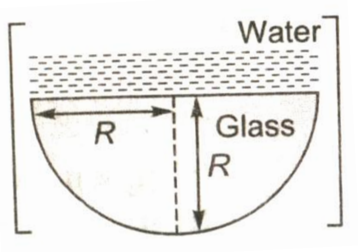
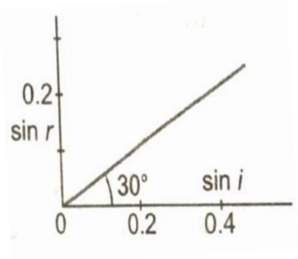
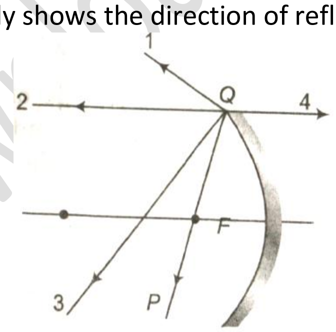
	(a)4.6 m^2 (b)3.2 m (c)5.6 m^{-2} (d)2.6 m^2	
7	The relation between n_1 and n_2' if the behavior of light ray is a shown in the figure.  (a) $n_2 > n_1$ (b) $n_1 \gg n_2$ (c) $n_1 > n_2$ (d) $n_1 = n_2$	
8	A convex lens A of focal length 20 cm and a concave lens B of focal length 56 cm are kept along the same axis with the distance d between them. If a parallel beam of light falling on A leaves B as a parallel beam, beam then distance, d in cm, will be (a)25 (b)36 ()30 (d).50	
9	As shown in figure, the liquids L_1, L_2 and L_3 have refractive indices 1.55, 1.50 and 1.20 respectively. Therefore, the arrangement corresponds to  (a)biconvex lens (b)biconcave lens (c)concavo-convex lens (d)convexo-concave lens	
10	You are given four sources of light each one providing a light of a single colour, blue, green and yellow. Suppose the angle of refraction for a beam of yellow light corresponding to a particular angle of incidence at the interface of two media is 90°. Which of the following statement is correct if the source of yellow light is replaced with that of other lights without changing the angle of incidence? (a) The beam of red light would undergo total internal reflection (b) The beam of red light would bend towards normal while it gets refracted through the second medium (c) The beam of blue light would undergo total internal reflection (d) The beam of green light would bend away from the normal as it gets refracted through the second medium	

11	A convex lens of focal length f produces a virtual image n times the size of the object. Then the distance of the object from the lens is (a) $(n-1)f$ (b) $(n+1)f$ (c) $\left(\frac{n-1}{n}\right)f$ (d) $\left(\frac{n+1}{n}\right)f$	
12	A concave lens of focal length 20 cm produces an image half in size of the real object. The distance of the real object is (a)20 cm (b)30 cm (c)10 cm (d)60 cm	
13	An object 15 cm high is placed 10 cm from the optical centre of a thin lens. Its image is formed 25 cm from the optical centre in the same side of the lens as the object. The height of the image is (a)2.5 cm (b)0.2 cm (c)16.7 cm (d)37.5 cm	
14	One surface of a lens is convex and the other is concave e. If the radii of curvature are r_1 and r_2 respectively, the lens will be convex, if (a) $r_1 > r_2$ (b) $r_1 = r_2$ (c) $r_1 < r_2$ (d) $r_1 = 1/r_2$	
15	A lens forms a virtual image 4 cm away from it when an object is placed 10 cm away from it. The lens is a …..lens of focal length…. (a) Concave, 6.67 cm (b) Concave, 2.86 cm (c) Convex, 2.86 cm (d) May be concave or convex, 6.67 cm	
16	A convex lens of focal length $\frac{1}{3}m$ forms a real, inverted image twice in size of the object. The distance of the object from the lens is (a)0.5 m (b)0.166 m (c)0.33 m (d)1 m	
17	The radius of curvature of the curved surface f a plane-convex lens is 20 cm. If the refractive index of the material of the lens be 1.5, it will (a) Act as a convex lens for the objects that lie on its curved side (b) Act as a concave lens for the objects that lie on its curved side (c) Act as a convex lens irrespective of the side on which the object lies (d) Act as a concave lens irrespective of side on which the object lies	
18	Consider an equiconvex lens of radius of curvature R and focal length f. if f > R, the refractive index μ of the	

	material of the lens (a) Is greater than zero but less than 1.5 (b) Is greater than 1.5 but less than 2.0 (c) Is greater than one but less than 1.5 (d) None of the above	
19	A convex lens for ms an image of an object placed 20 cm away from it at a distance of 20 cm on the other side of the lens. If the object is moved 5 cm towards the lens, the image will move (a) 5 cm towards the lens (b) 5 cm away from the lens (c) 10 cm towards the lens (d) 10 cm away from the lens	
20	A convex lens is placed in contact with a mirror as shown if figure. If the space between them is filled with water, its power will  (a) Decrease (b) Increase (c) Remain unchanged (d) Increase or decrease depending on the focal length	
21	The power of a thin convex lens($_an_g$ = 1.5) is + 5.0 D. when it is placed in a liquid of refractive index $_an_e$, then it behaves as a concave lens of focal length 100 cm. The refractive index of the liquid $_an_l$ will be (a)5/3 (b)4/3 (c) $\sqrt{3}$ (d)5/4	
22	A concave lens with unequal radii of curvature made of glass (μ_g = 1.5) has focal length of 40 cm. if it is immersed in a liquid of refractive index μ = 2, then (a) It behaves like a convex lens of 80 cm focal length (b) It behaves like a concave lens of 80 cm focal length (c) Its focal length becomes 60 cm (d) Nothing can be said	
23	An object approaches a convergent lens from the3 left of the lens with a uniform speed 5 m/s and stops at the focus. The image (a) Moves away from the lens with an uniform speed 5 m/s (b) Moves away from the lens with an uniform acceleration (c) Moves away from the lens with a non-uniform acceleration (d) Moves towards the lens with a non-uniform acceleration	

24	A virtual image twice as long as the object is formed by a convex lens when the object is 10 cm away from it. A real image twice as long as the object will be formed when it is placed at a distance……from the lens. (a)40 cm (b)30 cm (c)20 cm (d)15 cm	
25	An achromatic convergent doublet of two lenses in contact has a power of + 2 D. the convex lens has power of the convergent and divergent lenses? (a)2 : 5 (b)3 : 5 (c)5 : 2 (d)5:3	
26	There are certain material developed in laboratories which have a negative refractive index (figure). A ray incident from air (medium 1) into such a medium (medium 2) shall follow a path given by 	
27	What is the relation between refractive indices μ_1, μ_2 and μ_3 if the behavior of light rays is as shown in figure.  (a) $\mu_3 < \mu_2, \mu_2 = \mu_1$ (b) $\mu_2 < \mu_1, \mu_2 = \mu_1$ (c) $\mu_3 < \mu_2 < \mu_1$ (d) $\mu_3 > \mu_2 > \mu_1$	
28	Monochromatic light of wavelength, λ_1 travelling in medium of refractive index, n_1 enters a denser medium of refractive index, n_2 the wavelength in the second medium is (a) $\lambda_1\left(\frac{n_1}{n_2}\right)$ (b) $\lambda_1\left(\frac{n_2}{n_1}\right)$ (c) λ_1 (d) $\lambda_1\left(\frac{n_2 - n_1}{n_1}\right)$	

29	The optical density of turpentine is higher than that of water while its mass density is lower. Figure shows a layer of turpentine floating over water in a container. For which one of the four rays incident on turpentine in figure the path shown is correct?  (a)1 (b)2 (c)3 (d)4	
30	What is the angle of incidence for an equilateral prism of refractive index $\sqrt{3}$ so that the ray is parallel to the base inside the prism? (a)30^{o} (b)45^{o} (c)60^{o} (d)either 30^{o} or 60^{o}	
31	A car is moving either at a constant speed of $60 kmh^{-1}$ on a straight road. Looking at the rear view mirror, the driver finds that the car following him is at distance of 100 m and is approaching with a speed of 5 km h^{-1}. In order to keep track of the car in the rear, the begins to glance alternately at the rear and side mirror of his car after every 2 s till the other car overtakes. If the two cars were maintaining their speeds, which of the following statement (s) is/ are correct? (a) The speed of the car in the rear is 65 km h^{-1} (b) In the side mirror the car in the car in the rear would appear to approach with a speed of 5 km h^{-1} to the driver of the leading car (c) In the rear view mirror, the speed of the approaching car would appear to decrease as the distance between the cars decreases (d) In the side mirror, the speed of the approaching car would appear to increase as the distance between the cars decrease	
32	A ray of light travelling in glass $\left(\mu = \frac{3}{2}\right)$ is incident on a horizontal glass air surface at the critical angle θ_c. if thin layer of water $\left(\mu = \frac{4}{3}\right)$ is now poured on the glass air surface, the angle at which the ray emerges into air at the water-air surface is	

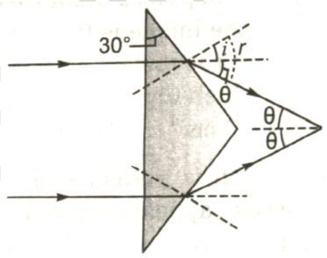
	 (a)60° (b)45° (c)90° (d)180°	
33	Light is incident from a medium X at an angle of incident I and is refracted into medium Y at angle of refraction r. The graph sin I versus sin r is shown in figure. Which of the following conclusions would fit the situation?  1 Speed of light in medium Y is $\sqrt{3}$ times that in medium X. 2 Speed of light in medium Y is $1/\sqrt{3}$ times that in medium X. 3 Total internal reflection will occur above a certain I value (a)2 and 3 (b)1 and 3 (c)2 only (d)3 only	
34	The direction of ray of light incident on a concave mirror is shown by PQ while directions in which the ray would travel after reflection is shown by for rays marked 1, 2, 3 and 4 (figure). Which of the four rays correctly shows the direction of reflected ray?  (a)1 (2)2 (c)3 (d)4	

CONCEPT 68: BASED ON OPTICAL INSTRUMENTS

1	A photograph of the moon was taken with telescope.	

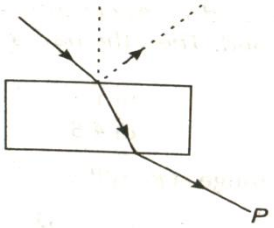
	Later on, it was found that a housefly was sitting on the objective lens of the telescope, in photograph, (a) There is a reduction in the intensity of the image (b) There is an increase in the intensity of the image (c) The image of housefly reduced (d) The image of the housefly will be enlarged	
2	The separation as between two microscopic particles is measured P_A and P_B by two different lights of wavelength 2000 $\overset{o}{A}$ and 30000 $\overset{o}{A}$ respectively, then (a) $P_A < P_B$ (b) $P_A > P_B$ (c) $P_A = P_B$ (d) $P_A < 3/2\ P_B$	
3	The magnifying power of a telescope is 9. When it is adjusted for parallel rays, the distance between the objective and the eyepiece is found to be 20 cm. The focal lengths of the lenses are (a)18 cm, 2 cm (b)11 cm, 9 cm (c)10 cm, 10 cm (d)15 cm, 5 cm	
4	In compound microscope, magnifying power is 95 and the distance of object from objective lens is $\frac{1}{3.8}$ cm. the focal length of objective lens is $\frac{1}{4}$ cm. What is the magnification of eyepiece? (a)5 (b)10 (c)100 (d)200	
5	The focal lengths of the objective and eye lenses of a microscope are 1.6 cm and 2.5 cm respectively. The distance between the two lenses is 21.7 cm. if the final image is formed at infinity, the distance between the object the objective lens is (a)1.8 cm (b)1.70 cm (c)1.65 cm (d)1.75 cm	
6	Two points, separated by a distance of 0.1 mm, can just be inspected on a microscope when light of wave length 6000 $\overset{o}{A}$ is used. If the light of wavelength 4800 $\overset{o}{A}$ is used, the limit of resolution is (a)0.8 mm (b)0.08 mm (c)0.1 mm (d)0.04 mm	
7	The diameter of moon is 3.5 x 10^3 km. the focal length of the objective and eyepiece are 4 m and 10 cm respectively. The limit of resolution of diameter of the image of the moon will be approximately (a)2^o (b)21^o (c)40^o (d)50^o	
8	With diaphragm the camera lens set at f/2, the correct exposure times is 1/100 s. then with diaphragm set at	

	f/8, the correct exposure time is (a)1/100 s (b)1/400 s (c)1/200 s (d)16/100 s	
9	An object is viewed through a compound microscope and appears in focus when it is 5 mm away from the 3 mm thick is placed between the objective and the microscope, the objective lens has to be moved 1 mm to bring to object back into the focus. The refractive index of the transparent material is (a)1.5 (b)1.6 (c)1.8 (d)2.0	
10	A hypermetropic person having near point at a distance of 0.75 m puts on spectacles of power 2.5D. the near point now is at (a)0.75 m (b)0.83 m (c)0.36 m (d)0.26 m	
11	An astronomical telescope has a converging eyepiece of focal length 5 cm and objective of focal length 80 cm. when the final image is formed at the least distance of distinct vi9sion (25 cm), the separation between the two lenses is (a)75.0 cm (b)80.0cm (c)84.2 cm (d)85.0 cm	
12	The focal length of objective and eye lens of an astronomical telescope are respectively 2 cm and 5 cm. Final image is formed at (1) least distance of distinct vision (2) infinity. Magnifying powers in two cases will be (a)-48, -40 (b)-40, 48 (c)-40,+48 (d)-48, +40	
13	A man's near point is 0.5 m and far point is 3 m. Power spectacle lenses repaired for (i) reading purpose (ii) seeing distant object, respectively. (a) -2 D and +3D (b)+2D and -3 D (c)+2D and 0.33 D (d)-2 D and +0.33 D	
14	A hypermetropic person has to use a lens of power +5 D to normalize his vision. The near point of the hypermetropic eye is (a)1 m (b)1.5 m (c)0.5 m (d)0.66 m	
15	The focal length of the objective and the eyepiece of a microscope are 4 mm and 25 mm respectively. If the final image is formed at infinity and the length of the tube is 16 cm, then the magnifying power of microscope will be (a)-337.5 (b)-3.75 (c)3.375 (d)33.75	

