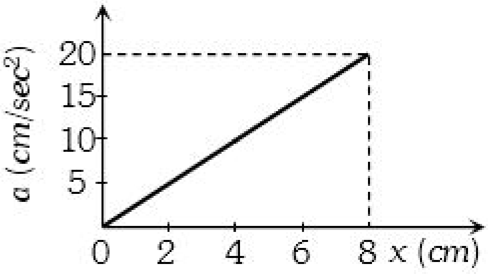
Jupiter Academy

Subjects : Physics PRACTICE PAPER 04

Total Marks : 180 (Solutions)

Physics - Section A (MCQ)

1. A 10kg mass moves along x $-$axis. Its acceleration as a function of its position is shown in the figure. What is the total work done on the mass by the force as the mass moves from $x = 0$ to $x = 8\,cm$

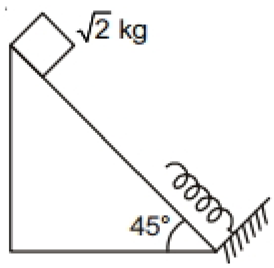


A) $8 \times 10^{-2} joules$ B) $16 \times 10^{-2} joules$
C) $4 \times 10^{-4} joules$ D) $1.6 \times 10^{-3} joules$

Solution : (Correct Answer: A)

Work done = Area covered in between force displacement curve and displacement axis
= Mass $\times$ Area covered in between acceleration-displacement curve and displacement axis.
= $10 \times \frac{1}{2}(8 \times 10^{-2} \times 20 \times 10^{-2})$
= $8 \times 10^{-2}\, J$

2. A block of mass $\sqrt{2}\,kg$ is released from the top of an inclined smooth surface as shown in figure. If spring constant of spring is $100\ N/m$ and block comes to rest after compressing the spring by 1 m, then the distance travelled by block before it comes to rest is .... m

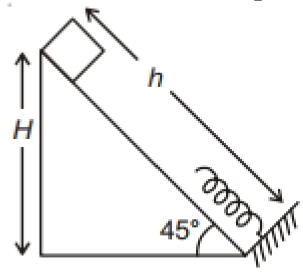


A) 1 B) 1.25 C) 5 D) 2.5

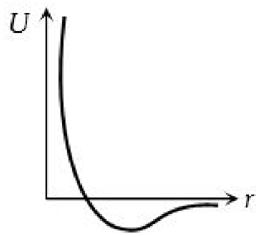
Solution : (Correct Answer: C)

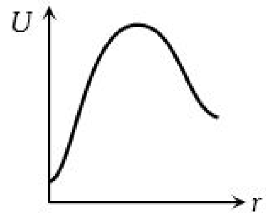
$U_i + k_i = U_f + k_f$

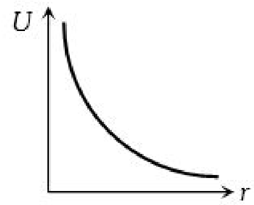
$(mgh \sin 45^\circ) + 0 = \frac{1}{2}k(1)^2 + 0$ by solving $h = 5\,m$

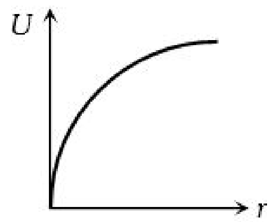


3. The diagrams represent the potential energy U of a function of the inter-atomic distance r. Which diagram corresponds to stable molecules found in nature.

A) 

B) 

C) 

D) 

Solution : (Correct Answer: A)

When the distance between atoms is large then interatomic force is very weak. When they come closer, force of attraction increases and at a particular distance force becomes zero. When they are further brought closer force becomes repulsive in nature.
This can be explained by slope of $U - x$ curve shown in graph (a).

4. A particle falls from a height h upon a fixed horizontal plane and rebounds. If e is the coefficient of restitution, the total distance travelled before rebounding has stopped is

A) $h\left(\frac{1+e^2}{1-e^2}\right)$ B) $h\left(\frac{1-e^2}{1+e^2}\right)$
C) $\frac{h}{2}\left(\frac{1-e^2}{1+e^2}\right)$ D) $\frac{h}{2}\left(\frac{1+e^2}{1-e^2}\right)$

Solution : (Correct Answer: A)

Particle falls from height h then formula for height covered by it in nth rebound is given by
$h_n = he^{2n}$
where $e =$ coefficient of restitution,$n =$ No. of rebound
Total distance travelled by particle before

