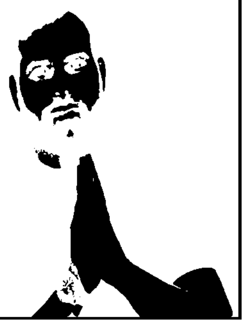
Work, Energy and Power

» IN ONE SHOT «

By – Dr. Manish Raj (MR Sir)



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FOR NOTES & DPP BATTLEGROUND, CHECK PW APP

Force (F)

How far (s) How long (t)

Work done by Constant Force

W $= \vec{F} \cdot \vec{S}$

$= FS\cos\theta$

= Component of force along displacement (S)

= Component of displacement along force (force)

Unit Nm (Joule)

Scalar

Depends on frame

Work done by one force does not depends on other force

$W = W_1 + W_2 + W_3 + W_4 + W_5 + \ldots$

may be +ve, –ve or zero

Work = Ve	Work = 0	Work = –Ve

QUESTION

Assertion (A): Slope of work v/s displacement group gives force.

Reason (R): Area of force v/s displacement graph gives work.

(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.

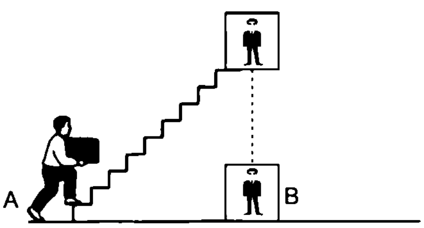
(C) If the Assertion is correct but Reason is incorrect.

(D) If the Assertion is incorrect but the Reason is correct.

(E) If both the Assertion and Reason are incorrect.

Ans.: (B)

WORK



QUESTION

A particle moves from a point $(-2\hat{i} + 5\hat{j})$ to $(4\hat{j} + 3\hat{k})$ when a force of $(4\hat{i} + 3\hat{j})$ N is applied. How much work has been done by the force? [NEET-II-2016]

1. 5 J
2. 2 J
3. 8 J
4. 11 J

QUESTION

H/W

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 $(2\hat{i}+\hat{k})$ meter to position $(4\hat{i}+3\hat{j}-\hat{k})$ meter. The work done by the force on the particle is: [NEET (UG)-2013]

1. 15 J
2. 9 J
3. 6 J
4. 13 J

QUESTION

A 2 kg mass lying on a table is displaced in the horizontal direction through 50 cm. The work done by the normal reaction will be:-

1. 0
2. 100 joule
3. 100 erg
4. 10 joule

QUESTION

A force of 10 N displaces an object by 10 m. If work done is 50 J then direction of force make an angle with direction of displacement:-

1. 120°
2. 90°
3. 60°
4. None of these

QUESTION

A stone of mass m is tied to a string of length ℓ at one end and by holding second end it is whirled into a horizontal circle, then work done will be:-

1. 0
2. $\left(\frac{mv^2}{\ell}\right)2\pi\ell$
3. $(mg).2\pi\ell$
4. $\left(\frac{mv^2}{\ell}\right)\ell$

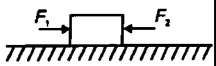
QUESTION

A rope is used to lower vertically a block of mass M by a distance x with a constant downward acceleration $g/2$. The work done by the rope on the block is:-

1. Mgx
2. $\frac{1}{2}Mgx^2$
3. $-\frac{1}{2}Mgx$
4. Mgx^2

QUESTION

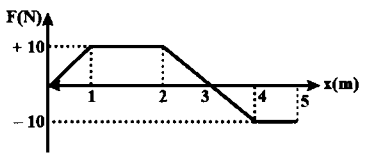
A block of mass 2 kg is placed on a smooth horizontal surface. Two forces $F_1 = 20$ N and $F_2 = 5$ N start acting on the block in opposite directions as shown. If block gets displaced by 5 m in the direction of net force then work done by F_2 is



1. -75 J
2. 75 J
3. -25 J
4. 25 J

QUESTION

A position dependent force F acting on a particle and its force-position curve is shown in the figure. Work done on the particle, when its displacement 0 to 5 m is

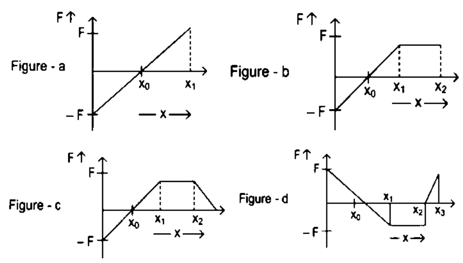


1. 35 J
2. 25 J
3. 15 J
4. 5 J

QUESTION

Arrange the four graphs in descending order of total work done; where W_1, W_2, W_3 and W_4 are the work done corresponding to figure a, b, c and d respectively. [JEE Main 2023]

