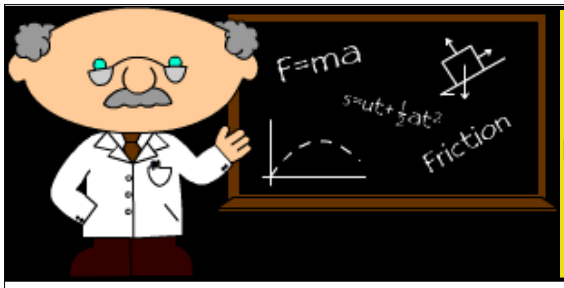
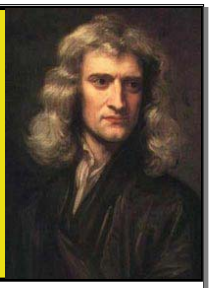


Unit 2: Dynamics



2.6 Static Equilibrium and Tension

Static = not moving

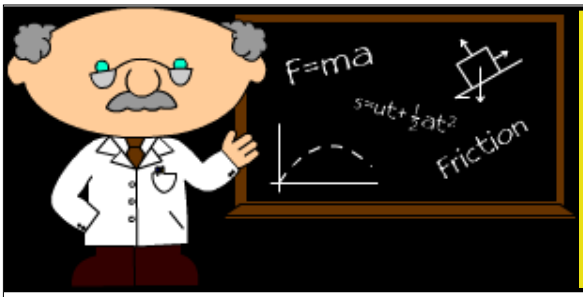
Equilibrium = balanced

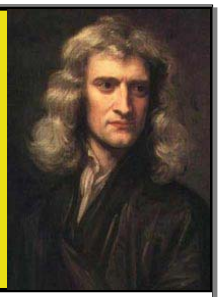
To say that the forces are balanced (an object is in equilibrium) means that the net force in both x and y directions is zero. Recall that the net force is the sum of all forces acting on an object.

Newton's 2nd Law says that an object with no net force acting on it will never accelerate.

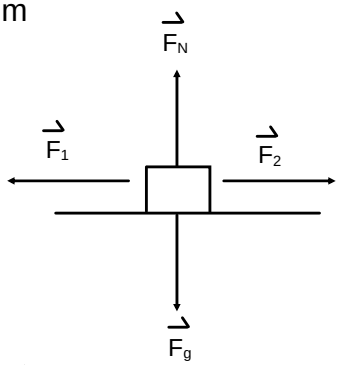
Therefore, we say "objects is equilibrium do not accelerate."

Often, these objects are at rest, hence the term static.





Ex.) Static Equilibrium



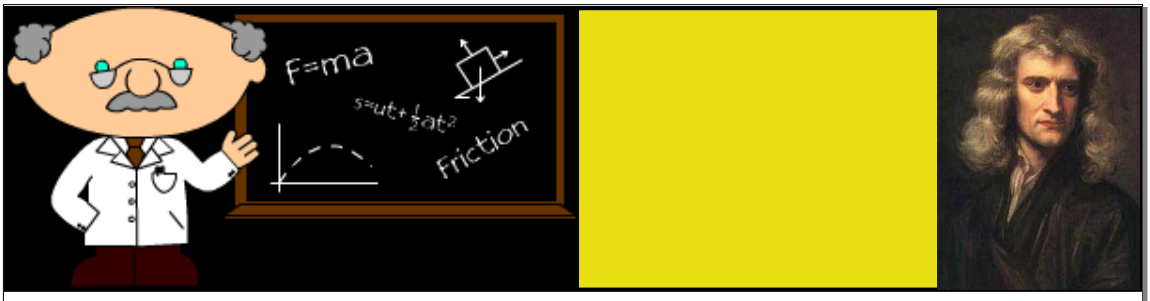
$\vec{F}_1 = \vec{F}_2$ (in magnitude)

