TENDER HEART HIGH SCHOOL, SEC-33'B, CHD.

Date: 15.4.2024
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CLASS- X
SUBJECT- PHYSICS
CHAPTER-2
TEACHER- CHARANJEET KAUR

Good Morning Students!

This lesson is of Class-X, for the Subject of - "Physics", Chapter-2, "Work, Energy and Power", of your Textbook, titled - 'Concise Physics by Selina Publications' and is being submitted to you on 15th April, 2024

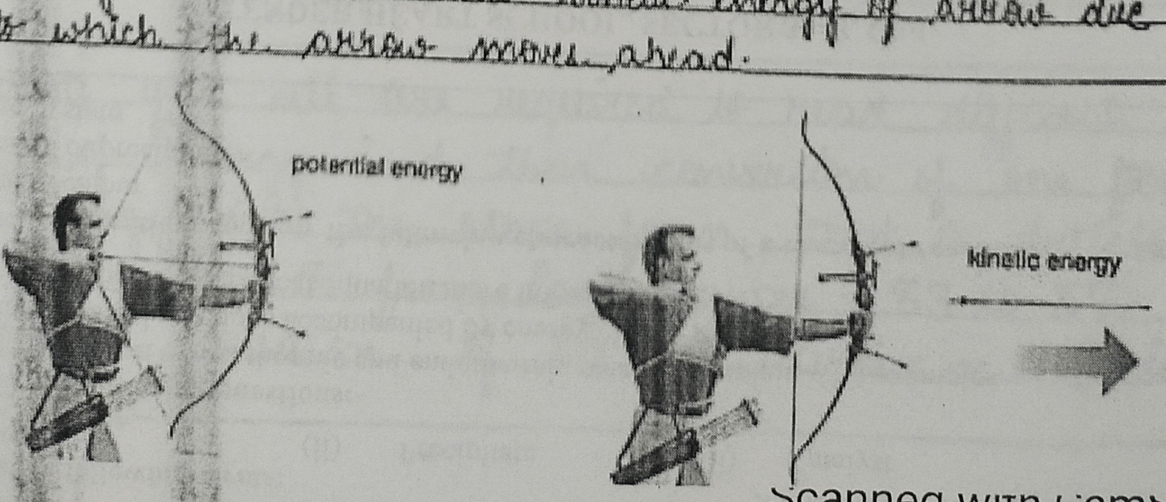
Students, let us learn:

CONVERSION OF P.E. INTO K.E. :

Potential Energy changes into Kinetic Energy whenever it is put to use. FOR EXAMPLE:

1.) A hammer at a height has gravitational potential energy which is equal to work done in moving the hammer against force due to gravity (m g h). The falling hammer (i.e. when the hammer has not struck the nail) has both potential energy as well as kinetic energy. When the hammer strikes the nail, the K.E. of hammer changes into the K.E. of the nail due to which the nail moves into the wooden piece.

2.) A stretched bow has elastic potential energy and when the arrow is released from the stretched bow, the elastic potential energy of the stretched bow transfers to the arrow. Infact, the elastic potential energy of bow gets converted into kinetic energy of arrow due to which the arrow moves ahead.



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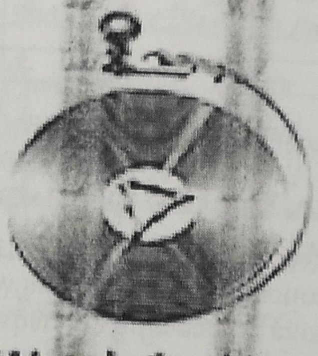
Students, now pause this interactive session for 5 minutes and in the meantime figure out the answer for the below written question.

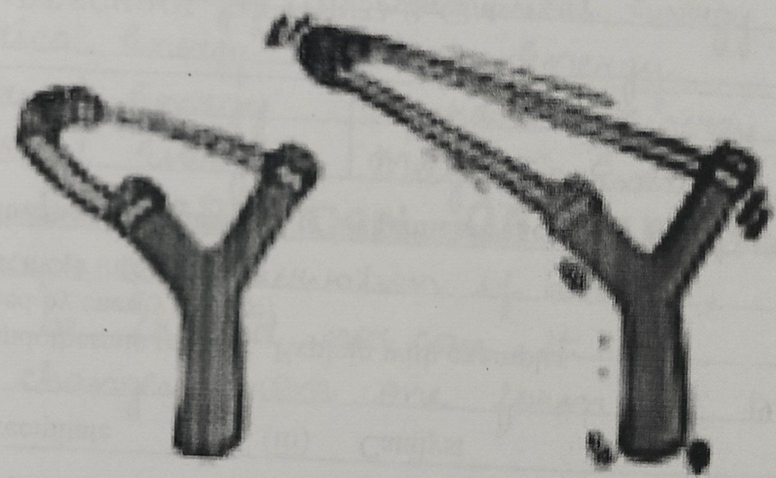
Q1. What energy conversion takes place in case of a wound up watch spring?

Q2. What energy conversion takes place in case of a stretched catapult?

(Refer to below given diagrams for both the questions).



