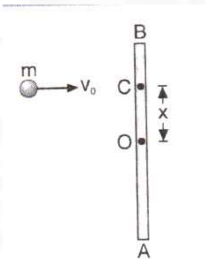
PHYSICS

31. A playground merry-go-round is at rest, pivoted about a frictionless axis. A child of mass 'm' runs along the path tangential to the rim with speed v and jumps on to merry-go-round. If R be the radius of merry-go-round and I is the moment of inertia, then the angular velocity of the merry-go-round and the child is

1) $\frac{mvR}{mR^2+I}$ 2) $\frac{mvR}{I}$ 3) $\frac{mR^2+I}{mvR}$ 4) $\frac{I}{mvR}$

32. A uniform rod AB of length L having mass m are lying on a smooth table. A small particle of mass m strikes the rod with a velocity V_0 at point C, a distance x from the centre O. The particle comes to rest after collision. The value of x, so that point A of the rod remains stationary just after collisions is



1) L/3 2) L/6 3) L/4 4) L/12

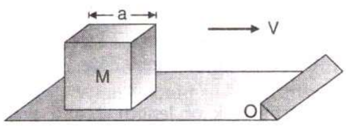
33. A circular platform of radius 2m and moment of inertia 200kgm^2 is mounted on a vertical frictionless axle. It is initially at rest. A 70kg man stands on the edge of the platform and begins to walk along the edge at speed $\upsilon_0 = 1ms^{-1}$ relative to the ground. When the man has walked once around the platform, so that he is at his original position on it, then his angular displacement relative to ground is

1) $\frac{6\pi}{5}$ 2) $\frac{5\pi}{6}$ 3) $\frac{4\pi}{5}$ 4) $\frac{5\pi}{4}$

34. A rigid spherical body is spinning around an axis without any external torque. Due to increase in temperature its volume increases by 3%. Then percentage change in its angular speed is

1) -2% 2) -1% 3) -3% 4) 1%

35. 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

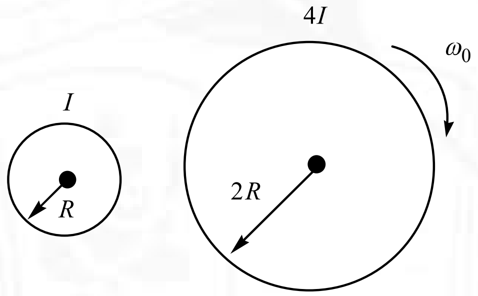


1) $\frac{3V}{4a}$ 2) $\frac{3V}{2a}$ 3) $\sqrt{\frac{3}{2}}\frac{V}{a}$ 4) Zero

36. A uniform and AB of mass m and length l is at rest on a smooth horizontal surface. An impulse J is applied to the end B perpendicular to the rod in horizontal direction. The speed of particle P at a distance $\frac{l}{6}$ from the centre towards A of the rod after time $t = \frac{\pi ml}{12J}$ is

1) $\frac{J}{m}$ 2) $\frac{2J}{m}$ 3) $\frac{J\sqrt{2}}{m}$ 4) $\frac{J}{\sqrt{2}m}$

37. Two cylinders having radii 2R and R and moment of inertias 4I and I about their central axes are supported by axles perpendicular to their planes. The large cylinder is initially rotating clockwise with angular velocity ω_0. The small cylinder is moved to the right until it touches the large cylinder and is made to rotate by the frictional force between the two. Eventually slipping ceases and the two cylinders rotate at constant rates in opposite directions. The final angular velocity of the small cylinder is



1) $\frac{\omega_0}{4}$ 2) ω_0 3) $\frac{\omega_0}{2}$ 4) $\frac{\omega_0}{8}$

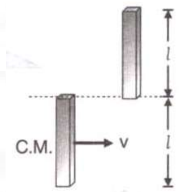
38. Two particles of equal mass m at A and B are connected by a rigid rod AB, lying on a smooth horizontal table. An impulse J is applied at A in the plane of the table and $\perp r$ to AB. Then the velocity of particle at A is

