Read 10.6-10.9

Group problem: equilibrium
Last one!

Action Center Thursday

evaluations available

H.W Due Friday

office hours → 9:30-10:30

Reminder

Equilibrium

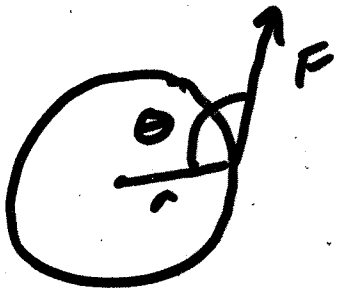
object not accelerating or rotating

$\vec{a} = 0$ $\quad$ $\vec{\alpha} = 0$

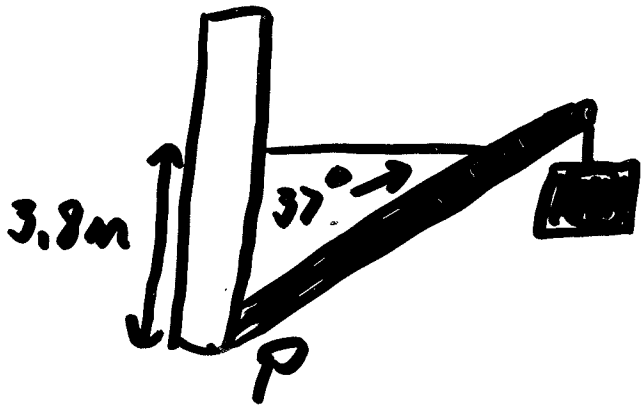
$\sum \vec{F} = 0$ $\quad$ $\sum \vec{\tau} = 0$

$(\sum \vec{F} = m\vec{a})$ $\quad$ $(\sum \vec{\tau} = I\vec{\alpha})$

$\tau = rF\sin\theta$

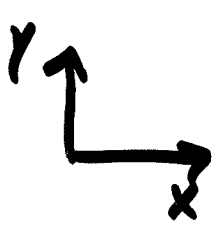


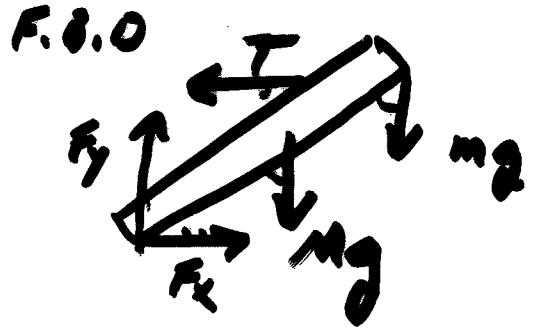
ex) A Traffic light hangs as shown

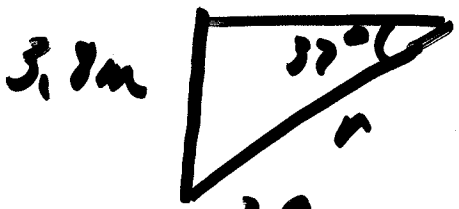


Pole 7.5m long (L)
Pole mass 8.0kg (M)
light mass 11kg (m)

Determine Tension in cable and Vertical and horizontal components of force on the pivot point P







$\sin 37° = \frac{3.8\,m}{r}$

$r \sin 37° = 3.8\,m$

$\Sigma \vec{\tau} = 0$

$-Mg\left(\frac{L}{2}\right)\sin 53° - mgL\sin 53° + T\underbrace{(r\sin 37°)}_{3.8m} = 0$