$\vec{F}_N = \vec{F}_g$ (in magnitude)

the box is at rest

$\vec{F}_{netx} = 0$

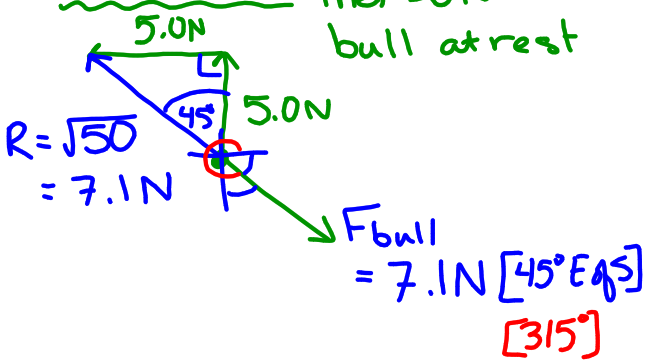
$\vec{F}_{nety} = 0$

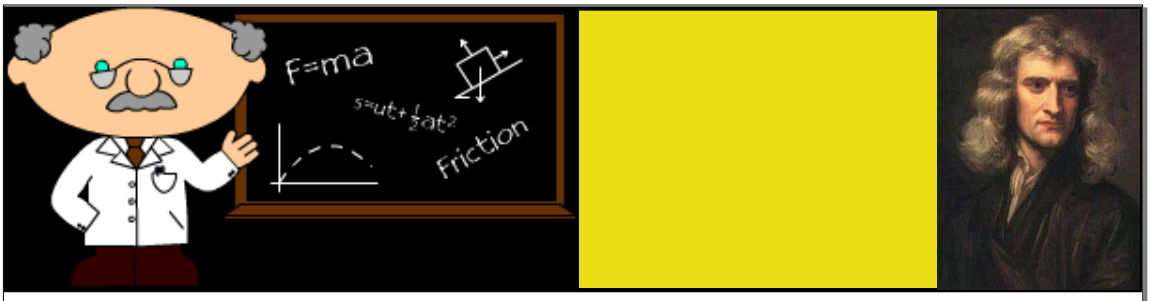


Ex.) Sarah and Cassidi are trying to lead a bull into a pen with ropes. Sarah pulls with 5.0 N due North and Cassidi pulls with 5.0 N due West. With what force must the bull pull at to maintain static equilibrium?

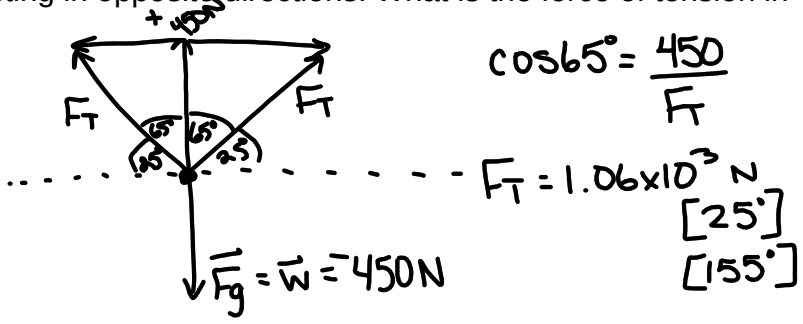
$F_{net} = 0N$
bull at rest

Steps:
1. Draw the vectors.
2. Write out total force statements.
3. Solve for the missing force.



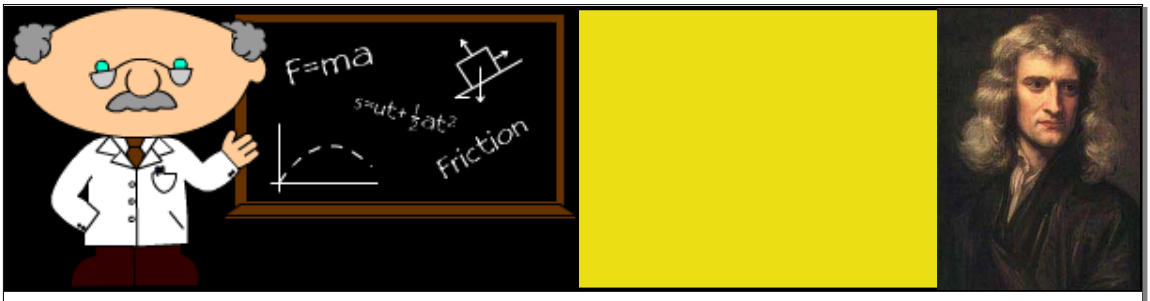


Ex.) A 450 N engine is suspended with two cables. The cables are both at 25° from the horizontal, acting in opposite directions. What is the force of tension in each cable?

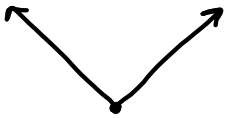


$\cos 65° = \frac{450}{F_T}$

$F_T = 1.06 \times 10^3$ N
[25°]
[155°]



Ex.) What happens to the tension of the cables when the angles are increased? Decreased?



