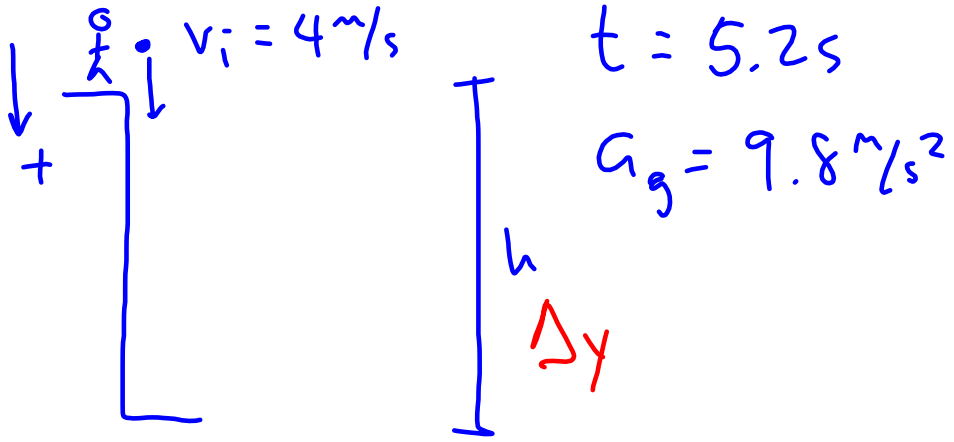
A person standing on a cliff throws a ball straight down with an initial velocity of 4 m/s. If the ball takes 5.2 s to reach the bottom of the cliff, what is the height of the cliff? What is the velocity of the ball just before it strikes the ground?



$t = 5.2\ s$

$a_g = 9.8\ m/s^2$

$$\Delta y = v_i t + \frac{1}{2} a_g t^2$$

$$= (4\ m/s)(5.2\ s) + \frac{1}{2}(9.8\ m/s^2)(5.2\ s)^2$$

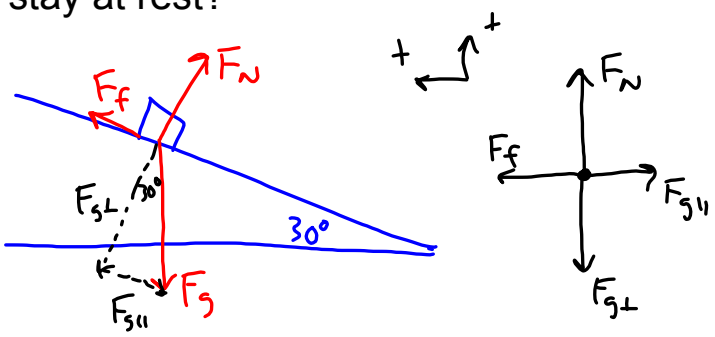
$$= 153.3\ m$$

$$v_f = v_i + at$$

$$= 4\ m/s + (9.8\ m/s^2)(5.2\ s)$$

$$= 55\ m/s$$

A box with mass of 20 kg is resting on a slope that has an angle of 30 degrees. What is the minimum coefficient of friction that allows the box to stay at rest?



$$F_{g\parallel} = F_g \sin(30°) = (20\,kg)(9.8\,m/s^2)\sin(30°)$$

$$= 98\,N$$

$$F_{g\perp} = F_g \cos(30°) = (20\,kg)(9.8\,m/s^2)\cos(30°)$$

$$= 170\,N$$

$$F_{net\,\parallel} = F_f - F_{g\parallel} = \emptyset$$

$$F_f = F_{g\parallel}$$

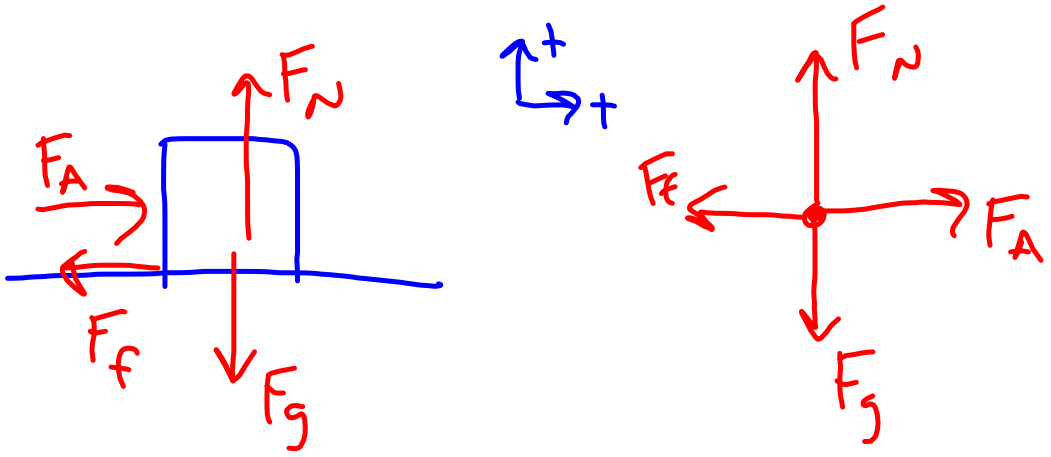
$$F_{net\,\perp} = F_N - F_{g\perp} = \emptyset$$