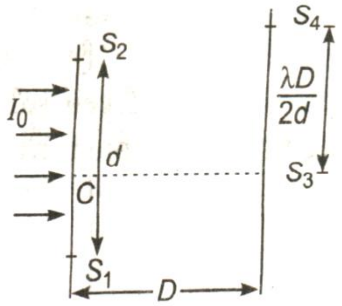
16	A simple microscope consists of a concave lens of power-10D and a convex lens of power + 20D in contact. If the image is formed at infinity, then the magnifying power when D = 25 cm is (a)2.5 (b)3.5 (c)2.0 (d).0	
17	The magnifying power of an astronomical telescope is 10 and the focal length of its eye-piece is 20 cm. the focal length of its objective will be d (a)200cm (b)2 cm (c)0.5 cm (d)0.5×10^{-2}cm	
18	A ray of light incident at an angle θ on a refracting face of a prism emerges from the other face normally. If the angle of the prism is 5^{o} and the prism is made of a material of refractive index 1.5, the angle of incidence is (a)7.5^{o} (b)5^{o} (c)15^{o} (d)2.5^{o}	
19	The refractive index of a prism for a monochromatic wave is $\sqrt{2}$ and its refracting angle is 60^{o}. For minimum deviation, the angle of incidence will be (a)30^{o} (b)45^{o} (c)60^{o} (d)90^{o}	
20	It is desired to make a converting achromatic combination of mean focal length 50 cm by using two lenses of materials A and B. If the dispersive powers of A and B are in ration1 : 2, the focal lengths of the convex and the concave lenses are respectively (a)25 cm and 50 cm (b)50 cm, and 25cm (c)50 cm and 100 cm (d)100 cm and 50 c	
21	Two parallel light rays are incident at one surface of a prism of refractive index 1.5 as shown in figure. The angle between the emergent rays is nearly  (a)19^{o} (b)37^{o} (c)45^{o} (d)49^{o}	
22	The refractive index of the material of a prism is 30^{o}. One of its refracting faces is polished, the incident beam of light will retrace back for angle of incidence (a)0^{o} (b)45^{o} (c)60^{o} (d)90^{o}	
23	The cross-section of a glass prism has the form of an isosceles triangle. One of the refracting faces is silvered. A ray of light falls normally on the other	

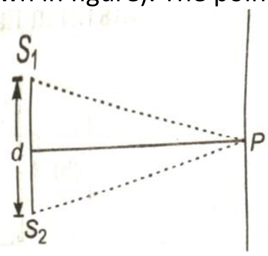
	refracting face. After being reflected twice, it emerges through the base of the prism perpendicular to it. The angles of the prism are (a)54^o, 54^o,72^o (b) 72^o, 72^o,36^o (c)45^o, 45^o,90^o (d)57^o,57^o,76^o	
24	The maximum refractive index of a prism which permits the passage of light through it, when the refracting angle of the prism is 90^o, is (a) $\sqrt{3}$ (b) $\sqrt{2}$ (c) $\frac{\sqrt{3}}{2}$ (d) $\frac{3}{2}$	

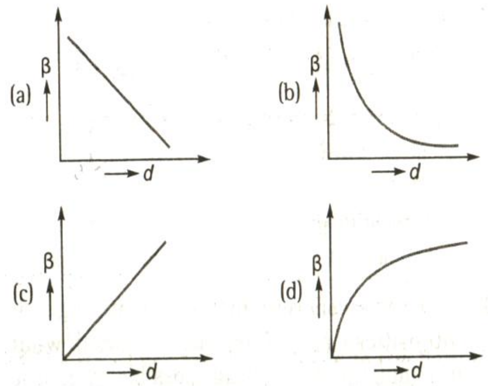
CONCEPT-69: BASED ON THEORIES OF LIGHT AND INTERFERENCE

1	Light propagates 2 cm distance in glass of refractive index 1.5 in time t_0. In the same time t_0, light propagates a distance of 2.25 cm in a medium. The refractive index of the medium is (a)4/3 (b)3/2 (c)8/3 (d)none of these	
2	Consider a light beam incident from air to a glass slab at Brewster's angle as shown in the figure .  A Polaroid is placed in the path of the emergent ray at a point P and rotated about an axis passing through the centre and perpendicular to the plane of the Polaroid. (a) For a particular orientation there shall be darkness as observed through the Polaroid (b) The intensity of light as seen through the Polaroid shall be independent of the rotation (c) The intensity of lights as seen through the Polaroid shall go through a minimum but not zero for two orientations of the Polaroid (d) The intensity of light as see through the Polaroid shall go through a minimum for four orientations of the Polaroid	
3	A lamp hanging at the height of 4 m over a table. Its height is decreased by 1m. By how much will illumination increase on the table? (a)72% (b)78% (c)65% (d)50%	
4	In a young's double-slit experiment, the slits are	

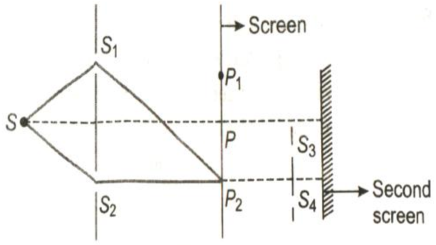
	separated by 0.28 mm and the screen is placed 1.4 m away. The distance between the central bright fringe and the fourth bright fringe is measured to be 1.2 cm. determine the wavelength of light used in the experiment. (a)4 x 10^{-9} m (b)5 x 10^{-10} m (c)3 x 10^{-7} m (d)6 x 10^{-7} m	
5	Consider sunlight incident on a slit of width 10^4A. the image seen through the slit shall (a) Be a fine sharp slit white in colour at the centre (b) A bright slit white at the centre diffusing to zero intensities at the edges (c) A bright slit white at the centre diffusing to regions of different colours (d) Only be a diffused slit white in colour	
6	Monochromatic light of wavelength 589 nm is incident from air on a water surface. What are the wavelength and speed of refracted light? Refractive index of water is 1.33 (a) 4.20 x 10^{-8} and 4.0 x 10^{7} m/s (b) 3.68 x 10^{-9} m and 3.02 x 10^{8} m/s (c) 1.9 x 10^{-10} m and 3.2 x 10^{8} m/s (d) 4.42 x 10^{7} m and 2.25 x 10^{8} m/s	
7	If young's double slit experiment, is performed in water (a) The fringe width will decrease (b) The fringe width will increase (c) The fringe width will remain unchanged (d) There will be no fringe	
8	In young's double slit experiment, the spacing between the slits is d and wavelength of light used is 6000 $\overset{0}{A}$. If the angular width of a fringe formed on a distance screen is 1^o, then value o0f d is (a)1 mm (b)0.05 mm (c)0.03 mm (d)0.01 mm	
9	In young's double slit experiment, when violet light of wavelength 4358 $\overset{0}{A}$ is used, the 84 fringes are seen in the field of view, but when sodium light of certain wavelength is used, then 62 fringes are seen in the field of view, the wavelength of sodium light is (a)6893 $\overset{0}{A}$ (b)5904 $\overset{0}{A}$ (c)5523 $\overset{0}{A}$ (d)6429 $\overset{0}{A}$	
10	Consider a ray of light incident from air into a slap of glass (refractive index n) of width d, at an angle θ. The phase difference between the ray reflected by the top surface of the glass and the bottom surface is	

	(a) $\frac{4\pi nd}{\lambda}\left(1-\frac{1}{n^2}\sin^2\theta\right)^{-1/2}+\pi$ (b) $\frac{4\pi nd}{\lambda}\left(1-\frac{1}{n^2}\sin^2\theta\right)^{-1/2}$ (c) $\frac{4\pi nd}{\lambda}\left(1-\frac{1}{n^2}\sin^2\theta\right)^{1/2}+\frac{\pi}{2}$ (d) $\frac{4\pi nd}{\lambda}\left(1-\frac{1}{n^2}\sin^2\theta\right)^{1/2}+2\pi$	
11	Two non-coherent sources emit light beams of intensities I and 4I. the maximum and minimum intensities in the resulting beam are (a)9I and I (b)9I and 3I (c)5I and I (d)5I and 3I	
12	The maximum intensity in the case of n identical incoherent waves, each of intensity 2 Wm^{-2} is 32 Wm^{-2f}. the value of n is (a)4 (b)16 (c)32 (d)64	
13	In an interference pattern the position of zeroth order maximum is 4.8 mm from a certain point P on the screen. The fringe width is 0.2 mm. the position of second maxima from point P is (a)5.1 mm (b)5 mm (c)40 mm (d)5.2 mm	
14	S_1 and S_2 are two coherent sourced. The intensity of both sources are same. If the intensity at the point of maxima is 4 Wm^{-2}, the intensity of each source is (a) 1 Wm^{-2} (b) 2 Wm^{-2} (c) 3 Wm^{-2} (d) 4 Wm^{-2}	
15	n incoherent source of intensity I_o are superimposed at a point, the intensity of the point is (a) nI_0 (b) $\frac{I_0}{n}$ (c) n^2I_0 (d)none of these	
16	In the given figure, C is middle point of lines S_1S_2. A monochromatic light of wavelength λ is incident on slits. The ration of intensities of S_3 and S_4 is  (a)zero (b)∞ (c)4 : 1 (d)1 : 4	

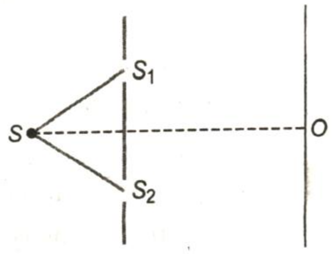
17	In the given arrangement, S_1 and S_2 are coherent sources (shown in figure). The point P is a point of  (a)bright fringe (b)dark fringe (c)either dark of bright (d)none of these	
18	When two coherent monochromatic light beams of intensities I and 4I are superimposed, what are the maximum and minimum possible intensities in the resulting beams? (a) 5I and I (b) 5I and 3I (c) 9I and I (d) 9I and 3I	
19	A parallel beam of light of intensity I_o is incident on a glass plate, 25% of light is reflected by upper surface and 50% of light is reflected from lower surface. The ratio of maximum to minimum intensity in interference region of reflected rays is (a) $\left(\frac{\frac{1}{2}+\sqrt{\frac{3}{8}}}{\frac{1}{2}-\sqrt{\frac{3}{8}}}\right)$ (b) $\left(\frac{\frac{1}{4}+\sqrt{\frac{3}{8}}}{\frac{1}{2}-\sqrt{\frac{3}{8}}}\right)$ (c) $\frac{5}{8}$ (d) $\frac{8}{5}$	
20	In a young's double slit experiment, the source is white light. One of the holes is covered by a red filter and another by a blue filter. In this case (a) There shall be alternate interference patterns of red and blue (b) There shall be an interference pattern for red district from that for blue (c) There shall be no interference fringes (d) There shall be an interference pattern for red mediating with one for blue	
21	In a young's experiment, one of the slits is covered with a transparent sheet of thickness 3.6×10^{-3} cm due to	

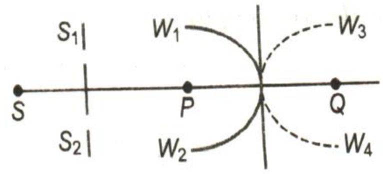
	which position originally occupied by 30^{th} fringe. The refractive index of the sheet, if λ = 6000 $\overset{0}{A}$, is (a)1.5 (b)1.2 (c)1.3 (d)1.7	
22	Light waves travel in vacuum along the y-axis. Which of the following may represent the wavefront? (a)y = constant (b)x = constant (c)z = constant (d)x+y+z = constant	
23	The correct curve between fringe width β and distance between the slits (d) in figure is 	
24	The correct formula for fringe visibility is (a) $V=\frac{l_{\max}-l_{\min}}{l_{\max}+l_{\min}}$ (b) $V=\frac{l_{\max}+l_{\min}}{l_{\max}-l_{\min}}$ (c) $V=\frac{l_{\max}}{l_{\min}}$ (d) $V=\frac{l_{\min}}{l_{\max}}$	
25	Two coherent waves are represented by $y_1 = a_1 \cos\omega t$ and $y_2 = a_2 \cos\omega t$, superimposed on each other. The resultant intensity is proportional to (a) (a_1+a_2) (b) (a_1-a_2) (c) $(a_1^2+a_2^2)$ (d) $(a_1^2-a_2^2)$	
26	The maximum intensity of fringes in Young's experiment is I. if one of the slit is closed, then the intensity at that place becomes I_o. Which of the following relation is true? (a)$I = I_0$ (b)$I = 2I_0$ (c)$I = 4I_0$ (d)$I = 0$	
27	The equation of two interfering waves are $y_1 = b\cos\omega t$ and $y_2 = b\cos(\omega t+\phi)$. For destructive interference the path difference is (a)0^o (b)360^o (c)180^o (d)720^o	

28	The young's double slit experiment is performed with blue and with green light of wavelength $\overset{o}{A}$ and 5460 $\overset{o}{A}$ respectively. If, x is the distance of 4th maxima from the central one, then (a) X (blue) = x (green) (b) X (blue) > x (green) (c) X (blue) < x (green) (d) X (blue) / x (green) = 5400/4360	
29	In a double slit interference experiment, the distance between the slits is 0.05 cm and screen is 2 m away from the slits. The wavelength of light is 8.0 x 10^{-5} cm. the distance between successive fringes is (a)0.24 cm (b)3.2 cm (c)1.28 cm (d)0.32cm	
30	Two light rays having the same wavelength λ in vacuum are in phase initially. Then the first ray travels a path L_1 through a medium of refractive index n_1, while the second ray travels a path of length L_2 through a medium of refractive index n_2. The two waves are then combined to observe interference. The phase difference the two waves is (a) $\frac{2\pi}{\lambda}(L_2 - L_1)$ (b) $\frac{2\pi}{\lambda}(n_1L_1 - n_2L_2)$ (c) $\frac{2\pi}{\lambda}(n_2L_1 - n_1L_2)$ (d) $\frac{2\pi}{\lambda}\left(\frac{L_1}{n_1} - \frac{L_2}{n_2}\right)$	
31	In young's experiment, the wavelength of red light is 7.8 x 10^{5}cm and that of blue light 5.2 x 10^{-5} cm. the value of n for which (n+1)th blue light band coincides with nth red bond is (a)4 (b)2 (c)3 (d)4	
32	We shift young's double slit experiment from air to water. Assuming that water is still and clear, it can be predicted that the fringe pattern will (a) Remain unchanged (b) Disappear (c) Shrink (d) Be enlarged	
33	In young's double slit experiment, the separation between slit is halved and the distance between the slits and screen is doubled. The fringe width is (a)unchanged (b)halved (c)double (d)quardrupled	

34	In an experiment, the two slits are 0.5 cm apart and the fringes are observed to 100 cm from the plane of the slits. The distance of the 11th bright fringe from the 1st bright fringe is 9.72 mm. the wavelength if (a)4.86×10^{-5}cm (b) 5.72×10^{-4}cm (c) 5.87×10^{-4}cm (d) 3.25×10^{-4}cm	
35	Figure shows a standard two slit arrangement with slits S_1, S_2, P_1, P_2 are the two minima points on either side of P.  At P_2 on the screen, there is a hole and behind P_2 is a second 2-slit arrangement with slits S_3, S_4 and second screen behind them. (a) There would be no interference pattern on the second screen but it would be lighted (b) The second screen would be totally dark (c) There would be a single bright point on the second screen (d) There would be a regular two slit pattern on the second screen	
36	Two coherent light sources S_1 and S_2 $(\lambda = 6000\,\overset{o}{A})$ are 1 mm apart from each other. The screen is placed at a distance of 25 cm from the sources. The width of the fringes on the screen should be (a)0.015 cm (b)0.013 cm (c)0.01 cm (d)0.10 cm	
37	Through quantum theory of light we can explain a number of phenomena observed with light, it is necessary to retain the wave nature of light to explain the phenomenon of (a) Photoelectric effect (b) Diffraction (c) Compton effect (d) Black body radiation	
38	If the intensities of the two interfering beams in young's double slit experiment be I_1 and I_2, then the contrast between the maximum and minimum intensity is good when (a) L_1 is much greater than L_2 (b) L_1 is much smaller than L_2 (c) $L_1 = L_2$	