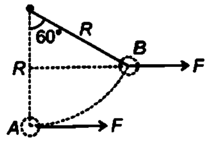
1. $W_3 > W_2 > W_1 > W_4$
2. $W_3 > W_2 > W_4 > W_1$
3. $W_2 > W_3 > W_4 > W_1$
4. $W_2 > W_3 > W_1 > W_4$



Ans (1)

QUESTION

block of mass m is pulled along a circular arc by means of a constant horizontal force F as shown. Work done by this force in pulling the block from A to B is



1. $FR/2$
2. FR
3. $\frac{\sqrt{3}}{2}FR$
4. mgR

QUESTION

A force $F = 20 + 10y$ acts on a particle in y direction where F is in newton and y in meter. Work done by this force to move the particle from $y = 0$ to $y = 1$ m is

(2019)

1. 30 J
2. 5 J
3. 25 J
4. 20 J

QUESTION

A force F = $(5 + 3y^2)$ acts on a particle in the y-direction, where F is newton and y is in meter. The work done by the force during a displacement from y = 2m to y = 5m is

[01 Feb, 2023 (Shift-II)]

QUESTION

A force $F = kx^2$ acts on a particle at an angle of 60° with the x-axis. The work done in displacing the particle from x_1 to x_2 will be:

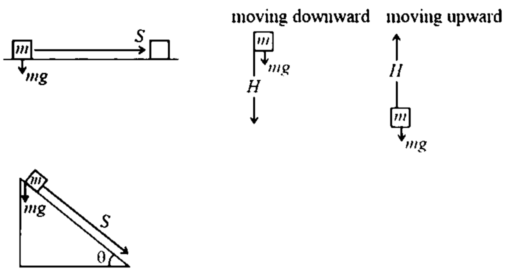
1. $\frac{kx^2}{2}$
2. $\frac{k}{2}(x_2^2 - x_1^2)$
3. $\frac{k}{6}(x_2^3 - x_1^3)$
4. $\frac{k}{3}(x_2^3 - x_1^3)$

QUESTION HW

A particle moves along X-axis from $x = 0$ to $x = 1$ m under the influence of a force given by $F = 3x^2 + 2x - 10$. Work done in the process is

1. +4 J
2. -4 J
3. +8 J
4. -8 J

Work done by Gravity



WORK DONE BY FRICTION

- Friction always acts along the path.
  (It depends on path.)

QUESTION

Work done by frictional force

1. Is always negative
2. Is always positive
3. Is zero
4. May be positive, negative or zero

WORK DONE BY NORMAL

QUESTION

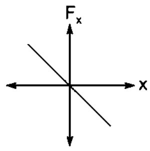
If 250 J of work is done in sliding a 5 kg block slowly up an inclined plane of height 4 m. Work done against friction is: ($g = 10\ ms^{-2}$)

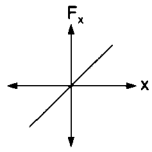
1. 50 J
2. 100 J
3. 200 J
4. zero

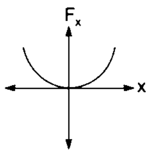
WORK DONE BY SPRING

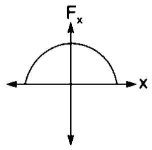
QUESTION

The restoring force of a spring with a block attached to the free end of the spring is represented by (2022 Re)

1. 

2. 

3. 

4. 

QUESTION

If work done by spring is ω in elongation 2 m then find work done in further elongation by 2 m.

1. ω
2. 3ω
3. 2ω
4. 4ω

QUESTION

The force constant of a wire is k and that of another wire is $2k$. When both the wires are stretched through same distance, then the work done:

1. $W_2 = 2\ W_1^2$
2. $W_2 = 2\ W_1$
3. $W_2 = W_1$
4. $W_2 = 0.5\ W_1$

QUESTION

Identify the correct statements from following:

A → Work done by a man in lifting a bucket out of a well by means of rope tied to the bucket is negative.

B → Work done by gravitational force in lifting a bucket out of well by rope tied to the bucket is negative.

C → Work done by friction on body sliding down an inclined plane is positive.

D → Work done by an applied force on a body moving on rough horizontal plane with uniform Velocity is Zero.

E → Work done by air resistance on an oscillating pendulum. is negative.

