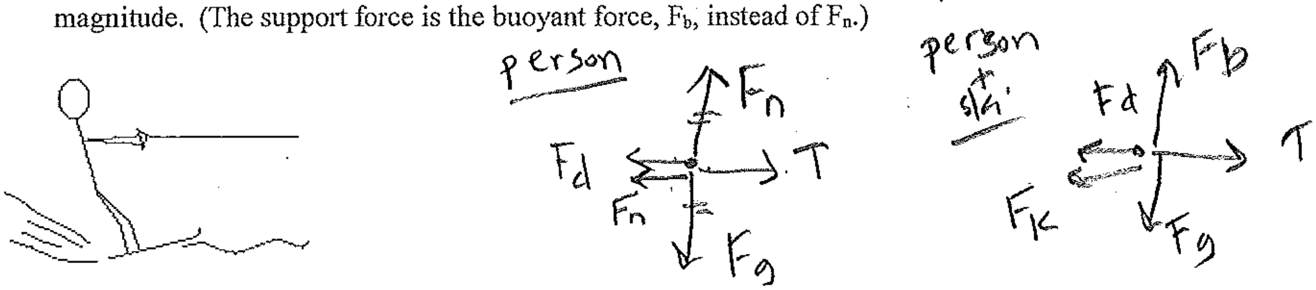
Name________________________________

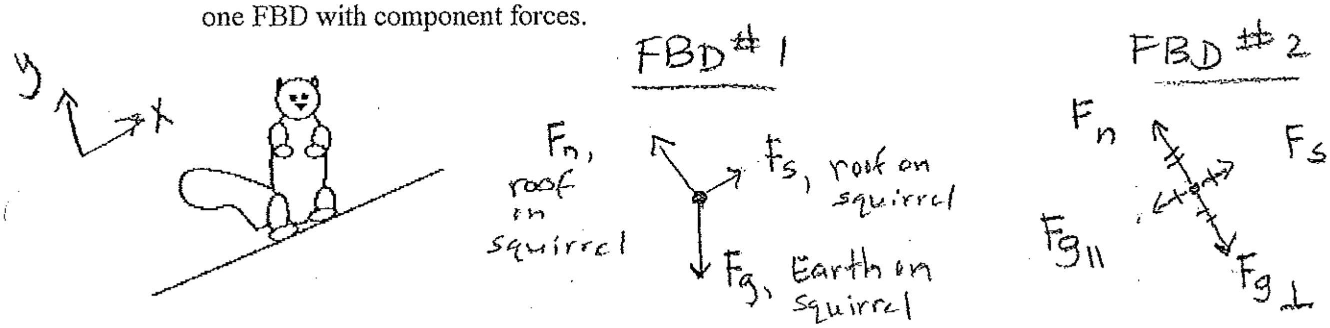
Forces Problem Set #2: Force Diagrams with Component Forces

In each of the following situations, represent the object with a particle (a dot). Sketch all the forces acting upon the object, making the length of each vector represent the magnitude of the force. Include agent-object notation in your force labels. Also use congruency marks to indicate which vectors are equal in magnitude.

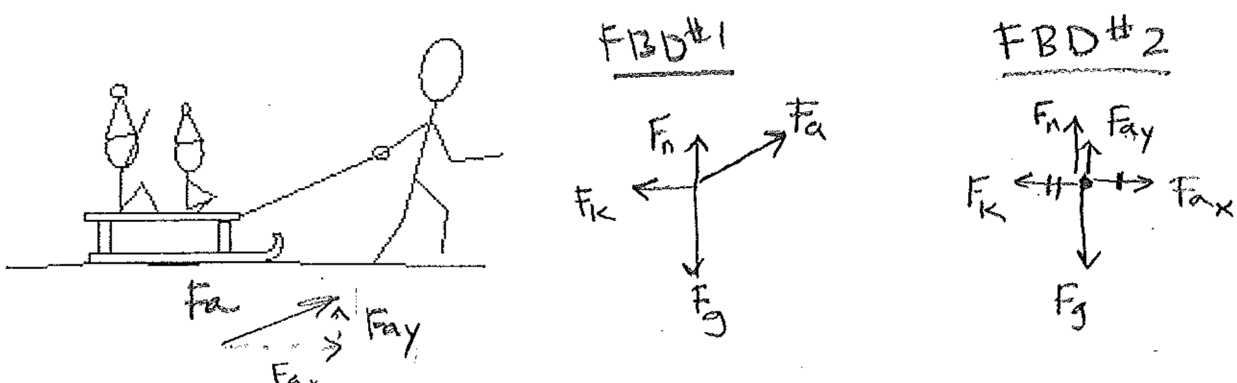
1. The water skier is moving at constant speed, so the forward and backward forces are equal in magnitude. (The support force is the buoyant force, F_b, instead of F_n.)



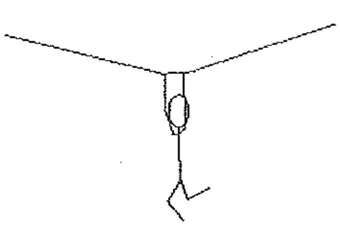
2. Draw a force diagram for a squirrel sitting still on a roof. Draw one FBD with forces at angles and one FBD with component forces.



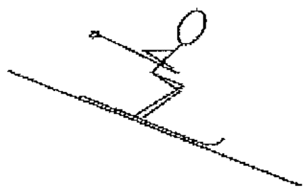
3. A sled being pulled at constant speed. The system is the sled+kids. Note that the pull on the sled is at an angle. Draw one FBD with forces at angles and one FBD with component forces.



