Given data

Case - I

W = 7800 N

P = 150 N

$\eta = 0.52$

① $M.A = \frac{W}{P}$

Ⅱ $\left\{ V.R = \frac{D_E}{d_L} \right\}$

Ⅲ $\eta = \frac{M.A}{V.R} \times 100\%$

To find:- ① M.A. Ⅱ V.R.

Case - (II)

P = 250 N

W = 13500 N

$\eta = ?$

Solve:- Case - I

① $M.A = \frac{W}{P} = \frac{7800}{150} = 52$

Ⅱ $\cancel{V.R} \; \eta = \frac{M.A}{V.R}$

$0.52 = \frac{52}{V.R}$

$\{V.R. = 100\}$

Case - (II)

$M.A = \frac{W}{P} = \frac{13500}{250} = 54$

Note:- VR is same for a single Machine.

V.R. = 100

$\left\{ \eta = \frac{M.A}{V.R} \times 100\% = \frac{54}{100} \times 100\% = 54\% \right\}$

Lifting Machines

(1) Levers. → will discuss in Moment chapter.

(2) pulleys-

- (i) Single pulley.
- (ii) First system of pulleys.
- (iii) Second " ".
- (iv) Third " ".
- (v) Weston's differential pulley.

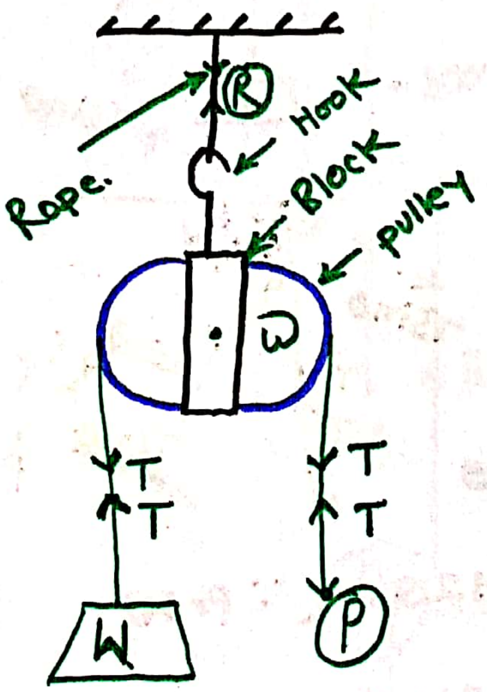
(3) Simple wheel & Axle

(4) Differential wheel and axle.

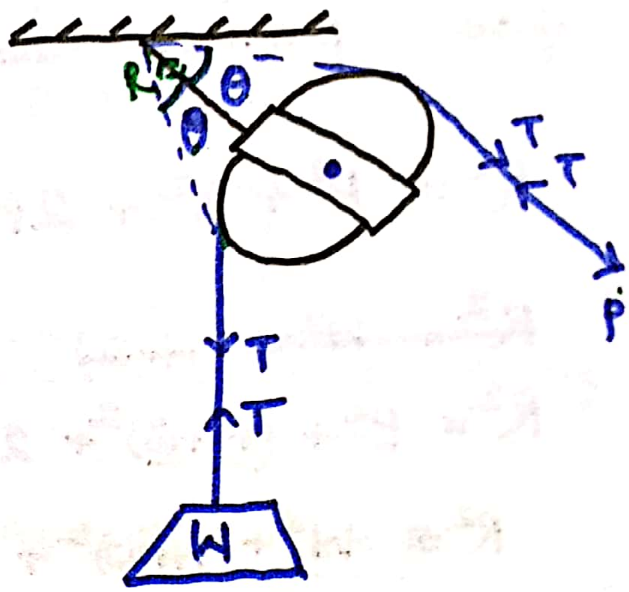
Single pulley :-

for Calculations it is assumed that pulley is frictionless and the ~~effort~~ / weight of the string is neglected. String is flexible.

①



②



W = Weight (N)

P = Effort (N)

R = Reaction (N)

At equilibrium -

$$P = W = T$$

$$\therefore M.A. = \frac{W}{P} = 1$$

$$\left\{ V.R. = \frac{D_E}{D_L} = \frac{D}{d} = 1 \right\}$$

There is no M.A. more Only one advantage that effort can be applied in any direction.

<u>from diagram - ①</u>

$$R = W + P = T + T = 2T$$
$$= 2W$$

but if weight of pulley is ω then

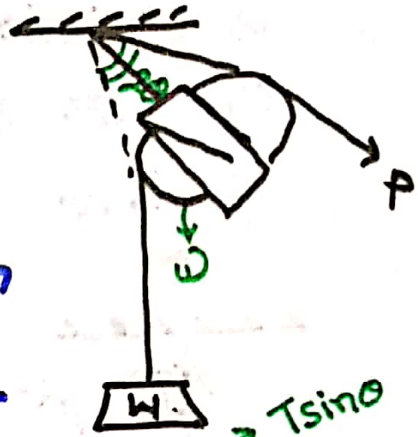
$$R = W + P + \omega = 2T + \omega$$
$$\left[R = 2W + \omega \right]$$

In ② diagram-

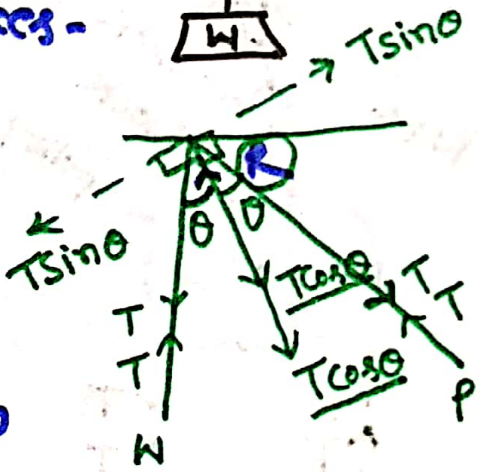
Effort is at 2θ from weight line of action.

$$R = T\cos\theta + T\cos\theta$$

$$R = 2T\cos\theta = 2W\cos\theta.$$



If the weight of the pulley is ω then from parallelogram law of forces-



$$R^2 = P^2 + Q^2 + 2PQ\cos\alpha$$

~~$R^2 = W^2 + (W+\omega)$~~

$$R^2 = P^2 + (W+\omega)^2 + 2P(W+\omega)\cos 2\theta$$

$$R^2 = W^2 + (W+\omega)^2 + 2W(W+\omega)\cos 2\theta \quad (\because P = W)$$

$$R^2 = W^2 + W^2 + \omega^2 + 2W\omega + (2W^2 + 2W\cdot\omega)(2\cos^2\theta - 1)$$

$$R^2 = \cancel{2W^2} + \omega^2 + \cancel{2W\omega} + 4W^2\cos^2\theta + 4W\omega\cos^2\theta - \cancel{2W^2} - \cancel{2W\cdot\omega}$$

$$\boxed{R^2 = \omega^2 + 4W\cos^2\theta\,(W+\omega)}$$