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www.aepstudycircle.com

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2ND FLOOR, SATKOUDI COMPLEX, THANA CHOWK, RAMGARH - 829122-JH

PREVIOUS YEARS QUESTION -NEET

WORK ENERGY POWER

1. The potential energy of a long spring when stretched by 2 cm is U. If the spring is stretched by 8 cm, potential energy stored in it will be: **(2023)**
(a) 16U
(b) 2U
(c) 4U
(d) 8U

2. A bullet from a gun is fired on a rectangular wooden block with velocity u. When bullet travels 24 cm through the block along its length horizontally, velocity of bullet become $\frac{u}{3}$. Then it further penetrates into the block in the same direction before coming to rest exactly at the other end of the block. The total length of the block is: **(2023)**
(a) 30 cm
(b) 27 cm
(c) 24 cm
(d) 28 cm

3. An electric lift with a maximum load of 2000 kg (lift + passengers) is moving up with a constant speed of $1.5\,ms^{-1}$. The frictional force opposing the motion is 3000 N. The minimum power delivered by the motor to the lift in watts is: $(g = 10\,ms^{-2})$ **(2022)**
(a) 20000
(b) 34500
(c) 23500
(d) 23000

4. Water falls from a height of 60 m at the rate of 15 kg/s to operate a turbine. The losses due to frictional force are 10% of the input energy. How much power is generated by the turbine? (g = 10 m/s^2) **(2021)**
(a) 8.1 kW
(b) 12.3 kW
(c) 7.0 kW
(d) 10.2 kW

5. A point mass 'm' is moved in a vertical circle of radius 'r' with the help of a string. The velocity of the mass is $\sqrt{7gr}$ at the lowest point. The tension in the string at the lowest point is **(2020 Covid Re-NEET)**
(a) 7 mg
(b) 8 mg
(c) 1 mg
(d) 6 mg

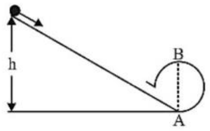
6. Body A of mass 4m moving with speed u collides with another body B of mass 2m, at rest. The collision is head on and elastic in nature. After the collision the fraction of energy lost by the colliding body A is : **(2019)**
(a) $\frac{1}{9}$
(b) $\frac{8}{9}$
(c) $\frac{4}{9}$
(d) $\frac{5}{9}$

7. A mass m is attached to a thin wire and whirled in a vertical circle. The wire is most likely to break when: **(2019)**
(a) The mass is at the highest point
(b) The wire is horizontal
(c) The mass is at the lowest point
(d) Inclined at an angle of 60° from vertical

8. A force F = 20 + 10y acts on a particle in y direction where F is in newton and y in metre. Work done by this force to move the particle from y = 0 to y = 1 m is **(2019)**
(a) 30 J
(b) 5 J
(c) 25 J
(d) 20 J

9. A body initially at rest and sliding along a frictionless track from a height h (as shown

in the figure) just completes a vertical circle of diameter AB = D. The height h is equal to:



(2018)

(a) $\frac{7}{5}D$
(b) D
(c) $\frac{3}{2}D$
(d) $\frac{5}{4}D$

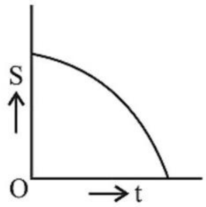
10. A spring of force constant k is cut into lengths of ratio 1 : 2 : 3. They are connected in series and the new force constant is K′. Then they are connected in parallel and force constant is K″. Then K′ : K″ is: **(2017 - Delhi)**
(a) 1 : 9
(b) 1 : 11
(c) 1 : 14
(d) 1 : 6

11. 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 50 m/s. Take 'g' constant with a value 10 m/s^2. The work done by the (i) gravitational force and the (ii) resistive force of air is: **(2017 - Delhi)**
(a) (i) 1.25 J (ii) –8.25 J
(b) (i) 100 J (ii) 8.75 J
(c) (i) 10 J (ii) –8.75 J
(d) (i) –10 J (ii) –8.25 J

