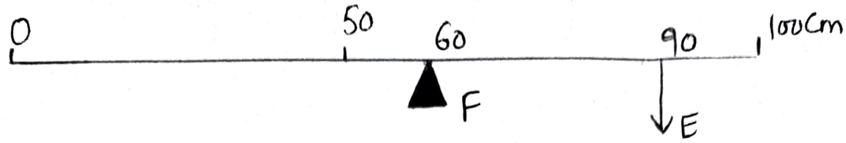
Dated:- 13.05.24

TENDER HEART HIGH SCHOOL, SEC-33B, CHD. (Page-1)

CLASS-X Sub:- PHYSICS, TEACHER: CHARANJEET KAUR

Chapter-3 (A) Machines

Q23



(a) State whether the weight W of the rule is greater than, less than or equal to the effort E.

Ans To balance the scale, weight of the rule must be greater

(here, Effort Arm > Load arm)

for balancing Effort Arm = Load arm)

(b) Find the Mechanical Advantage (M.A) in an Ideal Case?

Ans Load arm = 10cm

Effort arm = 30cm

as $M.A = \frac{\text{Effort arm}}{\text{Load arm}} = \frac{\cancel{30}\,cm}{\cancel{10}\,cm} = 3$

So $\boxed{M.A = 3}$

Q1 Numericals :→

Crow bar length = 120cm

Load arm = 20cm

Effort arm = 120 − 20 = 100 cm

Mechanical Advantage $= \frac{\text{Effort arm}}{\text{Load Arm}} = \frac{\cancel{100}}{\cancel{20}} = 5$

$\boxed{M.A = 5}$

(3) Load arm = 5cm, Effort Arm = 10cm

Also, Load = 5kgf

$\therefore M.A = \frac{EA}{LA}$

$= \frac{\cancel{10}\,2}{\cancel{5}} = 2$

$\boxed{M.A = 2}$

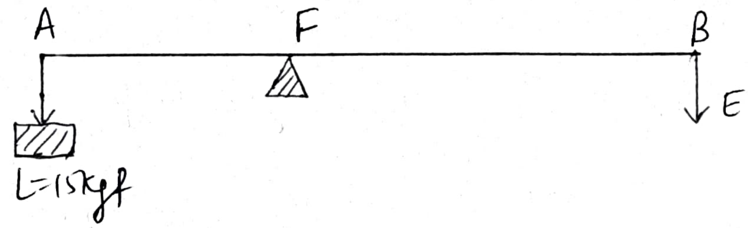
[EA - Effort arm

[LA = Load arm]

Also $M.A = \frac{\text{Load}}{\text{Effort}}$

$2 = \frac{5}{\text{Effort}}$ or Effort $= \frac{5}{2} = 2.5$ kgf Ans

Q4



(a) It is Class-I lever ($\because$ Fulcrum is in between L and E)

(b) AB = 1m = 100cm ; So BF = 1m − 0.4m = 0.6m (Effort arm)
Also AF = 0.4m (Given) (load arm = 0.4m)

$\therefore M.A = \frac{EA}{LA} = \frac{0.6m}{0.4m} = \frac{\cancel{6}3}{\cancel{4}2} = 1.5 = M.A$

(c) Calculate E = ?

$\because M.A = \frac{Load}{Effort} = \frac{15kgf}{E}$

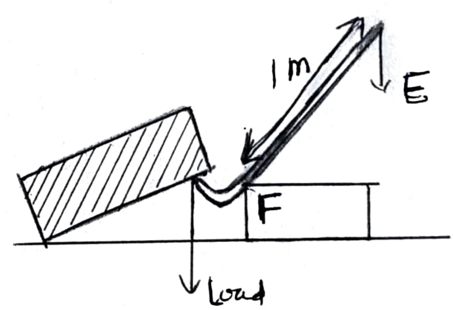
$1.5 = \frac{15}{E}$

$E = \frac{15}{1.5} = \frac{\cancel{15}\times 10}{\cancel{15}} = 10kgf$

So $\boxed{E = 10kgf}$

Q5

Crowbar length = 1.5m, Load = 75kgf
Effort arm = 1m
So Load arm = 1.5 − 1.0
= 0.5m



(i) Load arm = 0.5m

(ii) Effort arm = 1m

(iii) $M.A. = \frac{EA}{LA} = \frac{1.0m}{0.5m} = 2$ So $\boxed{M.A = 2}$

(iv) $M.A = \frac{L}{E} \Rightarrow 2 = \frac{75kgf}{E}$

So $E = \frac{75}{2}$ 37.5kgf

So $\boxed{E = 37.5kgf}$

Q6:→ Load arm = 8.0 cm , E = 10 kgf , EA = 2 cm

(a) $M.A = EA/LA = \frac{2\,cm}{8\,cm} = 0.25$ So $\boxed{M.A = 0.25}$

(b) Load = ? ∵ $M.A = \frac{L}{E} \Rightarrow 0.25 = \frac{L}{10}$ So $\boxed{Load = 2.5\,kgf}$

(c) A pair of scissors acts as a speed multiplier as there is large displacement of load as compared to effort displacement. Also (M.A < 1) ∵ 0.25

Q7:→ Rod length = 4m;

Load = 18 kgf which is placed at 60 cm from the support (fulcrum) on the shorter arm

(a) Let, weight is placed at 250 cm from the support (fulcrum) on the longer arm to balance the rod, find W = ?

