Question:
A certain rope can withstand 300 N of tension before breaking. If a 45 kg mass is to be lowered using the rope without the rope breaking, what is the maximum time it will take to lower the mass 50 m?

Numerical Answer:

a) About 5.64 seconds is the longest time the trip could take.

Reasoning;
By definition, the net force = (mass)(acceleration). Since an object's displacement is proportional to time, then the acceleration is needed.

$$F_{NET} = ma$$

$$T(+\hat{j}) + mg(-\hat{j}) = ma(-\hat{j})$$

$$a(-\hat{j}) = \frac{T(+\hat{j}) + mg(-\hat{j})}{m}$$

$$a(-\hat{j}) = \frac{300N - 45kg(9.81m/s^2)}{45kg}$$

$$a(-\hat{j}) = 3.14m/s^2$$

This acceleration represents the minimum acceleration, which leads to the longest possible trip time. Assuming the object to be lowered starts from rest, the vertical displacement of the object is written as

$$\Delta y(-\hat{j}) = 0 + \frac{1}{2}a(-\hat{j})t^2$$

$$\sqrt{\frac{2\Delta y}{a}} = t \sim \sqrt{\frac{100m}{3.14m/s^2}} = 5.64s$$