Solving Friction Problems

Unit 2: Dynamics

March 30, 2016

Summary

- Static friction exists between an object and a surface when the object is not sliding on the surface
- Static friction can be used to move objects
- Kinetic friction always acts in a direction that is opposite to the motion of the object
- Use kinematics equations (Big 5) to solve problems involving friction and other forces

Unit Test → Monday Oct. 31

Quiz Thursday - Oct. 27

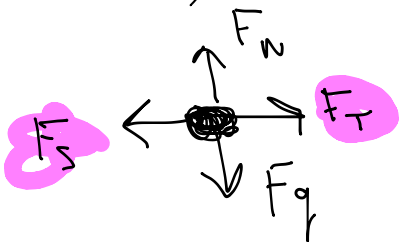
Sample #1

- Mr. Neave is pulling his 2 boys on sleds tied together by a rope. The coefficient of static friction between the sleds and the snow is 0.22. His youngest son sits in the front sled (total mass of 21kg) and his oldest son sits in the back sled (total mass 53kg).
- Determine the greatest horizontal force that Mr. Neave can exert on the front sled without moving either sled.
- Calculate the tension in the rope between the 2 sleds when the greatest horizontal force is applied

$m_2 = 53\,kg$ $m_1 = 21\,kg$

$\mu_s = 0.22$

FBD (combined)



$F_T = F_s$ (just before they move)

$F_s = \mu_s F_N$

$F_N = mg$

$F_N = (21\,kg + 53\,kg)\,9.8\,\frac{m}{s^2}$

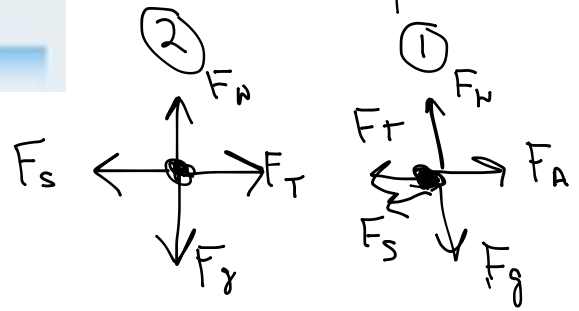
$F_N = (74\,kg)(9.8\,m/s^2)$

$F_N = 725\,N$

$F_s = 0.22(725\,N)$

$F_s = 160\,N$

FBD Separate



$F_{net} = 0$ (no acceleration)

2

$F_s = F_T$

$(0.22)(53 \times 9.8) = F_T$

$114\,N = F_T$

$110\,N = F_T$

1

$F_A = F_T + F_s$

$160\,N = F_T + F_s$

$160\,N = F_T + \mu_s F_N$

$160\,N = F_T + (0.22)(21\,kg \cdot 9.8)$

$160\,N = F_T + 45\,N$

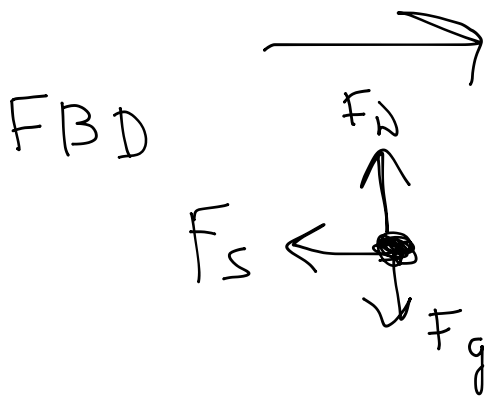
$160\,N - 45\,N = F_T$

$115\,N = F_T$

$110\,N = F_T$

Static Friction can cause motion....what?????

- The coefficient of static friction between a person's shoe and the ground is 0.70. Determine the maximum acceleration *of a 90kg person who starts running on a horizontal surface from rest.*



$F_{NET} = F_s$

$F_s = \mu_s F_N$

① $= 0.7\left(90\,kg \times 9.8\,m/s^2\right)$

$= 0.7(882\,N)$

$F_s = 617\,N$

$\therefore F_{NET} = 617\,N$

② $F_{NET} = ma$

$617\,kg\frac{m}{s^2} = (90\,kg)a$

$a = \frac{617\,kg\frac{m}{s^2}}{90\,kg}$

$a = 6.86\frac{m}{s^2}$

Questions

- Pg. 174 #1,2
- Pg. 175 #1,2
- Pg. 178 #1