1) zero 2) $\frac{J}{2m}$ 3) $\frac{J}{m}$ 4) $\frac{2J}{m}$

39. A uniform rod AB of mass and length 2a is falling with velocity v without rotation in gravity free space with AB horizontal. Suddenly the end A gets hit by an obstacle, when the speed of the rod is V. Assume the end A to hinge about the obstacle , the angular speed with which the rod begins to rotate is

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

40. A bar of mass m, length l is in pure translatory motion with its centre of mass velocity υ. It collides with and sticks to another identical bar at rest as shown in figure. Assuming that after collision it becomes one composite bar of length $2l$, the angular velocity of the composite bar will be



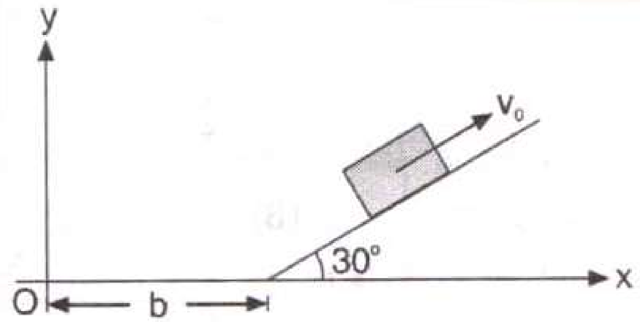
1) $\frac{3}{4}\frac{\upsilon}{l}$, anticlock wise 2) $\frac{4}{3}\frac{\upsilon}{l}$, anticlock wise

3) $\frac{3}{4}\frac{\upsilon}{l}$, clock wise 4) $\frac{4}{3}\frac{\upsilon}{l}$, clock wise

41. A smooth sphere A is moving on a frictionless horizontal plane with angular speed ω and centre of mass velocity υ. It collides elastically and head on with an identical sphere B at rest. Neglect friction everywhere After the collision their angular speeds are ω_A and ω_B, then

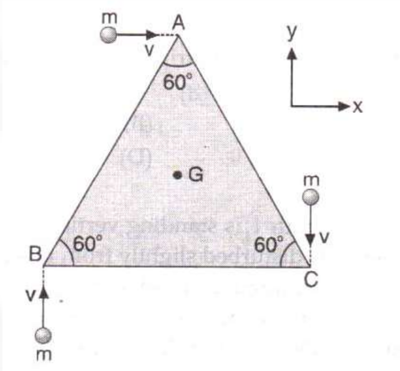
1) $\omega_A < \omega_B$ 2) $\omega_A = \omega_B$ 3) $\omega_A = \omega$ 4) $\omega = \omega_B$

42. A cube of mass m and side a is moving along a plane with constant speed υ_0 as shown in figure. The magnitude of angular momentum of the cube about z-axis would be



1) $\frac{m\upsilon_0 b}{2}$ 2) $\frac{\sqrt{3}m\upsilon_0 b}{2}$ 3) $m\upsilon_0\left(b-\frac{a}{2}\right)$ 4) none of these

43. A triangular wedge ABC of mass m and sides 2a lies on a smooth horizontal plane as shown. Three point masses of mass m each strike the wedge at A, B and C with speeds V as shown. After the collision, the particles come to rest. Select the correct alternative.



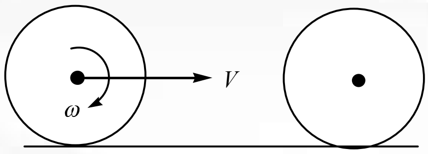
1) The centre of mass of ABC remains stationary after collision

2) The centre of mass of ABC moves with a velocity υ along x-axis after collision

3) The triangular wedge rotates with an angular velocity $\omega = \frac{2\sqrt{3}mva}{I}$ about its centre of mass (here, I is the moment of inertia of triangular wedge about its centroid axis perpendicular to its plane)

