PHYSICS

BOOKS - SARAS PUBLICATION

MOTION OF SYSTEM OF PARTICLES AND RIGID BODY

Example

1. A particle moving along x-axis has accelaration f, at time t , given by

$f = f_0\left(1 - \frac{t}{T}\right)$ where f_0 and T are constants . The particle at t=0 has zero velocity . In the time interval between t=0 and the instant when f=0, the particle's velocity (ν_x) is:

A. $\frac{1}{2}f_oT$

B. f_oT

C. $\frac{1}{2}f_oT^2$

D. f_oT^o

Answer:

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2. A wheel has angular acceleration of $3.0\mathrm{rad}/s^2$ and an initial angular speed of $2.00\mathrm{rad}/s$. In a time of 2 seconds it has rotated through an angle of (in radian) ..... .

A. 4

B. 6

C. 10

D. 12

Answer:

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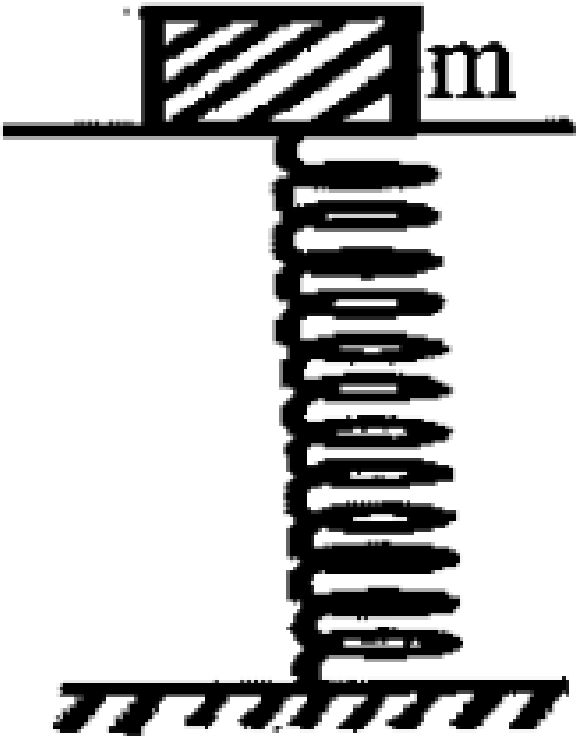
3. A mass of 2.0 kg is put on a flat pan attached to a vertical spring fixed on the ground as shown the figure.The mass of the spring and the pan is negligible.When pressed slightly and released the mass executes a simple harmonic motion. The spring constant is $200N/m$. What should be the minimum amplitude of the motion so that the mass gets

detached from the pan `(Take g = 10m//s^2)



A. 4.0 cm

B. 8.0 cm

C. 10.0 cm

D. any value less than 12.0 cm

Answer:

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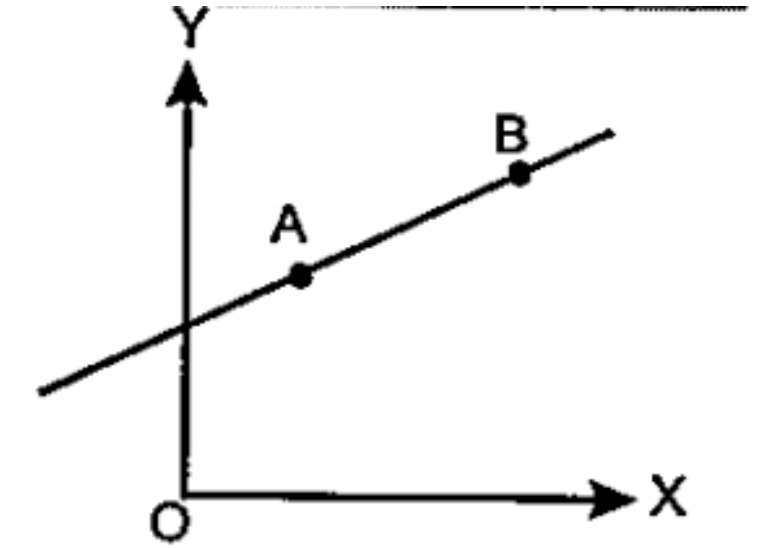
4. A particle of mass m moves in the XY plane with a velocity v along the straight line AB If the angular momentum of the particle with respect to orgin O is L_A when it is at A and L_B

when it is at B, then.