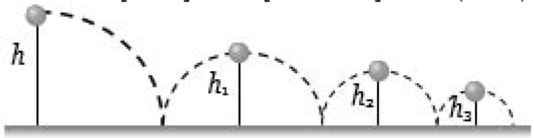
rebounding has stopped

$H = h + 2h_1 + 2h_2 + 2h_3 + 2h_n + \ldots\ldots..$

$= h + 2he^2 + 2he^4 + 2he^6 + 2he^8 + \ldots\ldots...$

$= h + 2h(e^2 + e^4 + e^6 + e^8 + \ldots\ldots.)$

$= h + 2h\left[\frac{e^2}{1-e^2}\right] = h\left[1 + \frac{2e^2}{1-e^2}\right] = h\left(\frac{1+e^2}{1-e^2}\right)$



5. A small sphere is moving at a constant speed in a vertical circle. Below is a list of quantities that could be used to describe some aspect of the motion of the sphere.
I - kinetic energy
II- gravitational potential energy
III - momentum
Which of these quantities will change as this sphere moves around the circle?

A) I and II only
B) I and III only
C) III only
D) II and III only

Solution : (Correct Answer: D)

Speed is given as constant Though the velocity is changing only in direction, its magnitude remains the same. Thus the kinetic energy remains constant as it is a scalar quantity but momentum would change as it is a vector quantity. Also as the elevation of the ball keeps on changing during the motion, the potential energy changes

6. The coefficient of restitution e for a 12.Perfectly Inelastic Collision is

A) 1 B) 0 C) ∞ D) -1

Solution : (Correct Answer: B)

Coefficient of restitution is the ratio between Relative velocity of separation to Relative velocity of approach of colliding bodies.

In 12.Perfectly Inelastic Collision, the two bodies stay togethere after collision and hence the relative velocity of separation is $zero.$

Therefore, coefficient of restitution is $zero.$

7. A ball hits a vertical wall horizontally at $10m/s$ bounces back at $10m/s$

A) There is no acceleration because $10\,\frac{m}{s} - 10\frac{m}{s} = 0$
B) There may be an acceleration because its initial direction is horizontal
C) There is an acceleration because there is a momentum change
D) Even though there is no change in momentum there is a change in direction. Hence it has an acceleration

Solution : (Correct Answer: C)

(c)As the ball bounces back with same speed so change in momentum $= 2mv$
and we know that force = rate of change of momentum
i.e. force will act on the ball so there is an acceleration.

8. An object of mass $80\;kg$ moving with velocity $2\;ms^{-1}$ hit by collides with another object of mass $20\;kg$ moving with velocity $4\;ms^{-1}$. Find the loss of energy assuming a 12.Perfectly Inelastic Collision .... J

A) 12 B) 24 C) 32 D) 30

Solution : (Correct Answer: C)

(c)

Loss in kinetic energy

$\Delta k = \frac{m_1 m_2}{2(m_1+m_2)}(u_1 - u_2)^2$

$\Delta k = 32\;J$

9. Tripling the speed of the motor car multiplies the distance needed for stopping it by

A) 3 B) 6
C) 9 D) 12

Solution : (Correct Answer: C)

(c)$s \propto u^2$ i.e. if speed becomes three times then distance needed for stopping will be nine times.

10. A body of mass $2\;kg$ is thrown up vertically with K.E. of 490 joules. If the acceleration due to gravity is $9.8m/s^2$, then the height at which the K.E. of the body becomes half its original value is given by .... m

A) 50 B) 12.5 C) 25 D) 10

Solution : (Correct Answer: B)

(b)Let h is that height at which the kinetic energy of the body becomes half its original value i.e. half of its kinetic energy will convert into potential energy

$mgh = \frac{490}{2}$

==> $2 \times 9.8 \times h = \frac{490}{2}$

==> $h = 12.5m.$

11. From a stationary tank of mass 125000 pound a small shell of mass 25 pound is fired with a muzzle velocity of $1000\;ft/sec$. The tank recoils with a velocity of .... $\mathrm{ft/sec}$

A) 0.1 B) 0.2 C) 0.4 D) 0.8

Solution : (Correct Answer: B)

(b)According to conservation of momentum

Momentum of tank = Momentum of shell

$125000 \times v_{tank} = 25 \times 1000 ==> v_{tank} = 0.2 ft/sec.$

12. Two bodies of masses m_1 and m_2 have equal kinetic energies. If p_1 and p_2 are their respective momentum, then ratio $p_1 : p_2$ is equal to

A) $m_1 : m_2$ B) $m_2 : m_1$
C) $\sqrt{m_1} : \sqrt{m_2}$ D) $m_1^2 : m_2^2$

Solution : (Correct Answer: C)

(c)$P = \sqrt{2mE}$

$P \propto \sqrt{m}$ (if$E = $const.))