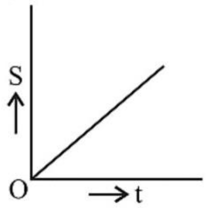
12. A body initially at rest, breaks up into two pieces of masses 2 M and 3 M respectively, together having a total kinetic energy E. The piece of mass 2 M, after breaking up, has a kinetic energy. **(2017 - Gujrat)**
(a) $\frac{2E}{5}$
(b) $\frac{E}{2}$
(c) $\frac{E}{5}$
(d) $\frac{3E}{5}$

13. A body starts moving unidirectionally under the influence of a source of constant power. Which one of the graph correctly shows the variation of displacement (s) with time (t)? **(2017 - Gujrat)**

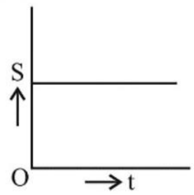
(a)



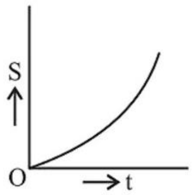
(b)



(c)



(d)



14. A particle moves from a point $(-2\hat{i}+5\hat{j})$ to $(4\hat{i}+3\hat{k})$ when a force of $(4\hat{i}+3\hat{j})$ N is applied.
How much work has been done by the force? **(2016 – II)**
(a) 5 J
(b) 2 J
(c) 8 J
(d) 11 J

15. Two identical balls A and B having velocities of 0.5 m/s and –0.3 m/s respectively collide elastically in one dimension. The velocities of B and A after the collision respectively will be: **(2016 – II)**
(a) –0.3 m/s and 0.5 m/s
(b) 0.3 m/s and 0.5 m/s
(c) –0.5 m/s and 0.3 m/s
(d) 0.5 m/s and –0.3 m/s

16. A bullet of mass 10 g moving horizontally with a velocity of 400 ms^{-1} strikes a wooden block of mass 2 kg which is suspended by a light inextensible string of length 5 m. As a result, the center of gravity of the block is found to rise a vertical distance of 10 cm. The speed of the bullet after it emerges out horizontally from the block will be: **(2016 – II)**
(a) 120 ms^{-1}
(b) 160 ms^{-1}
(c) 100 ms^{-1}
(d) 80 ms^{-1}

17. A body of mass 1 kg begins to move under the action of a time dependent force $F = (2t\hat{i} + 3t^2\hat{j})$ N, where $\hat{i}$ and $\hat{j}$ are unit vectors along x and y axis. What power will be developed by the force at the time t? **(2016 - I)**
(a) $(2t^2 + 3t^2)$W
(b) $(2t^2 + 4t^4)$W
(c) $(2t^3 + 4t^4)$W
(d) $(2t^3 + 3t^5)$W

18. A piece of ice falls from a height h so that it melts completely. Only one-quarter of the heat produced is absorbed by the ice and all energy of ice gets converted into heat during its fall. The value of h is [Latent heat of ice is 3.4×10^5 J/kg and g = 10 N/kg]: **(2016 - I)**
(a) 34 km
(b) 544 km
(c) 136 km
(d) 68 km

19. What is the minimum velocity with which a body of mass m must enter a vertical loop of radius R so that it can complete the loop? **(2016 - I)**
(a) $\sqrt{gR}$
(b) $\sqrt{2gR}$
(c) $\sqrt{3gR}$
(d) $\sqrt{5gR}$

20. . A particle of mass 10 g moves along a circle of radius 6.4 cm with a constant tangential acceleration. What is the magnitude of this acceleration if the kinetic energy of the particle becomes equal to 8×10^{-4} J by the end of the second revolution after the beginning of the motion? **(2016 - I)**
(a) 0.1 m/s^2
(b) 0.15 m/s^2
(c) 0.18 m/s^2
(d) 0.2 m/s^2

