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## PHYSICS

# BOOKS - DHANPAT RAI \& CO PHYSICS 

## (HINGLISH)

## WORK, POWER AND ENERGY

## Type A

1. A horizontal force of 15 N is required to maintain a velocity of $3 m s^{-1}$ in a body of mass

20 kg . How much work is done by this force in 1 mintue?

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2. Calculate the amount of work done by a
labourer who carries n bricks, each of mass m , to the roof of a house of height $h$ by climbing up a ladder.
3. A gardener pushes a lawn roller through a distance of 20 m . If he applies a force of 20 kg wt in a direction inclined at $60^{\circ}$ to the ground, find the work

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4. A person is holding a bucket by applying a force of 10 N . He moves a horizontal distance of 5 m and then climbs up a vertical distance of 10 m . Find the total work done him.
5. A body constrained to move along the $Z$-axis
of a co-ordinate system is subject to a constant forece $\vec{F}=-\hat{i}+2 \hat{j}+3 \hat{k}$, where $\hat{i}, \hat{j}, \hat{k}$ are unit vectors along the $\mathrm{X}-\mathrm{Y}$ - and Z -axis of the system respectively. What is the work done by this force in moving the body a distance of 4 m along the Z -axis ?
6. A force $\vec{F}=\hat{i}+5 \hat{j}+7 \hat{k}$ acts on a particle and displaces it throught $\vec{s}=6 \hat{I}+9 \hat{k}$.

Calculate the work done if the force is in newton and displacement in metre.
(ii) Find the work done by force $\vec{F}=2 \hat{i}-3 \hat{j}+\hat{k}$ when its point of application moves from the point $A(1,2,-3)$ to the point $B$ (2,0, -5).

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7. The distance $x$ covered by a body of 2 kg under the action of a force is related to time $t$ as $x=t^{2} / 4$. What is the work done by this force in 2 seconds ?

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8. A force $\mathrm{F}=\mathrm{a}+\mathrm{b} \mathrm{x}$ acts on a particle in the X direction, where $a$ and $b$ are constants. Find the work done by this force during a displacement from $x=0$ to $x=d /$
9. A body moves from point $A$ to $B$ under the action of a force, varying in magnitude as shown in figure. Obtain the work done. Force is expressed in newton and displacement in meter.


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10. A uniform chain of length $L$ and mass $M$ is
lying on a smooth table and one-third of its
length is hanging vertically down over the edge of the table. If g is the acceleration due to gravity, the work required to pull the hanging part on to the table is

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11. A rain drop of radius 2 mm , falls from a height of 500 m above the ground. It falls with decreasing acceleration due to viscous resistance of air until half its original height. It attains its maximum (terminal ) speed, and moves with uniform speed there after. What is
the work done by the gravitational force on the drop in the first half and second half of its journey? Take density of water $=10^{3} \mathrm{~kg} / \mathrm{m}^{3}$.

What is the work done by the resistive force in
the entire journey if its speed on reaching the ground is $10 \mathrm{~ms}^{-1}$ ?

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12. Calculate the work done in raising a stone of mass 5 kg and specific gravity 3, lying at the bed of a lake through a height of 5 m .

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13. A cluster of clouds at a height of 1000 m above the earth burst and enough rain fell to cover an area of $10^{6} \mathrm{~m}^{2}$ with a depth of 2 cm .

How much work would have been done in
raising water to the height of clouds ? Take $g=10 \mathrm{~m} / \mathrm{s}^{2}$ and density of water $10^{3} \mathrm{~kg} / \mathrm{m}^{3}$.

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## Type B

1. A body of mass 5 kg initially at rest is subject
to a force of 20 N . What is the kinetic energy acquired by the body at the end of 10 s ?
2. A body of mass 2 kg initially at rest is moved by a horizontal force of 0.5 N on a smooth frictionless table. Obtain the work done by the force in 8 s and show that this equals the change in kinetic energy of the body.

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3. A toy rocket of mass 0.1 kg hass a small fuel
of mass 0.02 kg , which it burns out in 3 s .

Starting from rest on a horizontal smooth track, it gets a speed of $20 \mathrm{~ms}^{-1}$ after the fuel
is burnt out. What is the approcimate thrust of
the rocket ? What is the energy content per unit mass of the fuel ? (Ignore the small mass
variation of teh rocket during fuel burning).

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4. An electron and a proton are detected in a cosmic ray experiment, the first with kinetic energy 10 keV , and the second with 100 keV . Which is faster, the electron or the proton ?