(A) A and C only
(B) B and D only
(C) B, D and E only
(D) B and E only

Ans.: (D)

MOMENTUM

- **Motion contained in a body.**
- **Vector (direction along velocity).**

KINETIC ENERGY

Energy stored in a body due to its motion is called kinetic energy

$K.E. = \frac{1}{2} m\,(\text{speed})^2$

- Scalar
- No direction

$K.E. = \frac{1}{2} mv^2 \left(\frac{m}{m}\right)$

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

$P = \sqrt{2m\,K.E}$

- Two identical particle having same kinetic energy must have same momentum.
  [False]
- Two identical particle having same momentum must have same kinetic energy.
  [True]

QUESTION

Two bodies of masses m_1 and m_2 have same momentum. The ratio of their KE is

1. $\sqrt{\frac{m_2}{m_1}}$
2. $\sqrt{\frac{m_1}{m_2}}$
3. $\frac{m_1}{m_2}$
4. $\frac{m_2}{m_1}$

QUESTION

Two bodies with kinetic energies in the ratio of 4 : 1 are moving with equal linear momentum. The ratio of their masses is

1. 4 : 1
2. 1 : 1
3. 1 : 2
4. 1 : 4

QUESTION

Object of mass 4 kg is moving with velocity $\vec{v} = \hat{i} + \hat{j}$ then find K.E?

Small Percentage Change

- Change is less than 5%
- We will use error analysis.

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

$\frac{\Delta K.E}{K.E} = 2\frac{\Delta P}{2} - \frac{\Delta m}{m}$

Large Percentage Change

Percentage Change $= \frac{x_f - x_i}{x_i} \times 100$

- If KE increase by 44% then KE_F = 144% Ke_i
- If KE decrease by 44% then KE_F = 56% Ke_i
- If KE increase by 30% then KE_F = 130% Ke_i
- If KE decrease by 17% then KE_F = 83% Ke_i
- If KE is changed to 30% then KE_F = 30% Ke_i

QUESTION

If momentum is increased by 3% then percentage change in K.E.

QUESTION

If the linear momentum is increased by 50%, the kinetic energy will increase by:

1. 50%
2. 100%
3. 125%
4. 25%

QUESTION

H/W

When momentum of a body increases by 200%, its Ke increases by

1. 200%
2. 300%
3. 400%
4. 800%

QUESTION

When momentum of a body increases to 200%, its Ke increases by

1. 200%
2. 300%
3. 400%
4. 800%

QUESTION

KE of a body is increased by 44%. What is the percent increases in the momentum?

1. 10%
2. 20%
3. 30%
4. 44%

QUESTION

H/W

If kinetic energy of a body is increased by 300% then percentage change in momentum will be

1. 100%
2. 150%
3. 265%
4. 73.2%

QUESTION

If K.E is ↓ decreases by 2% then find percentage change in momentum.

QUESTION

If KE decrease by 19% then percentage change in momentum?

QUESTION

Match the column I with column II

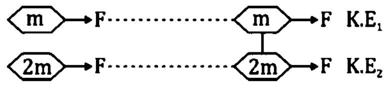
	Column-I		Column-II
(1)	If kinetic energy is increased by 300%, then percentage change in momentum	(A)	30%
(2)	When a momentum of body increases by 200%, It's kinetic energy increases by	(B)	100%
(3)	If kinetic energy is decreased by 19% then % changes in momentum	(C)	800%
(4)	If K.E. increases by 69%, then find % change in momentum	(D)	10%

WORK-ENERGY THEOREM

- ✓ Always valid for all fram
- ✓ Valid for all type motion
- ✓ Valid all type of force
- ✓ Valin in all chain
- ✓ Always valid

WORK-ENERGY THEOREM

Work done by all the force is equal to change in K.E.



QUESTION

Which of the following statements is correct?

1. Work done by static friction is always zero
2. Work done by kinetic friction is always negative
3. The negative of the work done by the conservative internal force on a system equals the change in kinetic energy
4. The work done by all the forces acting on a system equals the change in kinetic energy

QUESTION

KE acquired by a mass m in travelling a certain distance d, starting from rest, under the action of a constant force F is

1. Directly proportional to $\sqrt{m}$
2. Directly proportional to m
3. Directly proportional to $\frac{1}{m}$
4. None of these

QUESTION

A force of constant magnitude acts on a particle such that its always perpendicular to the velocity of particle moving in a plane then

1. Its velocity is cosntant
2. Its acceleration is constant
3. Its kinetic energy is constant
4. Its linear momentum is constant.

QUESTION

A particle of mass 3 kg is moving along x-axis and its position at time t is given by equation $x = (2t^2 + 5)$ m. Work done by all the forces acting on it in time interval $t = 0$ to $t = 3$ is

1. 144 J
2. 72 J
3. 108 J
4. 216 J

QUESTION

H|W

Object of mass 8 kg is moving such that displacement $S = t^2$ then find work done in 2-sec on that object.

QUESTION

H|W

Under the action of a force, a 2 kg body moves such that its position x as a function of time t is given by $x = t^2/3$, where x is in metres and t in seconds. The work done by the force in first two seconds is

1. 1600 J
2. 160 J
3. 16 J
4. 16/9 J

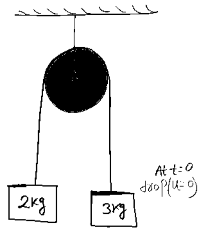
QUESTION

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

1. a^2
2. $2a^2$
3. $4a^2$
4. $\sqrt{2}a^2$

QUESTION

Find work done by tension on 2 kg and on 3 kg and on the system in t = 3 sec.

