Inclined Plane Examples

Ex 1: A crate of weight 675 N is placed on a ramp with negligible friction. The ramp is inclined at 30. degrees.

a) What is the acceleration of the crate as it moves down the ramp?

b) What is the acceleration down the ramp if there is a kinetic friction force of 125 N opposing the slippage of the crate along the ramp?

Ex 2 : How much force, exerted parallel to the plane, would you need to apply to a 35.8 kg crate in order to accelerate it up a frictionless ramp at 0.35 m/s^2 inclined at 25^0 to the horizontal?

Ex 3: A crate slides down a ramp, inclined at 33 ^{o} to the horizontal, with increasing speed. If the crate accelerates at 1.25 m/s^2 and has a mass of 22 kg, what is the coefficient of kinetic friction between the surfaces?

Practice Problems

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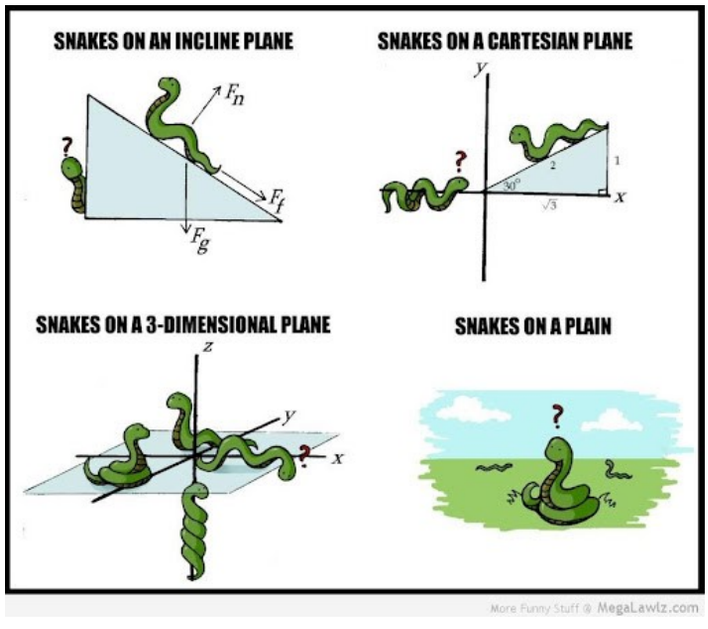
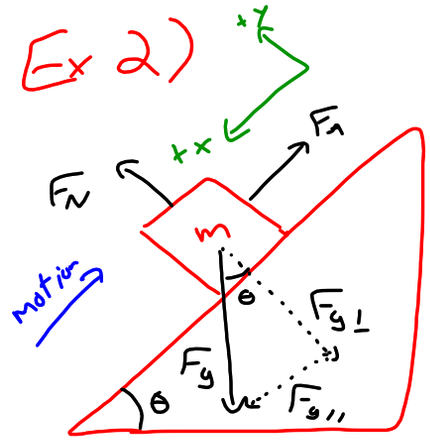


(Ex 2)



$m = 35.8\ kg$

$\vec{a}_x = 0.35\ m/s^2$ [upramp]

$\theta = 25°$

$\vec{a}_y = 0\ m/s^2$

$\vec{g} = 9.81\ m/s^2$ [down]

$$F_{net,x} = F_{g//} - F_A = -ma_x$$

$$+F_A = +ma_x + F_{g//}$$

$$F_A = ma_x + mg\sin\theta$$

$$= m(a_x + g\sin\theta)$$

$$= (35.8\ kg)(0.35\ m/s^2 + (9.81\ m/s^2)\sin(25°))$$

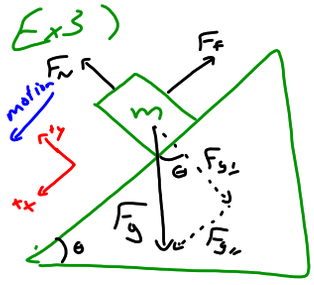
$$= (35.8\ kg)(4.4958\ m/s^2)$$

$$= 160.952\ N$$

$\vec{F}_A = 161\ N$ [upramp]

$= 161\ N$ [-x dir]

Ex 3)



$\theta = 33°$

$\vec{a}_x = 1.25\ m/s^2$ [downramp]

$m = 22\ kg$

$\vec{a}_y = 0\ m/s^2$

$\vec{g} = 9.81\ m/s^2$

$\mu_K = ?$

$$F_f = \mu_K F_N$$

$$\mu_K = \frac{F_f}{F_N}$$

$$F_{Net,x} = F_{g//} - F_f = ma_x$$

$$F_f = F_{g//} - ma_x$$

$$F_{Net,y} = F_N - F_{g\perp} = 0N$$

$$F_N = F_{g\perp}$$

$$\mu_K = \frac{F_f}{F_N} = \frac{F_{g//} - ma_x}{F_{g\perp}}$$

$$= \frac{mg\sin\theta - ma_x}{mg\cos\theta}$$

$$= \frac{g\sin\theta}{g\cos\theta} - \frac{a_x}{g\cos\theta}$$

$$= \tan\theta - \frac{a_x}{g\cos\theta}$$

$$= \tan(33°) - \frac{(1.25\ m/s^2)}{(9.81\ m/s^2)\cos(33°)}$$

$$= 0.497475$$

$$\mu_K = 0.497$$