***Problem*** **1.** The distance between the carbon atom and the oxygen atom in a carbon monoxide molecule is 1.1 Å. Given, mass of carbon atom is 12 *a.m.u.* and mass of oxygen atom is 16 *a.m.u.*, calculate the position of the center of mass of the carbon monoxide molecule

(a) 6.3 Å from the carbon atom (b) 1 Å from the oxygen atom

(c) 0.63 Å from the carbon atom (d) 0.12 Å from the oxygen atom

***Problem*** **2.** The velocities of three particles of masses 20*g*, 30*g* and 50 *g* are $10\vec{i}, 10\vec{j}$, and $10\vec{k}$ respectively. The velocity of the centre of mass of the three particles is

(a) $2\vec{i}+3\vec{j}+5\vec{k}$ (b) $10(\vec{i}+\vec{j}+\vec{k})$ (c) $20\vec{i}+30\vec{j}+5\vec{k}$ (d) $2\vec{i}+30\vec{j}+50k$

***Problem*** **3.** Masses 8, 2, 4, 2 *kg* are placed at the corners *A, B, C, D* respectively of a square *ABCD* of diagonal 80 *cm*. The distance of centre of mass from *A* will be

(a) 20 *cm* (b) 30 *cm* (c) 40 *cm* (d) 60 *cm*

***Problem*** **4.** The coordinates of the positions of particles of mass 7, 4 and 10 *gm* are $(1, 5, -3)$, $(2, 5, 7)$ and $(3, 3, -1)$ *cm* respectively. The position of the centre of mass of the system would be

(a) $\left(-\frac{15}{7}, \frac{85}{17}, \frac{1}{7}\right)$ *cm* (b) $\left(\frac{15}{7}, -\frac{85}{17}, \frac{1}{7}\right)$ *cm* (c) $\left(\frac{15}{7}, \frac{85}{21}, -\frac{1}{7}\right)$ *cm* (d) $\left(\frac{15}{7}, \frac{85}{21}, \frac{7}{3}\right)$ *cm*

***Problem*** **5.** The angular velocity of *seconds* hand of a watch will be

(a) $\frac{\pi}{60}\,rad/sec$ (b) $\frac{\pi}{30}\,rad/sec$ (c) $60\,\pi\ rad/sec$ (d) $30\,\pi\ rad/sec$

***Problem*** **6.** The wheel of a car is rotating at the rate of 1200 revolutions per *minute*. On pressing the accelerator for 10 *sec* it starts rotating at 4500 revolutions per *minute*. The angular acceleration of the wheel is

(a) 30 $radians/sec^2$ (b) 1880 $degrees/sec^2$ (c) 40 $radians/sec^2$ (d) 1980 $degrees/sec^2$

**Problem 7.** Angular displacement $(\theta)$ of a flywheel varies with time as $\theta = at + bt^2 + ct^3$ then angular acceleration is given by

(a) $a + 2bt - 3ct^2$ (b) $2b - 6t$ (c) $a + 2b - 6t$ (d) $2b + 6ct$

**Problem 8.** A wheel completes 2000 rotations in covering a distance of $9.5\ km$. The diameter of the wheel is

(a) $1.5\ m$ (b) $1.5\ cm$ (c) $7.5\ m$ (d) $7.5\ cm$

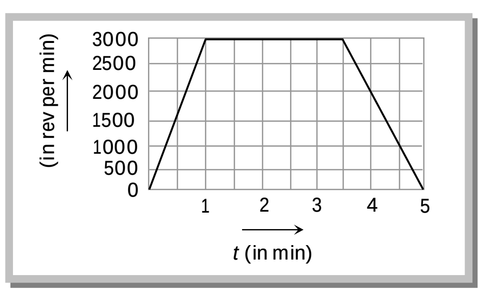
**Problem 9.** A wheel is at rest. Its angular velocity increases uniformly and becomes 60 *rad/sec* after 5 *sec*. The total angular displacement is