A. $L_A < L_B$

B. $L_A > L_B$

C. $L_A = L_B$

D. The relationship between L_A and L_B depends upon the slope of the line AB

Answer:

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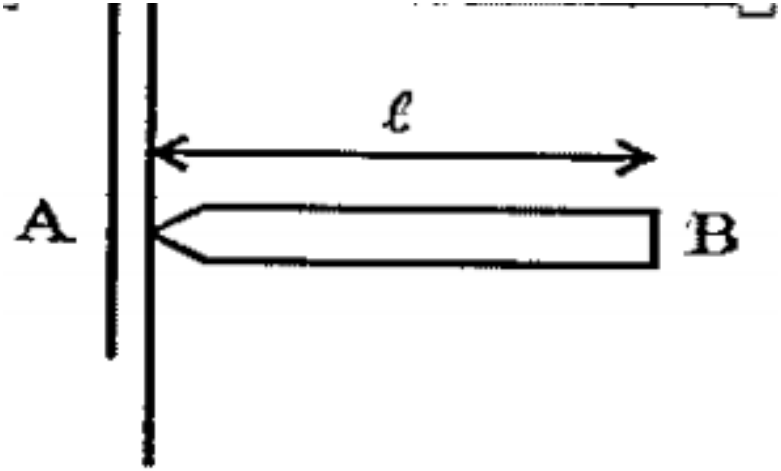
5. A unifrom rod AB of length l,and mass m is free to rotate about point A.The rod is release from rest in the horizontal position Given that the moment of inertia of the rod about A is $\frac{ml^2}{3}$, the initial angular acceleration of the

rod will be:



A. $\frac{3g}{21}$

B. $\frac{2g}{31}$

C. $mg\frac{1}{2}$

D. $\frac{1}{2}gl$

Answer:

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6. A thin rod of length l and mass M is bent at its midpoint into two halves so that the angle between them is 90° The moment of inertia of the bent rod about an axis passing through the bending point and perpendicular to the plane defined bt the two halves of the rod is

A. $\frac{ML^2}{24}$

B. $\frac{ML^2}{12}$

C. $\frac{ML^2}{6}$

D. $\left(\sqrt{2}\frac{ML^2}{24}\right.$

Answer:

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7. A particle of mass m is projected with velocity v making an angle of 45° with the horizontal When the particle lands on the level ground ,the magnitude of the change in its momentum will be

A. 2mv

B. $\frac{mv}{\sqrt{2}}$

C. $mv\sqrt{2}$

D. zero

Answer:

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8. Two bodies of mass 1kg and 3kg have position vectors $\hat{i}+2\hat{j}+\hat{k}$ and $-3\hat{i}-2\hat{j}+\hat{k}$, respectively.The centre of mass of this system has a position vector.

A. $-2\hat{i}-\hat{j}+\hat{k}$

B. $2\hat{i}-\hat{j}-2\hat{k}$

C. $-\hat{i}+\hat{j}+\hat{k}$

D. $-2\hat{i}+2\hat{k}$

Answer:

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9. The mass of a ${}^{3}_{7}Li$ nucleus is 0.042 u less than the sum of the masses of all its nucleons.

