Chapter 4

Force and Newton's Laws of Motion

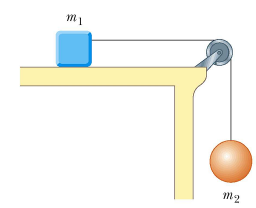
(Continuation)

Ch 4 Force and Motion

- Newton's 1st Law, 2nd law and 3rd law
- More applications
- Weight and apparent weight

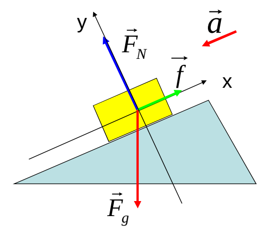
Example: two blocks

Two blocks are connected by a rope which wraps over a idea pulley. The two masses are m_1=3kg and m_2=2kg. The coefficient of friction between m_1 and table top is μ_k=0.3. Find acc. and tension.



Example: Block on an incline

- A block rests on a surface with adjustable inclination. When the angle increases to 60° the block starts slipping down the slope. Find the static friction coefficient. If the kinetic friction coefficient is 1.0, what is the acceleration of the block?



Weight $\vec{W}$

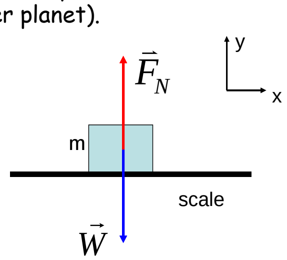
- The weight of a body is a force balancing the gravity force when the body is at rest at the ground (Earth or other planet).

$$\vec{F}_{net} = m\vec{a}$$

$$F_{net,y} = ma_y = 0$$

$$F_N - W = 0$$

$$F_N = W = mg$$



How much do you weigh on …

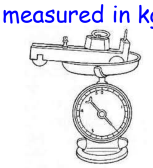
- Earth?

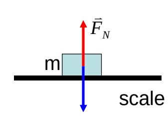
m = 70 kg
g(Earth)=9.8 m/s^2
$W_E = mg_E$= 686 N

- Mars?

m = 70 kg
g(Mars)=3.7 m/s^2
$W_M = mg_M$= 259 N

- The mass is the same, the weight changes.
- The mass is measured in kg, the weight in N.





Weight and Apparent Weight $\vec{F}_{app}$

- In a noninertial reference frame a spring scale measures an apparent weight.

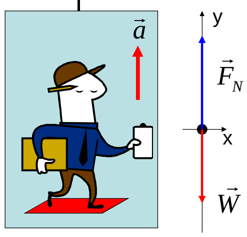
$$\vec{F}_{net} = m\vec{a}$$

$$F_{net,y} = ma_y$$

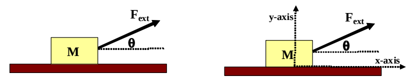
$$F_N - W = ma$$

$$F_N = W + ma = mg + ma$$

$$F_{app} = F_N = m(g+a)$$



Exam 1 Fall 2010: Problem 11



- Near the surface of the Earth, a block of mass M = 2 kg slides along the floor while an external force Fext is applied at an upward angle θ = 26°. If the coefficient of kinetic friction between the block and the floor is 0.488, and the magnitude of the acceleration of the block is 1.89 m/s², what is the magnitude of the external force?

Answer: 12 N
% Right: 59%

$$F_{ext}\cos\theta - f_k = Ma_x$$

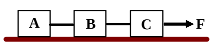
$$F_{ext}\sin\theta + F_N - Mg = 0$$

$$f_k = \mu_k F_N$$

$$F_{ext} = \frac{M(a_x + \mu_k g)}{\cos\theta + \mu_k \sin\theta}$$

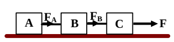
$$= \frac{(2kg)(1.89m/s^2 + (0.488)9.8m/s^2)}{\cos(26^\circ) + (0.488)\sin(26^\circ)} \approx 12.0N$$

Exam 1 Fall 2010: Problem 8



- Three blocks (A,B,C), each having mass $M_A = M$, $M_B = 2M$, $M_C = M$ are connected by strings on a horizontal frictionless surface as shown in the figure. Block C is pulled to the right by a horizontal force of magnitude F that causes the entire system to accelerate. What is the magnitude of the net horizontal force acting on block B due to the strings?

Answer: F/2
% Right: 41%



$$F = (M_A + M_B + M_C)a$$

$$F_B = (M_A + M_B)a$$

$$F_A = M_A a$$

$$F_{net}^B = F_B - F_A = M_B a = \frac{M_B}{M_A + M_B + M_C}F = \frac{2M}{M + 2M + M}F = \tfrac{1}{2}F$$