## Important Questions - Work,Energy and Power

11th Standard CBSE

## Physics

Reg.No.

Time : 01:00:00 Hrs

## Section-A

1) How much work is done by mass $M$ moving once around a horizontal circle of radius $r$ ?
2) Friction is a non-conservative force. Why?
3) A body is moving along a circular path.How much work is done by the centripetal force?
4) Aa person walking on a horizontal road with a load on his head does no work. Why?
5) 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 . [ $\left.\mathrm{g}=9.8 \mathrm{~m} / \mathrm{s}^{2}\right]$
6) What is the minimum amount of energy released in the annihilation of an electron-position pair? (Take, rtest mass of electron-position $=9.11 \times 10^{-3} \mathrm{~kg}$ and $\mathrm{c}=3 \times 10^{8} \mathrm{~m} / \mathrm{s}$ )
7) Can a body have without momentum? If yes, then explain how they are related with each other?
8) A spring balance reads forces in Newtons. The scale is 20 cm long and read from 0 to 60 N . Find potential energy of spring when the scale reads 20 N .
9) Calculate the kinetic energy of a body of mass 0.1 kg , if lenear momentum is $20 \mathrm{~kg}-\mathrm{m} / \mathrm{s}$.
10) momentum of a body is doubled. What is the percentage increase in kinetic energy?

## Section-B

11) A steel spring of spring constant $150 \mathrm{~N} / \mathrm{m}$ is compressed from its natural position through a mud wall 1 m thick, the speed of bullet drops to $100 \mathrm{~m} / \mathrm{s}$. Calculate the average resistance of the wall. Neglect friction of air.
12) $\wedge \lambda \lambda$ A body constrained to move along the $Z$-axis of a coordinate system is subject to a constant force $\mathbf{F}$ given by $\mathbf{F}=(-\hat{i}+2 j+3 k) N$, Where $\hat{i}, \hat{j}$ and $\hat{k}$ are unit vectors along the $x$,yand $z$ - axes of the system, respectively. What is the workdone by tghis force in moving a distance of 4 m alon the z - axis?
13) Calculate the work done by a car against gravity is zero because force of gravity is vertical and motion of car is along a straight horizontal road.
14) A 0.5 kg block slides from the point A on a horizontal track with an initial speed $4 \sqrt{5} \mathrm{~ms}^{-1}$ towards a weightless horizontal spring of length 10 m and spring constant 2 $\mathrm{N} / \mathrm{m}$.


The initial track is frictionless and part $B C$ under the unstretched length of spring has coefficient of kinetic friction $\mu_{k}=0.2$, Calculate total distance by which the block move before coming finally to rest. ( $\mathrm{g}=10 \mathrm{~ms}^{-1}$ ).
15) Calculate the energy equivelent of 1 amu in Mev, taking $1 \mathrm{amu}=1.66 \times 10^{-27} \mathrm{~kg}$
16) If 1000 kg of water is heated from $0^{\circ} \mathrm{C}$ to $100^{\circ} \mathrm{C}$.Calculate the increase in mass of water
17) a pump on the ground floor of building can pump up water to fill a tankl of volume 30 m 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?
18) The blades of windmill sweep out a circle of area A.

Assume that the windmill converts $25 \%$ of the wind's energy $\mathrm{v}=36 \mathrm{~km} / \mathrm{h}$ and density of the air is 1.2 kg m . What is the el;ectrical power produced?
19) The bob of pendulum is released from a horizontal position. If the length of the pendulum is 1.5 m , what is the speed with which the bob arrives at the lowermost point, given that if dissipated $5 \%$ of its initial energy against air resistance?
20) Under the correct alternative.

Whan a conservation force does positive work on a body, the potential energy of the body increase decrease/remains unaltered.

## Section-C

21) A person trying to lose weight lifts a 10 kg mass upto $0.5 \mathrm{~m}, 1000$ times. Assume that the potential energy loss each time she lowers the mass is dissipated.

Fat supplies $3.8 \times 10^{7}$ J energy per kilogram which is converted to mechanical energy with $20 \%$ efficiency rate. How much fat will be dieter use up?

## 22) A Ball HIts The Ground

A ball falls from a height of 20 m . Find out of the velocity with which the ball hits the ground?
23) State if each of the following staement is true or false. Give reasons for your answer.
(ii) Total energy of a system is always conserved, no matter what internal and external forces on the body are present?
24) A simple pendulumof length 1 m has a wooden bob of mass 1 kg . It is struck of mass $10^{-2} \mathrm{Kg}$ moving with a speed of $2 \times 10^{2} \mathrm{~m} / \mathrm{s}$.The bullet embedded into the bob. Obtain the height to which the bobn rises before swinging back. take $10 \mathrm{~m} / \mathrm{s}^{2}$
8) We can calculate the spring constant of spring, as it ios extended by 20 cm under 60 N force.
$\mathrm{F}=\mathrm{kx} \Rightarrow 60=\mathrm{k} \times 20 \times 10^{-2}$
$\mathrm{k}=300 \mathrm{~N} / \mathrm{m}$
At a force of 20 N , the extension in spring is
$\mathrm{F}=\mathrm{kx} \Rightarrow 20=300 \mathrm{x}$
$\mathrm{x}=\frac{2}{30}=\frac{1}{15} m$
9) 2000 J
10) $100 \%$