The binding energy per nucleon of ${}_{7}^{3}Li$ nucleus is nearly

A. 46MeV

B. 5.6MeV

C. 3.9MeV

D. 23MeV

Answer:

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10. A circular disk of moment of inertia I_t is rotating in a horizontal plane, about its symmetry axis,with a constant angular, speed ω_1 Another disk of moment of inertia I_b is dropped coaxially onto the rotating disk initially the second disk has zero angular speed.Eventually both the disks rotate with a constant angular speed ω_f The energy lost by the initially rotating disc to friction is :

A. $\frac{1}{2}\frac{I_b^2}{(I_t+I_b)\omega_1^2}$

B. $\frac{1}{2}\frac{I_t^2}{(I_t+I_b)\omega_1^2}$

C. $\frac{I_b - I_t}{(I_t + I_b)}\omega_1^2$

D. $\frac{1}{2}\frac{I_b I_t}{(I_t + I_b)}\omega_1^2$

Answer:

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11. The moment of inertia of a thin uniform rod of mass M and length L about an axis passing through its mid point and perpendicular to is length is 10 . Its moment of inertia about an axis passing through one of its ends and

perpendicular to its ends and perpendicular to its length is

A. $I_0 + ML^2$

B. $I_0 + \frac{ML^2}{2}$

C. $I_0 + \frac{ML^2}{4}$

D. $I_0 + 2ML^2$

Answer:

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12. A body projected electrically from the earth reaches a height equal to earth's radius before retruning to the earth. The power exerted by the gravitational force is greatest

A. At the instant just after the body is projected

B. At the highest position of the body

C. At the instant just before the body hits the earth

D. It remains constant all through

Answer:

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13. When a mass is rotating in a plane about a fixed point, its angular momentum is directed along

A. the line making an angle of 45° to the plane of rotation

B. the radius

C. the tangent to the orbit

D. a line perpendicular to the plane of rotation

Answer:

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14. A solid cylinder of mass 3 kg is rolling on a horizontal surface wih velocity $4ms^{-1}$ .It collides with a horizontal spring of force constant $200Nm^{-1}$.The maximum compression produced in the spring will be

A. 0.6 m

B. 0.7 m

C. 0.2 m

D. 0.5 m

Answer:

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15. An explosion breaks a rock into three parts in a horizontal plane two of them go off at right angles to each other the first part of

mass 1 kg moves with a speed of 12 m/s the second part of mass 2kg moves with a speed of 8 m/s and the third aprt flies off with a speed of 4 m/s calculate the mass of third part

A. 3 kg

B. 5 kg

C. 7 kg

D. 17kg

Answer:

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16. A car is moving in a circular horizontal track of radius 10 m with a constant speed of $10m/s$.A bob is suspended from the roof of the car nby a light wire of length 1.0m.The angle made by the wire with the vertical is

A. 0°

B. $\frac{\pi}{3}$

C. $\frac{\pi}{6}$

D. $\frac{\pi}{4}$

Answer:

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17. A particle with total energy E is moving in a potential energy region U(x).Motion of the particle is restricted to the region when

A. $U(x) > E$

B. $U(x) < E$

C. $U(x) = 0$

D. $U(x) \leq E$

Answer:

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18. Two discs are rotating about their axes, normal to the discs and passing through the centers of the discs. $DiscD_1$ has 2 kg mass and 0.2m radius initial angular velocity of $50rads^{-1}$. Disc D_2 has 4 kg mass, 0.1 m radius and initial angular velocity of $200rad^s - 1$ The two discs are brought in Contact face to face,

with their axes of rotation coincident The final angular velocity $\left(\in rads^{-1} \right)$ of the system is

A. 40

B. 60

C. 100

D. 120

Answer:

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19. A charge ‘q’ is placed at centre of the line joining two equal charges 'Q' The system of the three charges will be in equilibrium if ‘q’ is equal to

A. $\frac{Q}{2}$

B. $-\frac{Q}{4}$

C. $\frac{Q}{4}$

D. $-\frac{Q}{2}$

Answer:

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20. A particle of unit mass undergoes one - dimensional motion such that its velocity varies according to v(x)=$\beta x^{-2n}$where $\beta$and n are constants and x is the position of the particle.The acceleration of the particle as a function of x, is given by:

A. $-2n\beta^2 x^{-4n-1}$

B. $-2n\beta^2 x^{-2n+1}$

C. $-2n\beta^2 e^{-4n+1}$

D. $-2n\beta^2 x^{-2n-1}$

Answer:

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21. A radiation of energy E falss normally on a perfectly reflecting surface. The momentum transferred to the surface is

A. $\frac{2E}{C}$

B. $\frac{2E}{C^2}$

C. $\frac{E}{C^2}$

D. $\frac{E}{C}$

Answer:

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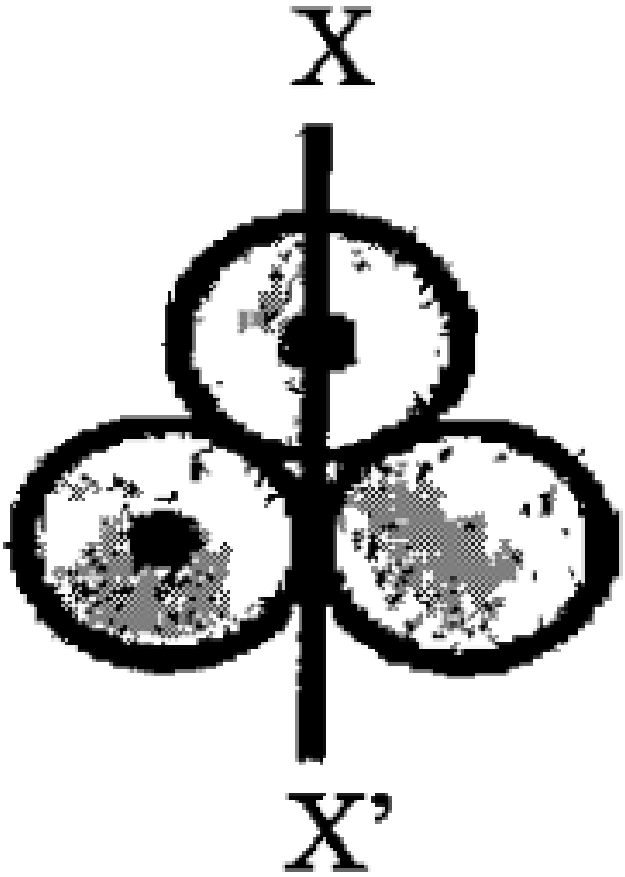
22. Three identical spherical shells, each of mass m and radius r are placed as shown in figure. Consider an axis XX which is touching to two shells and passing through diameter of third shell:Moment of inertia of the system

consisting of these three spherical shells about ' XX' axis is



A. $3mr^2$

B. $\frac{16}{5}mr^2$

C. $4mr^2$

D. $\frac{11}{5}mr^2$

Answer:

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23. If vectors $\vec{A}$ =$\cos\omega t\hat{i} + \sin\omega t\hat{j}$and $\vec{B}$ = $\frac{\cos(\omega t)}{2}\hat{i} + \frac{\sin(\omega t)}{2}\hat{j}$ are function of time,then the value of t at which they are orthogonal to each other is:

A. t=0

B. $t = \frac{\pi}{4\omega}$

C. $t = \frac{\pi}{2\omega}$

D. $t = \frac{\pi}{\omega}$

Answer:

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24. A satellite S is moving in an elliptical orbit around the Earth. The mass of the satellite is very small compared to the mass of the

Earth.Then, which one of the following statements is correct?

A. the acceleration of S is always directedtowards 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 constants in magnitude

Answer:

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25. The position vector of a particle $\vec{R}$ as a function of time is given by: $\vec{R} = 4\sin(2\pi t)\hat{i} + 4\cos(2\pi t)\hat{j}$where R is in meters,t is in second $\hat{i}$and$\hat{j}$and denote unit vectors along x and y directions respectively

Which one of the following statements is wrong for the motion for the motion of particle?

