Question:- 60 N weight of a drum is filled with 400 N of water is to be pulled up with the help of a wheel and axle from a well. Dia. of wheel and axle is 40 cm and 10 cm. If 120 N effort is applied to lift the drum up on wheel then find-

(i) M.A. (ii) V.R. (iii) η of Machine.

Given data

Wheel	Axle	
$R = 20\,cm$	$r = 5\,cm$	$P = 120\,N$

$$W = 60\,N + 400\,N = 460\,N$$

Solve:- To find out

(i) $M.A. = \frac{W}{P}$

(ii) $V.R. = \frac{R}{r}$

(iii) $\eta = \frac{mA}{VR} \times 100\%$

(i) $\left\{ m.A. = \frac{W}{P} = \frac{460}{120} = 3.83 \right\}_{//}$

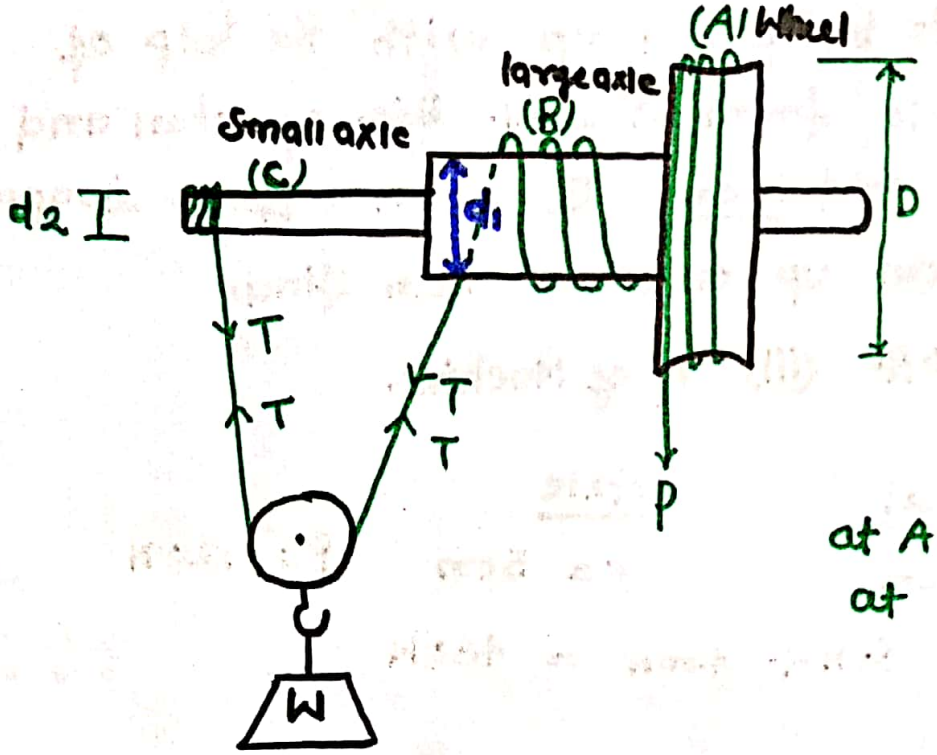
(ii) $\left\{ V.R. = \frac{R}{r} = \frac{20}{5} = 4 \right\}_{//}$

(iii) $\eta = \frac{M.A.}{V.R.} \times 100\% = \frac{3.83}{4} \times 100$

$$\eta = 0.95 \times 100$$

$$\boxed{\eta = 95\%}_{//}$$

Differential wheel and axle :-



at A and C → opens
at B → Wrapsup.

→ Distance Moved by effort = $2\pi R = \pi D$

→ Distance moved by load = $\frac{\pi d_1 - \pi d_2}{2}$

$$\therefore \left[V.R. = \frac{2\pi R}{\frac{2\pi R_1 - 2\pi R_2}{2}} = \frac{\pi D}{\frac{\pi d_1 - \pi d_2}{2}} = \frac{2D}{d_1 - d_2} \right]$$

D = Dia of wheel
d_1 = dia. of large Axle
d_2 = dia of small axle.

for ideal Machine -

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

$$\left[M.A. = V.R. = \frac{2D}{d_1 - d_2} \right]$$

Question:- In a differential wheel and axle, the dia of axles are 12 cm and 8 cm respectively. If it can lift 310 N with the effort of 14 N. then find the dia of wheel. η of the Machine is 85%.

Given data:-

Axle $\begin{cases} d_1 = 12\text{ cm} \\ d_2 = 8\text{ cm} \end{cases}$: $P = 14\text{ N}$

$W = 310\text{ N}$

$\eta = 85\% = 0.85$

To find out:- $D = ?$

Solve:-

(i) $V.R. = \dfrac{2D}{d_1 - d_2} = \dfrac{2D}{12-8}$:

$$\boxed{V.R = \frac{D}{2}}$$

(ii) $M.A. = \dfrac{W}{P} = \dfrac{310}{14} = \dfrac{310}{14}$

(iii) $\eta = \dfrac{M.A.}{V.R.}$

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

$\left(M.A. = \dfrac{310}{14}\right) = 0.85 \times \dfrac{D}{2}$

$D = \dfrac{310}{14} \times 2 / 0.85$

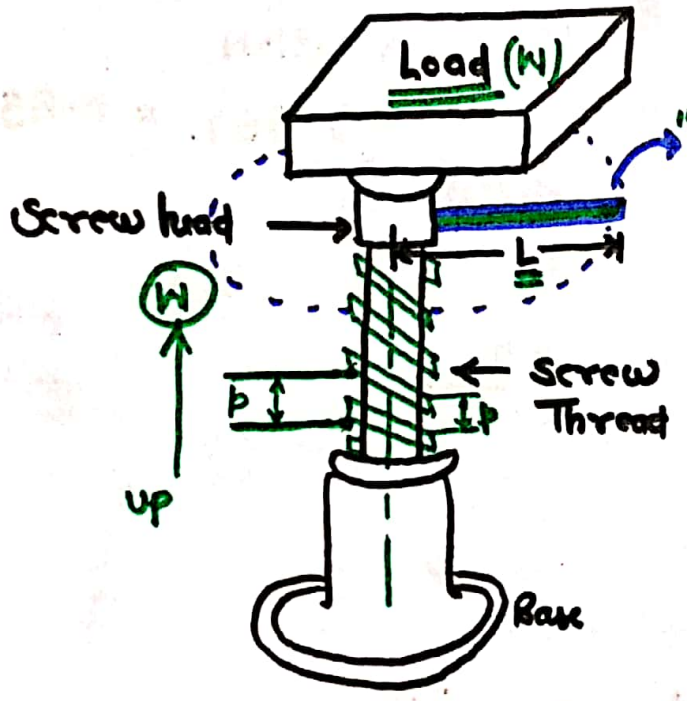
$D = \dfrac{310 \times 2}{14 \times 0.85} = \dfrac{620}{11.9}$

$[D = 52.1\text{ cm}]$ Wheel //.

Simple Screw Jack :-

→ To lift the maximum load with minimum effort.

→ The distance between one thread to another at same point is called pitch (p).



"Screw - jack"

→ Distance moved by effort = $2\pi L$

Distance moved by load = pitch = p

$$\therefore \left[V.R. = \frac{2\pi L}{p} \right]$$

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

if $\eta = 100\%$ (ideal)

then

$$\left\{ M.A. = V.R. = \frac{2\pi L}{p} \right\}$$