Obtain the ratio of their speeds.
(Electron mass $=9.11 \times 10^{-31} \mathrm{~kg}$, proton

## mass

$$
\left.=1.67 \times 10^{-27} \mathrm{~kg}, 1 \mathrm{eV}=1.60 \times 10^{-19} \mathrm{~J}\right)
$$

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5. A bullet weighing 10 g is fired with a velocity of $800 \mathrm{~ms}^{-1}$. After passing through a mud wall 1 m thick, its velocity decreases to $100 \mathrm{~ms}^{-1}$.

Find the average resistance offered by the mud wall.
6. A shot travelling at the rate of $100 \mathrm{~ms}^{-1}$ is just able to pierce a plank 4 cm thick. What velocity is required to just pierce a plank 9 cm thick ?

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7. A bullet has a mass of 20 g and is moving
with a speed of $1000 \mathrm{cms}^{-1}$. It can penetrate 10
cm of a given target before coming to rest. If
the same target were only 6 cm thick, what will be the speed of the bullet when it comes out?

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8. Two identical 5 kg blocks are moving with same speed of $2 m / s$ towards eachother along a frictionless horizontal surface. The two blocks collide, stick together and come to rest. Consider the two blocks as a system. Caluculate work done by (i) external forces (ii) internal forces.
9. A light and a heavy body have equal momenta. Which one has greater K.E

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10. A light body and a heavy body have the same kinetic energy. Which one will have a greater linear momentum ?
11. If the linear momentum of a body increases
by $20 \%$, what will be the $\%$ increase in the kinetic energy of the body ?

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12. If the kinetic energy of kinetic energy of a body increases by $300 \%$, by what $\%$ will the linear momentum of the body rease?
13. A bomb of mass 40 kg is dropped from an aeroplane at a height of 1 km above the ground. What is its kinetic energy (i) at the end of 10 s and (ii) on reaching the ground?

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14. A body falls on the ground from a height of

10 m and rebounds to a height of 2.5 m .
Calculate (i) the percentage loss of kinetic energy of the body during the collision with the
ground and (ii) the ratio of the velocities of the body just before and just after the collision.

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15. A body of mass 2 kg initially at rest moves
under the action of an applied horizontal force
of 7 N on a table with coefficient of kinetic
friction $=0.1$. Calculate the
(a) work done by applied force in 10s. (b) work done by friction in 10s.
(c ) work done by the net force on the body in 10s.
(d) change in K.E. of body in 10s, and interpret your result.

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16. A body of mass 0.3 kg is taken up an inclined plane of length 10 m and height 5 m , and then allowed to slide down to the bottom again. The coefficient of friction between the body and the plane is 0.15 .

What is the
(a) work done by the gravitational force over the round trip?
(b) work done by the applied force on the upward journey?
(c) work done by the frictional force over the round trip ,
(d)kinetic energy of the body at the end of the trip?

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17. When a 40 kg boy climbs a hills, his potential energy increases by $9.8 \times 10^{4} \mathrm{~J}$. What is the height of the hill ?
18. A bob of mass 0.3 kg falls from the ceiling of an elevator moving down with a uniform speed of $7 \mathrm{~ms}^{-1}$. If hits the floor of the elevator (length of the elevator $=3 \mathrm{~m}$ ) and does not rebound. What is the heat produced by the impact? Would your answer be different if the elevator were stationary?
19. Calculate the velocity of the bob of a simple pendulum at its mean position if it is able to rise to a vertical height of 10 cm . Take $g=9.8 m s^{-2}$.

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20. The bob A of a simple pendulum is released
from a horizontal position $A$ as shownin in
figure. If the length of the pendulum is 1.5 m ,
what is the speed with which the bob arrives at
the lowermost point B, given that it dissipates
$5 \%$ of its initial energy against air resistance?


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21. A girl of mass 40 kg sits in a swing formed by a rope of 6 m length. A person pulls the swing to a side so that the rope makies an
angle of $60^{\circ}$ with the vertical. What is the gain in potential energy of the girl ?

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22. A ball at rest is dropped from a height of

12m. It loses $25 \%$ of its kinetic energy in striking the ground, find the height to which it bounces. How do you account for the loss in kinetic energy?
23. A bullet of mass 0.012 kg and horizontal speed $70 \mathrm{~ms}^{-1}$ strikes a block of wood of mass
0.4 kg and instantly comes to rest with respect
to the block. The block is suspended from the ceiling by thin wire. Calculate the height to which the block rises. Also, estimate the amount of heat produced in the block.

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24. A 1 kg mass on a floor is connected to a 2 kg mass by a string passing over a pulley. Obtain
the speed of masses (after they are released),
when the 2 kg mass just touches the floor.

Establish that the gain in kinetic energy of the system equals the loss in its potential energy.