21. A particle of mass m is driven by a machine that delivers a constant power k watts. If the particle starts from rest the force on the particle at time t is: **(2015)**
(a) $\sqrt{mkt}^{\frac{-1}{2}}$
(b) $\sqrt{2mkt}^{\frac{-1}{2}}$
(c) $\frac{1}{2}\sqrt{mkt}^{\frac{-1}{2}}$
(d) $\sqrt{\frac{mk}{2}t^{\frac{-1}{2}}}$

22. . Two similar springs P and Q have spring constants K_P and K_Q such that $K_P > K_Q$. They stretched first by the same amount (case a), then by the same force (case b). The work done by the springs W_P and W_Q are related as in case (a) and case (b), respectively: **(2015)**
(a) $W_P = W_Q; W_P = W_Q$
(b) $W_P > W_Q; W_Q > W_P$
(c) $W_P < W_Q; W_Q < W_P$
(d) $W_P = W_Q; W_P > W_Q$

23. A block of mass 10 kg moving in x direction with a constant speed of 10 ms^{-1}, is subjected to a retarding force $F = -0.1x$ J/m during its travel from x = 20 m to 30 m. Its final K.E. will be: **(2015)**
(a) 450 J
(b) 275 J
(c) 250 J
(d) 475 J

24. Two particles of masses m_1, m_2 move with initial velocities u_1 and u_2. On collision, one of the particles get excited to higher level, after absorbing energy ε. If final velocities of particles be v_1 and v_2, then we must have: **(2015)**

(a) $\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_1v_2^2 - \varepsilon$
(b) $\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 - \varepsilon = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_1v_2^2$
(c) $\frac{1}{2}m_1^2u_1^2 + \frac{1}{2}m_2^2u_2^2 + \varepsilon = \frac{1}{2}m_1^2v_1^2 + \frac{1}{2}m_2^2v_2^2$
(d) $m_1^2u_1 + m_2^2u_2 - \varepsilon = \frac{1}{2}m_1^2v_1^2 + \frac{1}{2}m_2^2v_2^2$

25. The heart of a man pumps 5 litres of blood through the arteries per minute at a pressure of 150 mm of mercury. If the density of mercury be 13.6×10^3 kg/m^3 and $g = 10 m/s^2$, then the power of heart in watt is: **(2015 Re)**
(a) 1.50
(b) 1.70
(c) 2.35
(d) 3.0

26. On a frictionless surface, a block of mass M moving at speed v collides elastically with another block of same mass M which is initially at rest. After collision the first block moves at an angle θ to its initial direction and has a speed v/3. The second block's speed after the collision is: **(2015 Re)**
(a) $\frac{\sqrt{3}}{2}v$
(b) $\frac{2\sqrt{2}}{2}v$
(c) $\frac{3}{4}v$
(d) $\frac{3}{\sqrt{2}}v$

27. A ball is thrown vertically downwards from a height of 20 m with an initial velocity u_0 It collides with the ground, loses 50 percent of its energy in collision and rebounds to the same height. The initial velocity u0 is: (Take $g = 10\ ms^{-2}$) **(2015 Re)**
(a) 10 m/s
(b) 14 m/s
(c) 20 m/s
(d) 28 m/s

28. Two particles A and B, move with constant motion in one dimensional with 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 particle A and B for their collision is: **(2015 Re)**
(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) $\vec{r}_1.\vec{v}_1 = \vec{r}_2.\vec{v}_2$

29. If vectors $\vec{A} = \cos\omega t\hat{i} + \sin\omega t\hat{j}$ and $\vec{B} = \cos\frac{\omega t}{2}\hat{i} + \sin\frac{\omega t}{2}\hat{j}$ are functions of time, then the value of t at which they are orthogonal to each other are: **(2015 Re)**
(a) $t = 0$
(b) $t = \frac{\pi}{4\omega}$
(c) $t = \frac{\pi}{2\omega}$
(d) $t = \frac{\pi}{\omega}$

30. A body of mass (4m) is lying in x-y plane at rest. It suddenly explodes into three pieces. Two pieces, each of mass (m) move perpendicular to each other with equal speeds (v). The total kinetic energy generated due to explosion is **(2014)**
(a) mv^2
(b) $\frac{3}{2}mv^2$
(c) $2\ mv^2$
(d) $4\ mv^2$