## Section-B

11) 0.12 J
12) Here, $\mathrm{F}=\underset{(-\hat{i}+2 j+3 k)}{\hat{\mathrm{j}}} \mathrm{N}$ and $\mathrm{s}=\hat{(4 k)} \mathrm{m}$
$\mathrm{W}=\mathrm{F} . \mathrm{s}=\mathrm{F}_{\mathrm{Z}} \cdot \mathrm{S}_{\mathrm{z}}$
$=3 \times 4$
$=12 \mathrm{~N}-\mathrm{m}$
$=12 \mathrm{~J}$
13) The workdone by a car against gravity is zero because force of gravity is vertical and motion of car is along a straight horizontal road.
14) Let the block compresses the spring by $x$ before finally coming to rest on the rough part.


Total energy of the block on friction surface $=$ Work done against friction + Potential energy stored in spring.

$$
\frac{1}{2} \times 0.5 \times 16 \times 5=\mu_{k} \quad m g \quad s+\frac{1}{2} k x^{2}
$$

$$
20=0.2 \times 0.5 \times 10 \times x+\frac{1}{2} \times 2 \times x^{2}
$$

$20=x+x^{2}$
$x^{2}+x-20=0$
$x^{2}+5 x-4 x-200=0$
$x(x+5)-4(x+5)=0$

$$
x=4, x=-5
$$

Hence, the compression of spring is 4 m .
15) $933.75 \mathrm{M}<e \mathrm{v}$
16) $4.66 \times 10^{-6} \mathrm{~kg}$
17)

Hre,volume of water lifted $V=$ volume of tank $=30 \mathrm{~m}$, time $\mathrm{t}=15 \mathrm{~min}=900 \mathrm{~s}$,
Height of tank, $h=40 \mathrm{~m}$ and efficiency of motor, $n=30 \%$
$=\mathrm{mgh}=\mathrm{Vpgh}$
$\therefore$ Output power $=\frac{V p g h}{t}=\frac{30 \times 10^{3} \times 9.8 \times 40}{900}=1.307 \times 10^{4}$ WInput power $\quad=\quad \frac{\text { Output power }}{n}=+\frac{1.307 \times 10^{4}}{\frac{30}{100}}=\frac{1.307 X 10^{4} \times 100}{30}=4.357 X 10^{4} \quad \mathrm{~W}=43.54 \quad \mathrm{~kW}$
18)
(iii) If effciency of windmill be $25 \%$, then Output electrical power $=25 \%$ of input power
$\frac{25}{100} \times \frac{1}{2} A p v^{3}$ As
$A=30 \mathrm{~m}^{2}, \quad v=36 \quad \mathrm{~km} / \mathrm{h}=36 \times \frac{5}{18} \mathrm{~m} / \mathrm{s}=10 \mathrm{~m} / \mathrm{s} \quad$ and $\quad p=1.2 \quad \mathrm{kgm}^{-3} \therefore$ Output electrical power $=\frac{25}{100} \times \frac{1}{2} \times 30 \times 1.2 \times(10)^{3}=4500 \quad \mathrm{~W}=4.5 \quad \mathrm{~kW}$
19) On releasing the bob of pendulum from horizontal position, it falls vertically downward by a distance equal to length of pendulum i.e $h=l=1.5 \mathrm{~m}$ As $5 \%$ of loss in PE is dissipated against air resistance, the balance $95 \%$ energy is transformed into KE. Hence,
$\frac{1}{2} m v^{2} \frac{95}{100} \times m g h \Rightarrow \quad v=\sqrt{2 \times \frac{95}{10} \times g h}=\sqrt{\frac{2 \times 95 \times 9.8 \times 1.5}{100}} \quad=5.3 \mathrm{~ms}^{-1}$
20) The potential energy decrease, because
$\Delta \mathrm{U}=-\int F$. $d x$ lf work done by conservation force is p[ositive, then obviously $\Delta \mathrm{U}$ is -ve

## Section-C

21) Mechanical energy supplied by 1 kg of fat

$$
\begin{aligned}
& \mathrm{E}_{\mathrm{m}}=20 \% \text { of } 3.8 \times 10^{7} \mathrm{~J} \\
& \quad=\frac{20}{100} \times 3.8 \times 10^{7}=76 \times 10_{5} \text { JConsumption of fat }=\frac{1 \times 49000}{76 \times 10^{5}}=6.45 \times 10^{-3} \mathrm{~kg}
\end{aligned}
$$

22) Given $\mathrm{h}=20 \mathrm{~m} \mathrm{~V}=$ ?
when the ball hit the ground its kinetic energy is converted into potential energy.
$\therefore$ When its hits the ground KE $=\mathrm{PE}$
$\frac{1}{2} m v^{2} v=\sqrt{2 g h}=\sqrt{2 \times 9.8 \times 20}=\sqrt{392}=19.789 \mathrm{~m} / \mathrm{s}$
23) (ii) False, internal as well as external forces can change the kinetic energy.Again forces of conservative may change the potential energy of a system.
24) 0.2 m
