Forces Packet

1. A 0.140-kg baseball traveling 30 m/s strikes the catcher's mitt, which, in bringing the ball to rest, recoils backward 11.0 cm. What was the average force applied by the ball on the glove?

$v_i = 30 \frac{m}{s}$ find a w/o t

$v_f = 0$

$\Delta x = 0.11m$

$a = ?$

$v_f^2 = v_i^2 + 2a\Delta x$

$0 = 30^2 + 2a(0.11)$

$a = 4091 \ m/s^2$

$F = ma$

$F = (0.14)(4091)$

$F = 573N$

2. Each bucket in the adjacent diagram has a mass of 10.0kg. The balloons provide an upward pull of 150N. Find the acceleration of the buckets and the tension in the rope between the buckets.

Step 1

$F_{NET} = ma$

$150 - 196 = 20a$

$a = -2.3 \ m/s^2$

Step 2

$a = -2.3 \ m/s^2$

$F_T - 98 = 10(-2.3)$

$F_T = 75N$

If the lower rope is cut, find the acceleration of the remaining mass.

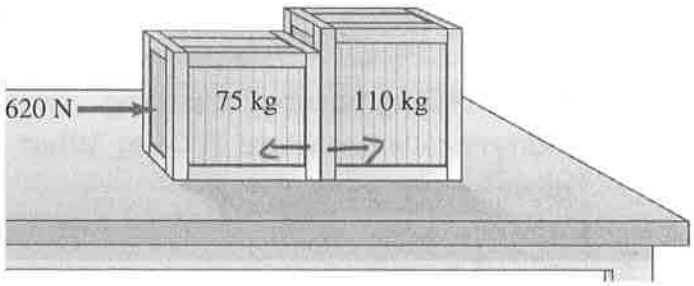
$F_{NET} = ma$

$150 - 98 = 10a$

$a = +5.2 \ m/s^2$

$a = 0$

3. If the boxes slide with constant velocity, find the coefficient of friction and the force of interaction between the 2 boxes.



$F_{NET} = ma$

Step 1

$620 - F_f = 0$

$F_f = 620$

$\mu(185)(9.8) = 620$

$\mu = 0.34$

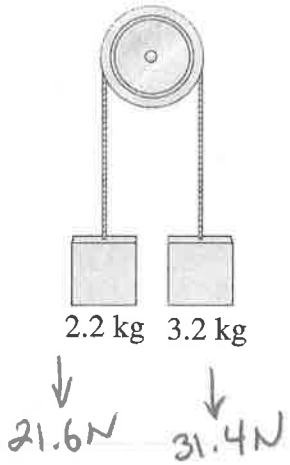
Step 2

$F - F_f = 0$

$F = \mu mg = (0.34)(110)(9.8)$

$F = 369N$

4. Find the tension in the rope that connects the 2 masses.



Step 1

$F_{NET} = ma$

$31.4 - 21.6 = 5.4a$

$a = 1.81 \frac{m}{s^2}$

Step 2

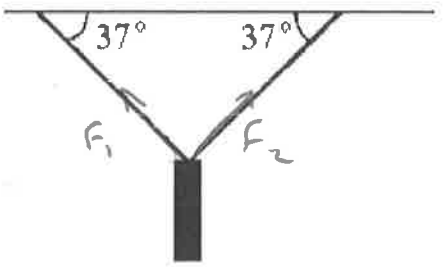
$F_{NET} = ma$

$F_T - 21.6 = (2.2)(1.81)$

2.2kg ↑ a

$F_T = 25.6N$

5. A traffic light is supported by two ropes as shown. If the tension in each rope is 750N, what is the mass of the traffic light?