A. Path of the particle is a circle of radius 4 meter

B. Acceleration vectors is along - $\overrightarrow{R}$

C. Magnitude of acceleration vector is $\frac{v^2}{R}$ where v is the velocity of particle.

D. Magnitude of the velocity of particle is 8 $meter/\sec ond$

Answer:

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26. From a disc of radius R a mass M, a circular hole of diameter R, whose rim passes through the centre is cut. What is the moment of inertia of the remaining part of the disc about a perpendicular axis passing through it

A. $\frac{9MR^2}{32}$

B. $\frac{15MR^2}{32}$

C. $\frac{13MR^2}{32}$

D. $\frac{11MR^2}{32}$

Answer:

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27. A uniform circular disc of radius 50 cm at is free to turn about an axis which is perpendicular to its plane and passes through its centre. It is subjected to a torque which produces a constant angular acceleration of

$2 \mathrm{rad} s^{-2}$. Its net acceleration is ms^{-2} at the end of 2.0 s is approximately.

A. 3.0

B. 8.0

C. 7.0

D. 6.0

Answer:

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28. A bar magnet is hung by a thin cotton thread in a unifrom horizontal magnetic field and is in equilibrium state.The energy required to rotate it by 60° is W. Now the torque required to keep the magnet in this new position is

A. $\frac{\sqrt{3W}}{2}$

B. $\frac{2W}{\sqrt{3}}$

C. $\frac{W}{\sqrt{3}}$

D. $\sqrt{3}W$

Answer:

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29. Two rotating bodies A and B of masses mand 2m with moments of inertia I_A and $I_B(I_B > I_A)$ have equal kinetic energy of rotation. If L_A and L_B be their angular momenta respectively, then

A. $L_B > L_A$

B. $L_A > L_B$

C. $L_A = \frac{L_B}{2}$

D. $L_A = 2L_B$

Answer:

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30. A light rod of length has two masses m_1 and m_2 attached to its two ends.The moment of inertia of the system about an axis perpendicular to the rod and passing through the centre of mass is

A. $(m_1 + m_2)I^2$

B. $\sqrt{m_1 + m + 2}I^2$

C. $\frac{m_1 m_2}{m_1 + m_2}I^2$

D. $\frac{m_1 + m_2}{m_1 + m_2}I^2$

Answer:

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31. Consider a drop of rain water having mass 1 g falling from a height of 1 km.It hits the ground with a speed of $50m/s$.Take 'g'

constant with a value $10m/s^2$.The work done by the gravitationl force of air is:

A. 1.25J

B. 100 J

C. 10 J

D. $-10J$

Answer:

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32. Consider a drop of rain water having mass 1 g falling from a height of 1 km.It hits the ground with a speed of $50m/s$.Take 'g' constant with a value $10m/s^2$.The work done by the resistive force of air is :

A. $-8.25J$

B. 8.75 J

C. $-8.75J$

D. $-8.25J$

Answer:

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33. One end of string of length L is connected to a particle of mass 'm' and the other end is connected to small peg on a smooth horizontal table.If the particle moves in circle with speed 'v'. te net force on the particle (directed towards centre) will be (T represents the tension in thestring)

A. $T + \frac{mv^2}{1}$

B. $T - \frac{mv^2}{1}$

C. Zero

D. T

Answer:

34. Two discs of same moment of inertia rotating about their regular axis passing through centre and perpendicular to the plane of disc with angular velocities ω_1 and ω_2. They are brought in to contanct face to face

coinciding the axis of rotation. The expression for loss of energy during this process is

A. $\frac{1}{4}I(\omega_1 - \omega_2)^2$

B. `I(omega_1-omega_2)^2

C. $\frac{1}{8}(\omega_1 - \omega_2)^2$

D. $\frac{1}{2}I(\omega_1 - \omega_2)^2$

Answer:

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35. Which of the following statements are correct?

A. Centre of mass of a body always coincides with the centre of gravity of the body

B. Centre of mass of a body is the point at which the total gravitational torque on the body is zero

C. A couple on a body produce both translational and rotational motion in a body.

D. Mechanical advantage greater than one means that small effort can be used to lift a large load

Answer:

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