	(d) Either L_1 = 0 or L_2 = 0	
39	The fringe width at a distance of 50 cm from the slits in young's experiment for light of wavelength 6000 $\overset{o}{A}$ is 0.048 cm. the fringe width at the same distance for $\lambda = 5000\overset{o}{A}$, will be (a)0.04 cm (b)0.4 cm (c)0.14 cm (d)0.45 cm	
40	Two waves originating from sources S_1 and S_2 having zero phase difference and common wavelength λ will show complete destructive interference at a point P, is $(S_1P - S_2P)$ = (a)5 λ (b) $\frac{3\lambda}{4}$ (c) $\frac{4\lambda}{2}$ (d) $\frac{11\lambda}{2}$	
41	Two coherent sources of intensities I_1 and I_2 produce an interference pattern. The maximum intensity in the interference pattern will be (a) $l_1 + l_2$ (b) $l_1^2 + l_2^2$ (c) $(l_1 + l_2)^2$ (d) $\left(\sqrt{l_1} + \sqrt{l_2}\right)^2$	
42	In young's double slit experiment, the seventh maximum wit wavelength λ_1 is at a distance d_1 and the same maximum with wavelength λ_2 is at a distance d_2. Then, d_1/d_2 = (a) $\frac{\lambda_1}{\lambda_2}$ (b) $\frac{\lambda_2}{\lambda_1}$ (C) $\frac{\lambda_1^2}{\lambda_2^2}$ (D) $\frac{\lambda_2^2}{\lambda_1^2}$	
43	When monochromatic light is replaced by white light in Fresnel's biprism arrangement, the central fringe is (a)coloured (b)white (c)dark (d)none of these	
44	In the setup shown in figure, the two slits, S_1 and S_2 are not equidistant from the slit S. The central fringe at O is, then	

	 (a) Always bright (b) Always dark (c) Either dark or bright depending on the position of S (d) Neither dark nor bright	
45	In a double slit interference experiment, the distance between the slits is 0.05 cm and screen is 2 m away from the slits. The wavelength of light is $6000\overset{o}{A}$. The distance between the fringes is (a)0.24 cm (b)0.12 cm (c)1.24 cm (d)2.28 cm	
46	The separation between successive fringes in a double slit arrangement is x. if the whole arrangement is dipped under water, what will be the new fringe separation? [The wavelength of light being used is $5000\overset{o}{A}$] (a)1.5x (b)x (c)0.75x (d)2x	
47	In a young's experiment, two coherent sources are placed 0.90 mm apart and the fringes are observed one metre away. If it produces the second dark fringe at a distance of 1 mm from the central fringe, the wavelength of monochromatic light used will be (a)60×10^{-4} cm (b)10×10^{-4} cm (c)10×10^{-5} cm (d)6×10^{-5} cm	
48	In the young's double slit experiment, the interference pattern is found to have an intensity ratio between bright and dark fringes as 9. This implies that (a) The intensities at the screen due to two slits are 5 units and 4 units respectively (b) The intensities at the screen due to two slits are 5 units and 1 unit respectively (c) The amplitude ratio is 3 (d) The amplitude ratio is 2	
49	Interference fringes are being produced on screen XY by the slits S_1 and S_2. In the figure, the correct fringe	

	locus is  (a)PQ (b)W_1 W_2 (c) W_3 W_4 (d)XY	
50	Microwaves from a transmitter are directed normally towards a plane reflector. A detector moves along the normal to the reflector. Between positions of 14 successive maxima, the detector travels a distance of 0.14 m. the frequency of transmitter is (a)1.5×10^{10} Hz (b) 10^{10} Hz (c)3×10^{10} Hz (d)6×10^{10} Hz	
51	Two waves having the intensities in the ratio 9:1 produce interference. The ratio of maximum to minimum intensity is equal to (a)10 : 8 (b)9 : 1 (c)4 :1 (d)2 : 1	
52	In young's double slit experiment, phase difference between light waves reaching 3rd bright fringe from the central fringe when $\lambda = 5000\,\overset{o}{A}$, is (a)6π (b)2π (c)4π (d)zero	
53	In an interference pattern produced by two identical slits, the intensity at the slit of the slit of the central maximum is I. the intensity at the same spot when either of the slits is closed I_0. Therefore, (a)$I = I_0$ (b)$I = 2 I_0$ (c)$I = 4 I_0$ (d)I and I_0 are not related to each other	
54	In a two slits experiment with monochromatic light, fringes are obtained on a screen placed at some distance from the slits. If the screen is moved by 5×10^{-2} m towards the slits, the change in fringe width is 3×10^{-5}m. if separation between the slits is 10^{-3}m, the wavelength of light used is (a)4500 $\overset{o}{A}$ (b)3000 $\overset{o}{A}$ (c)5000 $\overset{o}{A}$ (d)6000 $\overset{o}{A}$	
55	In young's double slits experiment, let S_1 and S_2 be the two slits, and C be the centre of the screen. If $\angle S_1CS_2 = \theta$ and λ is the wavelength, the fringe width will be (a) $\frac{\lambda}{\theta}$ (b) $\lambda\theta$ (c) $\frac{2\lambda}{\theta}$ (d) $\frac{\lambda}{2\theta}$	

56	In young's double slit experiment, the intensity on screen at a point where path difference is λ is K. what will be intensity at the point where path difference is $\lambda/4$ (a)K/4 (b)K/2 (c)K (d)zero	
57	In the young's double slit experiment, a mica slip of thickness t and refractive index μ is introduced in the ray from first source S_1. By how much distance fringes pattern will be displaced? (a) $\frac{d}{D}(\mu-1)t$ (b) $\frac{D}{d}(\mu-1)t$ (c) $\frac{d}{(\mu-1)D}$ (d) $\frac{D}{d}(\mu-1)$	
58	Oil floating on water appears coloured due to interference of light. What should be the order of magnitude of thickness of oil layer in order that this effect may be observed? (a)1,000 $\overset{0}{\mathrm{A}}$ (b)1 cm (c)10 $\overset{0}{\mathrm{A}}$ (d)100 $\overset{0}{\mathrm{A}}$	
59	Two waves $y_1 = A_1 \sin(\omega t - \beta_1)$ and wave whose amplitude is (a) $\sqrt{A_1^2 + A_2^2 2A_1A_2 \cos(\beta_1 - \beta_2)}$ (b) $\sqrt{A_1^2 + A_2^2 2A_1A_2 \sin(\beta_1 - \beta_2)}$ (c) $A_1 + A_2$ (d) $\lvert A_1 + A_2 \rvert$	
60	In double slit experiment, 12 fringes are obtained in a certain segment of the screen when light of wavelength 600 nm, number of fringes observed in the same segment of the screen is given by (a)12 (b)18 (c)24 (d)30	
61	In young's double slit experiment, distance between two sources is 0.1 mm. the distance of screen from the source is 20 cm. wave length of light used is 5460 $\overset{o}{A}$. Then angular position of first dark fringe is (a)0.08° (b)0.116° (c)0.20° (d)032°	
62	Two beams of light having intensities I and 4I interfere	

	to produce a fringe pattern on a screen. The phase difference between the beams is π/2 at point A and π at point B. then the difference between the resultant intensities at A and B is (a)2 I (b)4 I (c)5 I (d)7 I	
63	In a young's double slit experiment using red and blue lights of wavelengths 600 nm and 480 nm respectively, the value of n from which then the red fringe coincides with (n+1) the blue fringes is (a)5 (b)4 (c)3 (d)2	
64	In young's double slit experiment, distance between source is 1 mm and distance between the screen and source is 1 m. If the fringe width on the screen is 0.06 cm, then λ is (a) $6000\overset{o}{A}$ (b) $4000\overset{o}{A}$ (c) $1200\overset{o}{A}$ (d) $2400\overset{o}{A}$	
65	In young's double slit experiment, the central bright fringe can be identified (a) As it has greater intensity than the other bright fringes (b) As it is wide than the other bright fringes (c) As it is narrower than the other bright fringes (d) By using while light instead of monochromatic light	
66	Two slits, 4 mm apart are illuminated by light of wavelength $600\overset{o}{A}$. What will be the fringe width on a screen placed 2 m from the slits (a)0.12 mm (b)0.3 mm (c)3.0 mm (d)4.0 mm	

CONCEPT-70: BASED ON DIFFRACTION OF LIGHT

1	In a young's double slit experiment, the source is white light. One of the holes is covered by a red filter and another by a blue filter. In this case (a) There should be no interference fringe (b) There should be an interference pattern for red mixing with one for blue (c) There should be an interference pattern for red mixing with one for blue (d) None of the above	
2	Consider a point at the focus point of a convergent lens. Another convergent lens of short focal length is placed on the other side. What is the nature of the wavefront emerging from the final image? (a)cylindrical (b)elliptical (c)spherical (d)square	

3	A parallel beam of light of wavelength 3141.59 $\mathring{A}$ is incident on a small aperture. After passing through the aperture, the beam is no longer parallel but diverges at 1^o to the incident direction. What is the diameter of the aperture? (a)180 m (b)18μm (c)1.8 m (d)0.18 m	
4	Estimate the distance for which ray optics is good approximation for an aperture of 4 mm and wavelength 400 nm. (a)40 m (b)43 m (c)47 m (d)38 m	
5	Three waves of equal frequency having amplitudes 10μm, μm, 7μm arrive at a given point with successive phase difference of $\frac{\pi}{2}$, the amplitude of the resulting wave (in μm) is given by (a)4 (b)5 (c)6 (d)7	
6	An astronaut floating freely in space decides to use his flash light as a rocket. He shines a 10W light beam in a fixed direction so that he acquires momentum in the opposite direction. If his mass is 80 kg, how long must he need to reach a velocity of 1 ms^{-1}? (a)9 s (b)2.4 x 10^3s (c) 2.4 x 10^6s (d) 2.4 x 10^9s	
7	A beam of light consisting of two wavelengths 650 nm and 520 nm is used to illuminate the slit of a young's double slit experiment. Then the order of the bright fringe of the longer wavelength that coincide with a bright fringe of the shorter wavelength at the least distance from the central maximum is (a)1 (b)2 (c)3 (d)4	
8	Two identical radiators have a separation of d = λ/4 where λ is the wavelength of the waves emitted by either source. The initial phase difference between the source is π/4. Then the intensity on the screen at a distant point situated at an angle, θ = 30^o from the radiators is (here, I_0 is intensity at that point due to one radiator alone) (a) I_0 (b)2 I_0 (c)3 I_0 (d)4 I_0	
9	In young's double slit experiment, the 8 th maximum with wavelength λ_1 is at a distance, d_1 from the central	

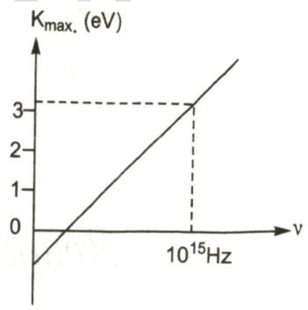
	maximum and the 6 th maximum with wavelength λ_2 is at a distance, d_2. Then, d_1/d_2 is equal to (a) $\frac{4}{3}\left(\frac{\lambda_2}{\lambda_1}\right)$ (b) $\frac{4}{3}\left(\frac{\lambda_1}{\lambda_2}\right)$ (c) $\frac{3}{4}\left(\frac{\lambda_2}{\lambda_1}\right)$ (d) $\frac{3}{4}\left(\frac{\lambda_1}{\lambda_2}\right)$	
10	Light of wavelength 500 nm is used to form interference pattern in young's double slit experiment. A uniform glass plate of refractive index 1.5 and thickness 0.1 mm is introduced in the path of one of the interfering beams. The number of fringes which will shift the cross wire due to this is (a)100 (b)200 (c)300 (d)400	
11	Air has refractive index 1.003. The thickness of air column, which will have one more wavelength of yellow light ($6000\overset{o}{A}$)than in the same thickness of vacuum is (a)2 mm (b)2 cm (c)2m (d)2 km	
12	The distance between the first and the sixth minima in the diffraction pattern of a single slit is 0.5 mm. the screen is 0.5 m away from the slit. If the wavelength of light used is $5000\overset{o}{A}$. Then the slit width will be (a)5 mm (b)2.5 mm (c)1.;25 mm (d)1.0 mm	
13	Plane microwaves are incident on a long slit having a width of 5 cm. the wavelength of the microwaves if the first minimum if formed at 30^o is (a)2.5 cm (b)2.5 mm (c)1.25 mm (d)2 mm	
14	A plane wave of wavelength 6250 $\overset{o}{A}$ is incident normally on a slit of width 2 x 10^{-2} cm. the width of the principal maximum on a screen distant 50 cm will be (a)312.5 x 10^{-3}cm (b) 312.5 x 10^{-4}cm (c)312 cm (d) 312.5 x 10^{-5}cm	
15	The main difference between the phenomena of interference and diffraction is that (a) Diffraction is caused by reflected waves from a source whereas interference is caused due n to refraction of waves from a source (b) Diffraction is due to interaction of waves derived from the same source, whereas interference is that bending of light from the same wavefront (c) Diffraction is due to interaction of light from wavefront, whereas the interference is the interaction	

	of two waves derived from the same source (d) Diffraction is due to interaction of light from the same wavefront whereas interference is the interaction of waves from two isolated sources	
16	Light of wavelength $6000\overset{o}{A}$ is incident on a single slit. The first minimum of the diffraction pattern is obtained at 4 mm from the centre. The screen is at a distance of 2 m from the slit. The slit width will be (a)0.3 mm (b)0.2 mm (c)0.15 mm (d)0.1 mm	
17	The fraunhofer diffraction pattern of a single slit is formed in the focal plane of a lens of focal length 1m. the width of slit is 0.3 mm. if third minimum is formed at a distance of 5 mm from central maximum, (a) $5000\overset{o}{A}$ (b) $2500\overset{o}{A}$ (c) $7500\overset{o}{A}$ (d) $8500\overset{o}{A}$	
18	What should be refractive index of a transparent medium to be invisible in vacuum? (a)1 (c)<1 (c)>1 (d)none of these	
19	A slit 5 cm wide irradiated normally with microwaves of wavelength 1.0 cm. Then the angular spread of the central maximum on either side of incident light is nearly (a)1/5 rad (b)4 rad (c)5 rad (d)6 rad	
20	Which of the following phenomena is not common to sound and light waves (a)interference (b)diffraction (c)coherence (d)polarization	
21	A beam of ordinary unpolarised light passes through a tourmaline crystal C_1 and then it passes through another tourmaline crystal C_2, which is oriented such that its principal plane is parallel to that of C_2. The intensity of emergent light is I_0. Now C_2 is rotated by 60^o about the ray. The emergent ray will have an intensity (a)$2I_0$ (b) $I_0/\sqrt{2}$ (c) $I_0/4$ (d) $I_0/\sqrt{3}$	
22	What is the Brewster's angle for air to glass transition? (Refractive index of glass = 1.5) (a)15^o,27' (b)36^o,27' (c)50^o,16' (d)56^o,18'	