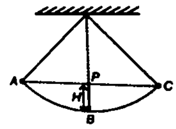


QUESTION

Object 5 kg dropped from a height 20 m then its velocity at ground is 5 m/s, then find work done by friction.

QUESTION

A simple pendulum with a bob of mass m oscillates from A to C and back to A such that PB is H. If the acceleration due to gravity is g, then the velocity of the bob is passes through B is



1. 1 mgH
2. 2 gH
3. Zero
4. 1 gH

QUESTION

A simple pendulum with bob of mass m and length x is held in position at an angle θ_1 and then angle θ_2 with the vertical. When released from these positions, speeds with which it passes the lowest positions are v_1 and v_2 respectively. Then, v_1/v_2 is

1. $\frac{1-\cos\theta_1}{1-\cos\theta_2}$
2. $\sqrt{\frac{1-\cos\theta_1}{1-\cos\theta_2}}$
3. $\sqrt{\frac{2gx(1-\cos\theta_1)}{1-\cos\theta_2}}$
4. $\sqrt{\frac{1-\cos\theta_1}{2gx(1-\cos\theta_2)}}$

QUESTION

A block of mass m is released on the top of a smooth inclined plane of length x and inclination θ as shown in figure. Horizontal surface is rough. If block comes to rest after moving a distance d on the horizontal surface, then coefficient of friction between block and surface is

1. $\frac{x\sin\theta}{2d}$
2. $\frac{x\cos\theta}{2d}$
3. $\frac{x\sin\theta}{d}$
4. $\frac{x\cos\theta}{d}$

QUESTION

A stone with weight w is thrown vertically upward into the air from ground level with initial speed v_0. If a constant force f due to air drag acts on the stone throughout its flight. The maximum height attained by the stone is

1. $h = \frac{v_0^2}{2g\left(1+\frac{f}{w}\right)}$
2. $h = \frac{v_0^2}{2g\left(1-\frac{f}{w}\right)}$
3. $h = \frac{v_0^2}{2g\left(1+\frac{w}{f}\right)}$
4. $h = \frac{v_0^2}{2g\left(1-\frac{w}{f}\right)}$

QUESTION

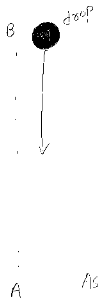
A rifle bullets loses (1/20)th of its velocity in passing through a plank. Assuming that the plank exerts a constant retarding force, the least number of such planks required just to stop the bullet is

1. 11
2. 20
3. 21
4. Infinite

QUESTION

If constant force acting on object then find KE as a function of time.

- **Force can be stored in the body → No**
- **Work can be stored in the body → No**
- **Heat can be stored in the body → No**
- **KE can be stored in the body → Yes**



Explanation 1	Explanation 2
Work done by gravity will increase its KE.	Potential energy is stored; when it move from A to B P.E.↑ and K.E.↓.
$W_g = mgh = \Delta K.E.$	U(loss)→ K.E. (gain)

As object fall its K.E is Increases??

- **Change in PE is just a name given to negative work done by CF.**

- **Potential energy is not a physical quantity, it is not defined at a point. Value of potential energy is not a unique value it may be anything depending on reference point.**
- **Change in Potential Energy is defined.**
- **Change in Potential Energy does not depends on reference.**

POTENTIAL ENERGY

- **It is a energy stored due to shape, size and position.**
- **It depends on a reference point.**
- **It may be positive, negative and zero.**
- **It is a scaler quantity.**
- **It always decreases in every natural phenomena.**

Conservation Force	Non Conservation Force
Work done does not depend on path. Ex.- Gravity, Electrostatic Force, Spring Force.	Work done depends on path taken. Ex.- Friction, Normal Force, Tension.
Potential Energy should due to negative work done by Conservation Force.	Potential Energy is not defined for Non- Conservation Force.
Work done by C.F. is reversible.	Work done by N.C.F. is non-reversible.
Work done in close loop is zero.	Work done in close loop may or may not be zero.

QUESTION

Assertion (A): Work done in close path for conservative forces is always zero.
Reason (R): Work depends only initial and final position for conservative forces.

(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 the Assertion is incorrect but the Reason is correct.

(E) If both the Assertion and Reason are incorrect.

Ans.: (A)

QUESTION

Potential energy is defined

1. Only in conservative fields
2. As the negative of work done by conservative forces
3. As the negative of work done by external forces when $\Delta K = 0$
4. All of these

QUESTION

When a conservation force does positive work on a body

1. The potential energy increases
2. The potential energy decreases
3. Total energy increases
4. Total energy decreases

1. The potential energy $U(x)$ of a particle moving long x-axis is given by $U(x) = ax - bx^2$. Find the equilibrium position of particle.

