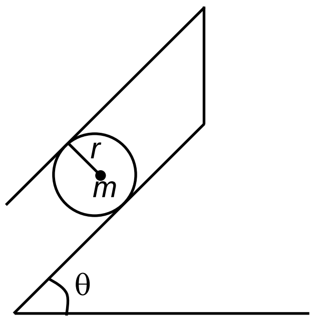
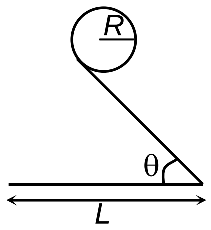
201. A disc of mass m and radius r rests on an inclined surface and is supported by a rope that it tangent to the disc and parallel to the inclined surface as shown in the figure. The minimum value of coefficient of static friction, in terms of θ, that will prevent the disc from slipping down the inclined surface is



(a) $\frac{2}{5}\tan\theta$ (b) $\frac{\tan\theta}{2}$

(c) $\frac{2}{3}\tan\theta$ (d) $\tan\theta$

202. A sphere which is rotating about its own axis is gently lowered down on to a smooth inclined surface making on angle θ with the horizontal. The initial angular velocity of rotation is ω. The translational velocity when it reaches the horizontal surface is



(a) $\sqrt{2gL\tan\theta}$ (b) $\sqrt{\frac{10}{7}gL\tan\theta}$

(c) $\sqrt{\frac{2\omega^2R^2+10gL\tan\theta}{7}}$ (d) none of these

203. A ball kept in a closed box moves in the box making collisions with the walls. The box is kept on a smooth surface. The velocity of the centre of mass

(a) of the box remains constant

(b) of the box plus the ball system remains constant

(c) of the ball remains constant

(d) of the ball relative to the box remains constant

204. Which of the following sentences is not correct? When a body rolls on a horizontal surface

(a) its point of contact does not slip with respect to the surface

(b) its point of contact moves with the speed and acceleration of the surface

(c) its centre of mass moves along a straight line

(d) its top most point always move faster than the lowest point of contact

205. All the particles of a body are situated at a distance R from the origin. The distance of the centre of mass of the body from the origin is

(a) $-R$ (b) $\leq R$ (c) $> R$ (d) $\geq R$

206. Consider the following two statements

(A) Linear momentum of the system of particles is zero

(B) Kinetic energy of system of particles is zero

(a) *A* implies *B* and *B* implies *A*

(b) *A* does not imply *B* and *B* does not imply *A*

(c) *A* implies *B* but *B* does not imply *A*

(d) *B* implies *A* but *A* does not imply *B*

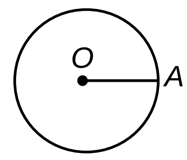
207. Two identical discs are moving with the same kinetic energy. One rolls and the other slides. The ratio of their speed is

(a) 1 : 1 (b) $\sqrt{2}:\sqrt{3}$ (c) 2 : 3 (d) 1 : 2

208. Three uniform rods, each of length 2*l* and mass *m* are attached (end to end) to form a triangular frame work. The moment of inertia of the frame work about on axis passing through the midpoints of two of its sides is

(a) $\frac{1}{4}ml^2$ (b) $\frac{1}{2}ml^2$ (c) $\frac{3}{4}ml^2$ (d) $\frac{5}{4}ml^2$

209. A horizontal uniform disc can rotate freely on a rigid vertical axis passing through its centre *O*. A man stands at rest at *A* due east of *O*. The mass of the disc is 22 times the mass of the man. The man starts walking along the edge of the disc anticlockwise. When he reaches A after completing one rotation relative to the disc, his position with respect to *O* will be



(a) 30^0 south of west (b) 30^0 east of south (c) 60^0 south of west (d) 60^0 east of south

210. Two uniform discs of moments of inertia I_1 and I_2 and radius *a* and *b* respectively can rotate separately on parallel axes. The first disc is rotating with angular velocity ω_0. While the second is at rest. The discs are now moves so as to make their rims touch. After a short time the two discs in contact start rotating without slipping. The final angular velocity of the first disc is