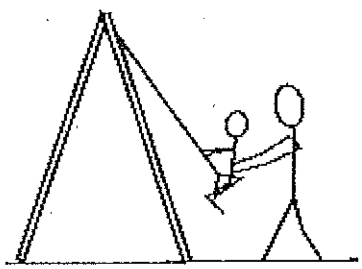
4. Draw a force diagram for the person hanging from a rope. It is as if the person is supported by two ropes. Draw two FBDs and use congruency marks.



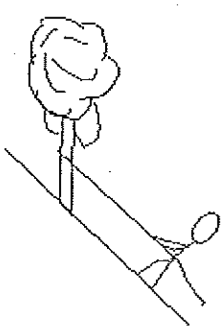
5. Draw a force diagram for the skier who slides with negligible friction. (That means you can ignore the friction force.) Draw two FBDs and use congruency marks.



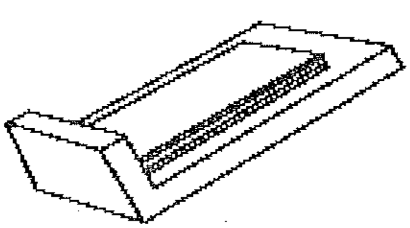
6. Draw a force diagram for the child on the swing who is being pulled back before being released. Draw two FBDs and use congruency marks.



7. Draw a force diagram for the climber who has stopped to rest. Draw two FBDs and use congruency marks.



8. Draw a force diagram for the magazine on a magazine rack. Draw two FBDs and use congruency marks.

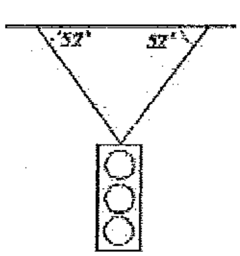


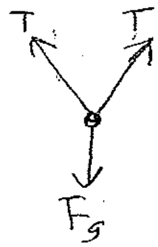
$\Sigma F = ma$ $F_g = mg$ $F_k = \mu_k F_n$

$F_x = F\cos\theta$ $F_y = F\sin\theta$ Name________________________

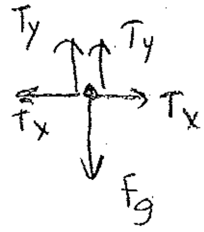
Forces PS #3: Equilibrium With Angles

Ex. A traffic light (mass = 14 kg) is hanging from two wires that have an angle of 52 degrees with the horizontal. Find the tension in each wire.





FBDs



ΣF

$F_g = mg = (14\,kg)(10\,m/s^2) = 140\,N$

$2T_y = F_g$

$T_y = \frac{F_g}{2} = \frac{140\,N}{2} = 70\,N$

$T_y = T\sin\theta \rightarrow T = \frac{T_y}{\sin\theta} = \frac{70N}{\sin 52} = 89\,N$

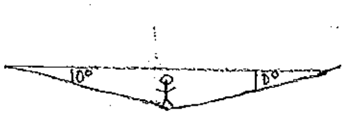
1. Another traffic light (also14 kg) hangs with a larger angle with the horizontal, 38°. Find the tension in each wire.

FBDs ΣF

2. What if the traffic light were hanging from two vertical cables? What would the tension be in each wire?

FBDs ΣF

3. An acrobat walks across a high wire strung horizontally between two buildings. The sag in the wire when she is at the midpoint is 10.0°. The tension in each wire is 1350 N. Find the weight and mass of the acrobat.



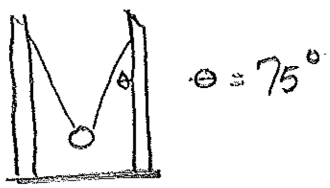
FBD ΣF

4. Now an acrobat with a mass of 60-kg walks to the midpoint and the sag in the wire is 12 degrees. Does the tension in the wire exceed the breaking tension of 1500 N?

FBD ΣF

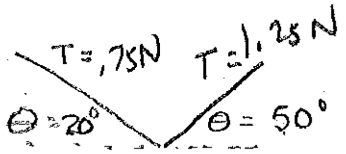
5. Find the tension in the Newton's cradle wires. The mass of the marble is 13 g. (Don't forget to convert grams to kg.)

FBDs ΣF

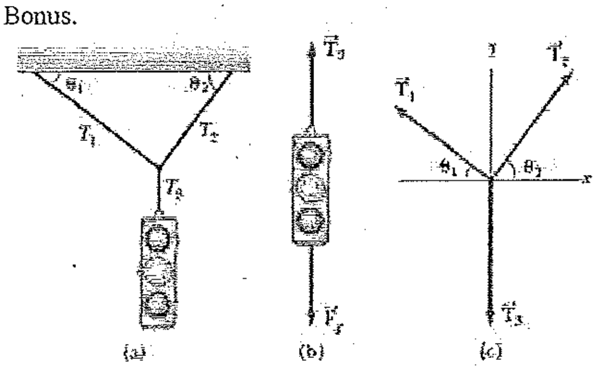


6. Find the weight of the hanging cart by reading the spring scales.

FBDs ΣF



Bonus.



A traffic light weighing 122 N hangs from a cable tied to 2 other cables fastened to a support. The upper cables make angles of 37 degrees and 53 degrees with the horizontal. These upper cables are not as strong as the vertical cable and will break if the tension in them exceeds 100 N. Does the traffic light remain hanging in this situation, or will one of the cables break? Defend your answer with calculations and an explanation.