31. A uniform force of $(3\hat{i} + \hat{j})$ newton acts on a particle of mass 2 kg. Hence the particle is displaced from position $(2\hat{i} + \hat{j})$ metre to position $(4\hat{i} + 3\hat{j} - \hat{k})$ metre. The work done by the force on the particle is: **(2013)**
(a) 15 J
(b) 9 J
(c) 6 J
(d) 13 J

32. The upper half of an inclined plane of inclination θ is perfectly smooth while lower half is rough. A block starting from rest at the top of the plane will again come to rest at the bottom, if the coefficient of friction between the block and lower half of the plane is given by: **(2013)**
(a) $\mu = \tan\theta$
(b) $\mu = \frac{1}{\tan\theta}$
(c) $\mu = \frac{2}{\tan\theta}$
(d) $\mu = 2\tan\theta$

33. Small object of uniform density rolls up a curved surface with an initial velocity v. It reaches up to a maximum height of $\frac{3v^2}{4g}$ with respect to the initial position. The object is **(2013)**

(a) Disc
(b) Ring
(c) Solid sphere
(d) Hollow sphere

Answer Key

S1. Ans. (a)
S2. Ans. (b)
S3. Ans. (b)
S4. Ans. (a)
S5. Ans. (b)
S6. Ans. (b)
S7. Ans. (c)
S8. Ans. (c)
S9. Ans. (d)
S10. Ans. (b)
S11. Ans. (c)
S12. Ans. (d)
S13. Ans. (d)
S14. Ans. (a)
S15. Ans. (d)
S16. Ans. (a)
S17. Ans. (d)
S18. Ans. (c)
S19. Ans. (d)
S20. Ans. (a)
S21. Ans. (d)
S22. Ans. (b)
S23. Ans. (d)
S24. Ans. (b)
S25. Ans. (b)
S26. Ans. (b)
S27. Ans. (c)
S28. Ans. (b)
S29. Ans. (d)
S30. Ans. (b)
S31. Ans. (b)
S32. Ans. (d)
S33. Ans. (a)

Solutions

S1. Ans. (a)

Potential energy stored in the spring

$=\frac{1}{2}kx^2$

Now $\frac{1}{2}k(2)^2 = U$

$\&\frac{1}{2}k(8)^2 = U'$ (say)

$\Rightarrow U' = \frac{64}{4}U = 16\,U$

S2. Ans. (b)

$\frac{1}{2}m\left(\frac{u}{3}\right)^2 - \frac{1}{2}mu^2 = -F_R \times 24$

$0 - \frac{1}{2}mu^2 = -F_R \times d$

$\frac{\frac{1}{2}mu^2}{\frac{1}{2}mu^2 \times \frac{8}{9}} = \frac{d}{24}$

$d = 24 \times \frac{9}{8} = 27\ cm$

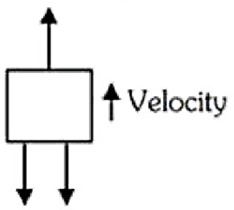
S3. Ans. (b)

Constant velocity $\Rightarrow a = 0$

$\Rightarrow T = W + f$

$= 20000 + 3000$

$= 23000\ N$



$\Rightarrow$ Power $= Tv$

$= 23000 \times 1.5$

$= 34500$ watts

S4. Ans. (a)

Hint: $E = mgh$

$P_{input} = \frac{mgh}{t}$

$= \frac{15 \times 10 \times 60}{1} = 9000 = 9kw$

10% loss $= 0.9 \times 10^3$

$P_{input} = 9 \times 10^3 - 0.9 \times 10^3 = 8.1$ kw

S5. Ans. (b)

Hint: According to the given question

$T - mg = m\frac{(\sqrt{7gr})^2}{r}$

$\Rightarrow T = 8\ mg$

S6. Ans. (b)

Hint: From law of conservation of momentum we have

$m_1u_1 = m_1v_1 + m_2v_2$

$m_2u_2 = m_1u_1 + m_1v_1$ ....(1)

