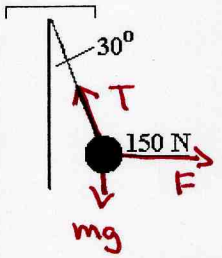
a. A 3500 kg statue is placed on top of a cylindrical concrete stand. ($Y = 2.3\times10^{10}\ \text{N/m}^2$). The stand has a cross-sectional area of $7.3\times10^{-2}\ \text{m}^2$ and a height of 1.8 m. By how much does the statue compress the stand?

$$\Delta L = \frac{FL_0}{YA} = \frac{3500(9.8)1.8}{(2.3\times10^{10})(7.3\times10^{-2})} = \boxed{3.7\times10^{-5}\ \text{m}}$$

b. A ball hangs from the ceiling on a massless rope and is pulled by a horizontal rope with a 150 N force as shown below. Determine the tension in the rope attached to the ceiling.



$$-T\cos60 + 150 = 0$$

$$T = \frac{150}{\cos60} = \boxed{300\text{N}}$$

c. A helium-filled balloon has a volume of 1.0 m^3. As it rises in the Earth's atmosphere, its volume expands. What is it's new volume (in cubic centimeters) if it's original temperature and pressure are 20.0°C and 1.00 atm and it's final temperature and pressure are -40.0 °C and 0.10 atm?

$$V_2 = \frac{P_1}{P_2}\frac{T_2}{T_1}V_1 = \frac{1.0}{0.1}\frac{233}{293}1.0(10^6) = \boxed{7.95\times10^6\ \text{cm}^3}$$

d. What is the work done as two moles of an ideal gas expand at 150°C from 2.00 m^3 to 3.00 m^3?

$$W = nRT\ln(V_2/V_1) = 2(8.31)423\ln(3/2) = \boxed{2850\text{J}}$$

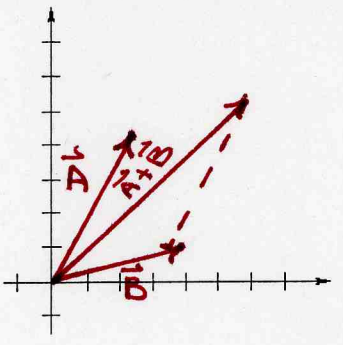
e. (10 pts!) Consider the two vectors:
A has magnitude 5.0, oriented 60° to the *x*-axis.
B has and *x*-component of 4.0 and a *y*-component of 1.0.

a. Find the *x* and *y* components of **A**.

$A_x = A\cos60 = \boxed{2.5}$

$A_y = A\sin60 = \boxed{4.3}$

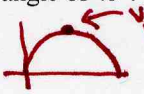
b. Sketch and label **A**, **B** and **A+B**.



f. The NewRiver Gorge Bridge in West Virginia is a steel arch bridge 518 m in length. How much does it's length change between the extreme temperatures of -20.0 °C and 35.0 °C? [$\alpha = 11\times10^{-6}\ (\text{°C})^{-1}$.]

$$\Delta L = \alpha L_0 \Delta T = (11\times10^{-6})518(55) = \boxed{0.31\text{m}}$$

g. A golf ball leaves a tee with an initial velocity of 30.0 m/s at an angle of 45°. What is the maximum height reached by the ball?



$V_{0x} = 30\cos45 = 21\ \text{m/s}$

$V_{0y} = 30\sin45 = 21\ \text{m/s}$

$$V_y^2 = V_{0y}^2 - 2gy$$

$$y = \frac{V_{0y}^2}{2g} = \boxed{23\text{m}}$$

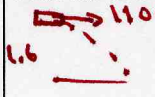
h. A uniform block of wood is 20.0 cm on a side. It floats in water so that its upper surface is 6.0 cm above the water surface. What is the buoyant force on the wood?

$$B = \rho_f V_f g = 10^3(.2)(.2)(.14)9.8 = \boxed{55\text{N}}$$

i. A 10.0 kg ball is raised 2.0 m from the ground. How much work was done to lift the ball?

$$W = mgh = \boxed{196\text{J}}$$

j. A bullet is fired from a rifle that is held 1.6 m above the ground in a horizontal position. The initial speed of the bullet is 1100 m/s. Find the time it takes for the bullet to strike the ground.



$$h = \tfrac{1}{2}gt^2$$

$$t = \sqrt{\frac{2h}{g}} = \boxed{0.57\text{s}}$$

k. Putting a mass of 200 g on a spring with spring constant 8 N/m results in what oscillation frequency?

$$f = \frac{1}{2\pi}\sqrt{\frac{K}{m}} = \frac{1}{2\pi}\sqrt{\frac{8}{.2}} = \boxed{1\text{ Hz}}$$