2. The potential energy of an object of mass m moving in xy-plane in a conservative field is given by $U = ax + by$, where x and y are position coordinates of the object. Find magnitude of its acceleration.

QUESTION

If potential energy $U = xy + yz + zx$, then find force at $(1, 1, 1)$.

QUESTION

If work done by C.F. to move the object from A to B is 50 J then find potential energy at A if $U_B = -20$ J.

1. 30 J
2. - 30 J
3. 70 J
4. - 70 J

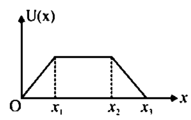
QUESTION

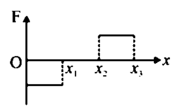
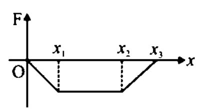
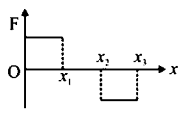
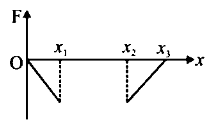
If work done by C.F. is –30 J in moving from A to B if potential energy at A is 30 J then find potential energy at B.

1. 60 J
2. -60J
3. 0
4. 30 J

QUESTION

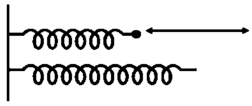
The variation of potential energy U of a system is show in figure. The force acting on the system is best represented by



1. 
2. 
3. 
4. 

WORK DONE BY GRAVITATION FIELD ONLY POTENTIAL

WORK DONE BY SPRING FORCE AND POTENTIAL ENERGY



QUESTION

When a long spring is stretched by 2 cm, its potential energy is U. If the spring is stretched by 10 cm, the potential energy stored in it will be: (2003)

1. U/5
2. 5 U
3. 10 U
4. 25 U

QUESTION

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)

1. 16U
2. 2U
3. 4U
4. 8U

QUESTION

Force constants K_1 and K_2 of two springs are in the ratio 5 : 4. They are stretched by same length. If potential energy stored in one spring is 25 J then potential energy stored in second spring is

1. 25 J
2. 16 J
3. 100 J
4. 20 J

QUESTION

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

1. $W_P < W_Q$; $W_Q < W_P$
2. $W_P = W_Q$; $W_P = W_Q$
3. $W_P = W_Q$; $W_P > W_Q$
4. $W_P > W_Q$; $W_Q > W_P$

QUESTION

A chain is on a frictionless table with one fifth of its length hanging over the edge. If the chain has length L and mass M, the work required to be done to pull the hanging part back onto the table is

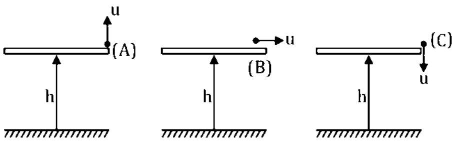
QUESTION

A uniform cable of mass M and length L is placed on a horizontal surface such that its $\frac{1}{n}$th part is hanging below the edge of the surface. To lift the hanging part of the cable up to the surface, the work done should be: [IIT-2022]

1. $\frac{MgL}{n^2}$
2. $\frac{MgL}{2n^2}$
3. $\frac{2MgL}{n^2}$
4. $nMgL$

QUESTION

Statement-I : If A, B and C all are projected with same speed in different directions as shown. Their velocity while striking the ground will be same.



Statement-II : In all the given scenarios, work done by gravity is same.

QUESTION

A air bubble in water raising up then potential energy of water bubble will

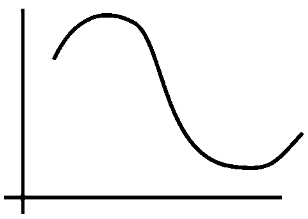
QUESTION

Two proton moving towards each other the P.E. will increase or decrease?

QUESTION

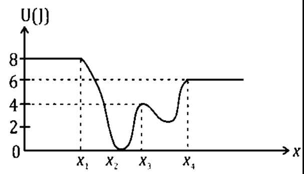
Electron and Proton moving towards each other then P.E. will increase or decrease?

Potential Energy Distance Graph



QUESTION

Given below is the plot of a potential energy function $U(x)$ for a system, in which particle is in one dimensional motion, while a conservative force $f(x)$ acts on it. Suppose that E (mechanical) = 8 Joule, the incorrect statement for this system is



(A) At $x > x_4$, K.E. is constant throughout the region.

(B) At $x < x_1$, K.E. is smallest and particle is moving at slowest speed. At $x > x_4$, K.E. is constant throughout the region.

(C) At $x = x_2$, K.E. is greatest and the particle is moving at fastest speed.

(D) At $x = x_3$, K.E. = 4 J

Ans.: (B)

QUESTION

Assertion (A): Law of conservation of mechanical energy is always valid.
Reason (R): As it is derived from work energy theorem which is always valid.

(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.