$\frac{P_1}{P_2} = \sqrt{\frac{m_1}{m_2}}$

13. A simple pendulum of mass $200\ gm$ and length $100\ cm$ is moved aside till the string makes an angle of 60^o with the vertical. The kinetic and potential energies of the bob, when the string is inclined at 30^o to the vertical, are

A) $7.174 \times 10^6\ erg,\ 2.626 \times 10^6\ erg$
B) $8.2 \times 10^6\ erg,\ 2.2 \times 10^6\ erg$
C) $2.6 \times 10^6\ erg,\ 5.6 \times 10^6\ erg$
D) $3.6 \times 10^6\ erg,\ 6.2 \times 10^6\ erg$

Solution : (Correct Answer: A)

Reference level

(Here $\mathrm{m} = 200\mathrm{gm}$

$\mathrm{L} = 100\mathrm{cm} = 1\mathrm{m}$

$g = 10 m/sec^2$)

$\mathrm{W} = \Delta \mathrm{k}$

$\mathrm{mgL}(\cos 30^\circ - \cos 60^\circ) = \mathrm{KE_f} - \mathrm{KE_i}$

$\mathrm{K} \cdot \mathrm{E_f} = \mathrm{mgL}(\cos 30^\circ - \cos 60^\circ)$

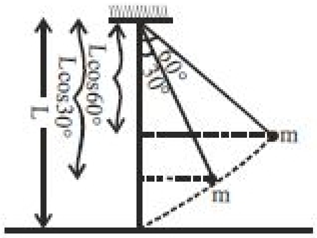
$= 0.732\mathrm{J}$

$= 7.32 \times 10^6 \mathrm{erg}$

$\mathrm{PE} = \mathrm{mgL}(1 - \cos 30^\circ)$

$= 0.268\mathrm{J}$

$= 2.68 \times 10^6 \mathrm{erg}$



14. A bullet of mass $0.01\ kg$ and travelling at a speed of $500\ m/s$. strikes a block of mass $2\ kg$. which is suspended by a string of length $5\ m$. The centre of gravity of the block is found to raise a vertical distance of $0.1\ m$. What is the speed of the bullet after it emerges from the block- .... $\mathrm{m/s}$

A) 110 B) 220 C) 330 D) 200

Solution : (Correct Answer: B)

By $COLM$ $0.01 \times 500 = 2\mathrm{V_B} + 0.01\mathrm{V_b} \ldots (1)$

By $COME$ $\quad \mathrm{V_B} = \sqrt{2 \times 9.8 \times 0.1} = 1.4 \quad \ldots(2)$

By $(1)\&(2)\mathrm{V_b} = 220\mathrm{m/s}$

15. A bomb of mass $12\ kg$ at rest explodes into two fragments of masses in the ratio $1:3$. The $K.E.$ of the smaller fragment is $216\ J$. The momentulm of heavier fragment is (in $kg - m/sec$)

A) 36 B) 72
C) 108 D) Insufficient data

Solution : (Correct Answer: A)

$\mathrm{M_1E_1} = \mathrm{M_2E_2} \quad \Rightarrow \mathrm{E_2} = 72\mathrm{J}$

$\Rightarrow \mathrm{P_2} = \sqrt{2 \times 9 \times 72}$

$\mathrm{P_2} = 36\mathrm{kgm/s}$

16. A ball bounces to 80% of its original height. What fraction of its mechanical energy is lost in each bounce ?

A) 0.20 B) 0.60 C) 0.40 D) 1

Solution : (Correct Answer: A)

