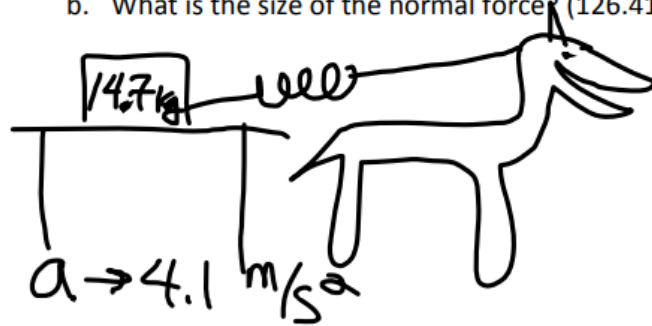


1. A box is being pulled along a horizontal table by a rope connected to a donkey's shoulders at an angle of 15° to the table. There is a spring between the rope and the box with $k = 12.2 \text{ N/cm}$. The mass of the box is 14.7 kg . If friction is opposing the box's motion with a constant force of 5.6 N , and the box is accelerating at 4.1 m/s^2 horizontally:

- How many centimeters does the spring stretch? (5.59 cm)
- What is the size of the normal force? (126.41 N)



$$\Sigma F_x = ma_x$$

$$-F_{fr} + F_s \cos \theta = ma_x$$

$$-5.6 + F_s \cos 15^\circ = (14.7)(4.1)$$

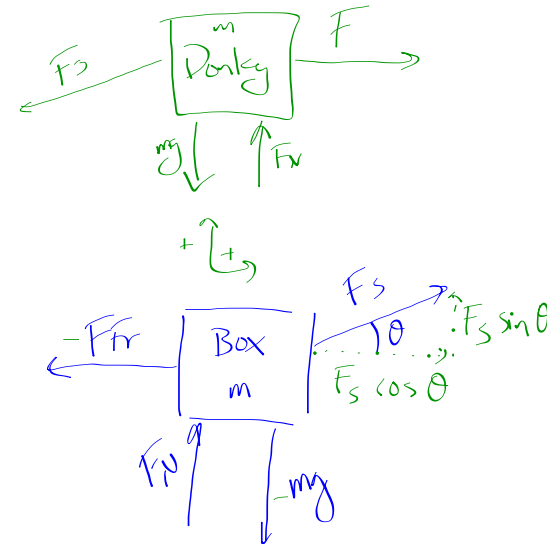
$$F_s = \frac{(14.7)(4.1) + 5.6}{\cos 15^\circ}$$

$$F_s = 68.2 \text{ N}$$

$$F_s = kx$$

$$68.2 \text{ N} = (12.2 \text{ N/cm})x$$

$$x = 5.6 \text{ cm}$$



$$\Sigma F_y = ma_y$$

$$F_N + -mg + F_s \sin \theta = ma_y = 0$$

$$F_N = (14.7)(9.8) - (68.2)(\sin 15^\circ)$$

$$= 126.41 \text{ N}$$

2. A football with a mass of 0.32 kg is hooked to an airplane by a spring at a constant angle (with the vertical) of 24° . The spring is stretched out 11 cm. The football is not moving in the vertical direction.

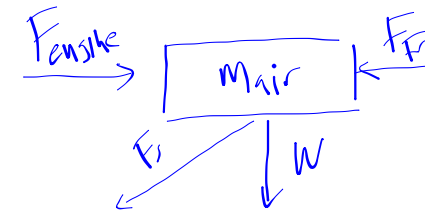
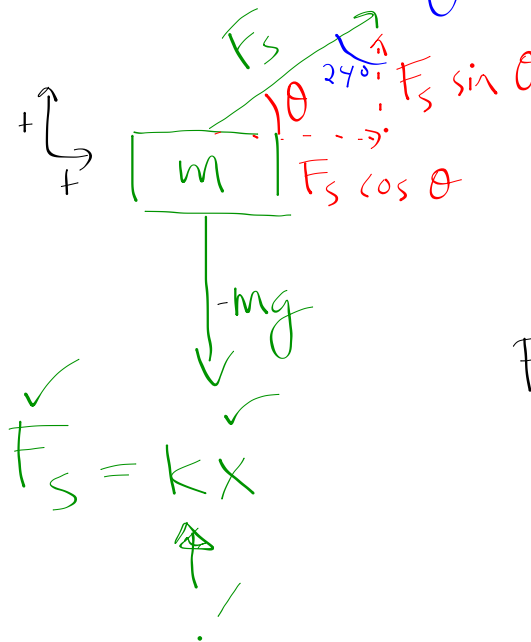
- a. What is the spring constant of the spring (in N/cm)? (0.31 N/cm)
 b. How quickly is the football accelerating horizontally? (4.36 m/s^2)



$$\Sigma F_x = ma_x$$

$$F_s \cos \theta = ma_x$$

✓ ✓ ✓ ↑



$$\theta = 90 - 24 = 66^\circ$$

$$\Sigma F_y = ma_y$$

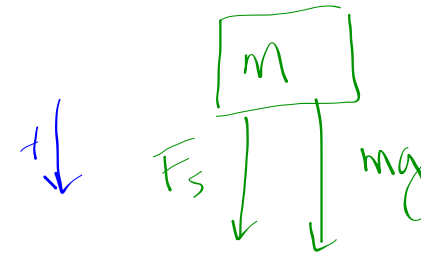
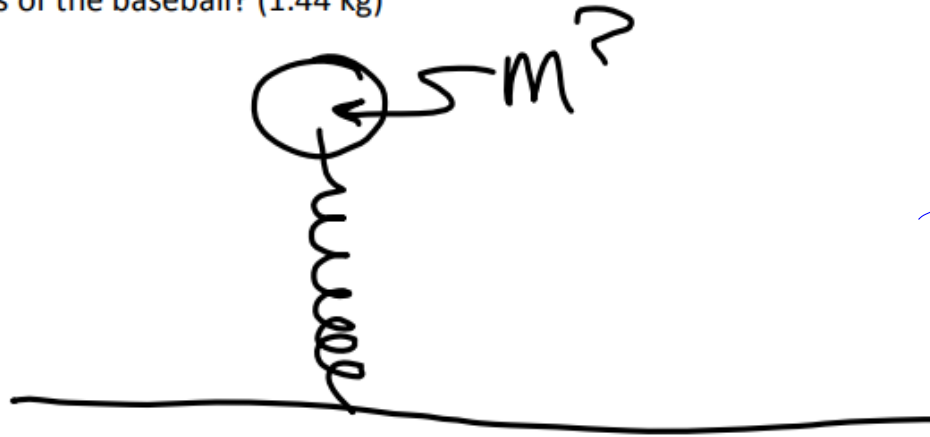
$$F_s \sin \theta - mg = ma_y = 0$$

$$F_s \sin \theta - mg = 0$$

$$F_s = \frac{mg}{\sin \theta} = \frac{(0.32)(9.8)}{\sin 66}$$

$$F_s = 3.43 \text{ N}$$

3. A baseball is thrown directly up into the air. It is attached to a spring that is hooked to the ground. The spring has a k of 0.41 N/cm . When the spring has stretched out 5.6 cm , the baseball has an instantaneous acceleration of 11.4 m/s^2 downward. What is the mass of the baseball? (1.44 kg)



$$\Sigma F = ma$$

$$F_s + mg = ma$$

$$F_s = ma - mg$$

$$\leftarrow m = \frac{F_s}{(a - g)}$$

$$F_s = kx$$

$$\checkmark = (0.41 \text{ N/cm})(5.6)$$