**Dynamics Notes**

4 – Two Objects and Tension

There are a number of common force problems that involve 2 objects, that you will be expected to be able to solve. We will focus on 3 of these.

**Atwood’s Machine**: Two masses suspended by a pulley

Diagram: **Include all forces at work on the two masses**.

Both masses have a Fg that pull downwards, but since they are connected by a pulley those forces work in \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**The masses will accelerate so that the…**

Since they are attached by a rope the acceleration of the masses must be

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**The Strategies:**

* When solving these problems it is easiest for us to choose the direction …
* Remember that the acceleration on the two masses...
* It can also be easier to conceptualize this problem if we “unfold” the masses and lay them out in a line, while keeping all of our forces as they are…I know that sounds weird so, here’s an example.

Note that there is a force of *TENSION* (T) that exists along the rope. Tension acts the same as all other forces, with two important peculiarities:

1) It is an internal force, acting…

2) It cancels out…

Ex

Two masses are suspended from a lightweight rope over a frictionless pulley as shown.

What will their acceleration be once released?

kg

kg

**NOTE:** When calculating the acceleration we use the \_\_\_\_\_\_\_\_\_\_\_\_\_ because the Fnet is accelerating the entire system (both masses)!

**Strategy**: To solve for tension chop your diagram in half and only consider one of the masses. Either one is fine because…

If we use the same force diagrams and equations as before we hit a snag. The two tension forces \_\_\_\_\_\_\_\_\_\_\_\_\_\_ !!!

This is because tension is an\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_.

In order to solve for tension we have to consider…

Alright that wasn’t too hard, but can you find the tension in the rope?

Ex - Find the tension in the rope in the preceding example.

**Note:** When finding the tension we are only considering half of the equation therefore we only use \_\_\_\_\_\_\_\_\_\_\_.

**The Hanging Mass:** One mass hanging, one horizontal

8.0 kg

6.0 kg

Ex

Consider the two masses shown. Find their acceleration and the tension in the rope.

Because one tricky concept is never enough, I give you…

Ex

Two forces are attached by a rope over a frictionless pulley as shown.
(Assume the incline is frictionless) Determine:

a. The acceleration of the masses.

b. The tension in the rope.

***Problem: What direction will they accelerate?***

In earlier pulley problems it was obvious, the bigger mass always wins. When an inclined plane is involved this is not always the case because for the mass on an incline only...

m2 = 6.0 kg

m1 =

4.0 kg

30o

So determine the forces on each one separately and see which one is the winner.

Force 1 =\_\_\_\_\_\_\_\_\_ Force 2 = \_\_\_\_\_\_\_\_\_

Ex

In the name of physics, a monkey is attached to a sleeping sheep on a ramp. Don’t ask why.

As we all know, the coefficient of friction for a sleeping sheep on a ramp is precisely 0.15. Determine:

a. The acceleration of the system.

b. The tension in the rope.

even adorabler sheep

28 kg

adorable monkey

24 kg

40o

**Strategies:**

1. Find the forces acting on the two bodies separately to determine a winner
2. Determine the friction on the sheep. Friction can work **either** up or down the ramp, because it **always** opposes motion, so we don’t know which direction it is acting until we know the winner.
3. Based on the winner find the acceleration using mtotal
4. Choose either body and examine it separately to determine the tension in the rope