23	An polarized beam of intensity 2 a^2 passes through a thin Polaroid. Assuming zero absorption in the Polaroid, the intensity of emergent plane polarized light is (a)$2a^2$ (b) a^2 (c) $\sqrt{2}$ a^2 (d) $\frac{a^2}{2}$	
24	80 g of impure sugar, when dissolved in a litre of water gives an optical rotation of 9.9°, when placed in a tube of length 20 cm. If, the specific rotation of sugar is 66° , then concentration of sugar solution will be (a)80 gL^{-1} (b)75 gL^{-1} (c)65 gL^{-1} (d)50 gL^{-1}	
25	If, for a calcite crystal, μ_0 and μ_e are the refractive indices of the crystal for O-ray and E-ray respectively, then , along the optic axis of the crystal (a)$\mu_0 = \mu_e$ (b) $\mu_e > \mu_0$ (c) $\mu_e < \mu_0$ (d)none of these	
26	λ_a and λ_m are the wavelengths of a beam of light in air and medium respectively. If θ is the polarizing angle, the correct relation between λ_a , λ_m and θ is (a) $\lambda_a = \lambda_m \tan^2\theta$ (b) $\lambda_m = \lambda_a \tan^2\theta$ (c) $\lambda_a = \lambda_m \cot\theta$ (d) $\lambda_m = \lambda_a \cot\theta$	
27	In a double-slit experiment the width of a fringe is found to be 0.2° on a screen placed 1 m away. The wavelength of light used is 600 nm. What will be the angular width of the fringe if the entire experimental apparatus is immersed in water? Take refractive index of water to be 4/3. (a)0.15° (b)0.30° (c)0.27° (d)0.45°	
28	The 6563 $\overset{o}{A}$ H_α sign line emitted by hydrogen in a star is found to be red-sifted by 15 $\overset{o}{A}$. Estimate the speed with which the star is receding from the earth. (a) 6.9 m/s approaching the earth (b) 6.86 m/s receding the earth (c) 7.9 m/s receding the earth (d) 8.9 m/s receding the earth	

CONCEPT-71: BASED ON EMISSION OF ELECTRONS AND PHOTOELECTRIC EFFECT

1	The photoelectric threshold of tungsten is 2300 $\overset{o}{A}$ is. The energy of the electrons ejected from the surface by ultraviolet light of wavelength 1800 $\overset{o}{A}$ is (h = 6.6 x 10^{-34}J-s) (a)0.15 x eV (b)1.5 eV	

	(c)15 eV (d)150 eV	
2	Consider a beam of electrons (each electron with energy E_0) incident on a metal surface kept in an evacuated chamber. Then, (a) No electrons will be emitted as only photons can emit electrons (b) Electrons can be emitted but all with an energy, E_0 (c) Electrons can be emitted with any energy, with a maximum of E_0-ϕ(ϕ is the work function) (d) Electrons can be emitted with any energy, with a maximum of E_0	
3	Ultraviolet radiation of 6.2 eV falls on an aluminum surface (work function 4.2 eV). The kinetic energy in joule of the fastest electron emitted is approximately. (a)3×10^{-21} (b)3.2×10^{-19} (c)3×10^{-17} (d)3×10^{-15}	
4	Radiations of two photon's energy, twice and ten times the work function of metal are incident on the metal surface successively. The ratio of maximum velocities of photoelectrons emitted in two cases is (a)1 :2 (b)1 : 3 (C)1 : 4 (d)1 : 1	
5	A proton, a neutron, an electron and an α-particle have same energy. Then their de-Broglie wavelengths compare as (a) $\lambda_p = \lambda_n > \lambda_e > \lambda_\alpha$ (b) $\lambda_\alpha = \lambda_p > \lambda_n > \lambda_e$ (c) $\lambda_e = \lambda_p > \lambda_n > \lambda_\alpha$ (d) $\lambda_e = \lambda_p > \lambda_n > \lambda_\alpha$	
6	Represents a graph of kinetic energy of most energetic photoelectrons K_{max} (in eV) and frequency v for a metal used as cathode in photoelectric experiment. The threshold frequency of light for the photoelectric emission from the metal is  (a)4×10^{14}Hz (b)3.5×10^{14}Hz (c)2.0×10^{14}Hz (d)2.7×10^{14}Hz	
7	For a certain metal, v = $2v_0$ and the electrons come out with a maximum velocity of 4×10^6 ms^{-1}. If the value of v= $5v_0$, then maximum velocity of photoelectrons will be (a)2×10^7 ms^{-1} (b) 8×10^6 ms^{-1} (c)2×10^6 ms^{-1} (d) 8×10^5 ms^{-1}	

8	The wavelength of the photoelectric threshold for silver is λ_0. The energy of the electron ejected from the surfave of silver by an incident light of wavelength $\lambda(\lambda<\lambda_0)$ will be (a) $hc(\lambda_0-\lambda)$ (b) $\frac{hc}{\lambda_0-\lambda}$ (c) $\frac{h}{c}\left(\frac{1}{\lambda}-\frac{1}{\lambda_0}\right)$ (d) $hc\left(\frac{\lambda_0-\lambda}{\lambda_0\lambda}\right)$	
9	A metal surface is illuminated by a light of given intensity and frequency to cause photoemission. If the intensity of illumination is reduced to one-fourth of its original value, then the maximum kinetic energy of the emitted photoelectrons would become (a) Four times the original value (b) Twice the original value (c) 1/6 of the original value (d) unchanged	
10	The work function of a metal is 1 eV. Light of wavelength 3000 $\overset{o}{A}$ is incident on this metal surface. The velocity of emitted photoelectrons will be (a)10 ms^{-1} (b)10^3 ms^{-1} (c)$10^4 ms^{-1}$ (d)10^6 ms^{-1}	
11	In the photoelectric effect, the velocity of ejected electrons depends upon the nature of the target and (a) The frequency of the incident light (b) The polarization of the incident light (c) The time for which the light has been incident (d) The intensity of the incident light	
12	Light of wavelength 4000 $\overset{o}{A}$ is incident on a metal plate whose work function is 2 eV. The maximum KE of the emitted photoelectron would be (a)0.5 eV (b)1.1 eV (c)1.5 eV (d)2.0 eV	
13	A photon of energy 3.4 ev is incident on a metal having work function 2 eV. The maximum KE of photoelectrons is equal to (a)1.4 eV (b)1.7 eV (c)5.4 eV (d)6.8 eV	
14	The frequency fo the incident light falling on a photosensitive metal plate is doubled, the kinetic energy of the emitted photoelectron is (a) Double the earlier value (b) Unchanged	

	(c) More than doubled (d) Less than doubled	
15	A metal surface of work function 1.07 eV is irradiated with light of wavelength 332 nm. The retarding potential required to stop the escape of photoelectrons is (a)1.07 eV (b)2.66 eV (c)3.7 eV (d)4.81 eV	
16	If the work function for a certain metal is 3.2×10^{-19}J and it is illuminated with light of frequency v = 8×10^{14} Hz, the maximum kinetic energy of the photoelectron would be (a)2.1×10^{19} J (b) 3.2×10^{19} J (c) 5.3×10^{19} J (d) 8.5×10^{19} J	
17	Ultraviolet radiations of 6.2 eV falls on an aluminum surface. KE of fastest electron emitted is (work function = 4.2 eV) (a) 3.2×10^{-21} J (b) 3.2×10^{-19} J (c) 7×10^{-25} J (d) 9×10^{-32} J	
18	Ultraviolet light of wavelength 300 nm and intensity 1.0 Wm^{-2} falls on the surface of a photosensitive material. If one percent of the incident photons produce photoelectrons, then the number of photoelectrons emitted from an area of 1.0 cm^2 of the surface is nearly (a)$9.61 \times 10^{14} s^{-1}$ (b)$4.12 \times 10^{13} s^{-1}$ (c)$1.51 \times 10^{12} s^{-1}$ (d)$2.13 \times 10^{11} s^{-1}$	
19	The photoelectric threshold wavelength for a metal surface is 6600 $\overset{o}{A}$. The work function for this metal is (a)0.87 eV (b)1.87 eV (c)18.7 eV (d)0.18 eV	
20	Light of wavelength 4000 $\overset{o}{A}$ incident on a sodium surface for which the threshold wavelength of photoelectrons is 5420 $\overset{o}{A}$. The work function is sodium is (a)0.57 eV (b)1.14 eV (c)2.29 eV (d)4.58 eV	
21	The difference between kinetic energies of photoelectrons emitted from a surface by light of wavelength 2500 $\overset{o}{A}$ and 5000 $\overset{o}{A}$ will be (a)1.61 eV (b)2.47 eV (c)3.96 eV (d)3.96×10^{-19}eV	
22	When a point source of light is 1 m away from a photoelectric cell, the photoelectric current is found to be I mA. If the same source is placed at 4 m from the same photoelectric cells, the photoelectric current (in	

	mA)will be (a) $\frac{I}{16}$ (b) $\frac{I}{4}$ (c)4 I (d)16 I	
23	The work function of a metallic surface is. 5.01 eV. The photoelectrons are emitted when light of wavelength 2000 $\overset{o}{A}$ falls on it. The potential difference applied to stop the fastest photo electrons is (h = 4.14 x 10^{-15} eV) (a)2.24 V (b)1.2 V (c)4.8V (d)3.6 V	
24	The work function of tungsten and sodium are 4.s eV and 2.3 eV respectively. If the threshold wavelength, λ for sodium is 5460 $\overset{o}{A}$, the value of λ for tungsten is (a)2791 $\overset{o}{A}$ (b)3260 $\overset{o}{A}$ (c)1925 $\overset{o}{A}$ (d)1000 $\overset{o}{A}$	
25	A photon of energy E ejects a photoelectrons from a metal surface whose work function is W_0. If this electron enters into a uniform magnetic field of induction B in a direction perpendicular to the field and describes a circular path of radius r, then the radius, r is given by (a) $\sqrt{\frac{2m(W_0-E)}{eB}}$ (b) $\sqrt{\frac{2e(E-W_0)}{mB}}$ (c) $\sqrt{\frac{2m(E-W_0)}{eB}}$ (d) $\sqrt{\frac{2mW_0}{eB}}$	
26	The energy flux of sunlight reaching the surface of the earth is 1.388 x 10^3 W/m^2. How many photons (nearly) per square metre are incident on the earth per second? Assume that the photons in the sunlight have an average wavelength of 550 nm. (a) 3.8 x 10^{21} photon/m^2-s (b) 4.1 x 10^{18} photon/m^2-s (c) 2.6 x 10^{19} photon/m^2-s (d) 1.9 x 10^{20} photon/m^2-s	
27	The work function for the surface of A1 us 4.2 eV. How much potential difference will be required to just sstop the emission of maximum energy electrons emitted by light of 2000 $\overset{o}{A}$? (a)1.51 V (b)1.99 V (c)2.99 V (d)none of these	
28	Two monochromatic beams A and B of equal intensity I, hit a screen. The number of photons hitting the screen by beam A is twice that bty beam B. then, what inference can you move about their frequency? (a) The frequency of beam B is twise that of A] (b) The frequency of beam B is half that of A (c) The frequency of beam A is twice of B	

	(d) None of these	
29	A neutrons beam of energy E scaters from atoms on a surface with a spacing d = 0.1 nm. The first maximm of intensity in the reflected beam occurs at $\theta = 30^o$. the kinetic energy E of the beam (in e V) is (a)10.2 eV (b)5.02 eV (c)0.21 eV (d)0.78 eV	
30	Light of wavelength must be changed to λ strikes a photo sensitive surface and electrons are ejected with kinetic energy E if the KE is to be increased to 2 E, the wavelength must be changed to λ where (a) $\lambda' = \frac{\lambda}{2}$ (b) $\lambda' = 2\lambda$ (c) $\frac{\lambda}{2} < \lambda' < \lambda$ (d) $\lambda' > \lambda$	
31	The threshold wavelength for a metal having work function W_0 is λ_0. What is the threshold wavelength for a metal whose work function is $\frac{W_0}{2}$? (a)4 λ_0 (b)2 λ_0 (c) $\frac{\lambda_0}{2}$ (d) $\frac{\lambda_0}{4}$	
32	The work function of a substance is 4.0 eV. The longest wavelength of light that can cause photoelectric emission from this substance approximately. (a)540 nm (b)400 nm (c)310 nm (d)220 nm	

CONCEPT-72: BASED ON WAVE NATURE OF PARTICLE

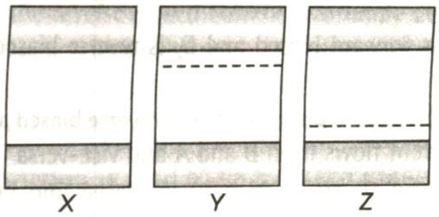
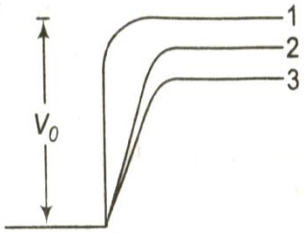
1	An electron and photon have same wavelength. If E is the energy of photon and p is the momentum of electron, then the magnitude of $\frac{E}{p}$ in SI unit is (a)3.33 x 10^{-9} (b)3.0 x 10^{8} (b)1.1x 10^{-19} (d)9 x 10^{16}	
2	The wavelength of de-Broglie wave associated with a thermal neutron of mass m at absolute temperature T is given by (here, k is the Boltzmann constant) (a) $\frac{h}{\sqrt{2mkT}}$ (b) $\frac{h}{\sqrt{mkT}}$ (c) $\frac{h}{\sqrt{3kmT}}$ (d) $\frac{h}{2\sqrt{mkT}}$	
3	An electrons is moving with an initial velocity v = $v_0 \hat{i}$ and is in a magnetic field B = $B_0 \hat{j}$. Then it's de-Broglie wavelength (a) Remains constant (b) Increases with time	

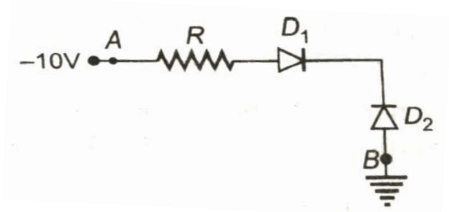
	(c) Decreases with time (d) Increases and decrease periodically	
4	An electrons (mass m) with an initial velocity v = $v_0\hat{i}$ (v_0>0) is in an electric field E = $E_0\hat{i}$ (E_0 = constant >) field. It's de-Broglie wavelength at time t is given by (a) $\frac{\lambda_0}{\left(1+\frac{eE_0}{m}\frac{t}{v_0}\right)}$ (b) $\lambda_0\left(1+\frac{eE_0 t}{mv_0}\right)$ (c) λ_0 (d) λ_0 t	
5	If the mass of neutral = 1.7 x 10^{-27}kg, then the de-Broglie wavelength of neutral of energy 3 eV is (h=6.6 x 10^{-34}J-s) (a) 1.6 x 10^{-16} m (b) 1.6 x 10^{-11} m (c) 1.6 x 10^{-10} m (d) 1.6 x 10^{-11} m	
6	An electron (mass m) with an initial velocity v = $v_0\ \hat{i}$ is in an electric E = $E_0\ \hat{j}$. If λ_0 = h/mv_0, it's de-Broglie wavelength at time t is given by (a) λ_0 (b) $\lambda_0\sqrt{1+\frac{e^2E^2t^2}{m^2v_0^2}}$ (c) $\frac{\lambda_0}{\sqrt{1+\frac{e^2E^2t^2}{m^2v_0^2}}}$ (d) $\frac{\lambda_0}{\left(1+\frac{e^2E^2t^2}{m^2v_0^2}\right)}$	
7	An electron of mass m and charge e initially at rest gets accelerated by a constant electric field E. the rate of change of de-Broglie wavelength of this electron at time t ignoring relativistic effect is (a) $\frac{-h}{eEt^2}$ (b) $\frac{-eEt}{E}$ (c) $\frac{-mh}{eEt^2}$ (d) $\frac{-h}{eEt}$	
8	What should be the velocity of an electron so that its momentum becomes equal to that of a photon of wavelength 5200 $\overset{o}{A}$ (a)10^7 ms^{-1} (b)1.2 x 10^3 ms^{-1} (c)1.4 x 10^3 ms^{-1} (d)2.8 x 10^3 ms^{-1}	