(a) $\left[\frac{I_1b^2}{I_1a^2+I_2b^2}\right]\omega_0$ (b) $\left[\frac{I_1b^2}{I_1b^2+I_2a^2}\right]\omega_0$

(c) $\left[\frac{I_1a^2}{I_1a^2+I_2b^2}\right]\omega_0$ (d) $\left[\frac{I_1}{I_1+I_2}\right]\left[\frac{b}{a}\right]\omega_0$

211. When a disc of radius *a* and mass *M* is reshaped into a ring of radius 2*a* and same mass the radius of gyration becomes *n* times of its initial value, where *n* is

(a) 2 (b) 4 (c) $\sqrt{2}$ (d) $2\sqrt{2}$

212. Two bodies of moments of inertia 25 and 45 kg-m^2 are rotating with uniform angular velocities 3 and 4 rad/s in the same sense. If one falls on the other and due to friction both move together, the common angular velocity is

(a) 3.6 (b) 2.6 (c) 3 (d) 4

213. Torque per unit moment of inertia is equivalent to

(a) angular velocity (b) angular acceleration

(c) radius of gyration (d) inertia

214. A circular disc starts slipping without rolling down an inclined plane then its velocity will be

(a) gh (b) 2 gh (c) $\sqrt{gh}$ (d) $\sqrt{2gh}$

215. A spherical shell first rolls and then slips down an inclined plane. The ratio of its acceleration in two cases will be

(a) 5/3 (b) 3/5 (c) 15/13 (d) 13/15

216. A car is moving with a speed of 72 kmh^{-1}. The radius of its wheel is 50 cm. If its wheels come to rest after 20 rotations as a result of application of brakes, then the angular retardation produced in the car will be

(a) 23.5 rads^{-2} (b) 0.25 rads^{-2} (c) 6.35 rads^{-2} (d) zero

217. The moment of inertia of a ring about its geometrical axis is I, then its moment of inertia about its diameter will be

(a) 2 I (b) I/2 (c) I (d) I/4

218. The unit of moment of inertia is

(a) Joule/sec (b) Joule-second/radian

(c) Joule-second^2/ radian^2 (d) Joule/radian

219. A ring is rolling on an inclined plane. The ratio of the linear and rotational kinetic energies will be

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

220. A solid cylinder of mass 0.1 kg and radius 0.025 metre is rolling on a horizontal smooth table with uniform velocity of 0.1 ms^{-1}. Its total energy will be

(a) 7.5×10^{-2} Joule (b) 7.5×10^{-3} Joule (c) 7.5×10^{-4} Joule (d) 7.5×10^{-4} Joule

221. The angular momentum and the moment of the inertia are respectively

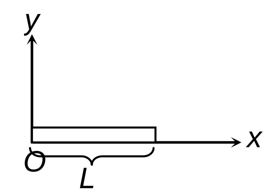
(a) vector and tensor quantities (b) scalar and vector quantities

(c) scalar and scalar quantities (d) vector and vector quantities

222. The kinetic energy of rotation of particle is 18 Joule. If the angular momentum vector coincides with the axis of rotation and the moment of inertia of the particle about this axis is 0.01 Kgm^2, then its angular momentum will be

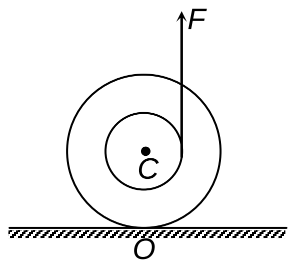
(a) 0.06 J-sec (b) 0. 6 J-sec (c) 0.006 J-sec (d) zero

223. A rod of length L is placed along the x-axis with one of its ends at the origin O. The mass of the rod increases linearly as $\frac{dm}{dx} = \lambda x$, where λ is constant. Then x-coordinate of centre of mass is



(a) $\frac{1}{3}L$ (b) L (c) $\frac{2}{3}L$ (d) $\frac{1}{4}L$

224. A Yo-Yo is placed on a rough horizontal surface and a constant force F pulls it vertically, which is less then its weight. Then