4) A point lying at a distance of $\left(\frac{I}{2\sqrt{3}ma}\right)$ from G on perpendicular bisector of BC (below G) is at rest just after collision

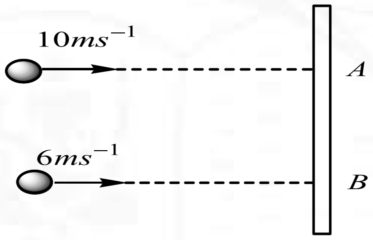
44. A solid sphere of mass m, radius R is rolling without slipping on rough horizontal surface a shown in figure. It collides elastically with another identical sphere at rest. There is no friction between the two spheres.



Linear velocity of first sphere after it again starts rolling without slipping is

1) $\frac{2}{5}R\omega$ 2) $\frac{2}{7}R\omega$ 3) $\frac{7}{10}R\omega$ 4) $\frac{7}{5}R\omega$

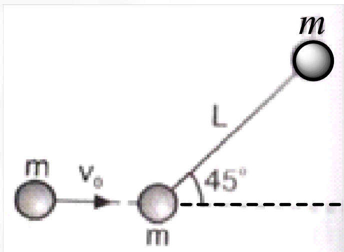
45. A thin uniform bar lies on a frictionless horizontal surface and is free to move in any way on the surface. Its mass is 0.16 kg and length is $\sqrt{3}m.$ Two particles, each of mass 0.08 kg are moving on the same surface and towards the bar in a direction perpendicular to the bar one with a velocity of $10ms^{-1}$, and the other with $6ms^{-1}$, as shown in figure. The first particle strikes the bar at points A and the other point B. Points A and B are at a distance of 0.5m from the centre of the bar. The particles strike the bar at the same instant of time and stick to the bar on collision.



The angular velocity of the system, just after impact is

1) $8\,rads^{-1}$ 2) $4\,rads^{-1}$ 3) $2\,rads^{-1}$ 4) $1\,rads^{-1}$

46. A rigid massless rod of length L joins two particles each of mass m. The rod lies on a frictionless table, and is struck by a particle of mass m and velocity v_0, moving as shown. After the collision, the projectile moves straight back. The angular velocity of the rod about its centre of mass after the collision, assuming that mechanical energy is conserved is



1) $\frac{\sqrt{2}V_0}{7L}$ 2) $\frac{3\sqrt{2}V_0}{7L}$ 3) $\frac{4\sqrt{2}V_0}{7L}$ 4) $\frac{2\sqrt{2}V_0}{7L}$

47. A 1kg weight is suspended by a rubber cord 2m long and of cross section $0.5cm^2$. It is made to describe a horizontal circle of radius 50cm in 4 times a second. The extension of the cord is $\left(Y = 5 \text{x} 10^8 Nm^{-2}\right)$

1) $3.43 \text{ x } 10^{-2}$m 2) $2.53 \text{ x } 10^{-2}$m 3) $1.23 \text{ x } 10^{-2}$m 4) $4.53 \text{ x } 10^{-2}$m

48. A uniform elastic plank moves over a smooth horizontal plane due to a constant force F_0 distributed uniformly over the end face. The surface of the end face is equal to A and Young's modulus of the material is Y . The compressive strain of the plank in the direction of the acting force is

1) $\frac{F_0}{2\pi Y}$ 2) $\frac{2F_0L}{AY}$ 3) $\frac{F_0L}{2AY}$ 4) $\frac{3F_0L}{AY}$

49. A ring of radius R made of lead wire breaking force σ and linear density δ, is rotated about a stationary vertical axis passing through its centre and perpendicular to the plane of the ring. The number of rotations at which the ring ruptures is