CONCEPT-73: BASED ON SEMICONDUCTORS

1	In an n-type silicon, which of the following statements is true?	

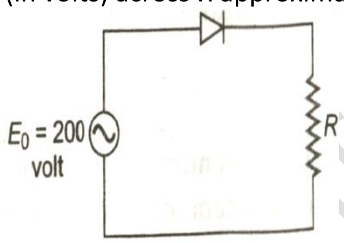
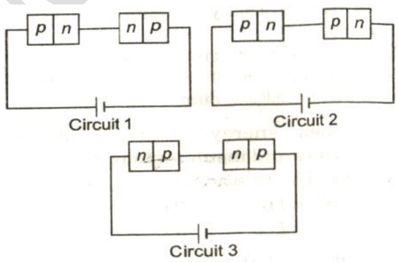
	(a) Electrons are majority carriers and trivalent atoms are the dopants (b) Electrons are minority carriers and trivalent atoms are the dopants (c) Holes are majority carriers and trivalent atoms are the dopants (d) Holes are minority carriers and trivalent atoms are the dopants	
2	The correct relation between n_e and n_h in an intrinsic semiconductor at ordinary temperature, is (a)$n_e>n_h$ (b) $n_e<n_h$ (c) $n_e=n_h$ (d) $n_e=n_h=0$	
3	The relation between number of free electrons (n)is a semiconductor and temperature (T) is given by (a)n $n \propto T$ (b) $n \propto T^2$ (c) $n \propto \sqrt{T}$ (d) $n \propto T^{3/2}$	
4	The conductivity of a semiconductor increases with increase in temperature because (a) Number density of free current carriers increases (b) Relaxation time increases (c) Both number density of carriers and relaxation time increase (d) Number density of carriers increases, relaxation is time decreases but effect of decreases in relaxation time much less than increase in number density	
5	The forbidden energy band gap in conductors semiconductors and insulators are EG_1, EG_2 and EG_3respectively. The relation among them, is (a) $EG_1 < EG_2 < EG_3$ (b) $EG_1 > EG_2 > EG_3$ (c) $EG_2 > EG_1 > EG_3$ (b) $EG_3 > EG_1 > EG_1$	
6	Wore P and Q have the same resistance at a ordinary room temperature. When heated resistance of P increases and that of Q decreases. We conclude that (a) P is semiconductor and Q is conductor (b) P is conductor and Q is semiconductor (c) P is n-type semiconductor and Q is p-type semiconductor (d) None of the above	

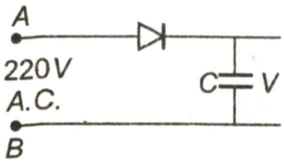
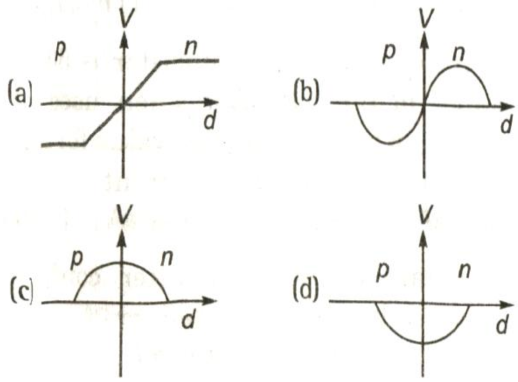
7	The energy band diagrams for three semiconductor samples of silicon are as shown. We can then assert that  (a) Sample X is undoped while samples Y and Z have been doped with a third group impurity respectively (b) Sample X is undoped while both samples Y and Z have been doped with a fifth group impurity respectively (c) Sample X has been doped with equal amounts of third and fifth group impurities while samples Y and Z are undoped (d) Sample X is undoped while sample Y and Z have been doped with a fifth group and a third group impurity respectively	
8	The ratio of electron and hole current in a semiconductor is 7/4 and the ratio of drift velocities of electrons and holes is 5/4, then ratio of concentrations of electrons and holes will be (a)5/7 (b)7/5 (c)25/49 (d)49/25	
9	In figure, V^0 is the potential barrier across a p-n junction, when no battery is connected across the junction  (a) 1 and 3 both correspond to forward bias of junction (b) 3 corresponds to forward bias of junction and 1 corresponds to reverse bias of junction (c) 1 corresponds to forward bias and 3 corresponds to reverse bias of junction (d) 3 and 1 both correspond to reverse bias of junction	
10	A piece of copper and other of germanium are cooled from the room te3mperature to 80 K, then (a) Resistance of each will increase (b) Resistance of each will decrease (c) The resistance of copper will increase, while that of germanium will decrease	

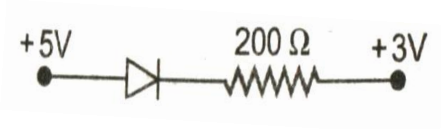
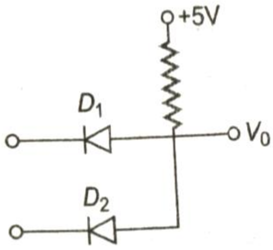
	(d) The resistance of copper will decrease, while that of germanium will increase	
11	In figure assuming the diodes to be ideal,  (a) $D_1$is forward biased and D_2 is reverse biased and hence current flows from A to B (b) $D_2$is forward biased and D_1 is reverse biased and hence current flows from A and B and vice-versa (c) D_1 and D_2 are both forward biased and hence current flows from A to B (d) D_1 and D_2 are both reverse biased and hence no current flows from A to B and vice-versa	
12	Electrical conductivity of a semiconductor d (a) Increases with the rise in its temperature (b) Decreases with the rise in its temperature (c) Decrease does not change with the rise in its temperature (d) First increase and then decreases with the rise in its temperature	
13	An n-type and a p-type silicon semiconductor can be obtained by doping pure silicon with (a) Sodium and magnesium (b) Phosphorus and boron respectively (c) Boron and phosphorus respectively (d) Indium and sodium respectively	
14	The Fermi level of an intrinsic semiconductor is pinned at the centre of the band gap. The probability of occupation of the highest electron state in valence band at room temperature, will be (a)zero (b)between zero and half (c)half (d)one	
15	A silicon specimen is made into a p-type semiconductor by dipping, on an average, one indium atom per 5 x10^7 silicon atoms. If the number density of atoms in the silicon specimen is 5 x 10^{28} atom m^{-3}, then the number of accepter atoms in silicon per cubic centimeter will be (a) 2.5 x 10^{10}atoms cm^{-3} (b) 2.5 x 10^{35}atoms cm^{-3} (c) 1.0 x 10^{13}atoms cm^{-3}	

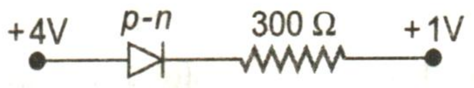
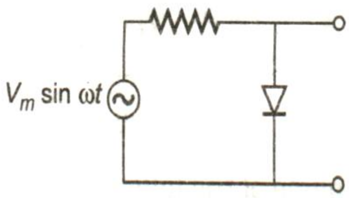
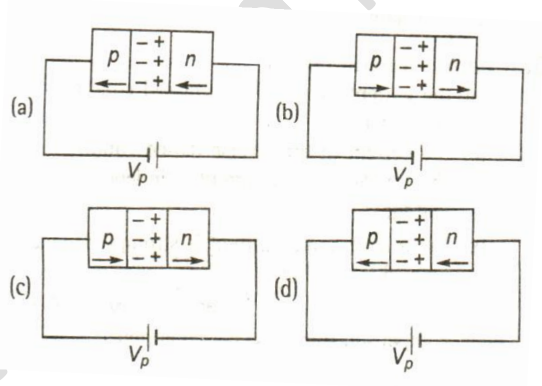
	(d) 1.0 x 10^{15}atoms cm^{-3}	
16	When an electric conductivity of semiconductor is due to the breaking of its covalent bands, then the semiconductor is said to be (a)acceptor (b)donor (c)intrinsic (d)extrinsic	
17	For a transistor amplifier, the voltage gain (a) Remains constant for all frequencies (b) Is high and low frequencies and constant in the middle frequency range (c) Is low at high and low frequencies and constant at mid frequencies (d) None of the above	

CONCEPT-74: BASED ON JUNCTION DIODE & TRANSISTOR

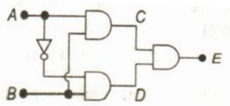
1	Three photodiodes D_1, D_2 and D_3 are made of semiconductors having band gaps of 2.5 eV, 2 eV and 3 eV, respectively. Which one will be able to detect light wavelength of 6000 $\overset{o}{A}$? (a)1.05 eV (b)0.05 eV (c)0.25 eV (d)2.06 eV	
2	A sinusoidal voltage of peak value 200V is connected to a diode and resistor R in the circuit figure, so that resistance of the diode is negligible compared to R, the rms voltage (in volts) across R approximately  (a)200 (b)100 (c) $\frac{200}{\sqrt{2}}$ (d)280	
3	Two identical p-n junction may be connected in series with a battery in three ways as shown in the adjoining figure. The potential drop across the p-n junctions are equal in  (a) Circuit 1 and circuit 2 (b) Circuit 2 and circuit 3 (c) Circuit 3 and circuit 1 (d) Circuit 1 only	
4	In the half, wave rectifier, circuit operating from 50 Hz mains frequency, the fundamental frequency in the ripple would be	

	(a)25 Hz (b)50 Hz (c)70.7 Hz (d)100 Hz	
5	A 220 V AC supply is connected between points A and B (figure). What will be the potential difference V across the capacitor?  (a)220 V (b)110 V (c)0 V (d)220 $\sqrt{2}$ V	
6	The current curve between potential (v) and distance (d) near p-n junction is  	
7	Two amplifier are connected after the other in series (cascaded). The first amplifier has a voltage gain of 10 and the second has a voltage gain of 20. If the input signal is 0.01 V, calculate the output AC signal. (a)3.6 V (b)4.2 V (c)2.0 V (d)5.2 V	
8	The value of ripple factor for full-wave rectifier is (a)40.6% (b)48.2% (c)81.2% (d)121%	
9	the average value of output direct current in a half wave rectifier is (a) $\frac{l_0}{\pi}$ (b) $\frac{I_0}{2}$ (c) $\frac{\pi l_0}{2}$ (d) $\frac{2l_0}{\pi}$	
10	for a junction diode, the ratio of forward current (I_f) and reverse current is [I_e = electronic charge, V = voltage applied across junction, K = Boltzmann constant, T = temperature in Kelvin]	

	(a) $e^{-V/kT}$ (b) $e^{V/kT}$ (c) $\left(e^{eV/kT}-1\right)$ (d) $\left(e^{V/kT}-1\right)$	
11	The value of current in the following diagram will be  (a)zero (b)10^{-2}–A (c)10 A (d)0.025 A	
12	Write the name of the following gate that the circuit shown in figure.  (a)AND gate (b)OR gate (c)NOR gate (d)XOR gate	
13	In a p-n junction diode (a) The current in the reverse biased condition is generally very small (b) The current in the reverse biased condition is small but the forward biased current is independent of the bias voltage (c) The reverse biased current is strongly depended on the applied bias voltage (d) The forward biased current is very small in small in comparison to reverse biased current	
14	P-n junction is said to be forward biased, when (a) The positive pole of the battery is joined to the n-semiconductor (b) The positive pole of the battery is joined to the n-semiconductor and p-semiconductor (c) The positive pole of the battery is connected to n-semiconductor (d) A mechanical force is applied in the forward direction	
15	The reverse bias in a junction diode is changed from 8 V to 13 V, then the value of the current changes from 40μA to 60μA. the resistance of junction diode will be (a)2 x $10^5\,\Omega$ (b)2.5 x $10^5\,\Omega$ (c)3 x $10^5\,\Omega$ (d)4 x $10^5\,\Omega$	
16	Consider the junction diode is ideal. The value of current in the figure is	

	 (a)zero (b)10^{-2} A (c)10^{-1} A (d)10^{-3} A	
17	Hole is (a) An anti-particle of electron (b) A vacancy created when an electron leaves a covalent bond (c) Absence of free electrons (d) an artificially created particle	
18	Output of the given circuit in figure  (a) Would be zero at all times (b) Would be like a half-wave rectifier with positive cycle in output (c) Would be like a half-wave rectifier with negative cycle in output (d) Would be like that of a full-wave rectifier	
19	I n the case of forward biasing of p-n junction, which one of the following figures correctly depicts the direction of flow of carriers?  	
20	A semiconductor device is connected in a series circuit with a battery and a resistance. A current is found to pass through the circuit. If the polarity of the battery is reversed, the current drops almost to zero. The device may be (a) A p-type semiconductor (b) An n-type semiconductor (c) A p-n junction (d) An intrinsic semiconductor	

21 Truth table for the given circuit



(a)

A	B	E
0	0	1
0	1	0
1	0	1
1	1	0

(b)

A	B	E
0	0	1
0	1	0
1	0	0
1	1	1

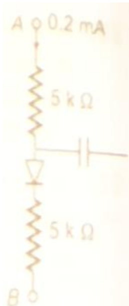
(c)

A	B	E
0	0	0
0	1	1
1	0	0
1	1	1

(d)

A	B	E
0	0	0
0	1	1
1	0	1
1	1	0

22 In the circuit show in figure. If the diode forward voltage drop is 0.3 V, the voltage difference between A and B is



(a)1.3 V (b)2.3 V (c)0 (d)0.5 V

23 In an n-p-n transistor, the collector current is 10 mA, if 90% of the electrons emitted reach the collector, the emitter current (I_E) and base current(I_B) are given by

(a) $I_E = -1mA, I_b = 9mA$

(b) $I_E = 9mA, I_B = -1mA$

(c) $I_E = 1mA, I_B = 11mA$

(d) $I_E = 11mA, I_B = 1mA$

24 The transfer ratio of the transistor is 50. The input resistance of the transistor when used in the CE configuration is 1 kΩ. the peak value for an AC input voltage of 0.01 V of collector current is

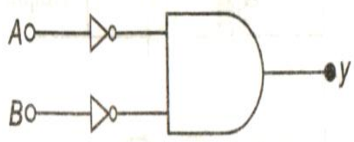
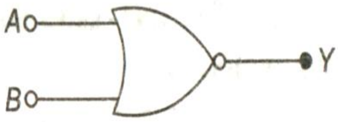
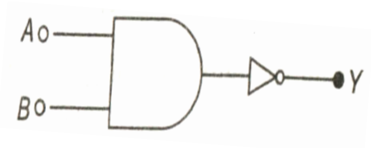
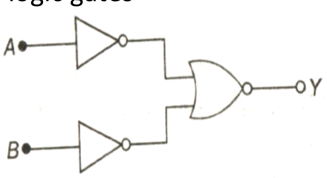
(a)500µA (b)0.25mA (c)400 mA (d)0.01 mA

25 Current gain in common-emitter configuration is more than 1, because

(a) $l_c < l_b$ (b) $l_c < l_e$ (c) $l_c > l_b$ (d) $l_e > l_b$

26 Current in gain common-base configuration is less than 1, because

	(a) $l_e < l_b$ (b) $l_b < l_e$ (c) $l_c < l_e$ (d) $l_e < l_c$	
27	Three amplifier stages each with a gain of 10 are cascaded. The overall gain is (a)10 (b)30 (d)1000 (d)100	
28	A transistor has β = 40. A change in base current of 100µA, produces change in collector current (a)40 x 100 µA (b)(100-40 µA) (c)100+40 µA (d)100 x/40 µA	
29	Current gain of a transistor in common base mode is 0.95. Its value in common emitter mode is (a)0.95 (b)1.5 (c)19 (d)$(19)^{-1}$	
30	Current gain of a transistor in a common emitter configuration is 40. If the emitter current is 8.2 mA, then base current is (a)0.02 mA (b)0.2 mA (c)2.0 mA (d)0.4 mA	
31	In a common emitter transistor amplifier β = 60, R_0 = 5000Ω and internal resistance of a transistor is 500 Ω. The voltage amplification of amplifier will be (a)500 (b)460 (c)600 (d)560	
32	In a n-p-n transistor 10^{10} electrons enter the emitter in 10^{-6} s. 4% of the electronics are lost in base. The current transfer ration will be (a)0.98 (b)0.97 (c)0.96 (d)0.94	
33	In n-p-n transistor circuit, the collector current is 10 mA. If 95 percent of the electronics emitted reach the collector, which of the following statements are true? (a) The emitter current will be 8mA (b) The emitter current will be 10.53 mA (c) The base current will be 5.53 ma (d) The base current will be 2 mA	
34	A transistor has a base current of 1 mA and emitter current 90 mA. The collector current will be (a)90µA (b)1 mA (c)89 mA (d)91 mA	
35	What is the value of $A\bar{A}$ in Boolean algebra? (a)zero (b)1 (one) (c)A (d) $\bar{A}$	
36	What is the output Y of the gate circuit shown in figure?	