Suppose the ball is dropped from a height h

Initial $K.E. = mgh$

$P.E.$ after the bounce $= mg \times (80\%)h = \frac{4}{5}mgh$

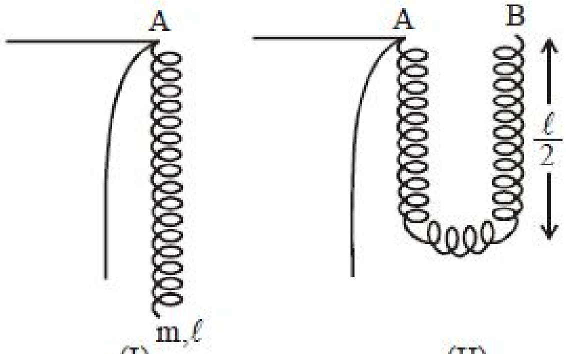
$P.E.$ lost in each bounce

$= mgh - \frac{4}{5}mgh = \frac{1}{5}mgh$

Fraction of $P.E.$ lost in each bounce

$= \frac{\frac{1}{5}mgh}{mgh} = 0.20$

17. A chain of mass m and length l is hanging freely from edge A (as shown in diagram I). Calculate the work done to fold it as shown in diagram (II)



(I) (II)

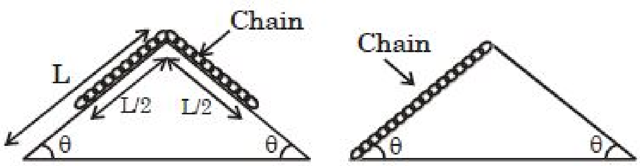
A) $mg\frac{l}{2}$ B) $-mg\frac{l}{2}$ C) $mg\frac{l}{4}$ D) $-mg\frac{l}{4}$

Solution : (Correct Answer: C)

CM reaised by $\mathrm{h}=\frac{\ell}{2}-\frac{\ell}{4}=\frac{\ell}{4}$

$\mathrm{W}=\mathrm{mgh}=\mathrm{mg}\,\frac{\ell}{4}$

18. A uniform chain of mass m and length L is originally placed mid-way on the top of a fixed smooth double-sided wedge (Figure- A). The length of each side of the wedge is L . It is then given a slight push. The kinetic energy of the chain when the whole chain has just slid to the left side of the wedge (Figure- B), is :



(A) (B)

A) $mgL\,sin\theta$ B) $\frac{mgLsin\theta}{2}$

C) $\frac{mgLsin\theta}{4}$ D) $\frac{mgLsin\theta}{8}$

Solution : (Correct Answer: C)

$\mathrm{U_i}=2\left(-\frac{\mathrm{m}}{2}\mathrm{g}\frac{\mathrm{L}}{4}\right)\sin\theta=-\frac{\mathrm{mgL}}{4}\sin\theta$

$\mathrm{U_f}=-\left(\mathrm{mg}\frac{\mathrm{L}}{2}\right)\sin\theta$

$\mathrm{K}=\mathrm{U_i}-\mathrm{U_f}$

19. Three particles A, B and C are thrown from the top of a tower with the same speed. A is thrown up, B is thrown down and C is horizontally. They hit the ground with speeds V_A, V_B and V_C respectively, then

A) $V_A=V_B=V_C$

B) $V_A=V_B>V_C$

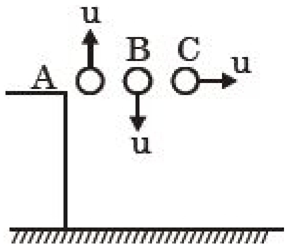
C) $V_B>V_C>V_A$

D) $V_A>V_B=V_C$

Solution : (Correct Answer: A)

since change in PE is same for $\mathrm{A, B}$ and C therefore change in KE is also same

$\Rightarrow \mathrm{V_A}=\mathrm{V_B}=\mathrm{V_C}$



20. If a person is pushing a box inside a moving train, the work done in the frame of the earth will be: (where $\vec{s}$ is the displacement of the box in the train and $\vec{s}_0$ is the displacement of the train relative to the ground)

A) $\vec{F}.\overrightarrow{s_0}$ B) $\vec{F}.\vec{s}$

C) $\vec{F}.\left(\vec{s}+\overrightarrow{s_0}\right)$ D) zero

Solution : (Correct Answer: C)

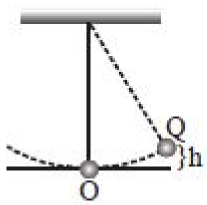
Displacement $w.r.t.$ ground $= vess+\vec{s}_0$

since train is moving with constant velocity net force acting on block is

$=\vec{F}$

Therefore work done . $-\vec{F}\cdot(\vec{S}+\vec{s}_0)$

21. The bob of a simple pendulum is displaced from its equilibrium position O to a position Q which is at height h above O and the bob is then released. Assuming the mass of the bob to be m and time period of oscillations to be $2.0\ s$, the tension in the string when the bob passes through O is



