

The class before the exam there will be a chance to earn extra credit. Groups of two to three can present a solution to one of the problems below. Up to 4% can be earned:

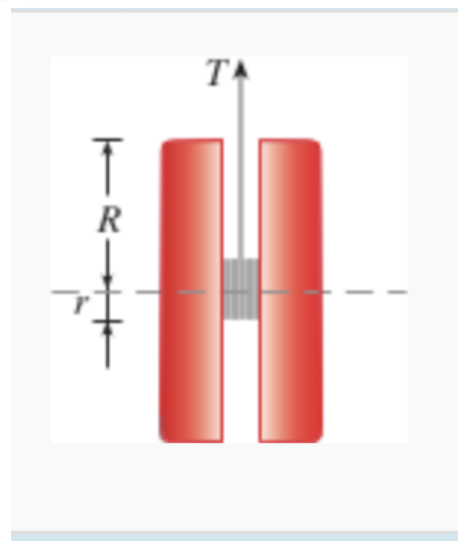
- [1] Mastery of the problem: Do you understand the problem and all of the steps used to solve it? Would you be able to solve the problem if given a slightly different question?
- [1] Presentation of the problem: You are presenting material to your classmates that will be on their exam next week! Take care to explain your steps and why you take them but your group also needs to complete your presentation in under 10 minutes!
- [1] Presentation: Do you interact with the class? Do you make eye contact?
- [1] Fielding questions: Can you understand the questions and give a cohesive answer?

Word Problem Practice

1. The tension T in the string of the yo-yo in the figure is

$$T = \frac{mgR}{2r^2 + R^2}$$

where m is the mass of the yo-yo and g is acceleration due to gravity. Use linear approximations to estimate the change in the tension if R is increased from 3cm to 3.1cm and r is increased from 0.7 cm to 0.8cm. Does the tension increase or decrease?



2. The pressure, volume, and temperature of a mole of an ideal gas are related by the equation $PV = 8.31T$ where P is measured in kilopascals, V in liters, and T in kelvins. Use linear approximations to find the approximate changes in the pressure if the volume increases from 12L to 12.2L and the temperature decreases from 310K to 308K.
3. If R is the total resistance of three resistors, connected in parallel, with resistances R_1 , R_2 , and R_3 , then

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}.$$

If the resistances are measured in ohms as $R_1 = 25\Omega$, $R_2 = 40\Omega$, and $R_3 = 50\Omega$ with a possible error of .5% in each case, estimate the maximum error in the calculated value of R .

4. A model for the surface area of a human body is given by $S = 0.1091w^{0.425}h^{0.725}$, where w is the weight (in pounds), h is the heights (in inches), and S is measured in square feet. If the errors in measurement for w and h are at most 2%, use a linear approximation to estimate the maximum percentage error in the calculated surface area.

5. Suppose over a certain region of space that the electrical potential V is given by $V(x, y, z) = 5x^2 - 3xy + xyz$. Find the rate of change of the potential at $P(3, 4, 5)$ in the direction of $\vec{i} + \vec{j} - \vec{k}$. In which direction does V change the most rapidly at P ?
6. The temperature T in a metal ball is inversely proportional to the distance from the center of the ball. If we let the center of the ball be the origin then the temperature at the point $(1, 2, 2)$ is 120° . Find the rate of change of T at $(1, 2, 2)$ in the direction toward the point $(2, 1, 3)$.
7. If the length of the diagonal of a rectangular box must be L , what is the largest possible volume? Justify your answer.
8. A rectangular building is being designed to minimize heat loss. The east and west walls lose heat at a rate of 10 units/square meters per day, the north and south walls at a rate of 8 units/square meters per day, the floor at a rate of 1 unit/square meters per day, and the roof at a rate of 5 units/square meters per day. Each wall must be at least 30 meters long, the height must be at least 4 meters, and the volume must be exactly 4000 cubic meters. Find the dimensions that will minimize heat loss.
9. A grain silo is to be built by attaching a hemispherical roof and a flat floor onto a circular cylinder. Use Lagrange multipliers to show that for a total surface area S , the volume of the silo is maximized when the radius and height of the cylinder are equal.
10. Section 15.1 #6