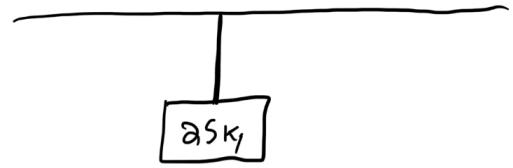# Physics 12

Booklet #2

- Translational Equilibrium
- Torque and Rotational Equilibrium
- Torque not at 90 degrees

Translational Equilibrium

A 25.0 kg sign is supported by a rope from the ceiling as shown. What is the net force acting on the sign?

A 25.0 kg sign is supported by a rope from the ceiling as shown. What is the net force acting on the sign?

Any time an object is not moving (or is moving at a constant velocity) the net force acting on it is

_____. We say such an object is in _____.

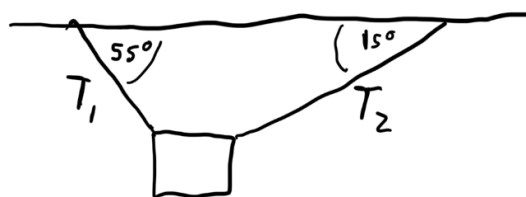If an object is in translational equilibrium the sum of all forces $= F_{net}$ =

And so
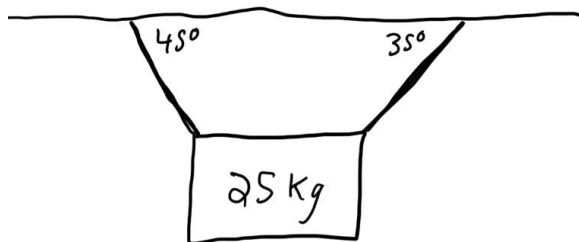
Sum of all forces in x direction =

Sum of all forces in y direction =
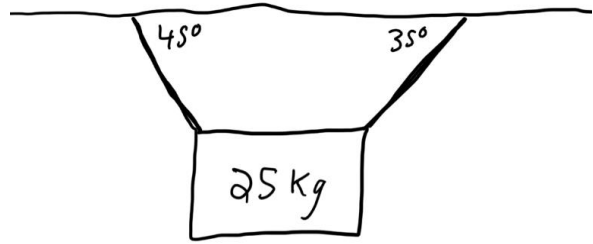
Method #1: Use Vector Components

A block is hung from two ropes as shown, the tension in the first rope is 120 N. What is the tension in the second rope, and what is the mass of the block?

Determine the tension in each of the ropes:

Method #2: Use a closed vector diagram.

Rotational Equilibrium

An object in translational equilibrium is not accelerating in the x or y directions, but it still could be rotating. An object in rotational equilibrium is not rotating.

If an object is not rotating and not moving through space, we say it is in _____ equilibrium.

For an object to be in rotational equilibrium the total _____ on it must be zero.

Torque =   =

Torque is a rotational vector it works either:

Consider tightening a bolt with a wrench, if the bolt needs 24 Nm of torque to tighten it:

How much force must be applied if using a 0.20 m long wrench?

How much force must be applied if using a 1.00 m long wrench?

Two kids sit on a see saw, if it is in rotational equilibrium the torques on each kid must cancel out.

One kid is 1.00 m from the centre and has mass of 25.0 kg, the other kid is 35.0 kg and is 0.7143 m from the centre. Is the see-saw in rotational equilibrium?
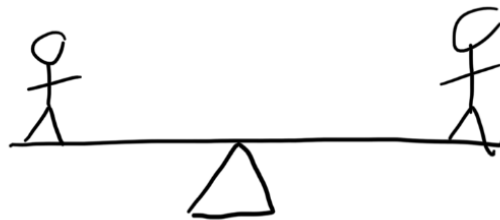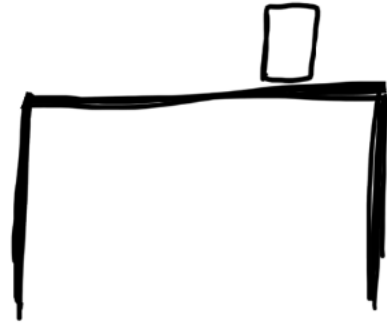
In rotational equilibrium

EXAMPLE: A 45 kg sign is attached to the middle of a 1.4 m long board of negligible mass which is connected to a wall with a hinge. The board is supported also by a rope. What is the tension in the rope? What are the forces acting on the hinge?
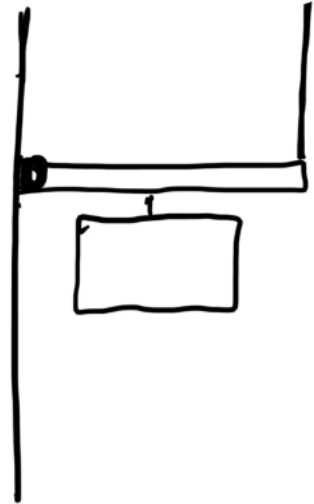
EXAMPLE: A stone table top of length 1.2 metres has a mass of 45 kg, a 65 kg pile of bricks is placed 0.22 metres from the right side of the table. What are the support forces provided by each side of the table?

Rotational Equilibrium when torque is not at 90 degrees.

A 4.2 m long 12 kg beam is connected to a wall with a hinge, a 45 kg mass hangs from the end of the beam. A rope holds the beam horizontally as shown. What is the tension in the rope?
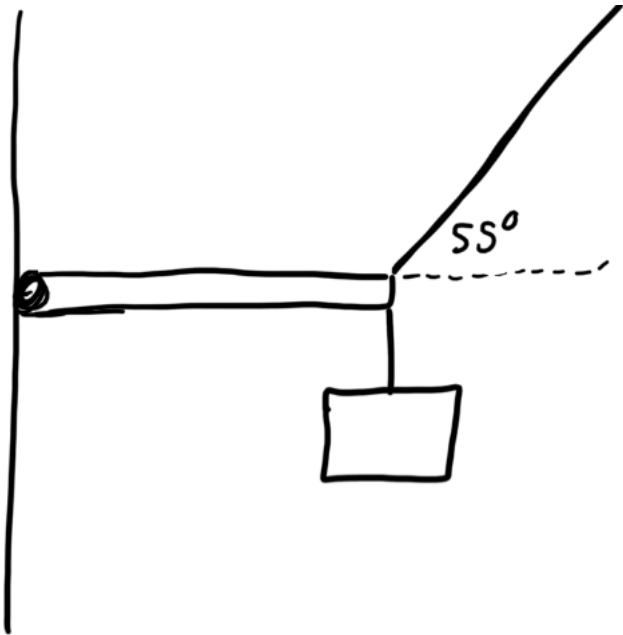
EXAMPLE: A 2.4 m long beam of mass 22 kg is attached to a wall with a hinge and is held at an angle of 25° above the horizontal by a rope. What is the tension in the rope? What is the force provided by the hinge?