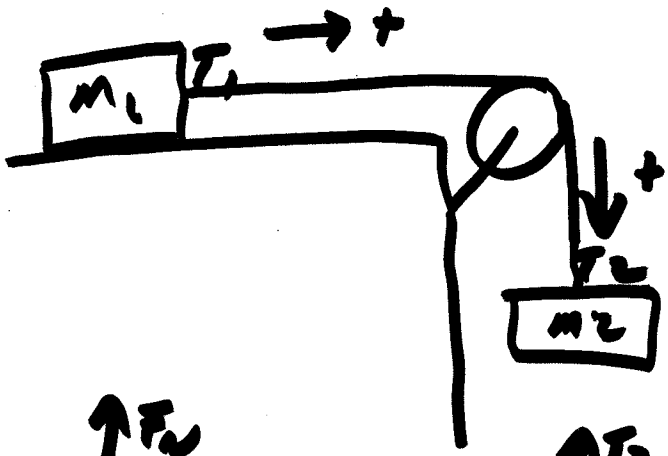
every thing known except for T

$T = 230\,N$

$\Sigma F_x = 0 \quad F_x - T = 0 \quad F_x = T = 230\,N$

$\Sigma F_y = 0 \quad F_y - Mg - mg = 0$

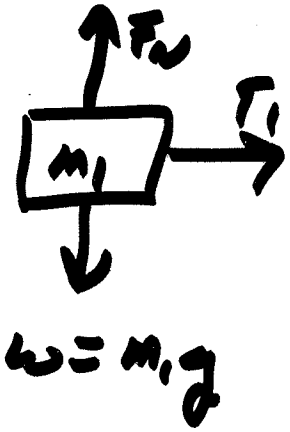
$F_y = Mg + mg = 190\,N$

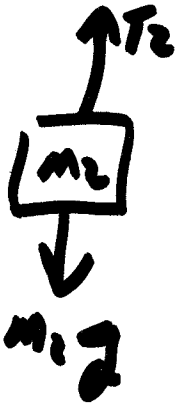


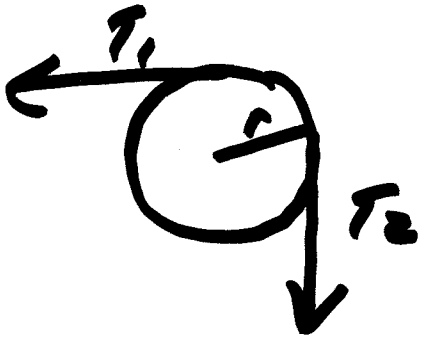
Pulley has moment of inertia I

table frictionless

Find acceleration







+ CCW

$\Sigma \tau = I\alpha$

① $T_1 = m_1 a$

$F_N = m_1 g$

② $m_2 g - T_2 = m_2 a$

③ $+rT_2 - rT_1 = I\alpha$

$+a = \alpha r +$

$\alpha = \frac{a}{r}$

③ → $rT_2 - rT_1 = I\frac{a}{r}$

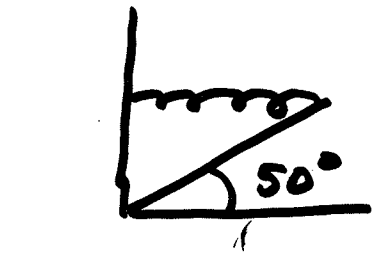
$r(m_2 g - m_2 a) - r(m_1 a) = I\frac{a}{r}$

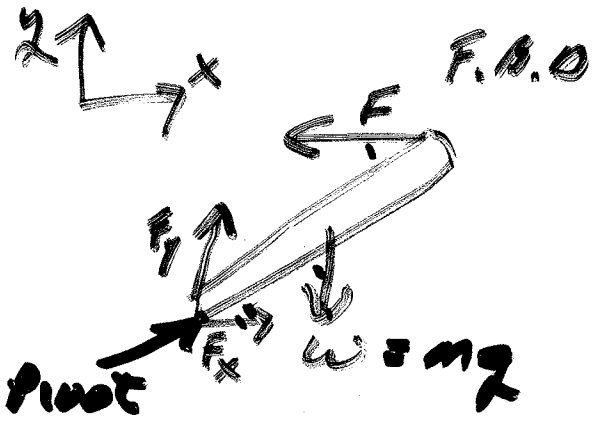
$r^2(m_2 g - m_2 a) - r^2(m_1 a) = Ia$

$a(I + r^2 m_2 + r^2 m_1) = r^2 m_2 g$

$$a = \frac{r^2 m_2 g}{I + r^2 m_2 + r^2 m_1}$$

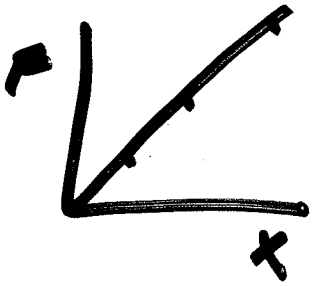
ex) A 10.1 kg uniform board is wedged in a corner and held by a spring at a 50° angle with respect to the horizontal. How much does spring stretch?
(k = 176 N/m)





$\Sigma\tau = 0 \qquad +F\left(\frac{L}{2}\right)\sin 50^\circ - mg\left(\frac{L}{2}\right)\sin 40^\circ = 0$

$\boxed{F = kx}$



$kx\sin 50^\circ - mg\left(\frac{L}{2}\right)\sin 40^\circ = 0$

$\boxed{x = .246\ m}$

Fluids

Fluid is an object which can flow
Does not maintain a fixed shape

Examples: liquids, gas

A convenient way to describe a fluid is density:

$$\rho \text{ (rho)} = \frac{m}{V}$$

often compare an object's density to density of water at 4.0°C

$$\rho \text{ (water at } 4^\circ\text{C)} = 1\ g/cm^3$$
$$= 1.00 \times 10^3\ kg/m^3$$

specific gravity: ratio of density of substance to water at 4.0°C

ex) Lead: density $= 11.3 \times 10^3\ kg/m^3$

specific density $= 11.3$

Pressure

Pressure : Force per unit area

$$P = \frac{F}{A}$$

Force acts perpendicular to surface area A.

Units of pressure (S.I.) $\frac{N}{m^2}$ = Pascal (Pa)

U.S : P.S.I. Pounds / square inch

Since atmosphere is always pushing on us with a pressure, Another unit is called an atmosphere

Standard pressure that atmosphere presses on us at sea level

$$1\ atm = 1.013 \times 10^5\ Pa$$

Another common unit is to use mercury.

760 mm of mercury

Torr: $\frac{mm}{Hg}$

1 atm = 760 Torr = 1.013×10^5 Pa

ex) A water bed is 2.0 m square and 30 cm deep.

a) what is its weight?

b) what pressure does bed exert on floor?

a) $w = mg = (\rho V)g$

$\left(1000 \frac{kg}{m^3}\right)(2m \times 2m \times .3m) \cdot 9.8 m/s^2$

$1.18 \times 10^4 N$

b) $P = \frac{F}{A} = \frac{w}{A} = \frac{1.18 \times 10^4 N}{(2m)(2m)}$

$2.95 \times 10^3 Pa$