	(a) $A.\bar{B}$  (b) $\bar{A}.\bar{B}$ (c) $\overline{\overline{A.B}}$ (d) $\overline{A.B}$	
37	Which gate is represented by the symbolic diagram given here?  (a)ANDgate (b)NAND gate (c)OR gate (d)NOR gate	
38	What is the name of the gate obtained by the combination shown in figure?  (a)NAND (b)NOR (c)NOT (d)XOR	
39	A truth table is given below. Which of the following has this type of truth table? <table><tr><th>A</th><th>B</th><th>Y</th></tr><tr><td>0</td><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>1</td><td>0</td></tr></table>(a) NOR gate (b) OR gate (c) AND gate (d) NAND gate	
40	Which of the following logic gate is represented by the combination of logic gates  (a) NAND gate (b) NOR gate (c) AND gate (d) OR gate	

CONCEPT-75: BASED ON BOHR'S THEORY AND HYDROGEN ATOM

1	Doubly ionized helium atom and hydrogen ions are accelerated, from rest, through the same potential difference. The ratio of final velocities of helium and hydrogen is (a)1 : $\sqrt{2}$ (b) $\sqrt{2}$: 1 (c)1 : 2 (d)2 : 1	
2	In Thomson's mass spectrographs, when an electric field of 2 x10^4Vm^{-1} is applied, then deflection produced on the screen is 20 mm. If the length of the plates is 5 cm and the distance of the screen from plates is 21cm and the velocity of positive ions is 10^6ms^{-1}, then their specific charge will be (a) 10^7 Ckg^{-1} (b) 2.59 x 10^7 Ckg^{-1} (c) 5.9 10^7 Ckg^{-1} (d) 9.52 10^7 Ckg^{-1}	
3	The working principle of the mass spectrograph is that for a given combination for accelerating potential and magnetic field, the ion beam (with charge q and mass M) to be collected at different positions of ion collectors will depend upon the value of (a) $\sqrt{\frac{2}{M}}$ (b) $\left(\frac{q}{M}\right)^2$ (c) $\frac{q}{M}$ (d)qM	
4	The mass of photon is 1836 times that of an electron. An electron and a proton are projected into a uniform electric field in a direction perpendicular to the field with equal initial kinetic energies. Then (a) The electron trajectory is less curved than the proton (b) The proton trajectory is less curved than the electron trajectory (c) Both trajectories are equally curved (d) Both trajectories will be straight	
5	An ionization chamber, with parallel conducting plates as anode and cathodes has 5 x 10^7cm^{-3} electrons and the same number of singly charged toward the anode to cathode is o.4 ms^{-1}. The current density from anode to cathode is 4μAm$^{-2.}$ The velocity of positive ions moving towards cathode is (a)0.1 ms^{-1} (b)0.4 ms^{-1} (c)zero (d)1.6 ms^{-1}	
6	In Thomson mass spectrograph, singly and doubly ionized particles from similar parabola corresponding to magnetic fields of 0.8 T and 1.2 T for a constant electric field. The ratio of masses of ionized particles will be (a)3 : 8 (b)2 : 9 (c)8 : 3 (d)9 : 2	

7	In an ionization experiment it is found that a doubly ionized particle enters a magnetic field of 1 T and moves in a circular path of radius 1 m with a speed of 1.6 x 10^7ms^{-1}. The particle must be (a)C^{++} (b)Be^{++} (c)Li^{++} (d)He^{++}	
8	An α-particle of mass 6.65 x 10^{-27} kg travels at right angles to a magnetic field of 0.2 T with a speed of 6 x10^5ms^{-1}. The acceleration of α-particle will be (a) 9.77 x 10^{11} ms^{-2} b) 8.55 x 10^{11} ms^{-2} (c) 5.77 x 10^{12} ms^{-2} (d) 7.55 x 10^{12} ms^{-2}	
9	Cathode rays of velocity 10^6ms^{-1} describe an approximate circular path of radius 1m in an electric field of 500 V cm^{-1}. If the velocity of cathode rays is doubled, the value of electric field needed so that the rays describe the same circular path is (a)1000 V cm^{-1} (b)1500 v cm^{-1} (c)2000 V cm^{-1} (d)500 V cm^{-1}	
10	An oil drop with charge q is held stationary between two plates with an external potential difference of 400 V. if the size of the drop is doubled without any change of charge, the potential difference required to keep the drop stationary will be (a)400V (b)1600V (c)3200V (d)4000V	
11	Air becomes conducting when the pressure ranges between (a)76 cm and 10 cm (b)10 cm and 1 cm (c)1 cm and 10^{-3}cm (d)10^{-4} cm and 10^{-7} cm	
12	An electron with (rest mass m_0) moves with a speed of 8.0c. its mass when it moves with this speed is (a)m_0 (b) $\frac{m_0}{6}$ (c) $\frac{5m_0}{3}$ (d) $\frac{3m_0}{3}$	
13	A charged dust particle of radius 5 x 10^{-7}m is located in a horizontal electric field having an intensity of 6.28 x 10^5 Vm^{-1}. The surrounding medium in air with coefficient of viscosity η = 1.6 x 10^{-15}Nsm^{-2}. If this particle moves with a uniform horizontal speed of 0.01 ms^{-1}, the number of electrons on it will be (a)20 (b)15 (c)25 (d)30	
14	The mass of a particle is 400 times than that of an electron and the charge is double. The particle is	

	accelerated by 5 V. initially the particle remained in rest, then its final KE will be (a)10 eV (b)5 eV (c)50 eV (d)100 eV	
15	If in a Thomson's mass spectrograph, the ratio of the electric field and magnetic field, in order to obtain coincident parabola of singly ionised and doubly ionized positive ions are 1 : 2 and 3 : 2 respectively, then the ration of masses of particles will be (a)3 : 1 (b)2 : 1 (c)9 : 4 (d)9 : 2	
16	The specific charge for positive rays is much less than that for cathode rays. This is because (a) Masses of positive rays are much larger (b) Charge on positive ray is less (c) Positive rays are positively charged (d) Experiment method is wrong	
17	If a cathode ray tube has a potential difference V volt between the cathode and anode, then the speed v of cathode rays is given by (a) $v \propto V^2$ (b) $v \propto \sqrt{V}$ (c) $v \propto V^{-1}$ (d) $v \propto V$	
18	An electric field of intensity 6 x $10^4 Vm^{-1}$ is applied perpendicular to the direction of motion of the electron. A magnetic field of induction 8 x 10^{-2} Wm^{-2} is applied perpendicular to both the electric field and direction of motion of the motion of the electron. What is the velocity of the electron if it passes undeflected? (a)7.5 x 10^5 ms^{-1} (b)7.5 x 10^{-5} ms^{-1} (c)48 x 10^{-2} ms^{-1}- (d)it is never possible	
19	The mean free path of the electron in a discharge tube is 20 cm. the length of the tube is 15 cm only. Then length of Crooke's dark space is (a)5cm (b)20 cm (c)15 cm (d)25 cm	
20	Light of wavelength 488 nm is produced by an argon laser, which is used in the photoelectric effect. When light from this spectral line is incident on the emitter, the stopping (cut-off) potential of photoelectrons is 0.38 V. find the work function of the material from which the emitter is made. (a)2.2 eV (b)3.7 eV (c)1.6 eV (d)4.2 eV	
21	A positively charged particle enters a magnetic field of value B $\hat{j}$ with a velocity $\hat{k}$ The particle will move along (a)+X-axis (b)-X-axis (c)+Z-axis (d)-Z-axis	

22	In a mass spectrograph, an ion X of mass number 24 and charge +e and another ion Y of mass number 22 and charge+2e enter in a perpendicular magnetic field with the same velocity. The ratio of the radii of the circular path in the field will be (a) $\frac{11}{22}$ (b) $\frac{11}{2}$ (c) $\frac{22}{11}$ (d) $\frac{24}{11}$	
23	A beam of electrons of velocity 3×10^7 ms^{-1} is deflected 1.5 mm is passing 10 cm through an electric field of 1800 Vm^{-1} perpendicular to their path. The value of $\frac{e}{m}$ for electron is (a)1.78×10^{11} Ckg^{-1} (b)2×10^{11} Ckg^{-1} (c)1.5×10^{11} Ckg^{-1} (d)3.5×10^{11} Ckg^{-1}	

CONCEPT-76: BASED ON MODELS OF ATOM

1	Taking the Bohr radius as a_0 = 53 pm, the radius of Li^{++} ion in its ground state, on the basis of Bohr's model, will be about (a)53 pm (b)27 pm (c)18 pm (d)13 pm	
2	If E_p and E_k are the potential energy and kinetic energy of the electron in stationary orbit in the hydrogen atom, the value of $\frac{E_p}{E_{ps}}$ is (a)2 (b)-1 (c)1 (d)-2	
3	Let the PE of hydrogen atom in the ground state be zero. Then its total energy in the first excited state will be (a)27.2 eV (b)23.8 eV (c)12.6 ev (d)10.2 eV	
4	In accordance with the Bohr's model the quantum number that characterizes the earth's revolution around the sun in an orbit of radius 1.5×10^{11} m with orbital speed 3×10^4 m/s (mass of earth = 6.0×10^{24} kg). they belong to (a)Balmer series (b)lyman series (c)humbney series (d)none of these	
5	Hydrogen atom excites energy level from fundamental state to n = 3. Number of spectrum lines, according to Bohr, is (a)4 (b)3 (c)1 (d)2	
6	In hydrogen atm, electron jumps from second to first orbit, the energy emitted is (a)-13.6 eV (b)-27.2 eV (c)-6.8 ev (d)-10.2 eV	

7	The binding energy of a H-atom, considering an electron moving around a fixed nuclei (proton), is $B=\frac{me^4}{8n^2\varepsilon_0^2h^2}$.(M = proton mass). This last expression is not correct because (a) N would not be integral (b) Bohr-quantization applies only to electron (c) The from in which the electron is at rest is not inertial. (d) The motion of the proton would not be in circular orbits, even approximately.	
8	The ionization energy of hydrogen atom is 13.6 eV. Following Bohr's theory, the energy corresponding to a transition between 3rd and 4th orbit is (a)3.40 eV (b)1.51 eV (c)0.85 eV (d)0.66 eV	
9	The figure indicates the energy levels of a certain atom. When the system moves from 2E level to E, a photon produced during its transition from $\frac{4E}{3}$ level to E is (a) $\frac{\lambda}{3}$ (b) $\frac{3\lambda}{3}$ (c) $\frac{3\lambda}{4}$ (d) $\frac{4\lambda}{3}$ (d)3 λ	
10	An ionised H-molecule consist of an electron and two protons. One proton are separated by a small distance of the order of angstrom. In the ground state (a) The electron would not move in circular orbits (b) The energy would be $(z)^4$ times that of a H-atom (c) The molecule will soon decay in the proton and a H-atom (d) None of the above	
11	In H spectrum, the wavelength of H_α line is 658 nm whereas in a distance galaxy, the wavelength of H_α line is 706 nm. Estimate the speed of galaxy with respect to earth (a)2×10^8 ms^{-1} (b) 2×10^7 ms^{-1} (c) 2×10^6 ms^{-1} (d) 2×10^5 ms^{-1}	
12	If the shortest wavelength in the lyman series is 911.6 $\overset{o}{A}$, the longest wavelength in the same series will be (a)1600 $\overset{o}{A}$ (b)2430 $\overset{o}{A}$ (c)1215 $\overset{o}{A}$ (d) ∞	
13	Hydrogen atoms are excited are excited from ground state of the principal quantum number 4. Then, the	

	number of spectral lines observed will be (a)3 (b)6 (c)5 (d)2	
14	What is the de-Broglie wavelength of a nitrogen molecule in air at 300 K? Assume that the molecule is moving with the root-mean-square speed of molecules at this temperature (Atomic mass of nitrogen = 14.0076 u) (a)o.o1 nm (b)0.09 nm (c)0.03 nm (d)0.2 nm	
15	When a hydrogen atom is bombared, the atom is excited to then n = 4 state. The energy released, when the atom goes from n = 4 state to the ground state is (a)1.75 eV (b)12.75 eV (c)5 eV (d)8 eV	
16	An electron jumps from the 4th orbit to 2nd orbit of hydrogen atom. Given the Rydberg's constants R = 10^5 cm^{-1}, the frequency in hertz of the emitted radiation will be (a) $\frac{3}{16}\times10^5$ (b) $\frac{3}{16}\times10^{15}$ (c) $\frac{9}{16}\times10^{15}$ (d) $\frac{3}{4}\times10^{15}$	
17	The energy of an electron in nth orbit of the hydrogen atom is given by $E_n \frac{-13.6}{n^2}eV$ The energy required to raise an electron from, the first orbit to the second orbit will be (a)10.2 eV (b)12.1 eV (c)13.6 eV (d)3.4 eV	
18	For the ground state and electron in the H-atom has an angular momentum = h, according to the simple Bohr model. Angular momentum is a vector and hence there will be infinitely many orbits with the vector pointing in all possible directions. In actuality, this is not true, (a) Because Bohr model gives incorrect values of angular momentum. (b) Because only one of these would have a minimum energy. (c) Angular momentum must be in the direction of spin of electron. (d) Because electrons go around only in horizontal orbits.	
19	For light of wavelength 5000 $\overset{o}{A}$, photon energy is nearly 2.5 eV. For X-rays ols wavelength 1 $\overset{o}{A}$, the photon energy will be close to (a)(2.5 ÷ 5000)eV (b)(2.5 ÷(5000)^2]eV (c) (2.5 × 5000)eV (d) (2.5 × (5000)^2]eV	
20	Consider an electron in the nth orbit of a hydrogen	