Watch Spring



Students, A wound up watch spring has elastic potential energy which changes into rotational kinetic energy which further is used in doing work in moving the hands of the watch.

Students, you all are required to read different types of energy and then conversion of one form of energy into the other form, that is Article-2.14 and 2.15 from Page Number - 33 to 37.
(Further solution of 25 of Exercise - 2 (B) is done).

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CHAPTER-2 (Exercise-2(B))

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Ans25

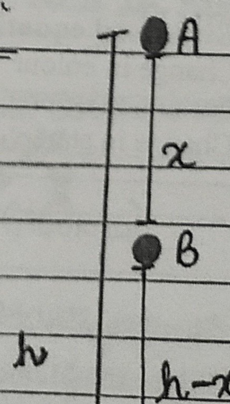
CASES	INITIAL ENERGY	FINAL ENERGY
a) Loudspeaker	Electrical Energy	Sound Energy
b) Steam Engine	Heat Energy	Mechanical Energy
c) Microphone	Sound energy	Electrical Energy
d) Washing Machine	Electrical Energy	Mechanical Energy
e) Electric Bulb	Electrical energy	Light Energy
f) Burning Coal	Chemical energy	Heat and Light Energy
g) Solar cell	Light Energy (from sun)	Electrical Energy
h) Bio-gas burner	Chemical Energy	Heat Energy
i) Electric cell	Chemical energy	Electrical Energy
j) Petrol Engine	Chemical energy	Mechanical Energy
k) An Electric iron	Electrical Energy	Heat Energy
l) A ceiling Fan	Electrical Energy	Mechanical Energy
m) An electromagnet	Electrical energy	Magnetic Energy

★ PRINCIPLE OF CONSERVATION OF ENERGY

According to principle of conservation of energy, energy can neither be created nor can it be destroyed. It only changes from one form to another.

When there is a transformation of energy from one form to another, the total energy always remains the same i.e. it remains conserved.

VERIFICATION OF CONSERVATION OF MECHANICAL ENERGY



If a body of mass 'm' is falling freely under gravity from a height 'h' above ground, then the P.E. and K.E. at different positions i.e. A (at the top), B (at x distance) and C (on the ground) is as discussed below

At Point A : P.E. = mgh

K.E. = 0

(as initial velocity at A = 0)

Hence, total Energy at A = P.E + K.E. = mgh — ①

At point B :

P.E. = $mg \times$ height from the ground = $mg(h-x)$

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

Using III equation of motion : $v^2 - u^2 = 2as$ $(a=g)$

$v^2 - 0^2 = 2g(x) \Rightarrow v^2 = 2gs$

$\therefore$ K.E. $= \frac{1}{\cancel{2}} m \times \cancel{2}gx = mgx$

$\therefore$ total energy at B = P.E. + K.E. = $mg(h-x) + mgx$

Total energy at B = $mgh - \cancel{mgx} + \cancel{mgx}$

Total energy at B = mgh — ②

At point C : (On the ground) : P.E. = 0

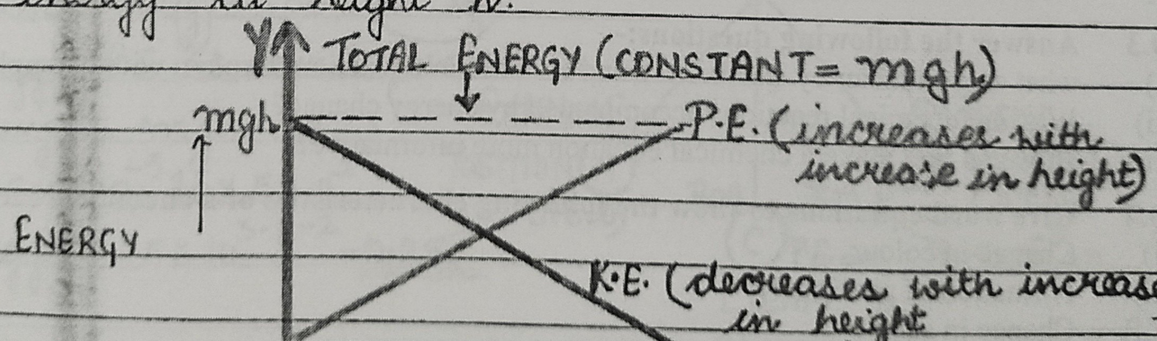
$u = 0$, $s = h$, $a = g \Rightarrow v^2 - u^2 = 2as$

$\therefore v^2 = 2gh$

K.E. = $\frac{1}{2}mv^2 = \frac{1}{2}m \times 2gh = mgh$

$\therefore$ Total Energy = K.E. + P.E. = $mgh - 0 = mgh$ — ③

Thus, from equations ①, ② and ③ total mechanical energy (i.e. the sum of kinetic and potential energy) always remains constant and is equal to the initial potential energy at height h.



NOTE — The conservation of mechanical energy is valid only in the absence of external forces such as friction due to air etc.

(Students, pause this interactive session and again go through the topic of conservation of mechanical energy).

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Conservation of mechanical energy will be further cleared in the following solutions of the numericals.