The 2 kg mass is initially at a height of 3 m above the ground. Take $g=9.8 m s^{-2}$.

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Type C

1. Two springs have force constants
$k_{1}$ and $k_{2}\left(k_{1}>k_{2}\right)$. On which spring is more work done, if (i) they are stretched by the same
force and (ii) they are stretched by the same amount?

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2. The length of a steel wire increases by
$0 \cdot 5 \mathrm{~cm}$, when it is loaded with a weight of
$5 \cdot 0 \mathrm{~kg}$. Calculate force constant of the wire and
workdown in stretching the wire. Take

$$
g=10 \mathrm{~ms}^{-1}
$$

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3. Figure shows a force compression curve of a spring. A body of mass $5 k g$ moving with the velocity of $8 m / s$ hits the spring. Calculate the force constant of the spring and also the compression produced in the spring when the
body hits it.


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4. A ball of mass $m$ is droppped from a height $h$ on a platform fixed at the top of a vertical spring. The platform is depressed by a distance $x$. What is the spring constant $K$ ?

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5. A block of mass 2 kg initially at rest is dropped from a height of 1 m into a vertical spring having force constant $490 \mathrm{Nm}^{-1}$.

Calculate the maximum distance through which the spring will be compressed.

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## Type D

1. What should be the power of an engine required to lift 90 metric tonnes of coal per hour from a mine whose depth is 200 m ?

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2. A car of mass 2000 kg is lifted up a distance of

30 m by a crane in 1 minute. A second crane does the same job in 2 minues. Do the cranes consume the same or different amounts of fuel
? What is the power supplied by each crane ?
Neglect power disspation against friction.

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3. A pump on the ground floor of a building can pump of water to fill a tank of volume $30 \mathrm{~ms}^{3}$ in

15 min . If the tank is 40 m above the ground and the efficiency of the pump is $30 \%$, how much electric power is consumed by the pump?
$\left(\right.$ Take $\left.g=10 \mathrm{~ms}^{2}\right)$

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4. The human heart discharges 75 ml of blood at
each beat against a pressure of 0.1 m of Hg .
Calculate the power of the heart assuming that the pulse frequency is 80 beats per minute.

Given, density of mercury $=13.6 \times 10^{3} \mathrm{~kg} / \mathrm{m}^{3}$

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5. An electric motor is used to lift an elevator and its load (total mass 1500 kg ) to a height of

20 m . The time taken for the job is 20 s . What work is done ? What is the rate at which work is
done. If efficiency of the motor is $75 \%$, at which rate is the energy supplied to the motor?

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6. A machine gun fires 60 bullets per minute with a velocity of $700 \mathrm{~ms}^{-1}$. If each bullet has a mass of 50 g , find the power of the gun.

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# 7. An elevator weighing 500 kg is to be lifted up 

 at a constant velociyt of $0.20 \mathrm{~m} / \mathrm{s}$. What would be the minimum horsepower of the motor to be used?
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8. A well $20 m$ deep and $3 m$ is diameter contains
water to a dept of $14 m$. How long will a $5 h p$ engine take to empty it ?
9. A man cycles up a hill whose slope is 1 in 20
with a velocity of $6.4 \mathrm{kmh}^{-1}$ along the hill. The
weight of the man and the cycle is 98 kg . What
work per minute is the man doing ? What is his
horse power?

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Type E

1. About $4 \times 10^{9} \mathrm{~kg}$ of matter is converted into energy in the sun each second. What is the
power output of the sun?

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2. How much mass is converted into tenergy per day in a nuclear power plant operated at $10^{7} \mathrm{~kW}$ ?

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3. If 1000 kg of water is heated from $0^{\circ} \mathrm{C}$ to
$100^{\circ} C$, calculate the increase in mass of water.

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4. Calculate the energy in MeV equivalent to
the rest mass of an electron. Given that the rest mass of an electron , $m=9.1 \times 10^{-31} \mathrm{~kg}$, $1 \mathrm{MeV}=1.6 \times 10^{-13} \mathrm{~J}$ and speed of light, $c=3 \times 10^{8} \mathrm{~ms}^{-1}$.

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5. Estimate the amount of energy released in
the nuclear fusion reaction:
${ }_{-}(1) H^{2}+{ }_{\cdot 1} H^{2} \rightarrow{ }_{\cdot 2} H e^{2}+{ }_{\cdot 0} n^{1}$ Given that
$M\left({ }_{1} H^{2}\right)=2.0141 u, M\left({ }_{.2} H e^{3}\right)=3.0160 u$
$m_{n}=1.0087 u$,
where $1 u=1.661 \times 10^{-27} \mathrm{~kg}$.
Express your answer in units of MeV.