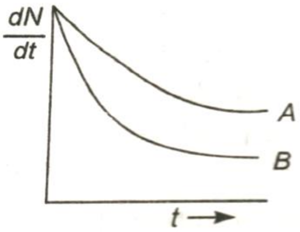
	atom in the Bohr model. The circumference of the orbit can be expressed in terms of the de-Broglie wavelength of that electron as (a)(0.529)n λ (b) $\sqrt{n}\lambda$ (c)(13.6) λ (d)n λ	
21	O_2 molecule consist of two oxygen atoms. In the molecule, nuclear force between the nuclei of the two atoms. (a) Is not important because nuclear forces are short-ranged (b) Is as important as electrostatic force for binging the two atoms (c) Cancels the repulsive electrostatic force between the nuclei (d) Is not important because oxygen nucleus have equal number of neutrons and protons.	
22	If the wavelength of the first line of the Balmer series of hydrogen is 6561 $\overset{o}{A}$, the wavelength of the second line of the series should be (a)13122 $\overset{o}{A}$ (b)3280 $\overset{o}{A}$ (c)4860 $\overset{o}{A}$ (d)2187 $\overset{o}{A}$	
23	The ratio of the energies of the hydrogen atom in its first to second excited stated is (a)9/4 (b)4/1 (c)8/1 (d)1/8	
24	A hydrogen atom initially in the ground level absorbs a photon, which excites it to the n = 4 level. Determine the wavelength and frequency of photon. (a) 9.7 x 10^{-8} and 3.1 x 10^{15} Hz (b) 7.6 x 10^{-9} and 2.6 x 10^{14} Hz (c) 2.9 x 10^{-10} and 4.9 x 10^{12} Hz (d) 8.6 x 10^{-9} and 3.1 x 10^{14} Hz	
25	An α-particle of energy 5 Me V is scattered through 180^o by a fixed uranium nucleus. The distance of closest approach is of the order of (a)1 $\overset{o}{A}$ (b)10^{-10}cm (c) 10^{-12}cm (d) 10^{-15}cm	
26	Ionization potential of hydrogen atom is 13.6 eV. Hydrogen atoms in the ground state are excited by monochromatic radiation of photon energy 12.1 eV. The spectral lines emitted by hydrogen atom according to Bohr's theory with be (a)one (b)two (c)three (d)four	
27	The first line of Balmer series has wavelength 6563 $\overset{o}{A}$. What will be the wavelength of the first member of Lyman series?	

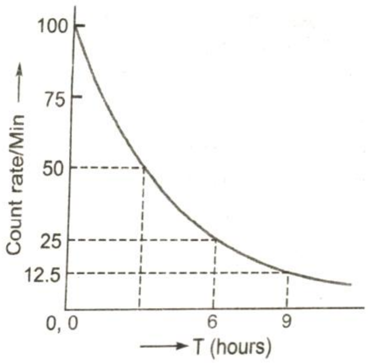
	(a)1215.4 $\overset{o}{A}$ (b)2500 $\overset{o}{A}$ (c)7500 $\overset{o}{A}$ (d)600 $\overset{o}{A}$	
28	Two H atoms in the ground state collide in elastically. The maximum amount by which their combined kinetic energy is reduced is (a)10.20 eV (b)20.40 eV (c)13.6 eV (d)27.2 eV	
29	The wave number of the energy emitted when electron comes from fourth orbit to second orbit5 in hydrogen is 20, 397 cm^{-1}. The wave number of the energy for the same transition in He^{+} is (a)5,009 cm^{-1} (b)20,497cm^{-1} (c)14400 $\overset{o}{A}$ (d)81,588 cm^{-1}	
30	In the Bohr model of the hydrogen atom, let R, V and E represent the radius of the orbit, the speed of electron and the total energy of the electron and the total energy of the electron respectively. Which of the following quantities is proportional to quantum number n? (a) $\frac{R}{E}$ (b) $\frac{E}{V}$ (c)RE (d)VR	
31	Using the Bohr's model calculate the speed of the electron in a hydrogen atom in the π = , 2 and 3 levels. (a) 4.2 x 10^{4}m/s, 3.2 x 10^{4}m/s and 7.2 x 10^{6}m/s (b) 2 x 10^{9}m/s, 3.3 x 10^{5}m/s and 7 x 10^{5}m/s (c) 2.19 x 10^{6}m/s,1.9 x 10^{6}m/s and 7.5 x 10^{5}m/s (d) 2.2 x 10^{6}m/s, 1.9 x 10^{6}m/s and 7.5 x 10^{4}m/s	
32	A particle moving with a velocity of $\frac{1}{100}$th of that of light will cross a nucleus on about (a)10^{-8} s (b)10^{-12} s (c)6 x 10^{-15} s (d)10^{-20}s	
33	Suppose we consider a large number of containers each containing initially 10000 atoms of a radioactive material with a half life of 1 year. After 1 year (a) All the containers will have 5000 atoms of the materials. (b) All the containers will contain the same number of atoms of the material but that number will only be approximately 5000. (c) The containers will in general have different numbers of the atoms of the material but their average will be close to 5000. (d) None of the containers can have more than 5000 atoms.	
34	If Avogadro number is 6 x 10^{23}, then number of protons, neutrons and electrons is 14 g of $_{6}C^{14}$ are	

	respectively (a) 36×10^{23}, 48×10^{23}, 36×10^{23}, (b) 36×10^{23}, 36×10^{23}, 36×10^{23}, (c) 48×10^{23}, 36×10^{23}, 48×10^{23}, (d) 48×10^{23}, 48×10^{23}, 36×10^{23}	
35	The binding energies per nucleon of Li^7 and He^4 are 5.6 MeV and 7.06 MeV respectively, then the energy of the reaction $Li^7 + p = 2\ [_2He^4]$ will be (a)17.28 MeV (b)39.2 MeV (c)28.24 MeV (d)1.46 MeV	
36	The gravitational force between a H-atom and another particle of mass m will be given by Newton's law: $F = G\frac{M.m}{r^2}$, where r is in km and (a) $M = m_{photon} + m_{electron}$ (b) $M = m_{photon} + m_{electron} - \frac{B}{c^2}$ (B = 13.6 eV) (c) M is not related to the mass of the hydrogen atom (d) $M = m_{photon} + m_{electron} - \frac{\lvert V\rvert}{c^2}$ ($\lvert V\rvert$ = magnitude of the potential energy of electron in the h-atom).	
37	M_x and M_y denote the atomic masses of the parent and the daughter nuclei respectively in a radioactive decay. The Q-value of a β^- decay is Q_1 and that for a β^+ decay is Q_2. If m_e denotes the mass of an electron, then which of the following statements is correct? (a) $Q_1 = (M_x - M_y)\ c^2$ and $Q_2 = (M_x - M_y - 2m_e)c^2$ (b) $Q_1 = (M_x - M_y)\ c^2$ and $Q_2 = (M_x - M_y)c^2$ (c) $Q_1 = (M_x - M_y - 2m_e)c^2$ and $Q_2 = (M_x - M_y -+2m_e)c^2$ (d) $Q_1 = (M_x - M_y + 2m_e)c^2$ and $Q_2 = (M_x - M_y -+2m_e)c^2$	
38	The binding energy of two nuclei p^n and Q^{2n} are x joule and y joule respectively. If $2x > y$, then the energy released in the reaction $p^n + p^n = Q^{2n}$ will be (a)2x + y (b)2x – y (c)xy (d)x + y	
39	Energy released in the fission of a single nucleus is 200 MeV. The fission rate of a $^{235}_{92}U$ filled reactor operating at a power level of 5W is (a) $1.56 \times 10^{-10}\ s^{-1}$ (b) $1.56 \times 10^{11}\ s^{-1}$ (c) $1.56 \times 10^{-16}\ s^{-1}$ (d) $1.56 \times 10^{-17}\ s^{-1}$	
40	Two-nucleons are at a separation of 1 fm. The net force between them is F_1, if both neutrons, F_2 if both are protons and F_3 if one is a proton and the other is a	

	neutron. (a) $F_1 > F_2 > F_3$ (b) $F_2 > F_1 > F_3$ (c) $F_1 = F_3 > F_2$ (d)($F_1 = F_2 > F_3$	
41	R_1 and r_2 are the radii of atomic nuclei of mass numbers 64 and 27 respectively. The ratio (r_1/r_2) is (a)64/27 (b)27/64 (c)4/3 (d)1	
42	The mass number of a nucleus is 216. The size of an atom without changing its chemical properties are called (a)7.2 x 10^{13} cm (b)7.2 x 10^{11} cm (c)7.2 x 10^{-10} cm (d)3.6 x 10^{-11} cm	
43	Neutron decay in free space is given as follows $_0n^1 \rightarrow {}_1H^1 + {}_{-1}e^0 + []$ Then the parentheses represents a (a)neutrino (b)photon (c)antineutrino (d)graviton	
44	The energy equivalent of one atomic mass unit is (a) 1.6 x 20^{-29} J (b) 6.02 x 10^{-23}J (c) 931J (d) 931 MeV	
45	$_{92}U^{235}$ and $_{92}U^{238}$ differ as (a) $_{92}U^{235}$ has 2 protons less (b) $_{92}U^{238}$ has 3 protons more (c) $_{92}U^{238}$ has 3 neutrons more (d) None of the above	
46	Tritium is an isotope of hydrogen whose nucleus triton contains 2 neutrons and 1 proton. Free neutrons decay into $p+\bar{e}+\bar{v}$. if one of the neutrons in triton decays, it would transform into He^3 nucleus. This does not happen. This is because (a) Triton energy is less than that of a He^3 nucleus. (b) The electron created in the beta decay process cannot remain in the nucleus. (c) Both the neutrons in triton have to decay simultaneously resulting in a nucleus with 3 protons, which is not a He^3 nucleus. (d) Because free neutrons decay due to external perturbations which is absent in a triton nucleus	

CONCEPT-77: BASED ON RADIOACTIVITY

1	In the following figure, which of the following sample A or B has shorter mean life?  (a)B (b)A (c)A and B both (d)neither A nor B	
2	The half-life of radioactive Radon is 3.8 days. The time at the end of which (1/20) th of the Radon sample will remain undeclared is (given $\log_{10} e = 0.4343$) (a)13.8 days (b)16.5 days (c)33 days (d)76 days	
3	A radioactive isotope has a half-life of T years. How long will it take the actively to reduce to (a)4.6 T and 7.5 T (b)9.5 T and 5 T (c)5 T and 9.5 T (d)5 T and 6.65 T	
4	Half-life of radium is 1600 yr. Its average life is (a)3200 yr (b)4800 yr (c)2308 yr (d)4217 yr	
5	Plutonium decays with half-life of 24000 yr. If plutonium is stored for 7200 yr, the fraction of it that remains is (a)1/8 (b)1/3 (c)1/4 (d)1/2	
6	The penetrating powers of α,β and γ radiations, in decreasing order are (a) γ, α, β (b) γ, β, α (c) α, β, γ **(d)** β, γ, α	
7	**If** $N_1 = N_0 e^{-\lambda t}$ then the number of atoms decayed during time interval from t_1 and t_2(t_2>t_1) will be (a) $N_{t_1} - N_{t_2} = N_0[e^{-\lambda t_1} - e^{-\lambda t_2}]$	

	(b) $N_{t_2} - N_{t_1} = N_0[e^{-\lambda t_2} - e^{-\lambda t_1}]$ (c) $N_{t_2} - N_{t_1} = N_0[e^{\lambda t_2} - e^{-\lambda t_1}]$ (d) None of the above	
8	The count rate for 10g of radioactive material was measured at different times and this has been shown in figure with scale given. The half-life of the material and the total count in the first half value period, respectively are  (a) 4 h and 9000 (approximately) (b) 3 h and 14100 (approximately) (c) 3 h and 235 (approximately) (d) 10 h and 157 (approximately)	
9	A radioactive nucleus can decay simultaneously be two different processes which have decay constant λ_1 and λ_2. The effective decay constant of the nuclide is λ, where (a) $\lambda = \lambda_1 + \lambda_2$ (b) $\lambda = 2(\lambda_1 + \lambda)$ (c) $\frac{1}{\lambda} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$ (d) $\lambda = \sqrt{\lambda_1 \lambda_2}$	
10	The half-life period of radium is 1600 yr. The fraction of a sample of radium that would remain after 6400 yr is (a) $\frac{1}{4}$ (b) $\frac{1}{2}$ (c) $\frac{1}{8}$ (d) $\frac{1}{16}$	
11	Two radioactive sources A and B of half lives 1h and 2h respectively initially contain the same number of radioactive atoms. At the end of two hours, their rates of disintegration are in the ratio of (a)1 : 4 (b)1 : 3 (c)1 : 2 (d)1 : 1	
12	The normal activity of living carbon containing matter is found to be about 15 decays per minute for every gram of carbon. This activity arises from the small proportion of radioactive $^{14}_{6}C$ present with the stable carbon isotope $^{12}_{6}C$. When the organism is dead, its interaction with the atmosphere (which maintains the above	

	equilibrium activity) ceases and its activity begins to drop. From the known half-life (5730 yr) of ${}^{14}_{6}C$ and the measured activity, the age of the specimen can be approximately estimated. This is principle of ${}^{14}_{6}C$ dating used in archaeology. Suppose a specimen from Mohenjo-Daro gives an activity of 9 decays per minute per gram of carbon. Estimate the approximate age of the Indus-Valley civilization. (a)5224 yr (b)4224 yr (c)8264 yr (d)6268 yr	
13	Half-life of radioactive substance is 140 days. Initially, is 16g. Calculate the time for this substance when it reduces to 1 g (a)140days (b)280days (c)420days (d)560days	
14	Fusion process, line combining two deuterons to form a He nucleus are impossible at ordinary temperatures and pressure. This reasons for this can be traced to the fact (a) Nuclear forces have short range (b) Nuclei are positively change (c) The original nuclei must be completely ionized before fusion can take place (d) The original nuclei must first break up before combining with each other.	

