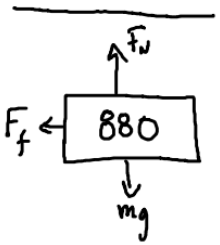
Practice problems

A bear on a motorcycle (880 kg) is traveling at 20 m/s and applies the brakes, stopping in 15 m. What is the stopping force (friction)? What is the coefficient of friction? How far would the bear take to stop if traveling twice his original speed?

0.123456;



$\sum F = ma$

$F_f = ma$

$= 880(13.3)$

$= 11733.3\ N$

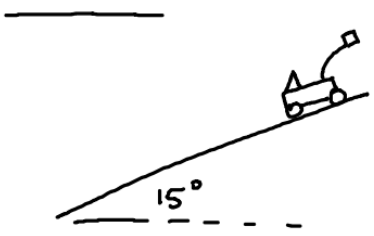
$v^2 = v_0^2 + 2a\Delta x$

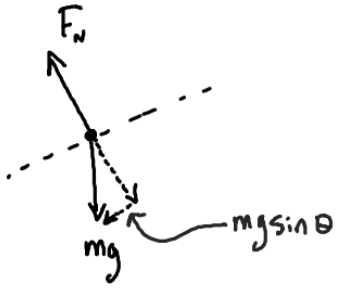
$\frac{-v_0^2}{2\Delta x} = a = 13.3 \frac{m}{s^2}$

$F_f = \mu F_N \Rightarrow \mu = \frac{F_f}{F_N} = \frac{11733}{mg} = 1.3$

60 m

A car (60 kg) is parked on hill (15 degrees). The hill freezes during the night and the car slides down the hill like it is frictionless. What is the car's speed after 6 seconds?





$\sum F_x = ma_x$

$mg\sin\theta = ma$

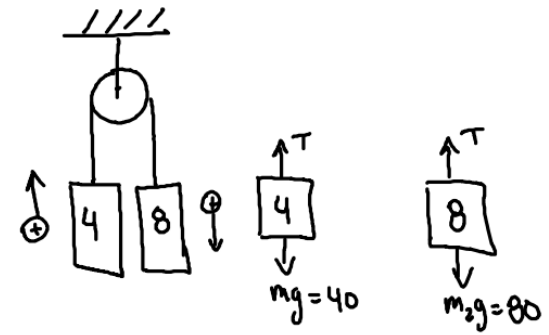
$10\sin 15 = a$

$\Delta v = at$

$= (10\sin(15))(6)$

$= 15.53 \frac{m}{s}$

An 8 kg mass and a 4 kg mass are connected by a light string over a massless frictionless pulley. What is the tension in the string? What is the acceleration of the system?



$T - 40 = 4a$ $\quad 80 - T = 8a$

$40 = 12a$

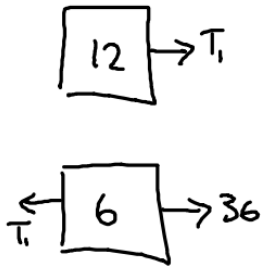
$\frac{40}{12} = a = 3.3 \frac{m}{s^2}$

$T = 80 - 8(3.3) = 53.3_N$

Two blocks, 6 and 12 kg are attached by a light string. Another string is attached to the 6 kg block and pulled with 36 N. What is the tension in the string between the two blocks?

$a = 2$

$T = 24$



A soccer player kicks a ball (1.4 kg) that is coming in at 14 m/s. If the ball is in contact for 0.12 seconds and leaves going 28 m/s, what force does the ball apply to the foot?

$$\frac{\Delta V}{t} = a = \frac{-28-14}{0.12} = -350 \frac{m}{s^2}$$

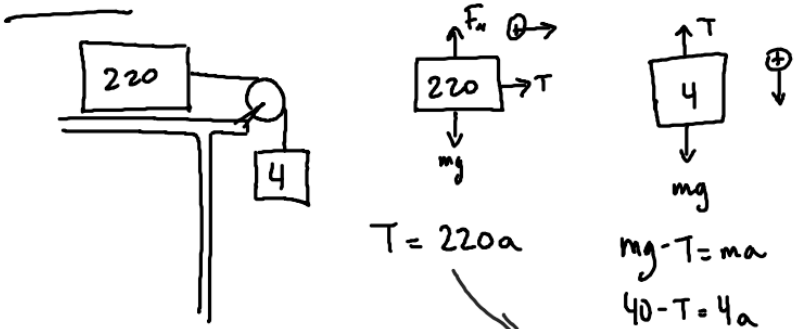
$$F_{FOOT} = m_{FOOT}(a) \quad \times$$

$$F_{ball} = F_{FOOT} \text{ (3rd law)} \Rightarrow F_{ball} = m_{ball}\, a$$

$$= 350(1.4)$$

$$= -490\ N$$

A 220 kg block sits on a frictionless table and is connected to a 4 kg block over a pulley, hanging off the table. How far does the 4 kg block fall in 5 seconds after the system is released?



$T = 220a$

$mg - T = ma$

$40 - T = 4a$

$40 = 224a$

$\frac{40}{224} = a = 0.18 \frac{m}{s^2}$

$\Delta x = \cancel{v_0 t}^{\,0} + \frac{1}{2}at^2$

$= \frac{1}{2}(.18)5^2 = 2.2\ m$

An elevator weighing 25 000 N is supported by a steel cable (but massless, go figure). What is the tension in the cable if the elevator is decending at 4 m/s?

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