Chapter-3(B) (Pulley)

Numericals:→ ① Mass of (Bucket + water) = load = 6kg.

So load = 6×10 N = 60N (Load = force = mg)

Effort (force applied by woman) = 70N

So Mech. Advantage = $\frac{\text{Load}}{\text{Effort}} = \frac{60\text{N}}{70\text{N}} = 0.857$ Ans

② Fixed pully :- load = 75Kgf = 75×10N (∵ 1Kgf = 10N)

load = 750N

here E = driven force = mg = 100 × 10 = 1000 N

Effort = 1000 N

(a) Power Input to pulley = ?

Also; Velocity = $\frac{\text{Displacement}}{\text{Time}} = \frac{8.0\text{m}}{4.0\text{s}} = 2\text{m/s}$

Power i/p = Force × velocity = effort × velocity

= 1000 N × 2 m/s

Pinput = 2000 watt

(b) $M.A = \frac{\text{Load}}{\text{Effort}} = \frac{750\text{N}}{1000\text{N}} = 0.75$

as $M.A = \eta \times V.R$ (η is efficiency)

So $0.75 = \eta \times 1$ (∵ V.R of Single fixed pulley is one i.e V.R = 1)

$0.75 = \eta$

or $\eta = \frac{75}{100} = 75\%$ Ans

(e) Height to which the load is raised in 4s ?

As Load and Effort displacements are same in a single fixed pulley i.e Load moves by the same distance upwards (or raised) when effort moves by a certain distance downwards.

So; Load raised by 8m in 4s. Ans

Q3:→ In Case of Single fixed pulley; MA = 1 So L = E

So, L = 50kgf ∴ E = 50kgf

In Case of Single movable pulley; MA = 2 So $E = \frac{L}{2}$

So, L = 50kgf ∴ $E = \frac{50\text{kgf}}{2} = 25\text{kgf}$

So; Ratio of these two will be; $\frac{E_{\text{Single fixed pulley}}}{E_{\text{Single movable pulley}}} = \frac{50\text{kgf}}{25\text{kgf}} = \frac{2}{1}$

$E_{\text{S.F Pulley}} : E_{\text{S.M Pulley}} = 2 : 1$

Q4:→ Block and Tackle system of 3 pulleys

So n = 3 (no of Pulleys)

Load = 75kgf; Effort = 25kgf

(i) $M.A = \frac{L}{E} = \frac{75\text{kgf}}{25\text{kgf}} = 3$

So MA = 3

(ii) Velocity Ratio :- ?

As there are 3 pulleys in the system or 3 sections or segments of the string

As VR = Segments of the String = 3

VR = 3 Ans

(4) (iii) Efficiency $= \frac{M.A}{V.R} = \frac{3}{3} = 1 = 1$

or $\boxed{\eta = 100\%}$

(5) Block and Tackle system has 5 pulleys. So $\boxed{n = 5}$

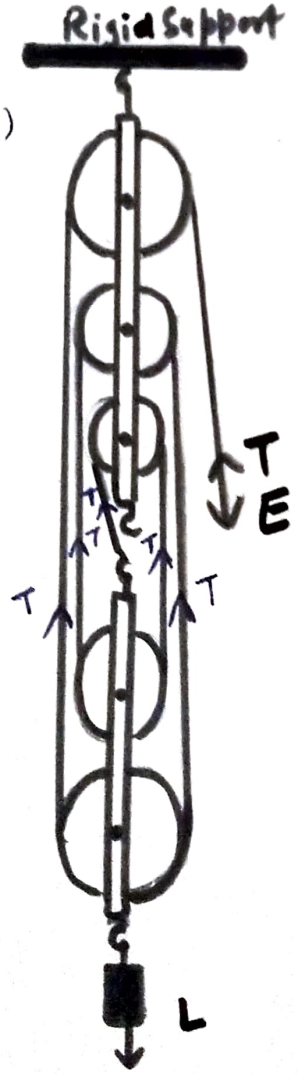
Effort = 1000N, Load ⇒ 4500N

(a) $M.A = \frac{4500\,N}{1000\,N} = 4.5$

(b) $V.R = 5$ [as 5 segments of system]

(c) $\eta = ? = \frac{M.A}{V.R} = \frac{4.5}{5} = 0.9$ or 90% Ans

(6)



(a)

(b) If load is raised by 1m then Effort will move up by 5m ∵ In a system of 5(n) pulleys if load moves up through d metre then each segment of string carrying the load is loosened by d metre so effort end moves through nd metre and here n = 5 so Effort displaces by 5m.

