1. (1 pt) Derek Dooley can’t decide which rope to use to drag his $5 million out of Knoxville. The two ropes are made of the same material, but one has a greater diameter. If Derek pulls on each rope with the same force, which rope will have the smallest factor of safety?
   a. bigger rope  
   b. smaller rope  
   c. same for both

2. (1 pt) Stephen A. Burroughs is chasing an ambulance down the street. To determine the frequency of the ambulance siren that Steven hears, you would use what signs in the Doppler equation?
   a. $v + v_L, v_S$
   b. $v + v_L, -v_S$
   c. $-v_L, v_S$
   d. $-v_L, -v_S$

3. (1 pt) What is the change in internal energy for a cyclic process?
   a. $W$  
   b. $-W$  
   c. 0  
   d. $Q$  
   e. $-Q$  
   f. depends

4. (1 pt) A capacitor is a device used to store:
   a. electric current  
   b. electric potential  
   c. electric charge  
   d. magnetic energy

5. (8 pts) The dimensions of a 450 lb goal post are shown. Disgruntled fans pull on opposite sides, as shown. Determine the magnitude of the reaction moment at A.
6. (8 pts) A sphere with a relative density of 1.6 and radius of 0.007m is falling through water. Determine its terminal velocity. (Volume of a sphere = \( \frac{4}{3} \pi r^3 \); surface area of a sphere = \( 4 \pi r^2 \); \( \eta_{water} = 1 \times 10^{-3} \text{ Pa} \cdot \text{s} \))

7. (8 pts) Water leaks out of a 45 gallon, 3 ft diameter tank through a 0.2 inch diameter hole at a rate of 3 gallons per minute. What is the height of the water in the tank after 45 seconds? 1 gallon = 231 in\(^3\)
8. (8 pts) Three people are singing Rocky Top. The first person sings with intensity $I$. The second person sings with twice this intensity, or $2I$. The third person, when singing by themselves, sings at an 80 dB level. The combined singers create an 85 dB sound. What is the intensity of the first singer, $I$?

9. (8 pts) A physical pendulum is made from an object that has a mass of 2 kg and a mass moment of inertia about the centroid of 0.05 kg·m$^2$. The object is hung from a pivot point and has a period of oscillation of 1.2 seconds. Determine the distance the pivot point is from the center of mass.
10. (8 pts) The third frequency of a 0.4 m long string is 2400 Hz. The tension on the string is 800 N. Determine the mass of the string.

11. (8 pts) A 0.26 kg ceramic coffee mug (c = 0.33 cal/g-°C) is initially at 23°C. 0.3 L of 96°C coffee is added to the mug. If 1600J of heat is lost to the atmosphere, what is the equilibrium temperature of the mug and coffee?

12. (8 pts) A freezer has a coefficient of performance of 2.7. What is the electrical power required to completely freeze 12 kg of water, initially at 25°C, in 3 hours?
13. (8 pts) The gabled side of a house consists of a 10 ft x 24 ft rectangular portion of brick (R=11 ft²·hr·°F/BTU) and an 8 ft high triangular section of vinyl siding (R=3 ft²·hr·°F/BTU). The interior wall consists of 0.5-inch-thick drywall (R=5 ft²·hr·°F/BTU). What is the effective R value of the entire wall?

14. (8 pts) Two point charges are placed as shown. Determine the x-coordinate of a third charge so that the net force on it is zero.
15. (8 pts) Determine the current through the 4Ω (R₂) resistor.

16. (8 pts) A heart defibrillator delivers 400 J of energy by discharging a capacitor initially at 1.00×10⁴ V. Determine the required area of a parallel plate capacitor in air (dielectric constant = 1), if the plates have a separation distance of 0.01 mm.