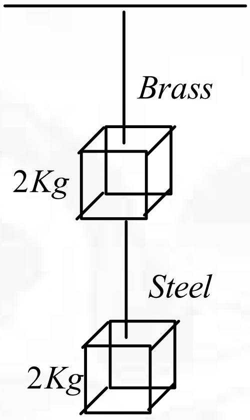
1) $\frac{1}{2\pi R}\sqrt{\frac{\sigma}{g}}$ 2) $\frac{1}{\pi R}\sqrt{\frac{\sigma}{g}}$ 3) $\frac{2}{\pi R}\sqrt{\frac{2\sigma}{g}}$ 4) $\frac{1}{\pi R}\sqrt{\frac{2\sigma}{g}}$

50. A student performs an experiment to determine the Young's modulus of a wire exactly 2m long by Searle's method. Increase in the length of the wire to be 0.8mm with an uncertainly of ± 0.05 mm at a load of exactly 1.0 kg . The student also measures the diameter of the wire to be 0.4 mm with an uncertainty of $\pm$ 0.01mm Take $g = 9.8 m/s^2$ (exact). The Young modulus obtained from the reading is

1) $(2.0 \pm 0.3)\times 10^{11} N/m^2$ 2) $(2.0 \pm 0.2)\times 10^{11} N/m^2$

3) $(2.0 \pm 0.1)\times 10^{11} N/m^2$ 4) $(2.0 \pm 0.05)\times 10^{11} N/m^2$

51. If the ratio of lengths, radii and Young's modulus of steel and brass wires shown in the figure are a,b and c respectively. The ratio between the increase in length of steel and brass wires would be

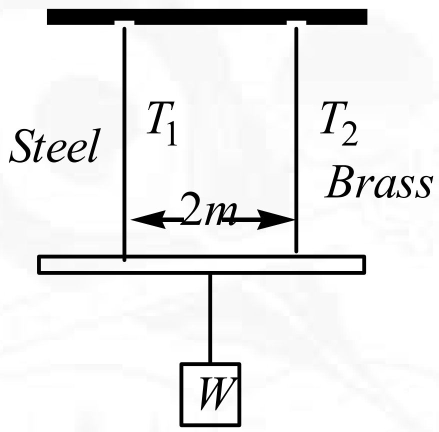


1) $\frac{b^2a}{2c}$ 2) $\frac{bc}{2a^2}$ 3) $\frac{ba^2}{2c}$ 4) $\frac{a}{2b^2c}$

52. A uniform cylindrical wire (Young's modulus = $2x10^{11}N/m^2$) is subjected to a longitudinal tensile stress of $5\times10^7 N-m^2$ .If the overall volume change in the wire is 0.02% , the fractional decrease in the radius of the wire is

1) 1.5×10^{-4} 2) 1.0×10^{-4} 3) 0.5×10^{-4} 4) 0.25×10^{-4}

53. A light rod of length 2m suspended from the ceiling horizontally by means of two vertical wires of equal length. A weight W is hung from a light rod as shown in figure. The rod hung by means of a steel wire of cross-sectional area $A_1 = 0.1cm^2$ and brass wire of cross-sectional area $A_2 = 0.2cm^2$. To equal stress in both wire $T_1 / T_2 =$



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

54. A copper rod length 2m and cross-sectional area 2.0 cm^2 is fastened end to end to a steel rod of length L and cross-sectional area 1.0 cm^2. The compound rod is subjected to equal and opposite pulls of magnitude $3\times10^4 N$ at its ends

$Y_{steel} = 2.0\times10^{11} N/m^2$

$Y_{copper} = 1.1\times10^{11} N/m^2$

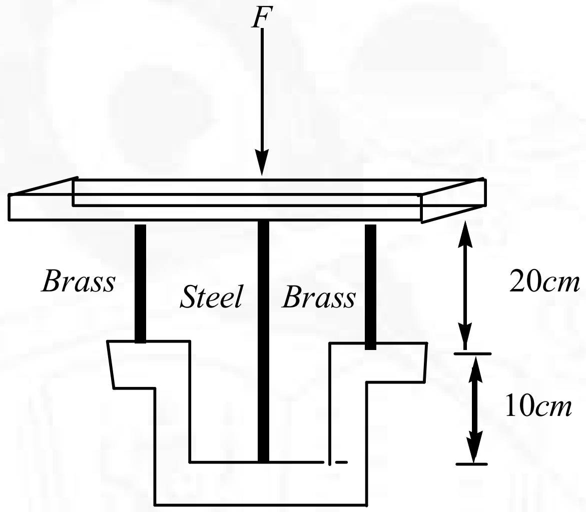
The length L of the steel rod if the elongations of the two rods are equal is approx