(a) 600 *rad* (b) 75 *rad* (c) 300 *rad* (d) 150 *rad*

**Problem 10.** A wheel initially at rest, is rotated with a uniform angular acceleration. The wheel rotates through an angle $\theta_1$ in first one second and through an additional angle $\theta_2$ in the next one second. The ratio $\frac{\theta_2}{\theta_1}$ is

(a) 4 (b) 2 (c) 3 (d) 1

**Problem 11.** As a part of a maintenance inspection the compressor of a jet engine is made to spin according to the graph as shown. The number of revolutions made by the compressor during the test is




(a) 9000 (b) 16570 (c) 12750 (d) 11250

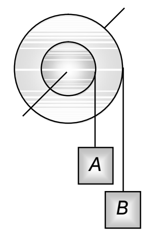
**_Problem_ 12.** Figure shows a small wheel fixed coaxially on a bigger one of double the radius. The system rotates about the common axis. The strings supporting $A$ and $B$ do not slip on the wheels. If $x$ and $y$ be the distances travelled by $A$ and $B$ in the same time interval, then

(a) $x = 2y$

(b) $x = y$

(c) $y = 2x$

(d) None of these




**_Problem_ 13.** If the position vector of a particle is $\vec{r} = (3\hat{i} + 4\hat{j})$ meter and its angular velocity is $\vec{\omega} = (\hat{j} + 2\hat{k})$ *rad/sec* then its linear velocity is (in *m/s*)

(a) $(8\hat{i} - 6\hat{j} + 3\hat{k})$ (b) $(3\hat{i} + 6\hat{j} + 8\hat{k})$ (c) $-(3\hat{i} + 6\hat{j} + 6\hat{k})$ (d) $(6\hat{i} + 8\hat{j} + 3\hat{k})$

**_Problem_ 14.** Five particles of mass = 2 *kg* are attached to the rim of a circular disc of radius 0.1 *m* and negligible mass. Moment of inertia of the system about the axis passing through the centre of the disc and perpendicular to its plane is

(a) 1 $kg\ m^2$ (b) 0.1 $kg\ m^2$ (c) 2 $kg\ m^2$ (d) 0.2 $kg\ m^2$

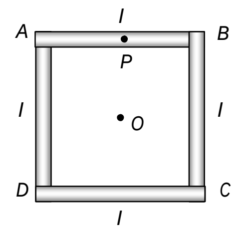
**_Problem_ 15.** A circular disc $X$ of radius $R$ is made from an iron plate of thickness $t$, and another disc $Y$ of radius $4R$ is made from an iron plate of thickness $\frac{t}{4}$. Then the relation between the moment of inertia $I_X$ and $I_Y$ is

(a) $I_Y = 64I_X$ (b) $I_Y = 32I_X$ (c) $I_Y = 16I_X$ (d) $I_Y = I_X$

**_Problem_ 16.** 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) 6 $I$ (c) 3 $I$ (d) 4 $I$

**Problem 17.** Four thin rods of same mass $M$ and same length $l$, form a square as shown in figure. Moment of inertia of this system about an axis through centre $O$ and perpendicular to its plane is



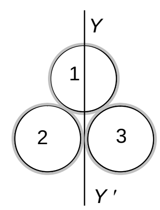

(a) $\frac{4}{3}Ml^2$

(b) $\frac{Ml^2}{3}$

(c) $\frac{Ml^2}{6}$

(d) $\frac{2}{3}Ml^2$

**Problem 18.** Three rings each of mass $M$ and radius $R$ are arranged as shown in the figure. The moment of inertia of the system about $YY'$ will be




(a) $3\ MR^2$

(b) $\frac{3}{2}MR^2$

(c) $5\ MR^2$

(d) $\frac{7}{2}MR^2$

**Problem 19.** Let $l$ be the moment of inertia of an uniform square plate about an axis $AB$ that passes through its centre and is parallel to two of its sides. $CD$ is a line in the plane of the plate that passes through the centre of the plate and makes an angle $\theta$ with $AB$. The moment of inertia of the plate about the axis $CD$ is then equal to