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6. When slow neutrons are incident on a target
containing $\quad{ }_{92} U^{235}$, a possitle fission

## reactionis

${ }_{.92} U^{235}+n \rightarrow{ }_{.56} B a^{141}+{ }_{36} K r^{92}+3 n+Q$

Estimate the amount of energy released using
the following data :
$M\left[.{ }_{92} U^{235}\right]=235.04 u$,
$M\left[{ }_{56} B a^{141}\right]=140.91 u$,
$M\left[{ }_{36} K r^{92}\right]=91.926 u$,
$M_{n}=1.0087 u$.
Take $1 u=1.661 \times 10^{-27} \mathrm{~kg}$.
$1 M e V=1.602 \times 10^{-13} J$

D Watch Video Solution

Type F

1. Two bodies of masses 5 kg and 3 kg moving in
the same direction along the same straingh
line with velocities $5 m s^{-1}$ and $3 m s^{-1}$ respectively suffer one-dimensional elastic collision. Find their velocities after the collision

## D Watch Video Solution

2. A 10 kg ball and 20 kg ball approach each other with velocities $20 \mathrm{~ms}^{-1}$ and $10 \mathrm{~ms}^{-1}$
respectively . What are their velocities after collision if the collision is perfectly elastic?

## - Watch Video Solution

3. Two ball bearings of mass $m$ each moving in opposite directions with each speeds v collide
head on with each other. Predict the outcome of the collision, assuming it to the perfectly elastic.

## D Watch Video Solution

4. A railway carriage of mass 9000 kg moving
with a speed of $36 k \mathrm{kh}^{-1}$ collides with a
stationary carriage of the same mass. After the
collision, the two get coupled and move
together. What is this common speed ? What type of collision is this?

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5. A ball of 0.1 kg makes an elastic head on
collision with a ball of unknown mass that is
initially at rest. If the 0.1 kg ball rebounds at one
third of its original speed, what is the mass of the other ball?

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6. What percentage of $K . E$. of a moving particle is transferred to a stationary particle, when moving particle strikes with a stationary particle of mass (a) 19 times in mass (b) equal in mass (c) $\frac{1}{19}$ th of its mass ?
7. A body of mass $M$ at rest is struck by a moving body of mass. Prove that the fraction of the initial kinetic energy of mass transferred to the struck body is $\frac{4 M m}{(m+M)^{2}}$

## D Watch Video Solution

8. A ball is droped to the ground from a height of 2 m . The coefficient of restitution is 0.6 . To what height will the ball rebound?
9. A ball is dropped vertically from a height of
3.6 m . It rebounds from a horizontal surface to
a height of 1.6 m . Find the coefficient of restitution of the material of the ball.

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10. A ball is dropped from a heigth H. It rebounds from the ground a number of times.

If coefficient is e , to what height does it go after nth rebounding ?
11. Sphere A of mass 'm' moving with a constant
velocity $u$ hits another stationary sphere $B$ of
the same mass. If $e$ is the co-efficient of restitution, then ratio of velocities of the two spheres $v_{A}: v_{B}$ after collision will be :
(D) Watch Video Solution
12. A nucleus of radium $\left(.88 R a^{226}\right)$
decays to $\cdot{ }_{86} R n^{222}$
by emisson of $\alpha-$ particle $\left({ }_{2} H e^{4}\right)$ of energy
4.8MeV. If meass of ${ }_{86} R n^{222}=222.0 a . m . u$
mass of ${ }_{.2} H e^{4}$ is 4.003 a.m.u. and mass of . $88 R a^{226}$ is 226.00826 a.m.u., then calculate the recoil energy of the daughter nucleus. Take 1a.m.u. $=931 M e V$

## D Watch Video Solution

13. In the bets decay of $N a^{24}$, the combined electron neutrino momentum has a magnitude equal to $4 M e V / c$. What is the recoil energy of daughter nucleus, given that its mass $23.99 u$ ?

$$
1 u=1.66 \times 10^{-27} k g
$$



Daughter nucleus



Electron Neutrino pai

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14. A ball moving with a speed of $9 m / s$ strikes
an identical ball at rest, such that after the
collision, the direction of each ball makes an angle of $30^{\circ}$ with the original line of motion.

Find the speeds of the two balls after collision.