From the law of conservation of K.E. we have

$\frac{1}{2}m_1u_1^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$ ....(2)

Rewriting (1) as

$m_2v_2 = m_1(u_1 - v_1)$ ....(3)

Rewriting (2) as

$m_2v_2^2 = m_1(u_1^2 - v_1^2)$ ....(3)

Dividing (4) with (3)

$v_2 = u_1 + v_1$ ....(5)

eliminating v_2 from (1) and (5) we get

$\frac{m_1u_1 - m_1v_1}{m_2} = u_1 + v_1$

$\left(\frac{m_1 - m_2}{m_1 + m_2}\right)u_1 = v_1$ ....(6)

Fraction of KE of m_1 carried by m_2 is

$1 - \left[\frac{m_1 - m_2}{m_1 + m_2}\right]^2 = \frac{4m_1m_2}{(m_1 + m_2)^2}$

This is also equal to the fractional transfer of KE of colliding body. Fractional transfer of KE of colliding body

$\frac{\Delta KE}{KE} = \frac{4\,(m_1m_2)_2}{(m_1 + m_2)}$

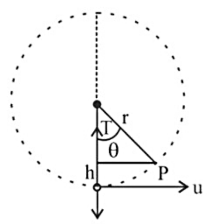
$= \frac{4(4m)2m}{(4m + 2m)^2}$

$= \frac{32m^2}{36m^2} = \frac{8}{9}$

This fractional transfer is equal to the fraction of energy lost by A

S7. Ans. (c)

Hint: Now, at point P from figure



$T - mg\cos\theta = \frac{mv^2}{r}$

$\therefore T = mg\cos\theta + \frac{mv^2}{r}$

From figure, $\cos\theta = \frac{r-h}{r}$

So T will be maximum when cos q will be 1

$\therefore \frac{r-h}{r} = 1$

$\Rightarrow h = 0$

The tension is maximum when the mass is at the lowest position of the verticle circle, so the chance of breaking is maximum.

S8. Ans. (c)

Hint: Work done by variable force is

$W = \int_{y_i}^{y_f} F dy$

Here, $y_i = 0, y_f = 1$ m

$\therefore W = \int_0^1 (20 + 10y)dy = [20 + 5y^2]_0^1 = 25$ J

S9. Ans. (d)

Hint: To complete verticle circle minimum velocity required at lowest point of circle is $\sqrt{5gr}$ so by

$mgh = \frac{1}{2}mv^2 \qquad r = \frac{D}{2}$

$mgh = \frac{1}{2}\ m \times 5g\frac{D}{2}$

$h = \frac{5D}{4}$

S10. Ans. (b)

Hint: Spring constant $K \propto \frac{1}{\ell}$

Where ℓ = natural length of spring

$K = \frac{c}{\ell}$ c = constant

It is cut into lengths of ratio 1 : 2 : 3 then ratio of spring constant,

$\frac{c}{1} : \frac{c}{2} : \frac{c}{3} \Rightarrow \frac{1}{1} : \frac{1}{2} : \frac{1}{3}$

$K_1 : K_2 : K_3 \Rightarrow 6 : 3 : 2$

Now,

parallel combination

$K = 6K + 3K + 2K \Rightarrow K = 11\ K$

$\frac{1}{K'} = \frac{1}{6K} + \frac{1}{2K} + \frac{1}{3K}$

$\frac{1}{K'} = \frac{1}{6K} + \frac{(3+2)}{6K} = \Rightarrow \frac{1}{K'} = \frac{1}{K}$

$K' = K$

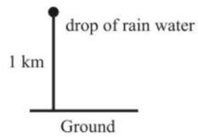
$\frac{K'}{K''} = \frac{K}{11K} \Rightarrow \frac{K'}{K''} = \frac{1}{11}$

S11. Ans. (c)