(a) $l$ (b) $l\sin^2\theta$ (c) $l\cos^2\theta$ (d) $l\cos^2\frac{\theta}{2}$

**Problem 20.** Three rods each of length $L$ and mass $M$ are placed along $X$, $Y$ and $Z$-axes in such a way that one end of each of the rod is at the origin. The moment of inertia of this system about $Z$ axis is

(a) $\frac{2ML^2}{3}$ (b) $\frac{4ML^2}{3}$ (c) $\frac{5ML^2}{3}$ (d) $\frac{ML^2}{3}$

**Problem 21.** Three point masses each of mass $m$ are placed at the corners of an equilateral triangle of side $a$. Then the moment of inertia of this system about an axis passing along one side of the triangle is

(a) $ma^2$ (b) $3ma^2$ (c) $\frac{3}{4}ma^2$ (d) $\frac{2}{3}ma^2$

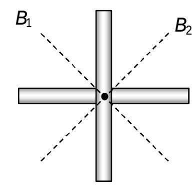
**Problem 22.** Two identical rods each of mass $M$. and length $l$ are joined in crossed position as shown in figure. The moment of inertia of this system about a bisector would be

(a) $\frac{Ml^2}{6}$

(b) $\frac{Ml^2}{12}$

(c) $\frac{Ml^2}{3}$

(d) $\frac{Ml^2}{4}$




**Problem 23.** The moment of inertia of a rod of length $l$ about an axis passing through its centre of mass and perpendicular to rod is $I$. The moment of inertia of hexagonal shape formed by six such rods, about an axis passing through its centre of mass and perpendicular to its plane will be

(a) $16I$ (b) $40\,I$ (c) $60\,I$ (d) $80\,I$

**Problem 24.** The moment of inertia of $HCl$ molecule about an axis passing through its centre of mass and perpendicular to the line joining the $H^+$ and $Cl^-$ ions will be, if the interatomic distance is 1 Å

(a) $0.61\times10^{-47}\,kg.m^2$ (b) $1.61\times10^{-47}\,kg.m^2$ (c) $0.061\times10^{-47}\,kg.m^2$ (d) 0

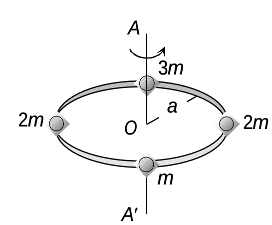
**Problem 25.** Four masses are joined to a light circular frame as shown in the figure. The radius of gyration of this system about an axis passing through the centre of the circular frame and perpendicular to its plane would be

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

(b) $a/2$

(c) $a$

(d) $2a$



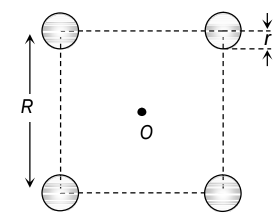
**Problem 26.** Four spheres, each of mass $M$ and radius $r$ are situated at the four corners of square of side $R$. The moment of inertia of the system about an axis perpendicular to the plane of square and passing through its centre will be

(a) $\frac{5}{2}M(4r^2+5R^2)$

(b) $\frac{2}{5}M(4r^2+5R^2)$

(c) $\frac{2}{5}M(4r^2+5r^2)$

(d) $\frac{5}{2}M(4r^2+5r^2)$




**Problem 27.** The moment of inertia of a solid sphere of density $\rho$ and radius $R$ about its diameter is

(a) $\frac{105}{176}R^5\rho$ (b) $\frac{105}{176}R^2\rho$ (c) $\frac{176}{105}R^5\rho$ (d) $\frac{176}{105}R^2\rho$

**Problem 28.** Two circular discs $A$ and $B$ are of equal masses and thickness but made of metals with densities $d_A$ and $d_B$ $(d_A > d_B)$. If their moments of inertia about an axis passing through centres and normal to the circular faces be $I_A$ and $I_B$, then

(a) $I_A = I_B$ (b) $I_A > I_B$ (c) $I_A < I_B$ (d) $I_A >=< I_B$