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15. A ball moving on a horizontal frictionless
plane hits an identical ball at rest with a velocity of $0.5 \mathrm{~m} / \mathrm{s}$. If the collision is elastic, calculate the speed imparted to the target ball, if the speed of projectile after the collision is $30 \mathrm{~cm} / \mathrm{s}$. Show that the two balls will move at right angles to eachother, after the collision.
16. The displacement $x$ of particle moving in one dimension, under the action of a constant force
is related to the time $t$ by the equation
$t=\sqrt{x}+3$
where xis $\in$ meters and $t \in \sec$ onds. Find
(i) The displacement of the particle when its
velocity is zero, and
(ii) The work done by the force in the first 6 sec onds.
17. A particle moves along the $X$-axis from $x=0$ to $x=5 \mathrm{~m}$ under the influence of a force given by $F=7-2 x+3 x^{2}$. Find the work done in the process.

## D Watch Video Solution

3. A locomotive of mass $m$ starts moving so that its velocity varies according to the law $V=\alpha \sqrt{s}$, where $\alpha$ is a constant and s is the distance covered. Find the total work done by
all the forces acting on the locomotive during the first $t$ seconds after the beginning of motion.

## D Watch Video Solution

4. A force $\vec{F}(y \hat{l}+x \widehat{J})$, where K is a positive
constant, acts on a particle moving in the XY-

Plane. Starting from the origin, the particle is
taken along the positive X -axis to a point $(\mathrm{a}, 0)$ and then parallel to the $y$-axis to the point ( $a, a$ ).

Calculate the total work done by the force on the particle.

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5. A particle of mass $m$ is moving in a horizontal circle of radius $r$, under a centripetal force equal to ( $-K / r^{2}$ ), where k is a constant. The total energy of the particle is -

## - Watch Video Solution

6. A chain is held on a frictionless table with
$1 / n$th of its length hanging over the edge. If
the chain has a length $L$ and a mass $M$, how
much work is required to pull the hanging part back on the table?

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## Problem

1. A ball falls under gravity from a hight of 10 m
height of 10 m wioth an initial downward velocity $u$.If collides with the gound, loses
$50 \%$ of its energy in collision and then rises
back back to the same heighrt .Find the initial velocity u.

## D Watch Video Solution

2. A particle of rest mass $m_{0}$ moves with a spess $c / 2$. Calculate its
(i) mass (ii) momentum (iii) total energy (iv)K.E.
3. A 50 g lead bullet (specific heat 0.02 ) is initially at $30^{\circ} \mathrm{C}$. It is fired vertically upward with a speed of $840 \mathrm{~ms}^{-1}$. On returning to the starting level it strikes a cake of ice at $0^{\circ} C$. How much ice is melted ? Assume that all energy is spent in melting only. Latent heat of ice $=336 j g^{-1}$.
(D) Watch Video Solution
4. A perosn decides to use his bath tub water to generate electric power to run a 40W bulb.

The bath tub is located at a height of 10 m from
the ground and it holds 200 litres of water. He instals a water driven wheel generator on the ground. At what rate should the water drain from the bath tub to light the bulb? How long can he keep the bulb on , if bath tub was full initially ? Efficiency of generator is $90 \%$. Take $g=9.8 m / s^{2}$

## - Watch Video Solution

5. A body is moved from rest along a straight
line by a machine delivering constant power
.Calculate the veloOcity and distance moved by the body as a function of time .

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6. The power output of a $\quad 92 U^{235}$ reactor if it takes 30 days to use up 2 kg of fuel and if each fission gives 185 MeV of energy (Avogadro number` $\left.=6 x x 10^{\wedge}(23) / / \mathrm{mole}\right)$ will be -
7. A massless platform is kept on a light elastic spring as shown in figure. When a small stone of mass 0.1 kg is dropped on the pan from a height of 0.24 m , the spring compresses by
0.01 m . From what height should the stone be droppped to cause a compression of 0.04 m in
the spring ?


- 

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8. A 0.5 kg block slides from the point A on a horizontal track with an initial speed $3 \mathrm{~m} / \mathrm{s}$ towards a weightless horizontal spring of length $1 m$ and force constant $2 N / m$. The part $A B$ of the track is frictionless and the part

BC has the coefficient of static and kinetic friction as ' 0.22 ' and 0.20 respectively. If the distances AB and BD are $2 m$ and $2.14 m$ respectively, find total distance through which
the block moves before it comes to rest completely. ${ }^{`}\left(\mathrm{~g}=10 \mathrm{~m} / / \mathrm{s}^{\wedge}(2)\right)$.
9. Two blocks $A$ and $B$ are connected to each other by a string and a spring, the spring pases and a frictionlesss pulley as down over in
the figure. Block $B$ sides over the horizental top surface of a strionry block $C$ both with the
verical side of $C$, both with the same conform
speed


The coefficient of friction between the surface the of block is 0.2 force constant of the spring is 1960 newtons, if mass of block $A$ is 2 kg , celculate the mass of block $F$ and $B$ and the energy stored is the spring

10. A string with one end fixed on a rigid wall, passing over a fixed frictionless pulley at a distance of $2 m$ from the wall, has a point mass

M of 2 kg attached to it at a distance of 1 m from the wall. A mass $m$ of 0.5 kg is attached to the free end. The system is initially held at rest so that the stirng is horizontal between wall and pulley and vertical beyond the pulley as shown in figure.