Hint: Apply work energy theorem

$W_{\text{all force}} = K_f - K_i$

$W_{(\text{conservative})} + W_{(\text{non conservative})} = K_f - K_i$



$W_g = mgh$

$= 10^{-3} \times 10 \times 10^3$

$= 10$ J

$(U_1 - U_2) + W_{fr} = \frac{1}{2}mv^2 - 0 \quad [K_i = 0, u = 0]$

$mgh + W_{fr} = \frac{1}{2}mv^2 \qquad [U_2 = 0]$

$10^{-30} \times 10 \times 1000 + W_{fr} = \frac{1}{2} \times 10^{-3} \times (50)^2$

$10 + W_{fr} = 1.25$

$\downarrow$

Work done by gravitational force

$W_{fr} = -8.25$ J

S12. Ans. (d)

Hint:

$F_{ext} = 0$

$\vec{P}$ = constant

$K.E. = \frac{P^2}{2m} \Rightarrow K.E. \propto \frac{1}{m}$

$\therefore K.E_{2M} = \frac{3E}{5}$

S13. Ans. (d)

Hint: Power $= \frac{K.E}{t} = \frac{\frac{1}{2}mv^2}{t}$

$v = \sqrt{t}$

$\frac{ds}{dt} = t^{\frac{1}{2}}$

$ds = t^{\frac{1}{2}}dt$

$s = \frac{2t^{\frac{3}{2}}}{3} \Rightarrow s \propto t^{\frac{3}{2}}$

Slope of x -t graph is +ve.

S14. Ans. (a)

Hint: $\vec{s} = \vec{r}_f - \vec{r}_i = 2\hat{i} - \hat{j} + 3\hat{k}$

$W = \vec{F}.\vec{s} = (4\hat{i} + 3\hat{j}).[2\hat{i} - \hat{j} + 3\hat{k}]$

$= 8 - 3 = 5J$

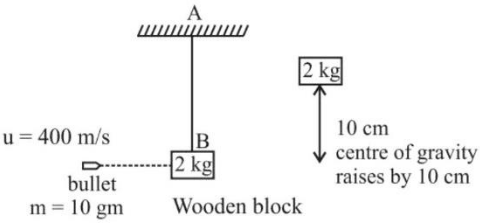
S15. Ans. (d)

Hint: Since both bodies are identical and collision is elastic. Therefore velocities will be interchanged after collision.

$v_A = -0.3$ m/s and $v_B = 0.5$ m/s

S16. Ans. (a)

Hint: AB = 5 m



Apply conservation of linear momentum

$mu + 0 = mv + Mv$

$\frac{10}{100} \times 400 + 0 = \frac{10}{100}v + 2V$

$0.01v + 2V = 4 \ldots\ldots\ldots(1)$

PE = KE

$MgH = \frac{1}{2} \times MV^2$

$2 \times 10 \times \frac{10}{100} = \frac{1}{2} \times 2 \times v^2$

$\Rightarrow V^2 = 2$

$v = \sqrt{2}\ ms^{-1}$

Substituting the value of V in Eq. (1), we get

$\frac{v}{100} + 2\sqrt{2} = \Rightarrow v = (4 - 2\sqrt{2})100$

$\simeq 120\ ms^{-1}$

S17. Ans. (d)

Hint: $\vec{F} = 2t\hat{i} + 3t^2\hat{j}$

$m\frac{d\vec{v}}{dt} = 2t\hat{i} + 3t^2\hat{j}$

$\int_0^{\vec{v}} d\vec{v} = \int_0^t (2t\hat{i} + 3t^2\hat{j})dt = t^2\hat{i} + t^3\hat{j}$

Power $= \vec{F}.\vec{V} = (2t^3 + 3t^5)W$

S18. Ans. (c)

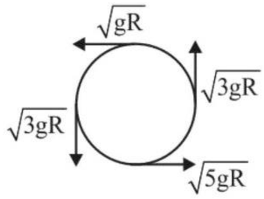
Hint: The potential energy gets converted into heat and only one quarter of it is absorbed by ice.