(c) No. of strands are 5

(d) $M.A = \frac{L}{E} = \frac{5T}{T} = 5$ Ans

[here L = 5T, E = T]

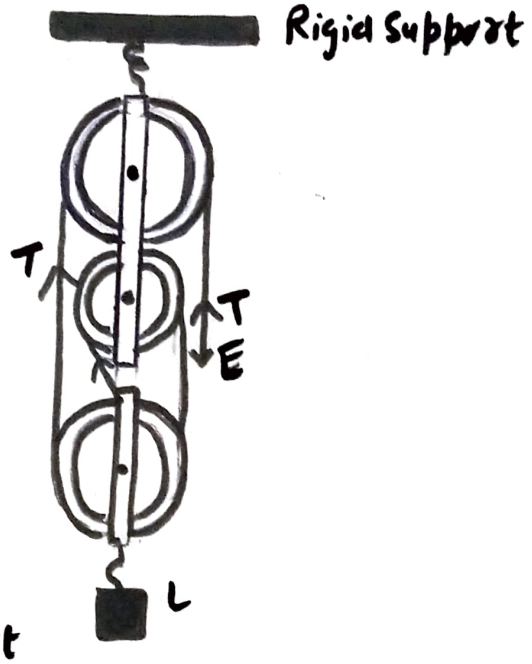
(7) V.R = 3 , Load = 150N, Effort = 60N

$$M.A = \frac{L}{E} = \frac{150}{60} = 2.5$$

For an Ideal Case; M.A = number of pulleys of the System

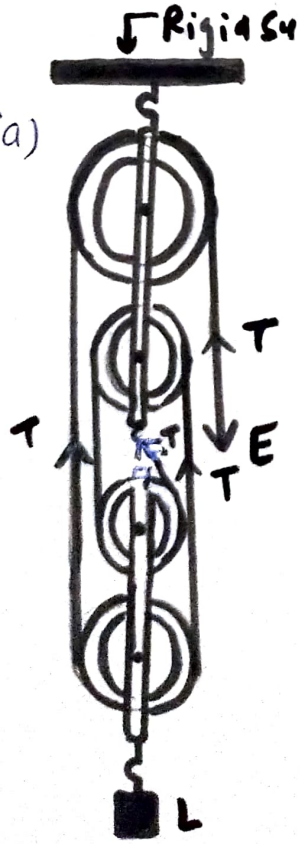
In this Case M.A = 2.5 < 3 (∵ here no. of pulleys in System = 3)

So, the pulley system is not Ideal.



Ques 8.

(a)



Velocity ratio (V.R) = $\frac{d_E}{d_L}$ = ?

(∵ In a System of n pulleys if load moves up by distance 'd' then each segment of string supporting the load is loosened by a length 'd' so effort moves by a distance nd] ($d_L = d$, $d_E = nd$)

∴ V.R = n

Here 4 pulleys are there so $d_L = d$

and $d_E = 4d$

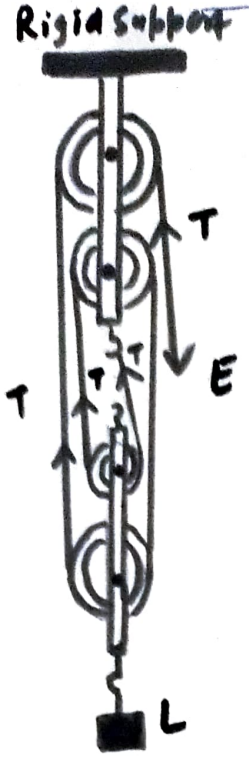
(b) S. V.R = $\frac{4d}{d} = 4$

Also;

(c) M.A = total no. of pulleys = 4

$M.A = \frac{L}{E} = 4$ or $\boxed{L = 4 \times E}$

Q.9:→



(a) No. of strands supporting the load is 4 Ans

(c) $M.A = \frac{L}{E}$, $L = 4T$ (from diagram)
$E = T$

So $M.A = \frac{4T}{T} = 4$ (as no. of pulleys = 4)