What will be the speed with which point mass
$M$ will hit the wall when the system is released?
$\left(g=10 m s^{-2}\right)$
(D) Watch Video Solution
11. A bullet of mass 0.01 kg travelling at a speed of $500 \mathrm{~m} / \mathrm{s}$ 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 rise a vertical distance of 0.1 m . The speed of the bullet after it emerges from the block will be -

12. A pendulum bob of mass $10^{-2} \mathrm{~kg}$ is raisted to hightof $5 \times 10^{-2} \mathrm{~m}$ and then released At the bottion of its swing, it up a mass of $10^{-3}$ kg to what hieght will the combimnated mass rise ? Take $g=10 \mathrm{~ms}^{-2}$

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13. A particle of mass $m$ and veocity $\vec{v}$ collides elastically with a stationary particle of mass $m$

Calculate the angle between velocity vector of the two partiicless after the collision.

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14. A bullet of mass $M$ is fired with a velocity
$50 \mathrm{~m} / \mathrm{s}$ at an angle with the horizontal. At the highest point of its trajectory, it collides headon with a bob of mass 3 M suspended by a massless string of length $10 / 3$ metres and gets embeded in the bob. After the collision, the string moves through an angle of $120^{\circ}$. Find
(i) the angle $\theta$,
(ii) the vertical and horizontal coordinates of
the initial position of the bob with respect to
the point of firing of the bullet. Take $g=10 m / s^{2}$

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## Problem For Self Practice

1. A man wighing 80 kg wt carrice a stone of
weight 20 kg wt to the top a builling 30 m high
.Calculatethe work done by him .Take

$$
g=9.8 m s^{-2}
$$

## - Watch Video Solution

2. A gardener pushes a lawn roller through a distance of 100 m with a force of 50 N Calcalye the wages if he is to be paid 10 paise for 25 J of work It is given that the applied force is inclined $60^{\circ}$ to the direction of motion.
3. What is the work done is crrrying a suitcase wighting 10 kg f on his head when he travels a distance of 5 m in the (i) verticl direction and
(ii) horizontal direction ? Takeg $=9.8 \mathrm{~ms}^{-2}$

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4. A body moving along a circular path with
unifrom speed covers a distance of 20 m If the
centripetal force acting on it is 10 N ,What is
the work done by the force?
5. A man moves on a straight horizontal road with a block of mass 2 kg in his hand If he covers a distance os 40 m with an accelertion of $0.5 \mathrm{~ms}^{-2}$ Find the work done by the man on the block during the motion.

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6. A bodys constrained to more in the $Y$ direction ,Is subject to a force $\vec{F}=(-2 \hat{i}+15 \hat{j}+6 \hat{k}) \mathrm{N}$ What is the work
done by force in moving the body through a distance of 10 m along the Y -axis ?

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7. A force $F=(15+0.50 x)$ acts on a particle in the
$X$-direction, where $F$ is in newton and $x$ in metre
Find the work done ' by this force during a displacement from $x=0$ to $x=2.0 \mathrm{~m}$.

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8. A particle is acted upon by constant forces
$\vec{F}=-2 \hat{i}+3 \hat{j}+4 \hat{k}$ and $\vec{F}_{2}=-\hat{i}+2 \hat{j}-3 \hat{k}$
is distanced from the point $A(2,1,0$,$) to the$ point $B(-3,-4,2)$ Find the work done by forces.

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9. A man weighing $60 \mathrm{~kg} f$ suports a body of

20 kgf on his head. Calculate work done by him
in moving a distance of 15 m up an incline of 1
in 10 . Take $g=9.8 \mathrm{~m} / \mathrm{s}^{2}$
10. Calculate the work done in raising a stone of mass 6 kg of specific gravity 2 immersed I water from a depth from a depth of 4 m to 1 m below the surface .Take $g=10 \mathrm{~ms}^{-2}$

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11. The relation between the displacement $x$ and
the time t for a body of mass 2 kg moving under the action of $a$ force is geven by
$x=t^{3} / 3$, where x is in metre and t in second
,Calculate the ork done by the body in first 2 seconds.

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12. A body moves from a point $A$ to $B$ under the action of a force shown in figure. What is
the amount of work done?


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Type B Based On K E

1. A body mass 4 kg initiallay at rest is moved by
a horizntally force 1 N on a frictionless table.

Find the work done by the force in 4s. Show that this equals the change in K.E. of the body.