A) $m\left(g+\pi\sqrt{2gh}\right)$

B) $m\left(g+\sqrt{\pi^2gh}\right)$

C) $m\left(g+\sqrt{\frac{\pi^2}{2}gh}\right)$

D) $m\left(g+\sqrt{\frac{\pi^2}{3}gh}\right)$

Solution : (Correct Answer: A)

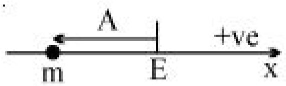
Tension in the string when bob passes through lowest poin

$\mathrm{T}=\mathrm{mg}+\frac{\mathrm{mv}^2}{\mathrm{r}}=\mathrm{mg}+\mathrm{mv}\omega(\because \mathrm{v}=\mathrm{r}\omega)$

putting $\mathrm{v}=\sqrt{2\mathrm{gh}}$ and $\omega=\frac{2\pi}{\mathrm{T}}=\frac{2\pi}{2}=\pi$

we get $\mathrm{T}=\mathrm{m}(\mathrm{g}+\pi\sqrt{2\mathrm{gh}})$

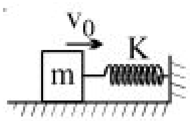
22. A particle of mass m is constrained to move on x-axis. A force F acts on the particle. F always points toward the position labeled E. For example, when the particle is to the left of E, F points to the right. The magnitude of F is a constant F except at point E where it is zero. The system is horizontal. F is the net force acting on the particle. The particle is displaced a distance A towards left from the equilibrium position E and released from rest at $t=0$. What is the period of the motion?



A) $4\left(\sqrt{\frac{2Am}{F}}\right)$
B) $2\left(\sqrt{\frac{2Am}{F}}\right)$
C) $\left(\sqrt{\frac{2Am}{F}}\right)$
D) None

Solution : (Correct Answer: A)

23. A block of mass m moving with a velocity v_0 on a smooth horizontal surface strikes and compresses a spring of stiffness k till mass comes to rest as shown in the figure. This phenomenon is observed by two observers:
A: standing on the horizontal surface
B: standing on the block To an observer A, the work done by the normal reaction N between the block and the spring on the block is



A) zero
B) $-\frac{1}{2}mv_0^2$
C) $+\frac{1}{2}mv_0^2$
D) none of these

Solution : (Correct Answer: B)

24. A small steel sphere of mass m is falling vertically through a viscous liquid with a constant speed v. Which row in the table correctly describes the changes with time in the kinetic energy and gravitational potential energy of the sphere?
Kinetic Energy || Gravitational Potential Energy

A) constant and equal to $\frac{1}{2}\ mv^2$ || decreases at a rate of mgv
B) constant and equal $\frac{1}{2}\ mv^2$ || decreases at a rate of $(mgv\ - ½\ mv^2)$
C) increases at a rate of mgv || decreases at a rate of mgv
D) increases at a rate of mgv || decreases at a rate of ($\frac{1}{2}\ mv^2$ -mgv)

Solution : (Correct Answer: A)

$\Delta \mathrm{KE}=0$, since $\mathrm{V}=$ constant

$\mathrm{KE}=\frac{1}{2}\mathrm{mv}^2=$ constant

Mass is falling down so potential energy decreases at rate

$=mg\left(\frac{-dx}{dt}\right)=-mgV \quad$ [decreases]

25. A wooden block of mass M is suspended by a cord and is at rest. A bullet of mass m, moving with a velocity v passes through the block and comes out with a velocity $v/2$ in the same direction. If there is no loss in kinetic energy, then upto what height the block will rise

A) $m^2v^2/2M^2g$
B) $m^2v^2/8M^2g$
C) $m^2v^2/4Mg$
D) $m^2v^2/2Mg$

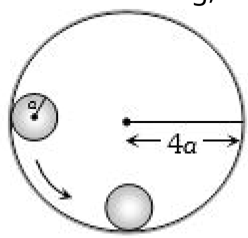
Solution : (Correct Answer: B)

