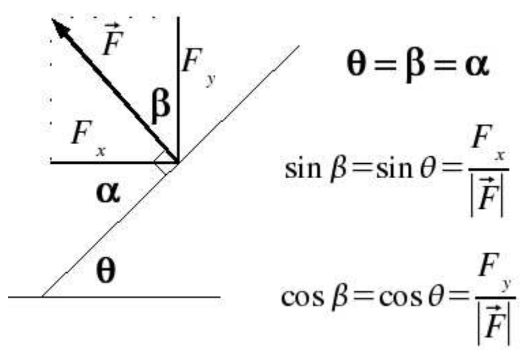
FREQUENTLY ASKED QUESTIONS

February 10, 2015

Content Questions

How did you determine the angle in the components of mg with mass on the incline? How do you know whether to use sine or cosine?

Here's a case where a force of interest is perpendicular to an incline (today's mass-on-incline problem had the force pointing down— but geometric arguments are very similar).



By the alternate angle theorem from geometry, we have that the angle θ is the same as the angle α. Since angles α and β are complementary to the same angle, they are equal. So θ, α and β are all the same angle. Now look at the right triangle formed by the vector $\vec{F}$ and F_y, with angle β between them. From this triangle you get that $F_x = F\sin\theta$ and $F_y = F\cos\theta$.

We'll be seeing lots of examples like this, so it will be worth your while to go through the geometry and trig carefully. Please ask again if it's not clear. This kind of thing will get much easier with practice.

What was that about moving coordinate frames?

We'll actually be covering more about this later, I think. In the conveyer belt problem, we considered the velocity of the mass in the frame of the factory (imagine you are on the floor and looking at the crate and conveyer belt). In this frame the crate starts with zero velocity when it's dropped onto the belt and ends up with some velocity with respect to you. In contrast, you could consider the frame of the belt: imagine you are sitting on the belt. In that frame, the crate would start with velocity v (away from you) when it is dropped, and then reach the same velocity as the belt— so it would end up with zero velocity with respect to you.

In the frame of the belt, as the crate comes to rest with respect to the belt, it's moving with respect to the belt (decelerated by friction). We calculated the distance it moved.

(If there were *no* friction, the crate would have zero velocity with respect to the floor after dropping. The belt would just slip under it. It would maintain velocity v with respect to the belt.)

Why can we assume U_i arbitrarily?

Well, you can't always choose a given potential energy arbitrarily, but we can choose a zero of potential energy wherever we like, and it won't change the answers to the problems. The reason is that what matters for energy conservation is *change* in potential energy, ΔU. If you have an energy conservation equation, say $U_i + K_i = U_f + K_f + E_{\text{th}}$, choosing a different zero of potential energy corresponds to adding or subtracting the same thing to/from both sides of the equation— so the answer will be the same.

Can you explain the prelab question about finding forces?

Well, I won't do this for you, but here are some hints:

- Remember velocity is integral of acceleration.
- Remember position is integral of velocity.
- You can "nest" integrals, i.e., you can plug velocity (as an integral) into an integral itself, but be careful about the limits of integration. You don't want to reuse variables of integration in more than one nested integral; use "dummy" variables. Also pay attention to your limits...

$v(t)$ for an arbitrary time should have what value as the upper limit of integration?

- Remember how force is related to acceleration (hint: second law!)
- The third law helps relate the two forces.