1) 1.82 m 2) 2.20 m 3) 3.04m 4) 3.84m

55. Two rods of different metals but of equal cross-section and length $(1.0m\, each)$ are joined to make a rod of length 2.0m. The metal of one rod has a coefficient of linear thermal expansion $10^{-5}/^0C$ and Young's modulus $3\times10^{10} N/m^2$. The other metal has the value $2\times10^{-5}/^0C$ and $10^{10} N/m^2$ respectively. The pressure that must be applied to the ends of the composite rod to prevent its expansion when the temperature is raised to 100^0C is

1) $1.25\times10^7 Nm^{-2}$ 2) $3.25\times10^7 Nm^{-2}$ 3) $2.25\times10^7 Nm^{-2}$ 4) $4.25\times10^7 Nm^{-2}$

56. A steel rod of length $l_1 = 30$cm and two identical brass rods of length $l_2 = 20$cm each support a light horizontal platform as shown in figure. Cross-sectional area of each of the three rods is $A = 1cm^2$. Calculate stress in steel rod when a vertically downward force $F = 5000N$ is applied on the platform. Given ,Young's modulus of elasticity for steel $Y_s = 2\times10^{11} Nm^2$ and brass $Y_b = 1\times10^{11} Nm^{-2}$



1) $2\times10^7 Nm^{-2}$ 2) $1\times10^7 Nm^{-2}$ 3) $3\times10^7 Nm^{-2}$ 4) $4\times10^7 Nm^{-2}$

57. The end of a 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 $\frac{3L}{4}$ from its lower end is

1) $\frac{W_1}{s}$ 2) $\frac{W_1+\frac{W}{4}}{s}$ 3) $\frac{W_1+\frac{3W}{4}}{s}$ 4) $\frac{W_1+W}{s}$

58. A wire elongates by l mm when a load W is hanged from it. If the wire goes over a pulley and two weights W each are hung at the two ends, the elongation of the wire (in mm) will be

1) l 2) $2l$ 3) zero 4) $l/2$

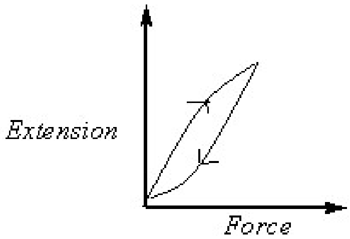
59. The diagram shows a force –extension graph for a rubber band . Consider the following statements

I) It will be easier to compress this rubber than expand it

II) Rubber does not return to its original length after it is stretched

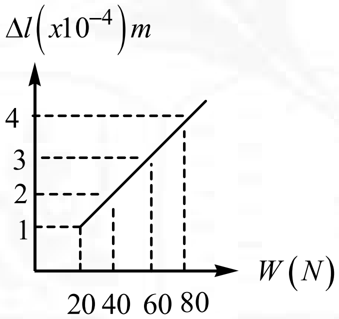
III) The rubber band will get heated if it is stretched and released.

Which of these can be deduced from the graph:



1)III only 2) II and III 3) I and III 4) I only

60. The adjacent graph shows the extension (Δl) of a wire of length 1m suspended from the top of a roof at one end with a load W connected to the other end. If the cross-sectional area of the wire is $10^{-6}m^2$, the Young's modulus of the material of the wire is



1) $2\times10^{11}Nm^2$ 2) $1\times10^{11}Nm^{-2}$ 3) $3\times10^{12}Nm^{-2}$ 4) $2\times10^{12}Nm^{-2}$