2024A4

TENSION & SINGLE PULLEYS

L1:

Part 1 - We are told that the box is held stationary, meaning all forces acting on it must be balanced. From the diagram, we can see that the force of weight is acting downwards, and so the balancing upwards force is from the tension in the rope. We now know that the tension in the rope will be the same magnitude as the weight of the block, so we need to calculate weight using the formula w = mg.

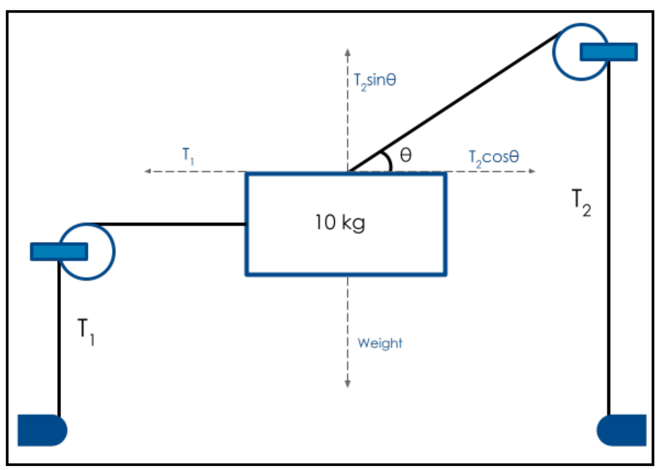
$$w = m*g = (30\text{kg}) * (9.81\ \text{m/s}^2) = \mathbf{294.3\ N}$$

Part 2 - We are asked if the angle the rope is making due to the frictionless pulley affects the lifting force. However, the lifting force on the block would only be affected if the pulley was not frictionless. Therefore, we can say that **the angle of the rope *does not* affect the lifting force, only the direction of the force**

L2:

Part 1 – The first step here is to see what forces are acting on the block, so we can start balancing them (since it is not moving.) We know that the weight of the block will be action downwards. We also see that the tension T_1 is acting towards the left, but T_2 is acting at an angle to the block. There is a component of T_2 in the horizontal as well as the vertical direction.

Since we know the value of T_2, and that the component balancing weight is $T_2 \sin\theta$, we can set up the equation as follows.



$$T_2 \sin\theta = w$$

$$T_2 \sin\theta = m*g$$

$$\sin\theta = \frac{m*g}{T_2}$$

Thus, substituting values into the equation gives us,

$$\sin\theta = \frac{(10\text{kg})*(9.81\text{m/s}^2)}{(196.2\ \text{N})} = 0.5$$

And so, we get $\theta = \sin^{-1}(0.5) = \mathbf{30°}$

Part 2 – Our next step is to find T_1 knowing that the other component of T_2 (which is $T_2 \cos\theta$) would be balancing it. So, we just need to find the value of $T_2 \cos\theta$:

$$T_1 = T_2 \cos\theta = (196.2\ \text{N}) * \cos(30°)$$

$$T_1 = \mathbf{169.91\ N}$$