MET 2124 Spring 2025: Practice In-Class Quiz 1 Name: SOLUTION

INSTRUCTIONS:

This quiz is open-book, open-note, and you may work with your classmates.

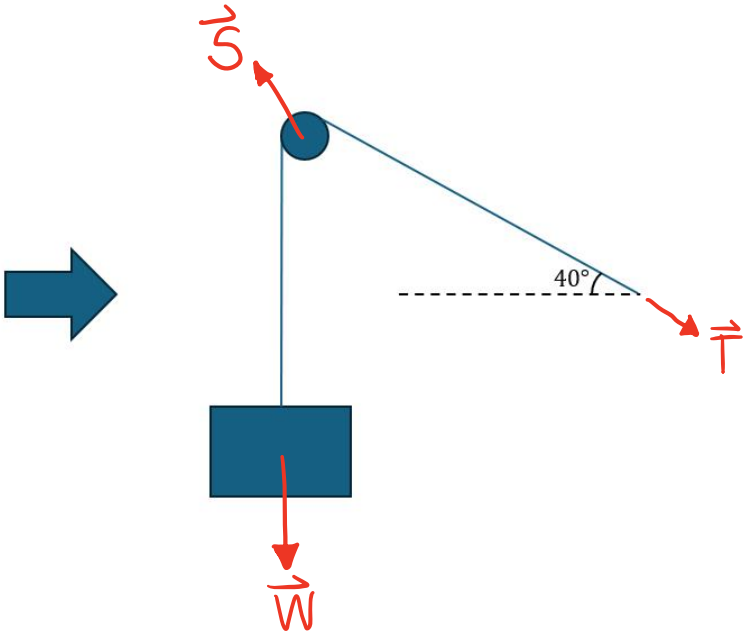
Please answer all questions on your individual papers and submit to me by the end of today's class period.

GIVEN:

A crane is lifting a 500 kg load. The tension in the cable is represented by the force vector ***T***, which makes a 40° angle with the horizontal.

FIND:

1) (20 points) Draw a Free-Body Diagram (FBD) of the crane cable, simplifying the load as a point mass with a weight acting straight downwards. Use the diagram provided on the right below.



2) (20 points) Assume the acceleration due to gravity is g = 9.8 m/s^2. Determine the weight of the 500 kg load.

$$|\vec{W}| = W = mg = (500\,kg)\left(9.8\,\frac{m}{s^2}\right)$$

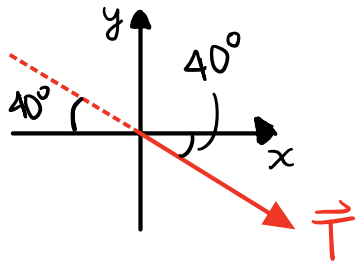
$$\boxed{W = 4900\,N}$$

3) (20 points) Determine the magnitude of ***T***.

BECAUSE THE CONTACT BETWEEN THE CABLE AND THE CRANE PULLEY IS FRICTIONLESS, THE TENSION IN THE CABLE IS EQUAL TO THE WEIGHT OF THE LOAD

$$|\vec{T}| = |\vec{W}| = \boxed{4900\ \text{N}}$$

4) (20 points) Resolve the force vector *T* into its Cartesian components T_x and T_y.



$$T_x = |\vec{T}|\cos(40°) = (4900\ \text{N})\cos 40°$$

$$\boxed{T_x = 3750\ \text{N}}$$

$$T_y = -|\vec{T}|\sin(40°) = -(4900\ \text{N})\sin 40°$$

$$\boxed{T_y = -3150\ \text{N}}$$

5) (20 points) Represent ***T*** in Cartesian vector form.

$$\vec{T} = T_x\hat{\imath} + T_y\hat{\jmath}$$

$$\boxed{\vec{T} = 3750\hat{\imath} - 3150\hat{\jmath}\ \text{N}}$$

BONUS: (5 points) Find the unit vector that points in the direction of ***T***.

$$\hat{T} = \frac{\vec{T}}{|\vec{T}|} = \frac{3750\hat{\imath} - 3150\hat{\jmath}\ \text{N}}{4900\ \text{N}}$$

$$\boxed{\hat{T} = 0.77\hat{\imath} - 0.64\hat{\jmath}}$$