$mv+M\times 0=m\frac{v}{2}+M\times V$

==> $V=\frac{m}{2M}v$

$h=\frac{V^2}{2g}=\frac{(mv/2M)^2}{2g}=\frac{m^2v^2}{8M^2g}.$

26. A ring of radius $4a$ is rigidly fixed in vertical position on a table. A small disc of mass m and radius a is released as shown in the fig. When the disc rolls down, without slipping, to the lowest point of the ring, then its speed will be



A) $\sqrt{ga}$
B) $\sqrt{2ga}$
C) $\sqrt{3ga}$
D) $\sqrt{4ga}$

Solution : (Correct Answer: D)

27. Four particles given, have same momentum which has maximum kinetic energy

A) Proton
B) Electron
C) Deutron
D) α-particles

Solution : (Correct Answer: B)

(b)$E=\frac{P^2}{2m}$

$E\propto\frac{1}{m}$ (If $P=$ constant)
i.e. the lightest particle will possess maximum kinetic energy and in the given option mass of electron is minimum.

28. In an elastic collision of two particles the following is conserved

A) Momentum of each particle
B) Speed of each particle
C) Kinetic energy of each particle

D) Total kinetic energy of both the particles

Solution : (Correct Answer: D)

(d)

29. An engine pump is used to pump a liquid of density ρ continuously through a pipe of cross-sectional area A. If the speed of flow of the liquid in the pipe is v, then the rate at which kinetic energy is being imparted to the liquid is

A) $\frac{1}{2}A\rho v^3$ B) $\frac{1}{2}A\rho v^2$
C) $\frac{1}{2}A\rho v$ D) $A\rho v$

Solution : (Correct Answer: A)

(a)Energy supplied to liquid per second by the pump = $\frac{1}{2}\frac{mv^2}{t}$= $\frac{1}{2}\frac{V\rho v^2}{t}$

= $\frac{1}{2}A \times \left(\frac{l}{t}\right) \times \rho \times v^2 \left[\frac{l}{t} = v\right]$

= $\frac{1}{2}A \times v \times \rho \times v^2$= $\frac{1}{2}A\rho v^3$

30. The rate of doing work by force acting on a particle moving along x-axis depends on position x of particle and is equal to $2x$. The velocity of particle is given by expression

A) $\left[\frac{3x^2}{m}\right]^{1/3}$ B) $\left[\frac{3x^2}{2m}\right]^{1/3}$
C) $\left(\frac{2mx}{9}\right)^{1/2}$ D) $\left[\frac{mx^2}{3}\right]^{1/2}$

Solution : (Correct Answer: A)

(a)

$P = \frac{F \cdot dx}{dt}$

$= m\left(\frac{vdv}{dx}\right)v = 2x$

$m\int v^2 dv = \int 2x dx$

$\frac{mv^3}{3} = x^2$

$v = \left(\frac{3x^2}{m}\right)^{\frac{1}{3}}$

31. A body of mass $0.4\,kg$ is whirled in a vertical circle making $2\,rev/sec$. If the radius of the circle is $2\,m$, then tension in the string when the body is at the top of the circle, is .... N

A) 41.56 B) 89.86
C) 109.86 D) 115.86

Solution : (Correct Answer: D)

(d) Tension at the top of the circle,$T = m\omega^2 r - mg$

$T = 0.4 \times 4\pi^2 n^2 \times 2 - 0.4 \times 9.8 = 115.86\,N$

32. A weightless thread can support tension upto 30 N. A stone of mass 0.5 kg is tied to it and is revolved in a circular path of radius 2 m in a vertical plane. If $g = 10m/s^2$, then the maximum angular velocity of the stone will be .... rad/s

A) 5 B) $\sqrt{30}$ C) $\sqrt{60}$ D) 10

Solution : (Correct Answer: A)

(a) $T_{\max} = m\omega_{\max}^2 r + mg$

$\Rightarrow \frac{T_{\max}}{m} = \omega^2 r + g$

$\Rightarrow \frac{30}{0.5} - 10 = \omega^2{}_{\max} r$

$\Rightarrow \omega_{\max} = \sqrt{\frac{50}{r}} = \sqrt{\frac{50}{2}} = 5\,rad/s$

33. A particle of mass $2\ kg$ travels along a straight line with velocity $v = a\sqrt{x}$, where a is a constant. The work done by net force during the displacement of particle from $x = 0$ to $x = 4\,m$ is ....