CONCEPT-78: BASED ON NUCLEAR REACTIONS, NUCLEAR FISSION AND NUCLEAR FUSION

1	The number of neutrons released during the fission reaction is ${}^{1}_{0}n+{}^{235}_{92}U \rightarrow {}^{133}_{51}Sb+{}^{99}_{41}Nb+$ neutrons (a)1 (b)92 (c)3 (d)4	
2	A moderator is used in nuclear reactors in order to (a) slow down the speed of the neutrons (b) accelerate the neutrons (c) increase the number of neutrons (d) decrease the number of neutrons	
3	During a nuclear fusion reaction (a) A heavy nucleus breaks into two fragments by itself (b) A light nucleus bombarded by thermal neutrons break up (c) A heavy nucleus bombarded by thermal neutrons break up (d) Two light nuclei combine to give a heavier nucleus and possible other products	
4	${}_{92}U^{238}$ on absorbing a neutron goes over to ${}_{92}U^{239}$. This nucleus emits an electron to go over electron goes over to plutonium. The resulting plutonium can be	

	expressed as (a) ${}_{94}U^{239}$ (b) ${}_{92}U^{239}$ (c) ${}_{93}U^{240}$ (d) ${}_{92}U^{240}$	
5	The nucleus ${}_{6}C^{2}$ absorbs an energetic neutron and emits a β-particle. The resulting nucleus is (a) ${}_{7}N^{14}$ (b) ${}_{5}B^{13}$ (c) ${}_{7}N^{13}$ (d) ${}_{6}C^{13}$	
6	In the uranium radioactive series, the initial nucleus is ${}_{92}U^{238}$ and that the final nucleus is ${}_{82}Pb^{206}$. When uranium nucleus decays to lead, the number of α-particle and β-particles emitted are (a)8α, 6β (b)6α,7β (c)6α,8β (d)4α,3β	
7	Complete the equation for the following fission process ${}_{92}U^{235}+{}_{0}n^{1}\rightarrow....{}_{38}Kr^{90}+...$ (a) ${}_{50}Xe^{143}+3{}_{0}n^{1}$ (b) ${}_{54}Xe^{145}$ (c) ${}_{57}Xe^{142}$ (d) ${}_{54}Xe^{142}+{}_{0}n^{1}$	
8	A source contains two phosphorous radio nuclides ${}^{32}_{15}P$ ($T_{1/2}$ = 14.3 days) and ${}^{33}_{15}P$ ($T_{1/2}$ = 25.3 days). Initially, 10% of the decay come from ${}^{33}_{15}P$. How long one must wait until 90% do so? (a)250 days (b)295 days (c)305 days (d)208 days	
9	If the mass of a radioactive sample is doubled, the activity of the sample and the disintegration constant of the sample are respectively. (a) increases, remains th same (b) Decreases, increases (c) Decreases remaining same (d) Increases, decreases	
10	Highly energetic electrons are bombarded on a target of an element containing 30 neutrons. The ratio radii of nucleus to that of Helium nucleus is $(14)^{1/3}$ the atomic number of nucleus will be (a)25 (b)26 (c)56 (d)30	

CONCEPT-79: BASED ON COMMUNICATION SYSTEMS

1	For an amplitude modulated wave, the maximum amplitude is found to be 10V while the minimum amplitude is found to be 2 V. Determine e modulation index μ. (a) $\frac{2}{3},1$ (b) $1,\frac{2}{3}$ (c) $\frac{4}{5},1$ (d) $1,\frac{4}{5}$	

2	The modulation techniques used for transformi9ng digital data into analog signals are (a) Amplitude shift keying (ASK) only (b) Frequency shift keying (FSK) only (c) Phase shift keying (PSK) only (d) all of the above	
3	The speech signal of 3 kHz is used to modulate a carrier signal of frequency 1 MHz, using amplitude modulation. The frequencies is the side bands will be (a) 1.003 MHz and 0.997 MHz (b) 1.954nMHz and 2.0 MHz (c) 40.5 MHz and 27.6 MHz (d) 5 MHZ and 0.997 MHZ	
4	Three waves A,B and C of frequencies 1600 kHz, 5 MHz and 60 MHz, respectively are to be transmitted from one place to another. Which of the following is the most appropriate mode of communication? (a) A is transmitted via space wave while B and C are transmitted via sky wave (b) A is transmitted via ground wave, B via sky wave and C via space wave (c) B and C are transmitted via ground wave while A is transmitted via sky wave (d) B is transmitted via ground wave while A and C are transmitted via space wave	
5	Range of frequencies allotted for commercial UHF TV broadcast is (a)470-960 kHz (b) 47-960 MHz (c) 470-960 MHz (d) 47-960 kHz	
6	Is it necessary for a transmitting antenna to be at the same height as that of the receiving antenna for line of sight communication? A TV transmitting antenna s 81 m tall. How much service area can it cover, if the receiving antenna is at ground level? (a)3800 km^2 (b)3260 km^2 (c)7400 km^2 (d)3320 km^{21}	
7	A transmitter transmits the original. (a) True (b) False (c) Sometimes true and sometimes false (d) Never true	
8	A receiver reconstructs the original message after	

	propagation through the channel (a) May be true (b) May be false (c) May be true or false (d) Is certainly true	
9	A 100 m long antenna is mounted on a 500 m tall building. The complex can become a transmission tower for waves with λ (a) ~ 400m (b) ~ 25 m (c) ~ 150 m (d) ~ 2400 m	
10	In amplitude modulation, carrier wave frequencies are (a) Lower compared to those in frequency modulation (b) Higher compared to those in frequency modulation (c) Same as in frequency modulation (d) Lower sometimes and higher sometimes to those in frequency modulation	
11	Digital signals (a) Do not provide a continuous set of values (b) Represents value as discrete steps (c) Can utilize binary system and (d) Can utilize decimal as well as binary systems	
12	In pulse modulation of analog signals, common pulse systems employed are (a) Pulse Amplitude modulation (PAM) (b) Pulse position and pulse duration modulation (PPM and PDM) (c) All of the above	
13	A 1kW signal is transmitted using a communication channel which provides attenuation at the rate of -2dB per km. if the communication channel has a total length of 5 km, the power of th signal received is $\left[GainindB = 10\log\left(\frac{p_0}{p_i}\right)\right]$ (a)900 W (b)100 W (c)990 W (d)1010 W	
14	Sinusoidal carrier voltage of frequency 1.5 MHz and amplitude 50 V is amplitude modulated by sinusoidal voltage of frequency 10 kHz producing 50% modulation. The lower and upper side band frequencies in kHz are (a)1510, 1490 (b)1820, 1012 (c) $\frac{1}{1510}, \frac{1}{1490}$ (d)2490, 1510	

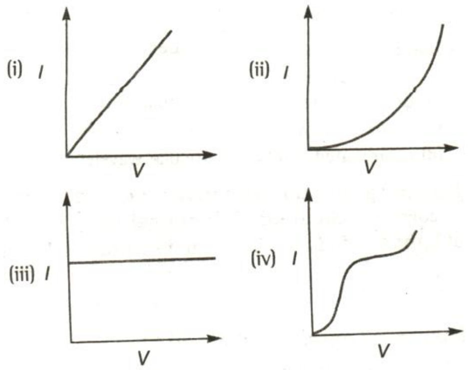
CONCEPT-80: BASED ON SPACE COMMUNICATION & OPTICAL FIBRES

1	A signal emitted by an antenna from a certain point can be received at another point of the surface in the form of (a) sky wave (b) ground wave (c) sea wave (d) both (a) and (b)	
2	In satellite communication, the communication satellite; (a) acts as a reflector for a beam of modulated microwave from transmitter sent directly towards it (b) acts as a repeater for a signal reaching there, without any change infrequency (c) receives the coming modulated microwave signal, amplifies it and returns it to earth at a different frequency (d) none of the above	
3	Which of the following frequencies will be suitable for beyond the horizon communication using sky waves? (a)10 kHz (b)10 MHZ (c)1 GHz (d)1000GHz	
4	The space wave propagation is utilized in (a) only television communication (b) can be reflected by ionosphere (c) can be reflected by mesosphere (d) cannot be reflected by any layer of earth's atmosphere	
5	The radiowaves of frequency 30 MHz to 300 MHz belong to (a) high frequency band (b) very high frequency band (c) ultra high frequency band (d) super high frequency band	
6	In earth's atmosphere, for F_1-layer, the virtual height and critical frequency are (a)150 km and 3 MHZ (b)160 km and 3.5 MHz (c)170 km 4.5 MHz (d)180 km and MHZ	
7	Frequency rage for microwaves is (a)3×10^4 to 3×10^9 Hz (b)3 x 10 to 3 x 10 Hz (c)3 x 10 to 1 x 10 Hz (d)1 x 10 to 3 x 10 Hz	
8	Ozone layer above earth's atmosphere will not (a) Prevent infrared radiations from sun reaching on earth (b) Prevent infrared radiations originated from earth	

	from escaping earth's atmosphere (c) Prevent ultraviolet rays from sun (d) Reflect back radiowaves	
9	A geo synchronous satellite is (a) Located at a height of 34860 km to ensure global coverage (b) Appears stationary over a place on earth's magnetic pole (c) not really stationary, but orbits the earth within 24 h (d) always at a fixed location in state and simply spins about its own axis	
10	a message signal of frequency ω_m is superposed on a carrier wave of frequency ω_c to get an amplitude modulated wave (AM). The frequency of the AM wave will be (a) ω_m (b) ω_c (c) $\frac{\omega_c+\omega_m}{2}$ (d) $\frac{\omega_c-\omega_m}{2}$	
11	Which one of the following is correct? (a) A single geostationary satellite can cover the whole part of the earth for microwave communication (b) Atleast three geostationary satellites in the same orbit around earth's can cover the whole part of the earth for microwave communication (c) The first Indian communication satellite is apple (d) The satellite communication is not like the of sight microwave communication	
12	When electromagnetic waves enter the ionized layer of ionosphere, then the relative permittivity i.e., dielectric constant of the ionized layer (a) Does not change (b) Appears to increase (c) Appears to decrease (d) Sometimes appears to increase and sometimes to decrease	
13	Fading is the variations in the radiowaves which when sent at some angle towards the ionosphere, gets reflected from that and returns to the earth is called (a) interference of waves (b) diffraction of waves (c) polarization of waves (d) none of these	
14	The highest fre3quency of radiowaves which when sent at some angle towards the ionosphere, gets reflected from, that and returns to the earth is called (a) Critical frequency (b) Maximum unusable frequency (c) Polarization of waves (d) None of the above	

15	A carrier wave of peak voltage 12 V is used to transmit a message signal. What should be the peak voltage of the modulating signal in order to have a modulation index of 75%? (a)7V (b)6V (c)9V (d)8V	
16	A communication between fixed base station and several mobile units, located it ships or aircraft utilizing two way radio communication in the VHF and UHF is of frequency band (a)3 to 30 MHz (b)30 to 300MHz (c)30 to 470 MHz (d)30 to 600MHz	
17	In earth's atmosphere, for E=layer, the virtual height and critical frequency are (a)80 km and 3 MHz (b)90 km and 3.5 MHz (c)120 km and 470 MHZ (d))110 km and 4 MHz	
18	In space communication, the information can be passed from one place to another at a distance of 100 km in (a) 1 s (b)0.5 s (c)0.003 s (d)none of these	
19	The layer of earth's atmosphere responsible for absorbing a large portions of ultraviolet radiations by the sun is (a)mesosphere (b)troposphere (c)ozone layer (d)ionosphere	
20	Intel-sat satellite is used for (a) Radio communication (b) Radar communication (c) Intercontinental communication (d) None of the above	
21	1000 Hz carrier wave is amplitude modulated by the signal frequencies 200-400 Hz. The channel width of this case is (a) 3 kHz (b) 8 kHz (c) 10 kHz (d) 14 kHz	
22	The range of characteristic impedance for coaxial wire lines is (a)40 Ω to 150 Ω (b)400 Ω to 1500 Ω (c)4 Ω to 15 Ω (d)4k Ω to 15k Ω	
23	The diameter of an optical fibre is (a)10 m (b)10 cm (c)10 cm (d)10 cm	
24	Optical fibre communication is generally preferred over general communication system because (a) It is more efficient	

	(b) It has signal security (c) It cannot be jammed as easily as radiowaves (d) All of the above	
25	A laser is a coherent source because it contains (a) Many wavelengths (b) Uncoordinated waves of particular wavelength (c) Coordinated waves of many wavelength (d) Coordinated waves of particular wavelength	
26	If μ_1 and μ_2 are the refractive indices of the materials of core and cladding of an optical fibre, then the loss of light due its leakage can be mini9mised by having (a) $\mu_1 > \mu_2$ (b) $\mu_1 < \mu_2$ (c) $\mu_1 = \mu_2$ (d)none of these	
27	Numerical aperture of optical fibre is a measure of (a) Its resolving power (b) its light gathering power (c) the pulse dispersion (d) the attenuation of light through it	
28	The population inversion in helium-neon laser is produced by (a) photon excitation (b) electron excitation (c) inelastic atomic collisions (d) chemical reaction	
29	The number of telephonic messages which are carried by a fibre at an instant with much less intensity loss are (a)2400 (b)2200 (c)2000 (d)1800	
30	Point to point communication requires the use of (a) guided medium only (b) unguided medium only (c) any medium (d) none of these	
31	The characteristic impendence (Z_0) of parallel line wire is (a) $Z_0 = \frac{276}{\sqrt{k}}\log\frac{2s}{d}$ (b) $Z_0 = \frac{376}{\sqrt{k}}\log\frac{2s}{d}$ (c) $Z_0 = \frac{276}{k}\log\frac{2s}{d}$ (d) $Z_0 = \frac{276}{\sqrt{k}}\log\frac{d}{2s}$	
32	An optical fibre made of glass with a core of refractive index of 1.55 and include woth another glass with a refractive index of 1.51. Launching takes place from air. What is the value of critical angle for core-clad	

	boundary? (a) 65^0 (b) 72^0 (c) 77^0 (d) 82^0	
33	I – V characteristics of four devices are shown in figure.  Identify devices that can be used for modulation (a) (i) and (iii) (b) only (iii) (c) (ii) and some regions of (iv) (d) All the devices can be used	
34	In coaxial cables, the repeater spacing is of the order of (a) 20 km (b) 2 km (c) 200 km (d) 2000 km	
35	Quality of transmission depends upon (a) Nature of medium only (b) Nature of signal only (c) Both (a) and (b) (d) Neither (a) nor (b)	
36	The losses in transmission lines are (a) Radiation losses only (b) Conductor heating only (c) Dielectric heating only (d) All of the above	
37	The resistance of a copper wire of length 1 m diameter = 2 mm is of the order of (a) 0.1 Ω m (b) 0.01 Ω km^{-1} (c) 1 Ω m (d) 1 kΩ	
38	Primary constants of a transmission line are (a) Resistance and inductance (b) Capacitance and conductance (c) Both (a) and (b) (d) None of the above	
39	Which fibres are less expensive and simple to construct? (a) Single-mode step index fibre (b) Multi-mode step index fibre (c) Multi graded index fibre (d) All are equally expensive	
40	A male voice after modulation-transmission sounds like that of a female to the receiver. The problem is due to (a) Poor selection of modulation index (selected 0 < m < 1) (b) Poor bandwidth selection of amplifiers	

	(c) Poor selection of carrier frequency (d) Loss of energy in transmission	
41	A basic communication system consists of (A) Transmitter (B) Information source (C) User of information (D) Channel (E) Receiver Choose the correct sequence in which these are arranged in a basic communication system (a) ABCDE (b) BADEC (c) BDACE (d) BEADC	
42	Identify the mathematical expression for amplitude modulated wave (a) $A_C \sin\{\omega_C + K_1 V_m(t)t + \phi\}$ (b) $A_C \sin\{\omega_C t + \phi + K_2 V_m(t)\}$ (c) $\{A_C + K_2 V_m(t)\}\sin\{\omega_C t + \phi\}$ (d) $A_C v_m$ (t) sin ($\omega_C t + \phi$)	