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2. The momentum of a body of masss of 5 kg is
$500 \mathrm{kgms}^{-1}$. Find the its K.E.
3. A bullet of mass 20 g is found is found to pass
two points 30 cm apart in a time interval of 4 s .
Calculate the kinetic energy of the bullet if it moves with constant speed.

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4. A force fo 3000 dyne acts on a body of mass

400 g for 10 s . Find the kinetic energy of the body after 10s.
5. A body having masss oif 100 g is allowed to fall freely under the action of gravity. Calcualate the kinetic energy after 10s. Take $g=9.8 m s^{-2}$.

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6. A electron and a proton are detected in a cosmic ray experiment, the electron with K.E. of

5 eV and the proton with K.E. of 50 e . Find the ratio of their speeds.

Given
$m_{e}=911 \times 10^{31} \mathrm{~kg}$ and $m_{p}-1.67 \times 10^{27} \mathrm{~kg}$

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7. A neutron of mass $1.66 \times 10^{-27} \mathrm{~kg}$ is moving with a speed of $7 \times 10^{5} \mathrm{~ms}^{-1}$. Calculate late (i) its kinetic energy and (ii) the average force it will exert in entering a body to depth of 0.1 cm .

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8. A body of masss 1 kg is allowed to fall freely under gravity. Find the mimimum and kinetic
energy of the body 5 second after it starts falling. Take $\mathrm{g}=10 \mathrm{~ms}^{-2}$

## D Watch Video Solution

9. Two bodies of masses 1 g and 16 g are moving with equal kinetic energies. Find the ratio of the magnitudes of their linear momenta.

## D Watch Video Solution

10. If the momentum of a body is increased by $50 \%$, then what will be the perentage increase in the kinetic energey of the body?

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11. The kinetic energy of a body decreases by $19 \%$. What is the percentage decreases in its linear momentum?
12. A running man has half the KE that a body
of half his mass has. The man speeds up by
$1.0 \mathrm{~ms}^{-1}$ and then has the same energy as the boy. What were the original speeds of the man and the boy?

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13. While catching a cricket ball of mass 200 g moving with a velocity of $20 \mathrm{~ms}^{-1}$, the player draws his hands backwards through 20 cm . Find
the work done in catching the ball and the average force exerted by the ball on the hand.

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14. A man of 60 kg jumps to a height of 1.0 m .

What is the potential energy of the man at the
highest point?

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15. A vehicle of mass 15 quintal climbs up a hill
$200 m$ high. It then moves on a level road with a speed of $30 \mathrm{~ms}^{-1}$. Calculate the potential energy gained by it and its total mechanical energy while running on the top of the hill.

## D Watch Video Solution

16. A stone of mass 0.4 kg is thrown vertically up
with a speed of $9.8 m s^{-1}$. Find the potential and kinetic energies after half second.
17. A ball is throuwn vertially up with a velcity of $20 \mathrm{~ms}^{-1}$. At height, will its K.E. be half its orginal value?

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18. 230 joules were spent inlifting a 10 kg wieight to a height of 2 m . Calculate the acceleration with which it was raised Take $\mathrm{g}=$ $10 m s^{2}$.
19. Calculate the worked done in lifting a 300 N weight to a height of 10 m with an accelertaion $0.5 m s^{2}$. Take $g=10 m s^{-2}$.

## - Watch Video Solution

20. A ball is dropped from rest from a height of

Om. If it loses $20 \%$ of its kinetic energy on
striing the ground, what is the height to which
the ball bounces?

## D Watch Video Solution

21. A 3.0 kg block has a speed of $2 \mathrm{~m} / \mathrm{s}$ A and $6 \mathrm{~m} / \mathrm{s}$ at B . If the distance from A and B along the curve is 12 m , how large a frictional force acts on it ? Assuming the same friction, how far from $B$ will it stop ?

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Type C Potential Energy Of A Spring

1. A 16 kg block moving on a frictionless horiozntal surface with a velocity of $5 \mathrm{~cm}^{-1}$ compreses an ideal spering and comes to rest.

If the force constant of the spring be $100 \mathrm{Nms}^{-1}$, then how much is the spring compressed?

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2. A block of mass $2 k g$ is propped from a heught of 40 cm on a spring where force
constant is $1960 \mathrm{Nm}^{-1}$ The maximum distance thought which the spring compressed by

## D Watch Video Solution

3. A block of massm, initally at rest is dropped from a height $h$ onto a spring whose force constant is $K$. Find the maximum distance $x$ through which the spring will be compressed.
4. An object is attached to a vertical springs
and lowered slowly to its equilibrium position.