(a) it will move towards left

(b) it will move towards right

(c) the friction force acts towards left

(d) both (a) and (c) are true

225. A small ring is tied to a smooth wire bent in the form of a vertical circular loop of radius r. The loop is rotating with constant angular velocity ω about the vertical diameter while the ring remains at rest relative to wire at a distance $\frac{r}{2}$ from the axis. The angular velocity of ring is equal to

(a) $\sqrt{\frac{2g}{r}}$ (b) $\sqrt{\frac{2g}{r\sqrt{3}}}$ (c) $\sqrt{\frac{\sqrt{3}g}{r}}$ (d) $\sqrt{\frac{\sqrt{3}g}{2r}}$

226. A circular disc A of radius R is made from an iron plate of thickness t and another disc B of radius $4R$ is made from an iron plate of thickness $\frac{t}{4}$. Then the relation between the moments of inertia I_A and I_B is

(a) $I_A = I_B$ (b) $I_B = 64I_A$ (c) $I_B = 32I_A$ (d) $I_B = 16I_A$

227. Four spheres, each of mass m and radius r are placed with their centres on the four corners of a square of side b. The moment of inertia of the system about any side of the square is

(a) $\frac{8}{5}mr^2 + mb^2$ (b) $\frac{8}{5}mr^2 + 2mb^2$ (c) $\frac{8}{5}mr^2 + 4mb^2$ (d) none of them

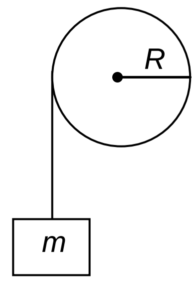
228. A carpet of mass M made of inextensible material is rolled along its length in the form of a cylinder of radius R and is kept on a rough surface (floor). The carpet starts unrolling without sliding on the floor when a negligibly small push is given to it. The horizontal velocity of the axis of cylindrical part of the carpet when its radius reduces to $\frac{R}{2}$ is

(a) $\sqrt{\frac{9gR}{2}}$ (b) $\sqrt{\frac{14gR}{3}}$ (c) $\sqrt{\frac{2}{5}gR}$ (d) $\frac{1}{4}gR$

229. Two spherical bodies of masses M and 5 M and radii R and $2R$ respectively are released in free space with their initial separation between their centres equal to $12R$. Then the distance covered by the smaller body just before collisions is

(a) 7.5 R (b) 1.5 R (c) 2.5 R (d) 4.5 R

230. A solid cylinder of radius R is free to rotate about its axis which is horizontal. A string is wound around it and *a* mass m is attached to its free end. When m folls through a distance h, its speed at that instant is



(a) proportional to R (b) proportional to $1/R$

(c) proportional to $1/R^2$ (d) proportional to R

231. Two point masses A of 300 gram and B of 700 gram are fixed at the ends of a rod of length 140 cm and of negligible masses. The rod is set rotating about an axis perpendicular to its length with a uniform angular speed. For the work required for rotation of the rod to be minimum, the rod should have axis through a point located at a distance of

(a) 42 cm from A (b) 70 cm fro m B

(c) 98 cm from A (d) 98 cm from B

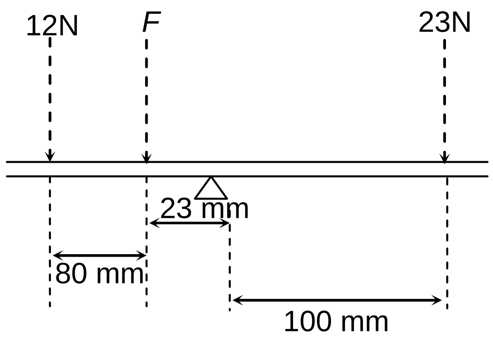
232. The point with position vector $\vec{r}_1$ is the centre of mass of a set of particles each of mass m while the point with position vector $\vec{r}_2$ is the centre of mass of a second set of particles each of mass (λm). The position vector $\vec{r}$ for the centre of mass of the combined set of all the masses will be given by

