

**Physics 101 Rec
Quiz # 10f**

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Name: Key Id: _____ Sect: _____

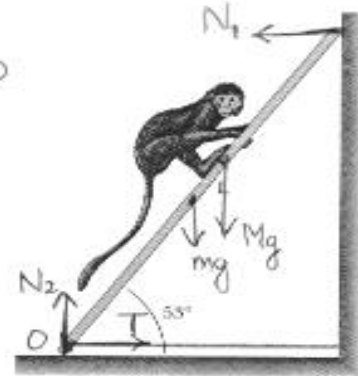
A 10 kg monkey climbs up a 120 N uniform ladder of length L as in the figure. The upper and lower ends of the ladder rest on frictionless surfaces. The lower end is fastened to the wall by a horizontal rope that can support a maximum tension of 110 N.

(a) Find the tension in the rope when the monkey is $1/3$ the way up the ladder.

$$\tau_0 = 0$$

$$\Rightarrow N_1 \sin 127^\circ - Mg \frac{L}{3} \sin 143^\circ - mg \frac{L}{2} \sin 143^\circ = 0$$

$$\Rightarrow N_1 = \frac{\left(\frac{Mg}{3} + \frac{mg}{2}\right) \sin 143^\circ}{\sin 127^\circ} = 69.8 \text{ N}$$



$$\sum F_x = 0$$

$$\Rightarrow -N_1 + T = 0 \Rightarrow T = N_1 = \boxed{69.8 \text{ N}}$$

(b) Find the maximum distance d the monkey can walk up the ladder before the rope breaks, expressing your answer in terms of L .

$$T = 110 \text{ N} \Rightarrow d = ?$$

$$T = N_1 = 110 \text{ N}$$

$$N_1 L \sin 127^\circ - Mg d \sin 143^\circ - mg \frac{L}{2} \sin 143^\circ = 0$$

$$\left(110 \sin 127^\circ - \frac{mg}{2} \sin 143^\circ\right) L = Mg \sin 143^\circ d$$

$$d = \frac{51.74}{58.98} L = 0.877L \approx 0.88L$$

from the bottom of
the ladder.