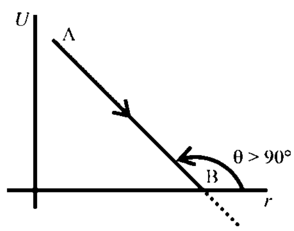
(D) If the Assertion is incorrect but the Reason is correct.

(E) If both the Assertion and Reason are incorrect.

Ans.: (D)

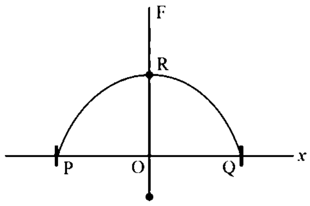
QUESTION

Force acting on object according to this U/r graph.



QUESTION

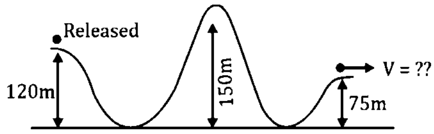
At which point particle is at equilibrium.



1. At P
2. At R
3. At Q
4. At P and Q

QUESTION

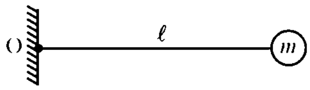
The value of V will be:



1. V = 30 m/s
2. V > 30 m/s
3. V < 30 m/s
4. Not possible

QUESTION

Ball is released from horizontal position then find its speed when it rotated by 60°.



QUESTION

Calculate K.E. and potential energy when ball is projected up with speed 20 m/s after 1 sec.

QUESTION

Initially half length of chain hanged vertically from table and released from smooth table find, speed of chain when it becomes vertical.

QUESTION

Ball is dropped from height H from ground then find maximum compression in spring, if length of spring is negligible in compare to H.

QUESTION

An open knife edge of mass M is dropped from a height h on a wooden floor. If the blade penetrates distance into the wood, the average resistance offered by the wood to the blade is [AIMPT]

1. Mg
2. $Mg\left(1+\frac{h}{s}\right)$
3. $Mg\left(\frac{1-h}{s}\right)$
4. $Mg\left(\frac{1+h}{s}\right)^2$

QUESTION

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 (ii) resistive force of airs is: [NEET-2017]

1. (i) 10 J (ii) –8.75 J
2. (i) 10 J (ii) 8.75 J
3. (i) 1.25 J (ii) –8.75 J
4. (i) 100 J (ii) –8.75 J

QUESTION

A particle is released from height S from the surface of the Earth. At a certain height its kinetic energy is three times its potential energy. The height from the surface of earth and the speed of the particle at that instant are respectively: (2021)

1. $\frac{S}{4}, \frac{\sqrt{3gS}}{2}$
2. $\frac{S}{2}, \frac{\sqrt{3gS}}{2}$
3. $\frac{S}{4}, \sqrt{\frac{3gS}{2}}$
4. $\frac{S}{4}, \frac{3gS}{2}$

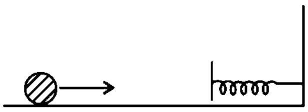
QUESTION

A vertical spring with force constant k is fixed on a table. A ball of mass m at a height h above the free upper end of the spring falls vertically on the spring so that the spring is compressed by a distance d. The net work done in the process is

1. $mg(h+d)-\frac{1}{2}kd^2$
2. $mg(h-d)-\frac{1}{2}kd^2$
3. $mg(h-d)+\frac{1}{2}kd^2$
4. $mg(h+d)+\frac{1}{2}kd^2$

QUESTION

A mass of 0.5 kg moving with a speed of 1.5 m/s on a horizontal smooth surface, collides with a nearly weightless spring of force constant k = 50 N/m. The maximum compression of the spring would be: [MR*] (2004)



1. 0.12 m
2. 1.5 m
3. 0.5 m
4. 0.15 m

QUESTION

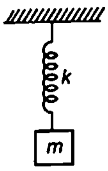
M|W

A mass of 0.5 kg moving with a speed of 1.5 m/s on a horizontal smooth surface, collides with a nearly weightless spring of force constant k = 50 N/m. The maximum compression of the spring would be

1. 0.15 m
2. 0.12 m
3. 0.5 m
4. 0.25 m

QUESTION

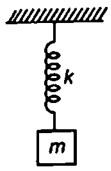
Initially mass m is held such that spring is in relaxed condition. If mass m is suddenly released, maximum elongation in spring will be



1. $\frac{m}{k}g$
2. $\frac{2mg}{k}$
3. $\frac{m}{2kg}$
4. $\frac{m}{4kg}$

QUESTION

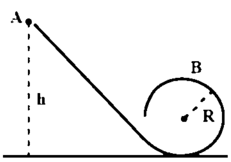
Initially mass m is held such that spring is in relaxed condition. If mass m is slowly released, maximum elongation in spring will be