(a) $\vec{\tau} = \frac{(\vec{r}_1 + \vec{r}_2)}{2}$ (b) $\vec{\tau} = \frac{\vec{r}_1 + \vec{r}_2}{(1+\lambda)}$ (c) $\vec{\tau} = \frac{\vec{r}_1 \times \vec{r}_2}{|\vec{r}_1 + \vec{r}_2|}$ (d) $\vec{r} = \frac{\vec{r}_1 + \lambda\vec{r}_2}{1+\lambda}$

233. A force of 15 N is applied to a spanner at an effective length of 140 mm from the centre of a nut. The magnitude of the force required to produce the same moment if the effective length is reduced to 100 mm is

(a) 2.1 N (b) 21 N (c) 15 N (d) 0 N

234. A beam is supported at its centre on a fulcrum and forces acts as shown. The force F for the beam to be in equilibrium is



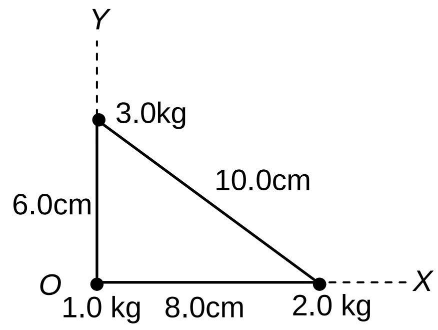
(a) 67 N (b) 12 N

(c) 46.26 N (d) 35 N

235. A rectangular block has a square base measuring $a \times a$ a and its height is h. It moves on a horizontal surface in a direction perpendicular to one of the edges. The coefficient of friction is μ. It will topple if

(a) $\mu > \frac{h}{a}$ (b) $\mu > \frac{2a}{h}$ (c) $\mu > \frac{a}{h}$ (d) $\mu > \frac{a}{2h}$

236. Three particles of masses 1.0 kg, 2.0 kg and 3.0 kg are placed at the three vertices of a right-angled triangle of side 6 cm, 8 cm and 10 cm as shown in the figure. Find the centre of mass of the system in terms of coordinates along the X-axis and the Y-axis.



(a) (2.7 cm, 3 cm) (b) (3 cm, 3 cm)
(c) (2 cm, 2 cm) (d) (4 cm, 4 cm)

237. A particle of mass 2 kg is moving with uniform velocity along the line $y = \frac{x}{\sqrt{3}} + 2$ in the *XY* plane. *X*- component of its velocity is 15 m/sec. Angular momentum (magnitude) of the particle about the point $\left(1\text{m}, \frac{1}{\sqrt{3}}\text{m}\right)$ is

(a) 60 kg m^2/sec (b) 40 kg m^2/sec (c) zero (d) $30\sqrt{3}$ kg m^2/sec

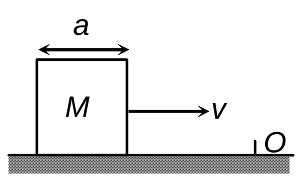
238. Two persons *A* and *B* , each of mass 60 kg, are standing together inside a trolley of mass 240 kg which is initially at rest on a frictionless surface. *B* now beings to walk along the length of the trolley and, after some time. A find *B* to be at a distance 10m. Distance travlled by *B* as observed by a person *C* standing on ground (outside the trolley) is approximately

(a) 8 m (b) 6 m (c) 5 m (d) 10 m

239. A solid sphere, starting from rest, rolls down (without slipping) an inclined plane of length *s* and inclination θ. Its speed when it reaches the bottom of the plane is

(a) $\sqrt{2gs\sin\theta}$ (b) $\sqrt{\frac{4}{3}gs\sin\theta}$ (c) $\sqrt{\frac{16}{9}gs\sin\theta}$ (d) $\sqrt{\frac{10}{7}gs\sin\theta}$

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



(a) $\frac{3v}{4a}$ (b) $\frac{3v}{2a}$ (c) $\frac{\sqrt{3}v}{\sqrt{2}a}$ (d) zero