$\frac{mgh}{4} = mL$

$h = \frac{4L}{g} = \frac{4 \times 3.4 \times 10^5}{10} = 136$ km

S19. Ans. (d)

Hint: Minimum velocity required at different points to complete full vertical circle



S20. Ans. (a)

Hint: $\frac{1}{2}mv^2 = E \rightarrow \frac{1}{2}\left(\frac{10}{1000}\right)v^2 = 8 \times 10^{-4}$

$v^2 = (8 \times 10^{-4})200 = \frac{16}{100}\ ms^{-1}$

$v = \frac{4}{10}ms^{-1}$

Now applying $v^2 - u^2 = 2as$

$\left(\frac{4}{10}\right)^2 = 2a(4\pi R); [s = 4\pi R = 2\ (2\pi R)]$

$\frac{16}{100} = 2a\left(4\pi\frac{6.4}{100}\right)$

$a = \frac{16}{100} \times \left[\frac{7 \times 100}{8 \times 22 \times 6.4}\right] = 0.1\ m/s^2$

S21. Ans. (d)

Hint: P = Fv = mav

$\Rightarrow k = m\frac{dv}{dt}$

By integrating the equation

$\Rightarrow \int v dv = \int \frac{k}{m}dt$

$\Rightarrow \frac{v^2}{2} = \frac{k}{m}t \Rightarrow v = \sqrt{\frac{2kt}{m}}$

$a = \frac{dv}{dt} = \sqrt{\frac{2k}{m}}\left(\frac{1}{2}t^{\frac{-1}{2}}\right)$

$F = ma = m\left(\frac{1}{2}\right)\sqrt{\frac{2k}{m}} \Rightarrow F = \sqrt{\frac{mk}{2t}} = \sqrt{\frac{mk}{2}}t^{\frac{-1}{2}}$

S22. Ans. (b)

Hint: Given $K_P > K_Q$

Case (a) : $x_1 = x_2 = x$

$\frac{W_P}{W_Q} = \frac{\frac{1}{2}K_P x^2}{\frac{1}{2}K_Q x^2} = \frac{K_P}{K_Q} \Rightarrow W_P > W_Q$

Case (b): $F_1 = F_2 = F$

For constant force

$W = \frac{F^2}{2K} \Rightarrow W \propto \frac{1}{K}$

So, $\frac{W_P}{W_Q} = \frac{K_Q}{K_P} \Rightarrow W_Q > W_P$

S23. Ans. (d)

F = -0.1 x J/m

According to Work Energy theorem Work done by all force = $K_f - K_i$

$\int F.dx = K_f - K_i$

$\int_{20}^{30} -0.1x\,dx = K_f - \frac{1}{2} \times mu^2$

$(-)0.1\left[\frac{x^2}{2}\right]_{20}^{30} = K_f - \frac{1}{2} \times 10 \times 10^2$

$\frac{1}{10\times2}[x^2]_{30}^{20} = K_f - 500$

Limit inverse to make –ve to positive

$\frac{1}{20} \times [400 - 900] = K_f - 500$

$-\frac{500}{20} = K_f - 500$

$K_f = 500 - 25 = 475J$

S24. Ans. (b)

Hint: Energy will always be conserved so

$K.E._{initial} = K.E._{final}$ + Excitation energy

$\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 + \varepsilon$

S25. Ans. (b)

Hint: Pressure = 150 mm Hg

Pumping rate = $\frac{dV}{dt} = \frac{5\times10^{-3}}{60} m^3/s$

Power of heart = $P.\frac{dV}{dt} = \rho gh \times \frac{dV}{dt}$

$= (13.6 \times 10^3 kg/m^3)\ (10) \times (0.15) \times \frac{5\times10^{-3}}{60}$

$= \frac{13.6\times5\times0.15}{6} = = 1.72$ watt

S26. Ans. (b)

Hint: In elastic collision energy of system remains same

$(K.E)_{before\ collision} = (K.E)_{after\ collision}$

Let speed of second body after collision is V

$\frac{1}{2}mv^2 + 0 = \frac{1}{2}m\left(\frac{v}{3}\right)^2 + \frac{1}{2}m(v')^2 \Rightarrow v' = \frac{2\sqrt{2}}{3}v$