EXAMPLE-1 (PAGE NUMBER-45)

mass, $m = 50\,g = 50 \times 10^{-3}\,kg$, $u = 20\,m/s$

i) Initial K.E. $= \frac{1}{2} mu^2 = \frac{1}{2} \times 50 \times 10^{-3} \times 20 \times 20 = \underline{\underline{10\,J}}$

ii) According to conservation of energy, if there is no friction then whole of K.E. is converted into P.E. So,

$$P.E. = K.E.$$

$$mgh = 10\,J \leftarrow \text{(as found above)}$$

$$h = \frac{10}{mg} = \frac{10}{50 \times 10^{-3} \times 10} \quad (\text{as } g = 10\,m/s^2)$$

$$h = \frac{10 \times 10^3}{500} = \underline{\underline{20\,m}}$$

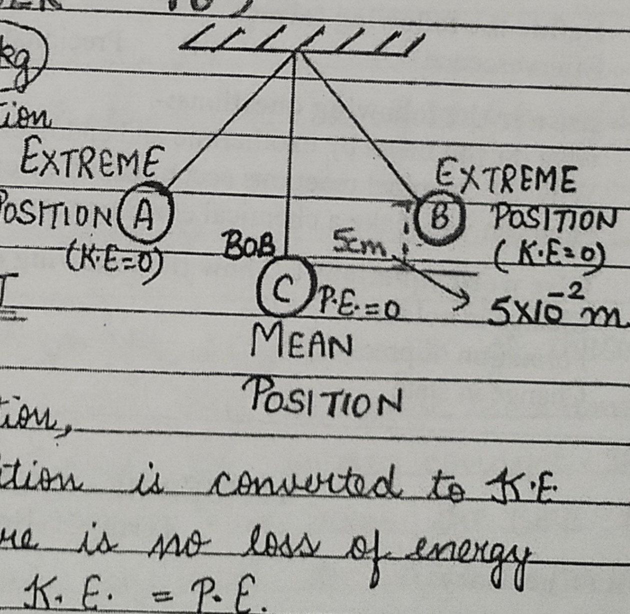
iii) 40% of initial energy is lost against air friction. It means that, 60% of initial energy = P.E.

i.e. 60% of K.E. = P.E. or, $\frac{60}{100} \times 10 = mgh$

$$h = \frac{\frac{60}{100} \times 10}{50 \times 10^{-3} \times 10} = \underline{12\,m}$$

EXAMPLE-3 (PAGE NUMBER-46)

mass of bob $= 500\,g = 500 \times 10^{-3}\,kg$



i) Total energy = P.E. at extreme position

$\therefore$ Total energy $= mgh$

$= 500 \times 10^{-3} \times 10 \times 5 \times 10^{-2}$

Total Energy $= 25 \times 10^{3-3-2} = \underline{0.25\,J}$

ii) To find velocity at mean position, whole of P.E. at extreme position is converted to K.E at mean, assuming that there is no loss of energy due to air friction. So, K.E. = P.E.

$$\frac{1}{2} \cancel{m} v^2 = \cancel{m} gh \Rightarrow v = \sqrt{2gh} = \sqrt{2 \times 10 \times 5 \times 10^{-2}}$$

$$v = 1\,m/s$$

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NUMERICALS OF EXERCISE – 2 (C)

5. (Page Number 47)

Efficiency (40%) = $\frac{\text{Output Energy}}{\text{Input Energy}}$ → Electrical Energy = P×t
→ Potential Energy

$$\left\{ \frac{40}{100} = \frac{\text{Power} \times \text{time}}{m \times g \times h} \right\}$$

Power = 1 MW = 1 Mega Watt = 1×10^6 Watt {given}

Time = 1 second

$$\frac{4\cancel{0}}{10\cancel{0}} = \frac{10^6 \times 1}{m \times 10 \times 50} \Rightarrow m = \frac{10^6 \times \cancel{10}}{4 \times \cancel{10} \times 50}$$

$$m = \frac{10^6}{200} = \frac{10000\cancel{00}}{2\cancel{00}} = \underline{\underline{5000\ kg}}$$

6. (Page Number 47) 60% of energy is lost means only 40% of input energy is getting converted into output energy.

40% of Input Energy = Output Energy

40% of K.E. (at mean position) = P.E. (at extreme)

$$\frac{40}{100} \times \frac{1}{2} \cancel{m} v^2 = \cancel{m} g h$$

$$\frac{\cancel{4}^{2}}{\cancel{10}_{5}} \times \frac{1}{\cancel{2}} \times \frac{5 \times 5}{10} = h \qquad (g = 10\ m/s^2)$$

$$h = \frac{5}{10} = \underline{0.5\ m}$$

INSTRUCTIONS: students you are required to go through the given notes thoroughly and try to solve the numericals again after understanding the entire concept. It is advised to read the respective topic from the Book ~~too~~.

HOME WORK: students are required to do Q-18, 19, 20, 24 of Exercise – 2 (B) (Page Number – 41) in physics notebook. Also do numerical 1 to 4 of Exercise – 2 (C) (Page – 47) in Physics notebook.

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