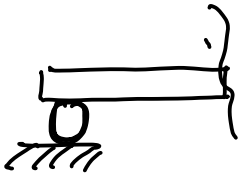
Equilibrium and Free Body Diagrams

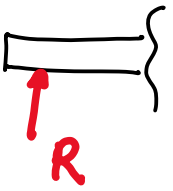
1. Draw a Free Body Diagram
2. Assign a coordinate frame
3. Apply equations of static equilibrium

$$\Sigma F_x = 0$$
$$\Sigma F_y = 0$$
$$\Sigma M_z = 0$$

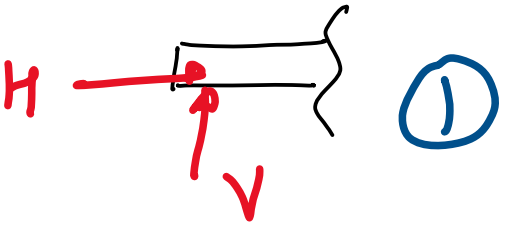
Reaction forces

1. Roller :

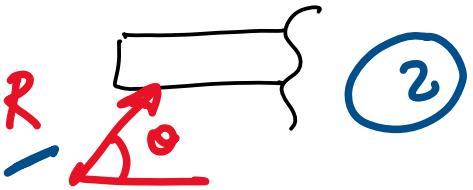




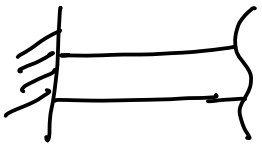
2. Pin / Bearing

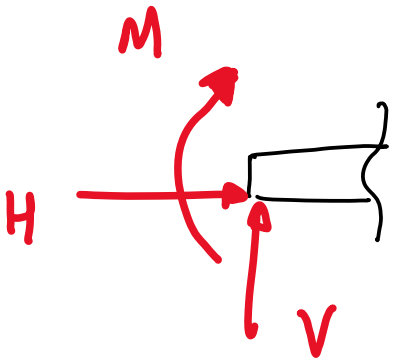


$$H = R\cos\theta$$
$$V = R\sin\theta$$

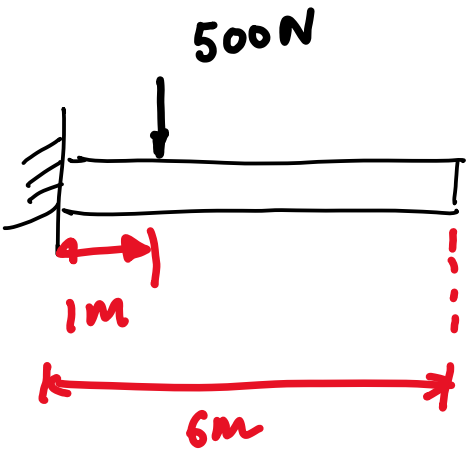


(3) Fixed support



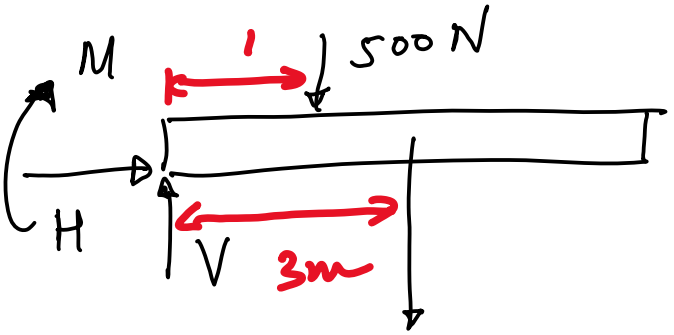


EXAMPLE



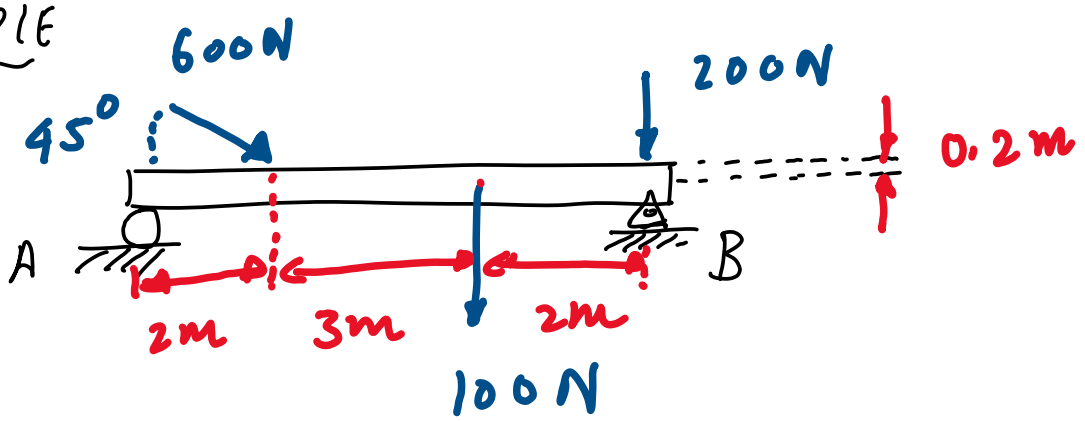
A beam with a mass of 100 kg is subject to a point load of 500 N. Draw a Free Body Diagram (FBD)

FBD



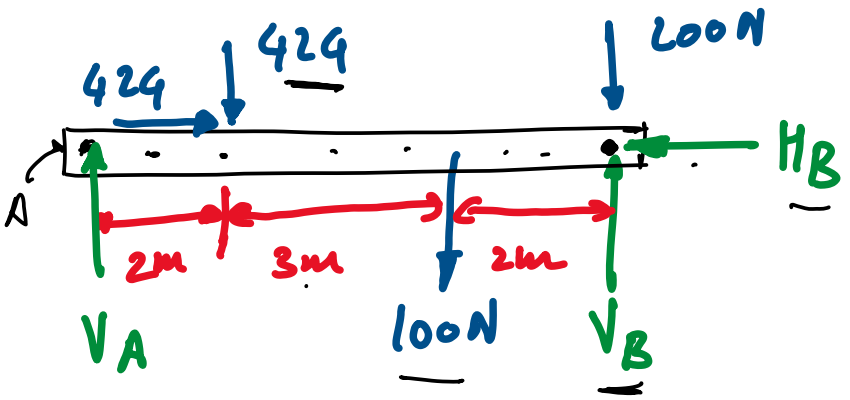
$W = 100\,(9.81) = 981\ N$

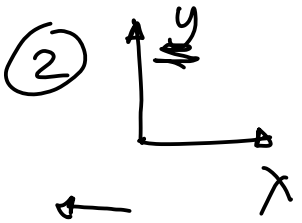
EXAMPLE



Compute the reaction forces at A and B

① FBD





$H = 600\ (\cos 45^\circ) = 600/\sqrt{2} = 424$

$V = 600\ (\sin 45^\circ) = 600/\sqrt{2} = 424$

③ $\Sigma F_x = 0 \Rightarrow -H_B + 424 = 0 \Rightarrow \boxed{H_B = 424\ N}$

$\Sigma F_y = 0 \Rightarrow V_A - 424 - 100 - 200 + V_B = 0$

$V_A + V_B = 724$

$\Sigma M_A = 0 \Rightarrow -(424)(2) - (424)(0.2) - (100)(5) - (200)(7) + V_B(7) = 0$

$\boxed{V_B = 405\ N}$ $\boxed{V_A = 724 - 405 = 319\ N}$

$V_B = 405\ N$

$V_A = 724 - 405 = 319N$

$=0$