1. $\frac{m}{k}g$
2. $\frac{2mg}{k}$
3. $\frac{m}{2kg}$
4. $\frac{m}{4kg}$

QUESTION

In the figure shown, a particle is released from the position A on a smooth track. When the particle reaches at B, then normal reaction on it by the track is



1. mg
2. $2\ mg$
3. $2/3\ mg$
4. $m^2 g$

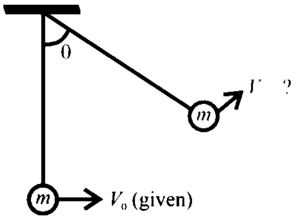
QUESTION

The PE of a 2 kg particle, free of move along x-axis is given by $V(x)=\left(\frac{x^3}{3}-\frac{x^2}{2}\right)$ J. The total mechanical energy of the particle is 4 Maximum speed (in ms^{-1}) is

1. $\frac{1}{\sqrt{2}}$
2. $\sqrt{2}$
3. $\frac{3}{\sqrt{2}}$
4. $\frac{5}{\sqrt{6}}$

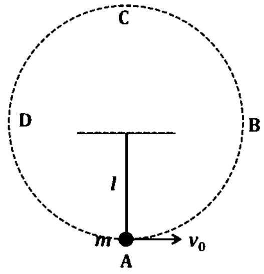
Vertical Circular Motion

Find velocity when it rotated by angle ‘θ’



QUESTION

Find tension at A, B, C and D.

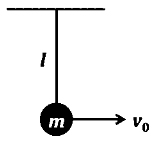


QUESTION

If $\frac{T_{max}}{T_{min}} = g$ then find T_{max} = ______. If object of mass m.

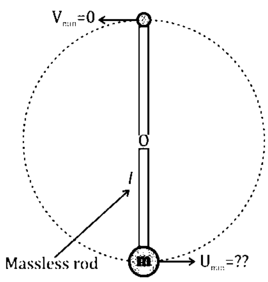
QUESTION

Find minimum given velocity at mean position so that it complete vertical circular motion.



QUESTION

Find minimum velocity so that it will complete vertical circular motion.



QUESTION

A stone of mass m, tied to a string is being whirled in a vertical circle with a uniform speed. The tension in the string is **[24 June, 2022 (Shift-II)]**

(A) The same throughout the motion

(B) Minimum at the highest position of the circle path

(C) Minimum at the lowest position of the circular path

(D) Minimum when the rope is the horizontal position

QUESTION

Find minimum given velocity at mean position so that it will complete vertical circular motion if it is connected will massless rod.

QUESTION

A mass m is attached to a thin wire and whirled in a vertical circle. The wire is most likely to break when: (2019)

1. **The mass is at the highest point**
2. **The wire is horizontal**
3. **The mass is at the lowest point**
4. **Inclined at an angle of 60° from vertical**

QUESTION

A stone of mass 1 kg is tied with a string and it is whirled in a vertical circle of radius 1 m. If tension at the highest point is 14 N, then velocity at lowest point will be:

1. 3 m/s
2. 4 m/s
3. 6 m/s
4. 8 m/s

QUESTION

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)

1. 7 mg
2. 8 mg
3. 1 mg
4. 6 mg

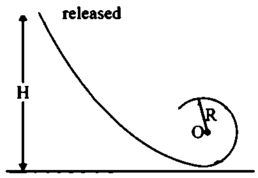
QUESTION

A stone is tied to a string of length 'l' and is whirled in a vertical circle with the other end of the string at the centre. At a certain instant of time, the stone is at its lowest position and has a speed 'u'. The magnitude of the change in velocity as it reaches a position where the string is horizontal (g being acceleration due to gravity) is: [MR*] (2004)

1. $\sqrt{u^2 - gl}$
2. $u - \sqrt{u^2 - 2gl}$
3. $\sqrt{2gl}$
4. $\sqrt{2(u^2 - gl)}$

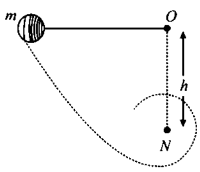
QUESTION

Find relation between H & R so that object will complete vertical circular motion.



QUESTION

A particle of mass m attached to the end of string of length 1 is released from the horizontal position. The particle rotates in a circle about 0 as shown. When it is vertically below O, the string makes contact with a nail N placed directly below O at a distance h and rotates around it. For he particle to swing completely around the nail in a circle.



Given velocity	Compt. circular motion	Tension at top	V at to P
V > $\sqrt{5gl}$			
V = $\sqrt{5gl}$			
$\sqrt{2gl}$ < V < $\sqrt{5gl}$			
V < $\sqrt{2gl}$			

QUESTION

If velocity V = $\sqrt{3gR}$ is given at the mean position then find angle where bob will leave circular path.

QUESTION

If given velocity at mean is V = $\sqrt{gR}$ then angle where it will leave circular path.

