

Mass-Pulley Diagram

Suppose there are two masses m_1 and m_2 which are equal to one another ($m_1 = m_2 = m$).

Mass m_1 sits on a table and is connected by rope and (frictionless) pulley to m_2 which is hanging off of the table. This simple diagram has been drawn for you on the board (and in the accompanying video if completing this assignment digitally). Draw this system in the free space on this paper and label the following force vectors.

1. Draw the **two** gravitational force vectors that point *downwards* from each mass. These vectors should be equivalent because both masses are equivalent. Label these force vectors mg (mass times gravitational acceleration where g is 9.8 m/s^2).
2. Draw the **one** normal force vector that points *upwards* from the mass which is supported by the table. This force is equal but opposite to the gravitational force because this block doesn't move up or down. Make sure that this vector is the same length as mg but opposite in direction. Label this vector $N = mg$.
3. Draw the **two** string tension forces on *opposing* sides of the frictionless pulley. Frictionless pulleys only change direction of a force. These two string forces only support the weight of one of the blocks (m_2). Therefore, each string force must be equal to $\frac{1}{2}mg$ (because $\frac{1}{2}mg + \frac{1}{2}mg = mg$). Make sure that the vectors are pointing the correct directions and are *half* the length of the mg vectors. Remember, strings can only exert *pulling/supporting* forces. Label these vectors $T_1 = \frac{1}{2}mg$ and $T_2 = \frac{1}{2}mg$.
4. If the table is frictionless: (a) What is the *magnitude* and *direction* of the **net force** acting on m_1 ? (b) What is the *magnitude* and *direction* of the **net force** acting on m_2 ?
5. If the table is *not* frictionless, a friction vector will act opposite to the string tension pulling on m_1 . (a) If the force of friction is equal to $\frac{1}{2}mg$, will the masses move? (b) If the force of friction is less than $\frac{1}{2}mg$ will the masses move?