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

$$\mu = \frac{F_f}{F_N} = \frac{F_{g\parallel}}{F_{g\perp}} = \frac{98\,N}{170\,N}$$

$$\mu = 0.577$$

A box with mass 20 kg is pushed along a flat floor at a constant velocity, and the box/floor has a coefficient of friction of 0.45. What is the applied force on the box?



$$F_{net-x} = F_A - F_f = 0$$

$$F_N = F_g$$

$$F_A = F_f$$

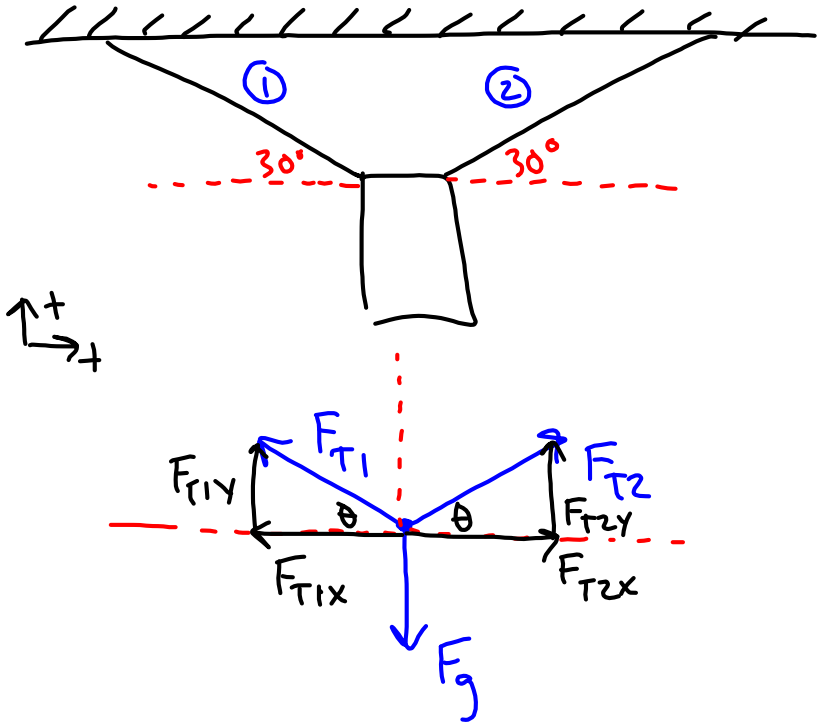
$$= 88.2\,N$$

$$F_f = \mu F_N$$

$$= \mu F_g$$

$$= 88.2\,N$$

A 20 kg box is hanging by two wires, and the wires make the same angle (30 degrees) with the box. What is the tension on each wire?



$$F_{net-y} = F_{T1Y} + F_{T2Y} = F_g$$

$$F_{T1}\sin(30°) + F_{T2}\sin(30°) = F_g$$

$F_{T1} = F_{T2}$

this is F_T

$$2\left[F_T \sin(30°)\right] = F_g$$

$$F_T = \frac{F_g}{2\sin(30°)}$$

$$= \frac{(20\,kg)(9.8\,m/s^2)}{2\sin(30°)}$$

$$= 196\,N$$

A 20 kg box is dropped from rest at a height of 10 m onto a spring. When this occurs, the spring compresses 0.35 m. What is the spring constant of the spring?

Initial Energy → E_g

Final Energy → E_{El}

$$E_g = E_{El}$$

$$mg_g h = \frac{1}{2} k (\Delta x)^2$$

$$k = \frac{2mg_g h}{(\Delta x)^2}$$

$$= 32{,}000 \ N/m$$