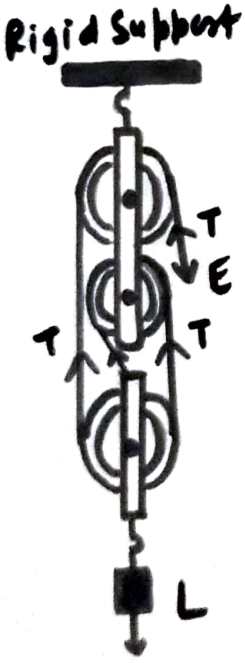
(d) Effort end moves through 4m
(∵ Effort moves by 4 times the distance through which load moves)
(∵ no. of pulleys are 4 here)

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

$4 = \frac{100N}{E}$ or $E = \frac{100}{4} 25N = 25N$

(f) Velocity ratio remains 4 (= no. of pulleys)

Q.10:→



So ↴
V.R = 3 (no. of pulleys = 3) & $\eta = 60\%$

(a) Effort = 200 kgf So $MA = \eta \times VR$ [V.R = 3]
Load = ?

$\frac{L}{E} = \frac{60}{100} \times 3$

$\frac{L}{2\omega} = \frac{60}{100} \times 3$

or $L = \frac{60 \times 3 \times 200}{100}$

$L = 360$ kgf

(b) $d_E = 60$cm
$d_L = ?$

$V.R. = \frac{d_E}{d_L}$

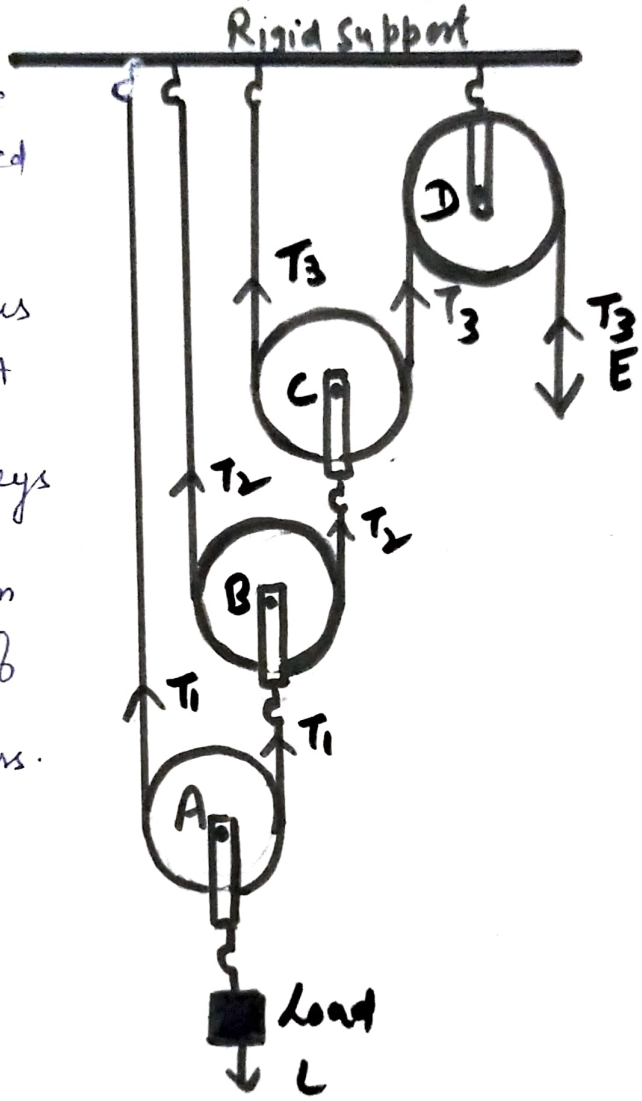
$3 = \frac{60}{d_L}$ or $d_L = \frac{60}{3} = 20$cm Ans

(11) Ans for M.A = 8 (we required n movable pulleys with one fixed pulley, then M.A = 2^n)

here M.A = 2^3, n = 3

So 3 movable pulleys and one fixed pulley is needed to obtain M.A = $2^3 = 8$

⇒ System of 3 movable and one fixed pulley:→



⇒ Assumptions made by us to obtain required M.A are

① Weight of the pulleys are negligible

② There is no friction b/w the bearings of the pulleys

③ String is massless.