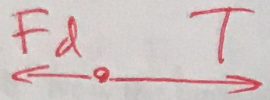
Name_____

Newton's Second Law Review Problems

1. An 80 kg water skier is being pulled by a boat with a force of 220 N causing the skier to accelerate at 1.8 m/s^2. Find the drag force on the skier.

FBD



ΣF

$$T - F_d = ma$$

Solution

$F_d = T - ma$

$= 220N - 80kg(1.8 m/s^2)$

$= 76 N$

2. A 2000 kg car is slowed down uniformly from 20 m/s to 5 m/s in 4 seconds. Determine the average net force on the car during this time, and how far the car traveled while slowing down.

$a = \frac{v_f - v_i}{t} = -3.75 m/s^2$

$F = ma = 7500N$

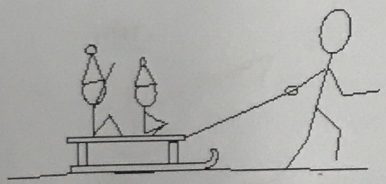
$\Delta x = v_i t + \frac{1}{2} a t^2$

$= 20(4) + \frac{1}{2}(-3.75)(4s)^2$

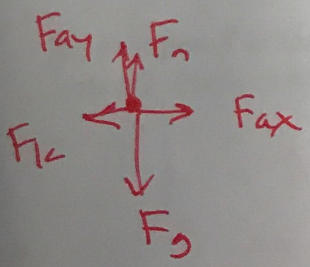
$= 80 - 30$

$= 50 m$

3. In the diagram below, the cord makes a 25° angle with the horizontal, the mass of the sled and occupants is 100 kg. The tension in the cord is 120 N and the friction force is 15 N. Find the acceleration of the sled and the coefficient of friction.



FBD



ΣF

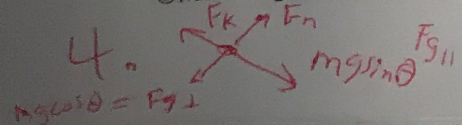
$F_n + F_{ay} = F_g$ $\quad F_n = 1000N - 120\sin 25$

$= 949N$

$F_k = \mu_k F_n \rightarrow$ $\quad \mu_k = \frac{F_k}{F_n} = \frac{15N}{949N} = .0158$

$F_{ax} = 120\cos 25 = 108.8 N$

$a = \frac{F_{ax} - F_k}{m} = \frac{108.8 - 15}{100} = .93 m/s^2$

4. 

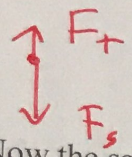
$mg\sin\theta - F_k = ma$

$F_k = \mu_k F_n = \mu_k mg\cos\theta = 39.3N$

$a = \frac{344 - 39.3N}{60 kg} = 5.08 m/s^2$

4a. An elevator is accelerating down with a = 2.0 m/s2 downward. The mass of the elevator is 400 kg. Find the tension in the elevator cable.

FBD



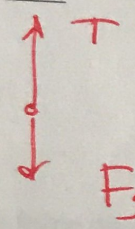
ΣF

$$F_g - F_T = ma$$

$$F_T = F_g - ma$$
$$= 4000N - 400kg(2 m/s^2)$$
$$= 3200N \text{ up}$$

4b. Now the same elevator is accelerating upwards with a = 2.5 m/s2 upwards. Find the tension in the cable.

FBD



ΣF

$$T - F_g = ma$$

Solution

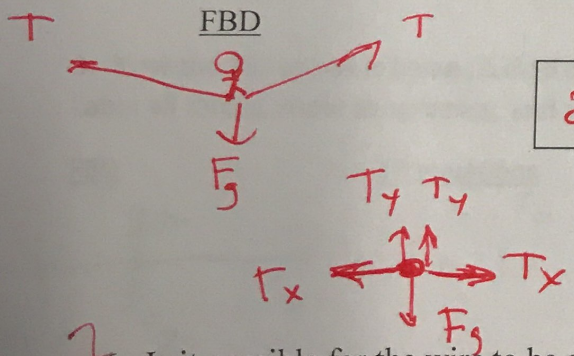
$$T = F_g + ma$$
$$= 4000N + 400(2.5 m/s^2)$$
$$= 5000N \text{ up}$$

4c. Describe the possible motion (up, down, speeding up, slowing down) for the elevator in 4a and 4b.

4a: down, su or up, sd

4b: up, su or down, sd

5. A tightrope walker (m=60 kg) is on a rope that is sagging with an angle of 5 degrees with the horizontal. You need to treat the left side of the wire and the right side of the wire as if they are two different wires. Find the tension in the wires.



ΣFy

$$2T_y - F_g = 0$$

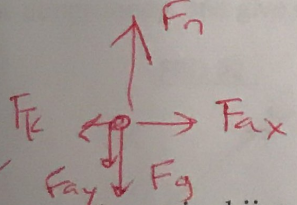
Solution

$$T_y = \frac{F_g}{2} = 300N$$

$$T_y = T \sin\theta$$

$$T = \frac{T_y}{\sin\theta} = \frac{300N}{\sin 5} = 3442N$$

6. Is it possible for the wire to be completely horizontal with a person still standing at the center? Explain why or why not, and use an FBD in your explanation.



$$F_n = F_{ay} + F_g = 135N + 1000N = 1135N$$

$$F_{ax} - F_k = ma$$

$$a = \frac{290N - 18N}{100kg} = 2.72 m/s^2$$

Level 4

A 60 kg skier shown is skiing down a 35° incline with a coefficient of friction is 0.08. Determine the acceleration of the skier.