By principle of moments at Eqm or balancing situation,

Load × load arm = Effort × Effort arm

$$18\,kgf \times 60\,cm = W \times 250\,cm$$

$$\frac{18 \times 6\cancel{0}}{25\cancel{0}} = W$$

$$4.32 = \frac{108}{25} = W$$

or $\boxed{W = 4.32\,kgf}$

(b) If a weight of 5 kgf is kept to balance the rod, find its position (d)?

Again using principle of moments;

$$18\,kgf \times 60\,cm = 5\,kgf \times d\,cm$$

$$\frac{18 \times \cancel{60}^{12}}{\cancel{5}} = d$$

$$216 = d$$

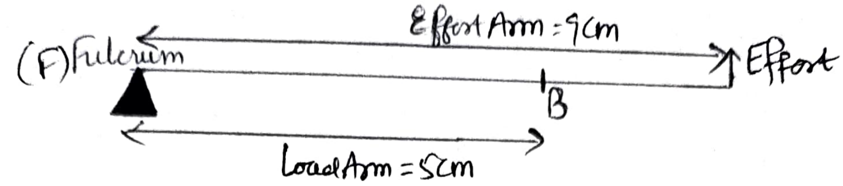
d = 216 cm or 2.16 m Ans

(c) It is class I lever (∵ Fulcrum is in b/w Load & Effort)

Q.8 lever length = 9cm, load arm = 5cm, Effort arm = 9cm

(a) as Effortarm > load arm so It is a class II lever.

(b)



$M.A = EA/LA = 9cm/5cm = 1.8$

$\boxed{M.A = 1.8}$

(c) $\because$ $M.A = \eta \times V.R$ ($\because$ V.R – Velocity ratio)
(η – Efficiency)

$\eta = 100\%$ (Given)

So $M.A = 1 \times V.R$

$1.8 = 1 \times V.R$

$\boxed{1.8 = V.R}$ as $M.A = V.R = 1.8$

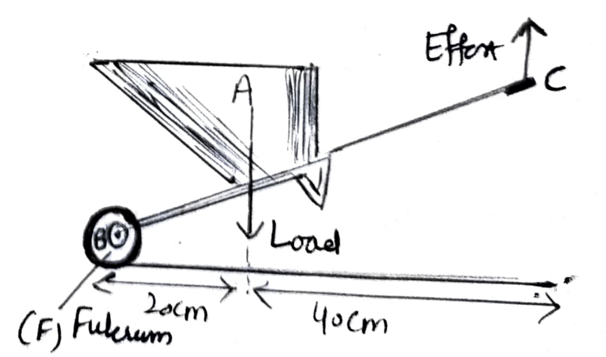
(d) If effiency becomes 50% or $\eta = 50\%$ or $\eta = \frac{1}{2}$

So $M.A = \eta \times V.R$

$M.A = \frac{1}{2} \times 1.8$

$\boxed{M.A = 0.9}$ So M.A reduces but V.R remains the same.

Q10:→ mass = 15kg, load = 30kgf



(a) Load Arm = 20cm

(b) Effort Arm = 60cm

(c) $M.A = EA/LA = \frac{\cancel{60}^{3} cm}{\cancel{20} cm}$

$\boxed{M.A = 3}$

(d) Effort = ? , $M.A = \frac{L}{E}$ (Total load = 15kgf + 30kgf = 45kgf $\because$ Wheel Barrow mass = 15kg)

So $3 = \frac{45kgf}{E}$

$E = \frac{\cancel{45}^{15}}{\cancel{3}} kgf = 15kgf$ Ans ($\because$ 1kgf = 1kg)

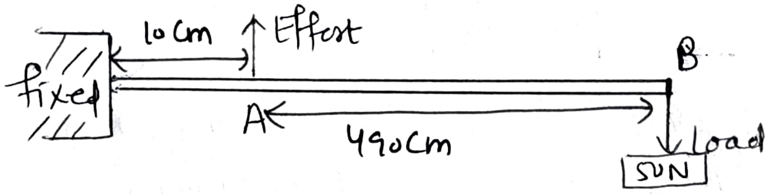
(11) (a) Principle of moments ~~is~~ moment of load about the fulcrum = moment of Effort about fulcrum

or [Load × load arm = Effort × Effort arm]

(b) CLASS-3 (III) lever and example of Class-3 lever is foot Treadle / Sugar tongs

(c) Effort arm (FA) = 10cm

AB = 490cm ; Load arm = 490cm + 10cm = 500cm



(i) M.A. = ? = Effort arm / Load arm

$= \frac{10}{500} = \frac{1}{50}$

$\boxed{\therefore M.A = 1/50}$

(ii) minimum effort required = ?

$M.A. = \frac{L}{E} = \frac{50N}{E}$

$\frac{1}{50} = \frac{50}{E}$

$E = 50 \times 50 = 2500N$

$\boxed{E = 2500N}$

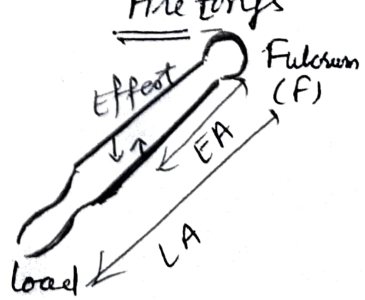
(12) fire tongs arm length = 20cm , Load = 1.5kgf

EA = 15cm , (i) M.A = ?

LA = 20cm

$M.A = \frac{EA}{LA} = \frac{\cancel{15}\,3}{\cancel{20}\,4} = 0.75$

$\boxed{M.A = 0.75}$



(ii) $M.A = \frac{L}{E}$

$0.75 = \frac{1.5}{E}$ or $E = \frac{1.5}{0.75} = \frac{15}{75} \times \frac{100}{10} = 2kgf = E$ Ans