S27. Ans. (c)

Hint: Let ball rebounds with speed V so

$v = \sqrt{2gh} = \sqrt{2 \times 10 \times 20} = 20$ m/s

Energy just after rebound

$E = \frac{1}{2} \times m \times v^2 = 200$ m

50% energy loses in collision means just before collision energy is 400 J By using energy conservation

$\frac{1}{2}mv_0^2 + mgh = 400$ J

$\Rightarrow \frac{1}{2}mv_0^2 + m \times 10 \times 20 = 400$ m

$\Rightarrow v_0 = 20\ ms^{-1}$

S28. Ans. (b)

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

i.e. $\frac{\vec{r}_1-\vec{r}_2}{|\vec{r}_1-\vec{r}_2|}$ → direction of relative position of 1

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

So for collision of A and B

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

S29. Ans. (d)

Hint: $\vec{A}.\vec{B} = 0$

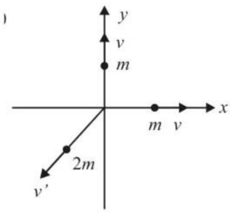
$\cos\omega t \cos\frac{\omega t}{2} + \sin\omega t \sin\frac{\omega t}{2} = 0$

$\cos\left(\omega t - \frac{\omega t}{2}\right) = 0 \Rightarrow \cos\frac{\omega t}{2} = 0$

$\Rightarrow \frac{\omega t}{2} = \frac{\pi}{2} \Rightarrow t = \frac{\pi}{\omega}$

S30. Ans. (b)

Hint:



Let

$\vec{v}$, be velocity of third piece of mass 2m.

Initial momentum, $\vec{p}_1 = 0$ (As the body is rest)

Final momentum, $\vec{p}_1 = mv\hat{i} + mv\hat{j} + 2m\vec{v}'$

According to law of conservation of momentum

$\vec{p}_i = \vec{p}_f$

$= mv\hat{i} + mv\hat{j} + 2m\vec{v}$

$\vec{v}' = -\frac{v}{2}\hat{i} - \frac{v}{2}\hat{j}$

The magnitude of $\vec{v}'$is

$$v' = \sqrt{\left(-\frac{v}{2}\right)^2 + \left(-\frac{v}{2}\right)^2} = \frac{v}{\sqrt{2}}$$

Total kinetic energy generated due to explosion

$$= \frac{1}{2}mv^2 + \frac{1}{2}mv^2 + \frac{1}{2}(2m)v^2$$

$$= \frac{1}{2}mv^2 + \frac{1}{2}mv^2 + \frac{1}{2}(2m)\left(\frac{v}{\sqrt{2}}\right)^2$$

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

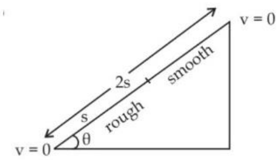
S31. Ans. (b)

Hint: $W = \vec{F}.\vec{S} = (3\hat{i} + \hat{j}).[(4-2)\hat{i} + (3-0)\hat{j} + (-1-1)k]$

$= (3\hat{i} + \hat{j}).(2\hat{i} + 3\hat{j} - 2\hat{k}) \Rightarrow 3(2) + 1(3) + 0(-2) = 9J$

S32. Ans. (d)

Hint:



From Work Energy theorem (W = ΔK.E)
(mg sin θ) (2s) – (μmg cos θ) (s) = 0 – 0 ⇒ μ = 2tan θ

S33. Ans. (a)

Hint: From conservation of mechanical energy

$$= \frac{1}{2}mv^2\left(1 + \frac{K^2}{R^2}\right) = mgh$$

$$\Rightarrow \frac{1}{2}mv^2\left(1 + \frac{K^2}{R^2}\right) = mg\left(\frac{3v^2}{4g}\right)$$

$$= \frac{K^2}{R^2} = \frac{1}{2}$$

∴ The object is a Disc