A) a^2 B) $2a^2$ C) $4a^2$ D) $\sqrt{2}a^2$

Solution : (Correct Answer: C)

(c)

$v = a\sqrt{x}$

$W = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$

$= \frac{1}{2}(2)\left[(a\sqrt{4})^2 - 0\right]$

$= 4a^2$

34. Given that $W = \vec{F}.\vec{s}\ = 0$ and $F \neq 0\,,\ s \neq 0$, then

A) $\vec{F}$ is equal to $\vec{s}$
B) $\vec{F}$ is parallel to $\vec{s}$
C) $\vec{F}$ is perpendicular to $\vec{s}$
D) none of these

Solution : (Correct Answer: C)

35. Two particles A and B, move with constant velocities $\vec{v}_1$ and $\vec{v}_2$. At the initial moment their position vectors are $\vec{r}_1$ and $\vec{r}_2$ respectively. The condition for their collision is

A) $\vec{r}_1 - \vec{r}_2 = \vec{v}_1 - \vec{v}_2$ B) $\frac{\vec{r}_1 - \vec{r}_2}{|\vec{r}_1 - \vec{r}_2|} = \frac{\vec{v}_2 - \vec{v}_1}{|\vec{v}_2 - \vec{v}_1|}$
C) $\vec{r}_1.\vec{v}_1 = \vec{r}_2.\vec{v}_2$ D) $\vec{r}_1 \times \vec{v}_1 = \vec{r}_2 \times \vec{v}_2$

Solution : (Correct Answer: B)

For two particles to collide, the direction of the relative velocity of one with respect to other should be directed towands the relative position of the other particle

ie. $\frac{\vec{r}_1 - \vec{r}_2}{|\vec{r}_1 - \vec{r}_2|}$ $\rightarrow$ clivection of relative position of $1\text{w.r.t }2$

$\frac{\vec{v}_2 - \vec{v}_1}{|\vec{v}_2 - \vec{v}_1|}$ $\rightarrow$ direction of velocity of $2\text{w } r.t.1$

so for collision of $\text{A\&B}$

$\frac{\vec{r}_1 - \vec{r}_2}{|\vec{r}_1 - \vec{r}_2|} = \frac{\vec{v}_2 - \vec{v}_1}{|\vec{v}_2 - \vec{v}_1|}$

36. A body of mass $5\,kg$ strikes another body of mass $2.5\ kg$ initially at rest. The bodies after collision coalesce and begin to move as a whole with a kinetic energy of $5\ J$. The kinetic energy of the first body before collision is .... J

A) 7.5 B) 5 C) 2.5 D) 10

Solution : (Correct Answer: A)

$5u+0=(5+2.5)v$

$\mathrm{v}=\frac{2}{3}\mathrm{u}$

$\mathrm{K}=\frac{1}{2}\times(5+2.5)\mathrm{v}^2=5\Rightarrow\mathrm{u}=\sqrt{3}\mathrm{m/s}$

$\mathrm{K_i}=\frac{1}{2}\times5\times3=7.5\mathrm{J}$

37. A particle of mass m is at rest in a train moving with constant velocity with respect to ground. Now the particle is accelerated by a constant force F_0 acting along the direction of motion of train for time t_0.A girl in the train and a boy on the ground measure the work done by this force. Which of the following are $INCORRECT$?

A) Both will measure the same work
B) Boy will measure higher value than the girl
C) Girl will measure higher value than the boy
D) Both (A) and (C)

Solution : (Correct Answer: D)

Work done $=\int\vec{F}.\vec{\delta}\,s$

Lets assume particle moved x (in m) during time, t_o in frame of train.

Then work done in train frame, $W_{\text{train}}=Fx$

Work done measured by girl, $W_g=F_0x$

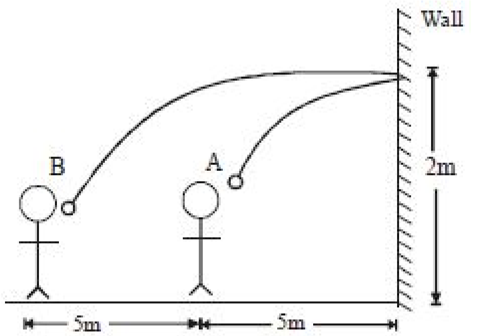
lets assume distance travelled by particle in ground frame $x+C$ where $C=t_o\times$ train speed

Work done measured by $W_b=F_0(x+C)$ where C come due to the train motion.

thus, $W_b>W_s$ and as the data insufficient so we can't measure work done by F_0.

so incorrect option $(A),(C)$.