Power

$$P_{avg} = \frac{W_{total}}{T_{total}}$$

$$P_{inst} = \frac{dW}{dt}$$

QUESTION

One coolie takes 1 minute to raise a suitcase through a height of 2 m but the second coolie takes 30 s to raise the same suitcase to the same height. The powers of two coolies are in the ratio

1. 1 : 2
2. 1 : 3
3. 2 : 1
4. 3 : 1

QUESTION

If a force of 9 N is acting on a body, then find instantaneous power supplied to the body when its velocity is 5 m/s in the direction of force

1. 195 watt
2. 45 watt
3. 75 watt
4. 100 watt

QUESTION

A particle moves with a velocity $(5\hat{i} - 3\hat{j} + 6\hat{k})$ ms^{-1} horizontally under the action of constant force $(10\hat{i} + 10\hat{j} + 20\hat{k})$N. The instantaneous power supplied to the particle is: (2023-Manipur)

1. 200 W
2. Zero
3. 100 W
4. 140 W

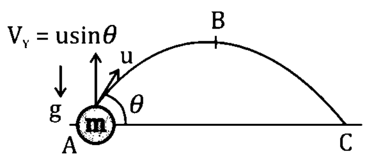
QUESTION

A body projected vertically form the earth reaches a height equal to earth's radius before returning to the earth. The power exerted by the gravitational force is greatest [AIPMT (Prelims)-2011]

1. At the instant just after the body is projected
2. At the highest position of the body
3. At the instant just before the body hits the earth
4. it remains constant all through

QUESTION

Ball is projected with u at angle θ then find power delivered by gravitational force at maximum height.



- Power delivered by gravitational force from A to B is negative.
- Power delivered by gravitational force from B to C is positive.
- Magnitude of power is decrease as object move from A to B.

QUESTION

If position of object $x \propto t$ then find power delivered as a function of time.

QUESTION

The position (x) of a body moving along x-axis at time (t) is given by $x = 3t^2$, where x is in metre and t is in second. If mass of body is 2 kg, then find the instantaneous power delivered to body by force acting on it at $t = 4$ s.

QUESTION

The power of water pump is 4 kW. If $g = 10$ ms^{-2}, the amount of water it can raise in 1 minute to a height of 20 m is

1. 100 litre
2. 1000 litre
3. 1200 litre
4. 2000 litre

QUESTION

An engine pumps 800 kg of water through height of 10 m in 80 s. Find the power of the engine if its efficiency is 75%.

QUESTION

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 [AIPMT-2015]

1. $\frac{1}{2}\sqrt{mk}\,t^{-1/2}$
2. $\sqrt{\frac{mk}{2}}\,t^{-1/2}$
3. $\sqrt{mk}t^{-1/2}$
4. $\sqrt{2mk}\,t^{-1/2}$

QUESTION

A particle of mass M starting from rest undergoes uniform acceleration. If the speed acquired in time T is V, the power delivered to the particle is [AIPMT (Mains)-2010]

1. $\frac{MV^2}{T}$
2. $\frac{1}{2}\frac{MV^2}{T^2}$
3. $\frac{MV^2}{T^2}$
4. $\frac{1}{2}\frac{MV^2}{T}$

QUESTION

The force required to row a boat at constant velocity is proportional to square of its speed. If a speed of v km/h requires 4 kW, how much power does a speed of $2v$ km/h require?

1. 8 kW
2. 16 kW
3. 24 kW
4. 32 kW

QUESTION

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 power is generated by the turbine? ($g = 10$ m/s^2) [AIPMT (Prelims)-2008]

1. 7.0 kW
2. 8.1 kW
3. 10.2 kW
4. 12.3 kW

QUESTION

An engine pumps water continuously through a hose. Water leaves the hose with a velocity v and m is the mass per unit length of the water jet. What is the rate at which kinetic energy is imparted water ? [AIPMT (Prelims)-2009]

1. mv^2
2. $\frac{1}{2}mv^2$
3. $\frac{1}{2}m^2v^2$
4. $\frac{1}{2}mv^3$

QUESTION

An engine pumps water through a hose pipe. Water passes through the pipe and leaves it with a velocity of 2 m/s. The mass per unit length of water in the pipe is 100 kg/m. What is the power of the engine? [AIPMT (Prelims)-2010]

1. 800 W
2. 400 W
3. 200 W
4. 100 W

QUESTION

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: ($g = 10\ ms^{-2}$) [MR*] (2022)

1. 23500
2. 23000
3. 20000
4. 34500

QUESTION

The energy that will be ideally radiated by a 100 kW transmitter in 1 hour is: (2022)

1. 1×10^5 J
2. 36×10^7 J
3. 36×10^4 J
4. 36×10^5 J

QUESTION

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, 2008)

1. 8.1 kW
2. 12.3 kW
3. 7.0 kW
4. 10.2 kW