Increased:

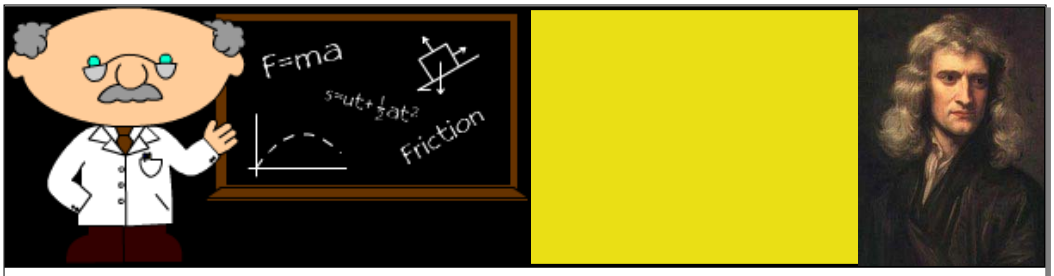
$\theta = 45°$

$\vec{F_T}$ Decreased

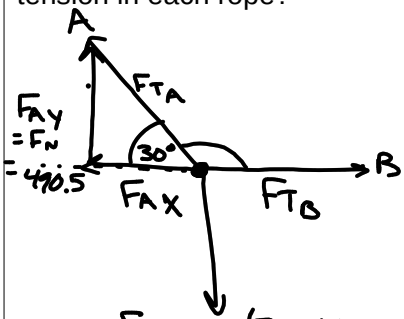
Decreased:

$\theta = 80°$

$\vec{F_T}$ Increases



Ex.) Two ropes suspend a 50.0 kg sign between two buildings. Rope A makes an angle of 30° to the horizontal while rope B is perfectly horizontal. What is the tension in each rope?



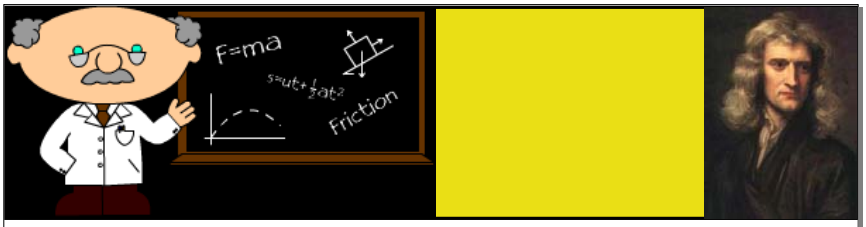
$\sin 30° = \frac{490.5}{F_{TA}}$ $\quad F_{TA} = 981\text{N}\ [150°]$

$\tan 30° = \frac{490.5}{F_{AX}}$ $\quad F_{AX} = 849.57\ldots\text{N}$

$F_{net} = F_{AX} + F_{TB}$

$0 = -849.57\ldots + F_{TB}$

$F_{TB} = 850\text{N}\ [0°]$



Ex.) A 3.0 kg photograph (width = 80 cm) is hung by a 120 cm wire attached to the corners of the frame. The frame is then hung on a nail so it is level. What is the magnitude of the tension in each part of the wire?

$\cos\theta = \frac{40}{60}$ no angle

60cm 60cm

θ

80cm

3.0kg

$F_g = (3.0)(-9.81)$
$= -29.43\ N$

Forces

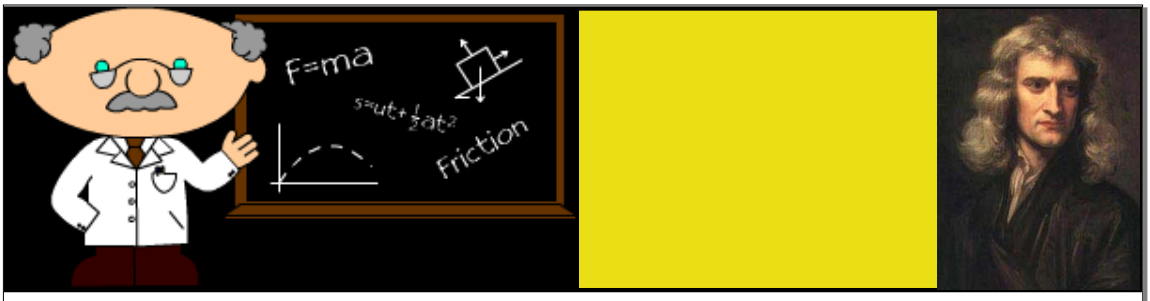
F_T

48°

F_x

$\sin 48° = \frac{29.43}{F_T}$

$F_T = 39N$



Questions: Pg. 136 # 5, 7, 8.