38. Two persons A & B are throwing ball of $200\ g$ on wall as shown in figure. Balls strike wall perpendicularly at same point height $2\ m$ from ground. Ball strike wall elastically at same time and returns back to A & B, at same time. They again repeat the same. What is the average force on wall .... N (take $g=10\ m/s^2$)



A) 3.25 B) 6 C) 7.5 D) 10

Solution : (Correct Answer: C)

$\mathrm{t.u_1}\cos\theta_1=5\Rightarrow5/\mathrm{u_1}\cos\theta_1=\mathrm{t}$

$\mathrm{t.u_2}\cos\theta_2=10;\mathrm{t}=\frac{10}{u_2\cos\theta_2}$

Now

$F=\frac{\Delta P}{\Delta t}=\frac{2m\left[\frac{5}{t}+\frac{10}{t}\right]}{2t}=\frac{15m}{t^2}=\frac{15\times m}{2h}\times g$

$\mathrm{F}=\frac{15\times0.2\times10}{2\times2}=7.5\mathrm{N}$

39. When a conservative force does positive work on a body

A) the potential energy increases
B) the potential energy decreases
C) total energy increases
D) total energy decreases

Solution : (Correct Answer: B)

In conservative force $\vec{F}=\frac{-dV}{dr}$

$=\vec{F}\cdot\overrightarrow{dr}=-dV$

$\int\vec{F}\cdot\vec{d}\,r=-\int dV$

When work done is positive. dV is negative so potential energy decreases.

40. Which of the following is a unit of energy

A) Unit B) Watt
C) Horse 10.Power D) None

Solution : (Correct Answer: D)

(d)Watt and Horse10.Power are the unit of 10.Power

41. The work done against gravity in taking $10\ kg$ mass at $1\,m$ height in 1sec will be....J

A) 49 B) 98
C) 196 D) None of these

Solution : (Correct Answer: B)

(b)Work done$=mgh=10\times9.8\times1=98\,J$

42. $Assertion$: n small balls each of mass m colliding elastically each second on surface with velocity u. The force experienced by the surface is $2\,mnu$.

$Reason$: On elastic collision, the ball rebounds with the same velocity.

A) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
B) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
C) If the Assertion is correct but Reason is incorrect.
D) If both the Assertion and Reason are incorrect.

Solution : (Correct Answer: A)

In elastic collision, kinetic energy remains conserved therefore the ball rebounds with the same velocity. According to Newton's second law $F \times t =$ change in linear momentum.

$\therefore F \times 1 = m \times n\,(u+u) \Rightarrow F = 2\,mmu$

43. If $\overrightarrow{F} = (60\hat{i} + 15\hat{j} - 3\hat{k})\ N$ and $\overrightarrow{V} = (2\hat{i} - 4\hat{j} + 5\hat{k})$ m/s, then instantaneous 10.Power is

A) 45 **B)** 195 **C)** 75 **D)** 100

Solution : (Correct Answer: A)

$P = \overrightarrow{F} \cdot \overrightarrow{v}$

$P = (60\hat{i} + 15\hat{j} - 3\hat{k}) \cdot (2\hat{i} - 4\hat{j} + 5\hat{k})$

$P = (120 - 60 - 15) = 45\ watt$

44. Water falls from a height of $60\ m$ at the rate of $15 kg/s$ to operate a turbine. The losses due to frictional forces are 10% of energy. How much 10.Power is generated by the turbine .... kW ? $(g = 10\,m/s^2)$

A) 12.3 **B)** 7 **C)** 8.1 **D)** 10.2

Solution : (Correct Answer: C)

Mass of water falling/second $-15\ kg/s$

$h = 60\ m,\quad g = 10\ m/s^2$, loss$= 10\%$ i.e., 90% is used.

10.Power generated $= 15 \times 10 \times 60 \times 0.9 = 8100\ W$
$= 8.1\ kW$

45. A body falling from a height of $10\ m$ rebounds from hard floor. If it loses 20% energy in the impact, then coefficient of restitution is

A) 0.89 **B)** 0.56 **C)** 0.23 **D)** 0.18

Solution : (Correct Answer: A)

As $20/$ energy lost in collision therfore

$mgh_2 = 80\%$ ofmgh_1 ==> $\frac{h_2}{h_1} = 0.8$

but $e = \sqrt{\frac{h_2}{h_1}} = \sqrt{0.8} = 0.89$