Class-X Work-Energy-Power

Sub- Physics

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Q What are conditions for do a work?

Answers → For do a work According to Physics.

We needs (i) Force (F) → acting on body

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(ii) Displacement (s) → on body

(iii) Direction (θ) → At what angle Force work on body.

Defination →

(i) When a Force (F) acts on a body and body Displaced by some ammount then work is said to be done.

(ii) Work define as product of Force (F) and Displacement (s). express as

$$W = F \cdot S \cos\theta$$

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Where 'θ' is an angle between 'F' and 's'

Note (i) When direction of 's' is in the direction of 'F' both have same (direction) then $\theta = 0^\circ \longrightarrow W = F \cdot S$

(ii) When Force (F) acting on body at 90° then work is zero

$\theta = 90 \longrightarrow$ and $\because \cos 90^\circ = 0 \longrightarrow W = F s \cos 90^\circ = 0$

ex. → A man taking a weight (F=mg) on his head and walking then work done by this weight on man is zero.

(iii) A body of mass (m) When Fall from a height (h) then work done is → $W = mgh$

* C.G.S. Unit of Work → dyne.cm → erg
* S.I. Unit of Work → newton.meter → N.m → Joule

① Symbol of-

* Velocity = V
* Acceleration = a
* Momentum = p
* Force = F
* Work = W
* Power = P
* Displacement = s
* Force of Gravity = F
* If a body of mass = m
* Force of Gravity acting on body = F = Weight

$$F = mg$$

Ex. ① If a body of mass 1000 Kg then it's Weight is

$$F = W = mg$$
$$= 1000 \times 9.8$$
$$= 1000 \times \frac{98}{10}$$
$$F = 9800 \text{ N}$$

Formula of

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① $a = \frac{V-u}{t}$

② $P = \text{mass} \times \text{velocity} = mv$

③ Force = mass x Acceleration

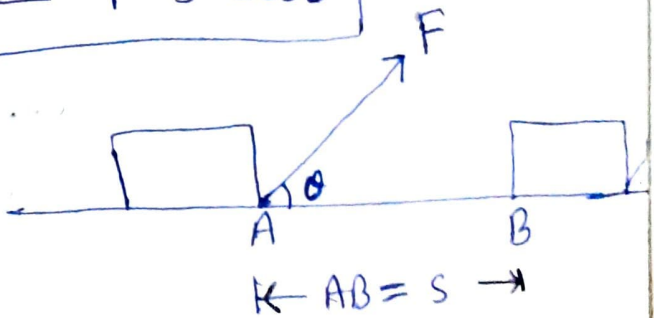
$$F = ma$$

④ Work = Force . Displacement

$$W = F \cdot S$$

If Force (F) acts on a body at an angle θ then Work done is

$$W = F \cdot S \cos\theta$$



Ex. ① If due to Force 50N a body Displaced by 10 meter Find Work done

Sol^n $F = 50N$

$S = 10$ meter

$W = F \cdot s = 50 \times 10$

$W = 500 \text{ N.m}$

$W = 500$ Joule

* **Energy** → Capacity of doing work is called Energy (E). Unit = Joule (J)

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On the basis of Physical state according to Physics. body either in motion or Rest state then types of Energy on the basis of Mechanical state of body are two.

(1) **Kinetic Energy** ⇒ The capacity of doing Work due to moving state of a body, is called K.E.

(i) If a body of mass (m) moving with Velocity (v) then it's K.E is

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$$K.E = \frac{1}{2}mv^2$$

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(ii) Formula of K.E. interm of Momentum = P

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

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(2.) **Gravitational Potential Energy (G.P.E)** →

→ The Work done on a body Under Force of Gravity or against Force of Gravity, store as Energy in that body, called G.P.E.

→ If a body of mass = m at a height = h then it's G.P.E is → $E = mgh$

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* Energy (E) = Work done ⇒ $E = W$
* How much you have Energy = Amount of Work done by You.