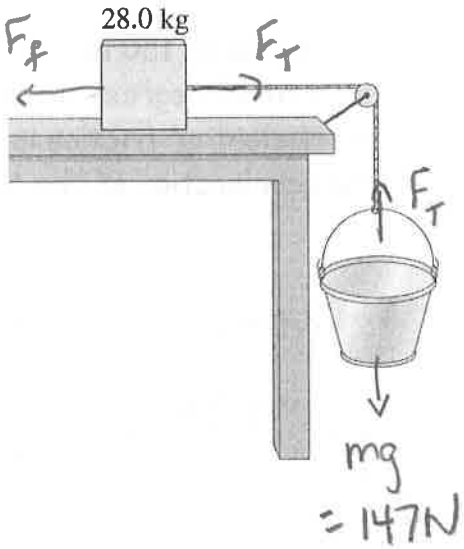


	x-comp	y-comp
F_1	$-750\cos 37°$	$750\sin 37°$
F_2	$750\cos 37°$	$750\sin 37°$
mg	0	$-mg$
	0	0

$mg = 2(750)\sin 37°$

$m = 92kg$

6. Sand is gradually added to the hanging bucket shown on the right. The 28 kg mass begins to accelerate when the mass of the hanging bucket and sand equals 15 kg. What is the coefficient of static friction between the 28 kg box and the table?



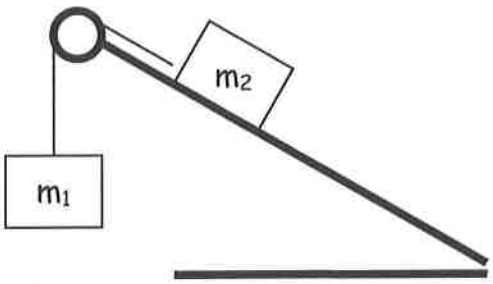
$F_{NET} = ma$

$147 - F_f = 0$

$\mu mg = 147$

$\mu = 0.54$

7. Consider the conditions given in the text box. Will the system accelerate? If so, find the acceleration of the system and the tension in the cable that connects them.



Conditions
$\mu_s = 0.5$
$\mu_k = 0.3$
$m_1 = 10.0$ kg
$m_2 = 5.0$ kg
$\theta = 70°$

$m_1 g = 98N$

$m_2 g \sin\theta = 46N$ it must accelerates

$\mu_s m_2 g \cos\theta = 8.4$

$F = ma$

$98 - 46 - 54 = 15a$

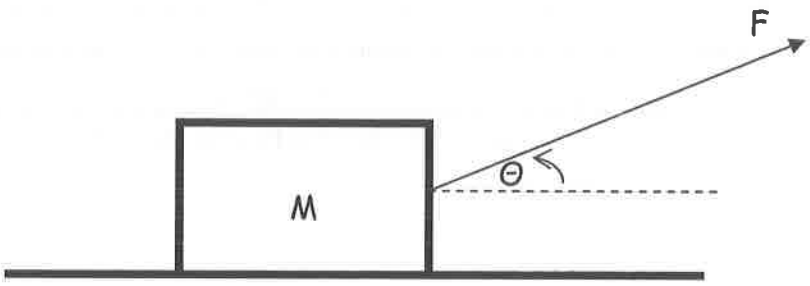
$a = 3.1\ m/s^2$

$a = -0.82\ m/s^2$

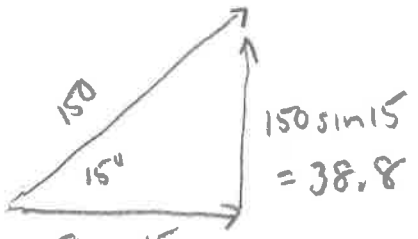
$-98 + F_T = -31$

$F_T = 67N$

8. A force of 150 N is applied at an angle of 15 degrees. If the coefficient of friction is 0.30, find the acceleration of the 12 kg mass.



	x-comp	y-comp
F:	144.9 N	38.8 N
F_N:	0	F_N
F_f:	$-F_f$	0
F_g:	0	−117.6 N
	ma	0



Conclusion: $F_N = 78.8$ N

so $F_f = 23.6$ N

$144.9 - 23.6 = 12a$

$a = 10.1\ m/s^2$