This stretches the spring by a distance $d$. If the
same object is attached to the same vertical spring, but permitted to fall freely, through what distance does it stretch the spring ?

## D Watch Video Solution

1. A lift is designed to carry a load of 4000 kg through 10 floors of a building averaging 6 m per floor in 10seconds. Calculate the forse power of the lift.

## D Watch Video Solution

2. A labour lifts 100 stones to a height of 6 m in
two minutes. If mass of each stone be 1 kg ,
calculate the average power of the labourer.
Take $\mathrm{g}=10 \mathrm{~ms}{ }^{-1} 1$.
3. A machine can take out 1000 kg of mud hour
from a dept of 100 m . If efficieny of the machine is 0.9 , calculate its power.

## D Watch Video Solution

4. One coolie takes 1 min to raise a box through
a height 2 m . Another takes 30 s for the same
job and does the same job and does the same amount of work. Which one of these two has a
greater power and which one uses greaster energy?

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5. An energies of 4.9 K.W power is used to pump water from a well 50 m deep. Calculate the quantity of water in kilo which it can pump out in one hour.
6. Water is pumped out of a well 10 m deep by mean of a pump rated at 10 kW . Find the efficient of the motor if 4200 kg of water is pumped out every minutes. Take $g=10 \mathrm{~ms}^{-2}$.

## - Watch Video Solution

7. A 30 m deep well is having water up to $15 m$.

An engine evacuates it in one hour. The power of the engine. If the diameter of the well is $4 m$ is
8. The human heart forces $4000 \mathrm{~cm}^{3}$ of blood per minute through the arteries under pressure of 130 mm . The density of blood is $1.03 \mathrm{~g} / \mathrm{cc}$. What is the horse power of the heart ?

- Watch Video Solution

9. A pump can throw up 10 quntals of coal per hour from a coal mine 120 m deep. Calculate
the power of the engine in watt assuming that efficiency is $80 \%$.

## D Watch Video Solution

10. A man cylces up a hill whose slope is 1 in 25
at $6 \mathrm{kmh}^{-1}$. The mass of the man and the cycle
is 150 kg . Find the power.

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11. A car weighting 1120 kg is going up an incline of 1 in 56 at the rate of 20 m in 2 s . Find the power of the engine if frictional force is 64 N.

## D Watch Video Solution

12. A standard car developes 40 H.P. Find the maximum speed the car can attain agains a resistance of 20 kg wt. due to air and friction.

$$
\begin{aligned}
& \text { Gvien efficiency of the engin is } \\
& 25 \% .1 H . P .=746 W \text { and } g=10 \mathrm{~ms}^{-2} \text {. }
\end{aligned}
$$

## (D) Watch Video Solution

13. A car of mass 1000 kg accelerates uniformly from rest to a velocity of $54 \mathrm{~km} / h$ in 5 seconds.

Calculate (i) its acceleration (ii) its gain in KE
(iii) average power of the engine during this period.

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## Type E Based On Mass Energy Equivalence

1. Show that energy equivalent of one atomic mass unit is nearly 933 MeV .

Take $1 a m u=1.66 \times 10^{-27} \mathrm{~kg}$

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2. 500 kg of water is heated from $20^{\circ}$ to $100^{\circ} \mathrm{C}$
. Calculate the increase in the mass of
water.Given specific heat of water
$=4.2 \times 10^{3} \mathrm{Jkg}^{-1} .^{\circ} \mathrm{C}^{-1}$.
3. 1 mg of uranium is completely destroyed in an atomic bomb. How much energy is liberated ?

## D Watch Video Solution

## Type F Based On Collisions

1. A 5 kg ball and a 10 ball approach each other with equal speeds of $21 m s^{-1}$. Determine their speeds after the elastic collision.
2. A body of mass 2 kg makes an elastic collision with another body at rest and continues to move in the original direction but with one fourth its original speed. What is the mass of the body it collides with ?

## - Watch Video Solution

3. Two particles of masses 0.5 kg and 0.25 kg moving with velocity $4.0 \mathrm{~m} / \mathrm{s}$ and $-3.0 \mathrm{~m} /$
collide head on in a perfectly inelastic collision.

Find the velocity of the composite particle after collision and KE lost in the collision.

## D Watch Video Solution

4. What percentage of the K.E. of a moving particle is transferred to a stationary particle when it strikes the stationary particle four times its mass ?
5. A ball is dropped from a height of 3 m . What is the height upto which the ball will rebound ?

The cofficient of restitution is 0.5 .

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6. A ball is dropped from a height $h$ on to a floor. If the cofficient of restitution is e, calculate the height the ball first rebounds ?

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