∴ Work done = Energy

* **Power** → The rate of doing work is called Power

$$\text{Power} = \frac{\text{Work done}}{\text{Time taken}}$$

$$P = \frac{W}{t}$$

$$P = F \cdot V$$

($\because \frac{S}{t}$ = Velocity = v)

Different Formula of Power

(i) $P = \frac{F \cdot S}{t}$

(ii) $P = \frac{F S \cos\theta}{t}$

(iii) $P = \frac{mgh}{t}$

Power → Rate of Consumption of Electric Energy(E) is called Electric Power

$$P = \frac{\text{Energy Consumed}}{\text{Time taken}} \Rightarrow \frac{E}{t}$$

$$P = \frac{E}{t}$$

Joule

Unit of Power → $P = \frac{W}{t} = \frac{E}{t} = \frac{\text{Joule}}{\text{second}}$

$$P = J/s = \text{Watt} = W$$

- 1 Kilo watt = 1 KW = 1000 W
- 1 Megawatt = 1 MW = 10^6 W
- 1 Giga Watt = 1 GW = 10^9 W
- 1 horse Power = 1 hP = 746 Watt.

Joule

* One Watt = 1 Watt = 1W = $\frac{1 \text{ Joule}}{1 \text{ Second}} = \frac{1J}{1s}$

↳ If one Joule (1J) work be done in one second (1 Sec) then Power is called one watt (1W).

* What is the meaning of 60W.? /Sonu Kr. Gupta Sony

Ans. $P = 60W = \frac{60 \text{ J}}{1 \text{ Second}}$ = It means if on a bulb written 60W, it consume 60 Joule electric Energy in one second.

* Relation between Power(P) and Velocity (V)

→ ∵ Work done is → $\boxed{W = F \cdot s}$

and time taken = t

then Power = $\frac{\text{Work done}}{\text{time}} \Rightarrow P = \frac{W}{t}$

$P = \frac{F \cdot s}{t} = F \cdot \left(\frac{s}{t}\right)$

[$\frac{s}{t}$ = rate of change of displacement is called Velocity = V.]

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∴ $\boxed{P = F \cdot V}$

* Relation between Electric Power (P) and Energy (E) and time (t)

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∵ Electric power = $\frac{\text{Electric Energy}}{\text{time}}$

$\boxed{P = \frac{E}{t}} \rightarrow \boxed{E = P \cdot t}$

↳ If $\boxed{P = 1KW}$ and $\boxed{\text{time} = t = 1 \text{ hour} = 1h}$

$\boxed{E = 1KW \times 1 \text{ hour} = 1 KWh}$

Q. When work is maximum? $[W = FS\cos\theta]$

Ans. → When Displacement (S) take place in the same direction of Force (F) or When $\boxed{\theta = 0^\circ}$

Q. When work done is zero?

Ans. → i) When Displacement (S) is zero ⇒ $\boxed{S = 0}$
then work = $\boxed{W = 0}$

ii) When Force (F) acts at 90° on body $\boxed{\theta = 90}$

Q. two body of masses m_1 and m_2 at a height h_1 and h_2 then ratio of work done is?

Ans $\boxed{W_1 = m_1 g h_1}$ → For 1st body

$\boxed{W_2 = m g h_2}$ → For 2nd body

A/c $\boxed{\frac{W_1}{W_2} = \frac{m_1 g h_1}{m_2 g h_2}}$

* Value of 1Kgf = 9.8 N
* Value of 1gf = 980 dyne
* Value of 1KWh = 3.6×10^6 Joule
* Value of 1 electron volt = 1eV = 1.6×10^{-19} Joule
* 1 Joule → If one Newton (1N) Force acts on a body and body displaced by one meter (1m) then work done is called 1 Joule (one Joule).
* 1erg ⇒ If one dyne Force acts on a body and body displaced by one centimeter (1cm). then work done is called one erg (1erg).

Q A Force 50N Displaced a body 20 meter. calculate Work done. [W = F. s]

Q A Force 20N acts on a body of mass 100kg at 60°. Calculate Work done. if body Displaced by 50m. [Fsaxsθ]

Q A body of mass 20kg at the height of 20m from Ground Surface, when it Fall down how much Work done by it.
[W = mgh]

Q Write C.G.S. and S.I. Unit of Work and Derive the relation between them.

Ans. For Work

(i) C.G.S. Unit = erg

$$\boxed{1\text{erg} = 1\text{dyne} \cdot \text{cm}}$$

(ii) S.I Unit = Joule

1 Joule = 1 newton · meter

1 J = 1 N · m

(iii) Relation betn S.I. and C.G.S. Unit of Work

$\because$ 1 Joule = 1 N · m

$1\text{ J} = 1\text{ N} \times 1\text{ m}$

$1\text{ J} = 10^5 \text{ dyne} \times 100 \text{ cm}$

$1\text{ J} = 10^7 \text{ dyne} \cdot \text{cm}$

$$\boxed{1\text{ J} = 10^7 \text{ erg}}$$

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