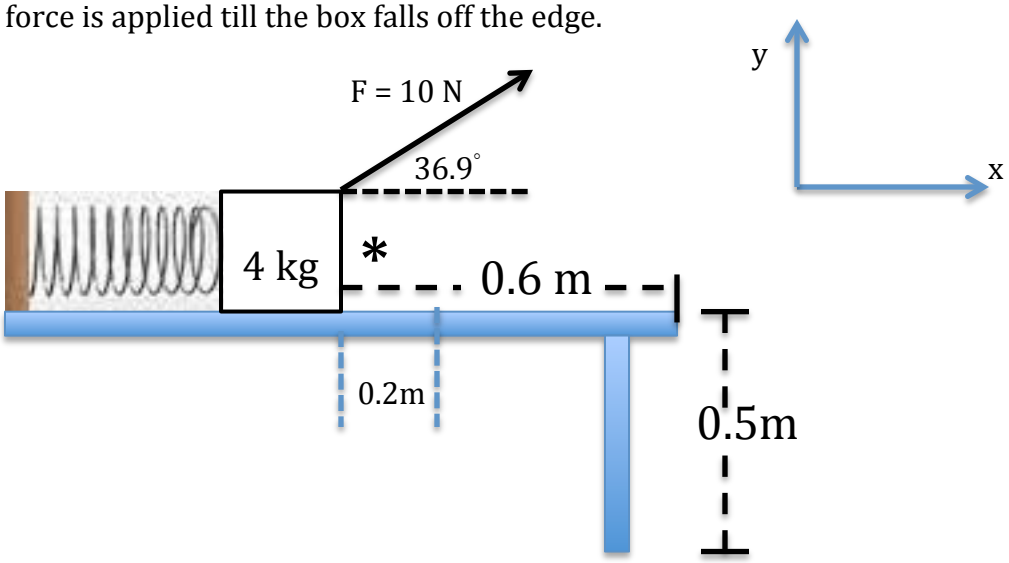
PHYSICS 1211 November 11, 2016

Conservation of Energy with external Force Part 2.

$W_{ext} = \Delta U + \Delta K + E_{th}$; $E_{th} = f_k d$, d is distance traveled.

$$\Delta U = \Delta U_g + \Delta U_{el}; U_g = mgy; U_{el} = \frac{1}{2}kx^2.$$

1. A 4-kg box compressed an ideal spring 20 cm from its equilibrium length. The box rests on a table with friction coefficients, $\mu_k = 0.15$ and $\mu_s = 0.25$, and the spring constant is $k = 400N/m$. The spring is released, and at the same time a 10-N force is applied at 36.9° above the horizontal. The constant force is applied till the box falls off the edge.



i) When the box is on the table, calculate the x-component of the force, F_x, the normal force on the F_N, and the **kinetic force** of **friction**, f_k. Use **Newton's law**, **Hooke's Law**, and the concept of **friction** to show that the box moves.

y-com, $F_y^{net} = F_N - mg + 10N \times \sin 36.9^\circ = 33.2N$

$f_{s,\max} = \mu_s F_N = 8.3N$, $f_k = \mu_k F_N = 4.98N$

x-com, $kx + 10N \times \cos 36.9^\circ > 8.3N$, it will move!

ii) Use **conservation of energy** to calculate the **speed** of the box at: the edge of the table; and just before it hits the floor.
Answer: speed 2.21 m/s at edge of table, speed 3.83 m/s on floor.

iii) During the trajectory above, calculate the speed of the box when the spring is compressed by 15cm by the box (position indicated by *)
Answer: 1.35 m/s