

Name \_\_\_\_\_

High School Name \_\_\_\_\_

**SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.**

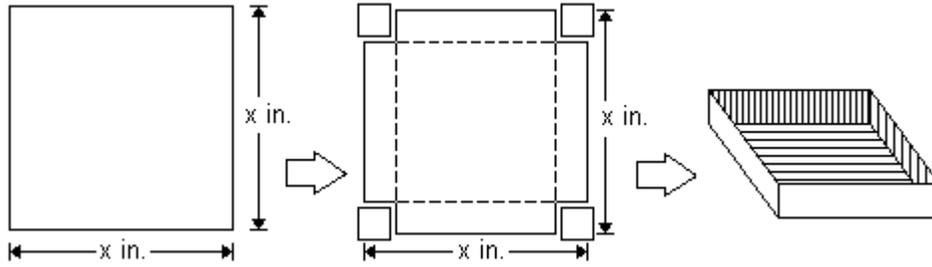
**Solve. Round the answer to the nearest whole number.**

- 1) An accidental spill of 75 grams of radioactive material in a local stream has led to the presence of radioactive debris decaying at a rate of 3% each day. Find how much debris still remains after 8 days. 1) \_\_\_\_\_

**Solve.**

- 2) Suppose that an open box is to be made from a square sheet of cardboard by cutting out 2-inch squares from each corner as shown and then folding along the dotted lines. If the box is to have a volume of 50 cubic inches, find the original dimensions of the sheet of cardboard.

2) \_\_\_\_\_

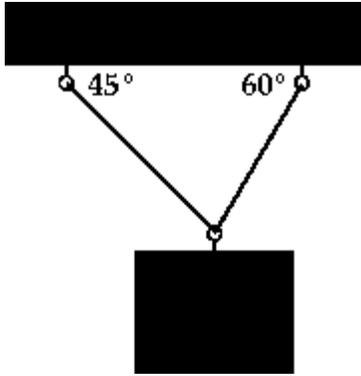


**Solve the problem.**

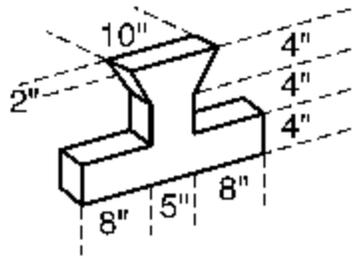
- 3) The function  $f(x) = 1 + 1.4 \ln(x + 1)$  models the average number of free-throws a basketball player can make consecutively during practice as a function of time, where  $x$  is the number of consecutive days the basketball player has practiced for two hours. After how many days of practice can the basketball player make an average of 7 consecutive free throws? 3) \_\_\_\_\_

4) A box of supplies that weighs 1500 kilograms is suspended by two cables as shown in the figure. To two decimal places, what is the tension in the two cables?

4) \_\_\_\_\_

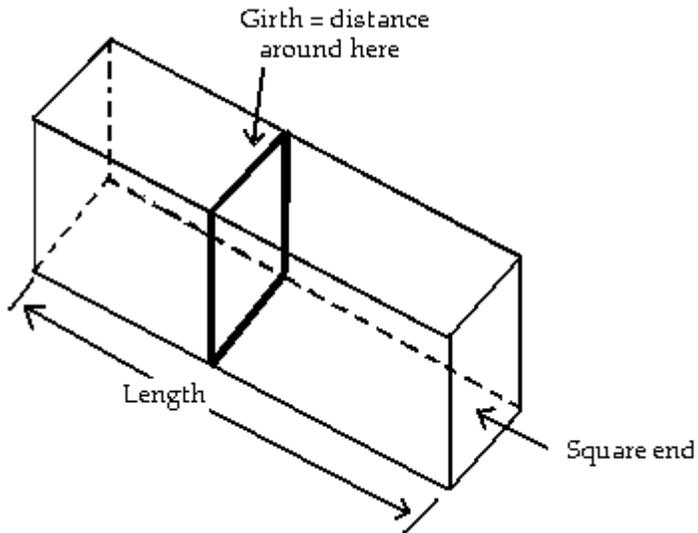


5) Find the weight of the piece of steel pictured. Steel weights 0.2833 pounds per cubic inch. Round to the nearest hundredth. 5) \_\_\_\_\_



**Solve the problem.**

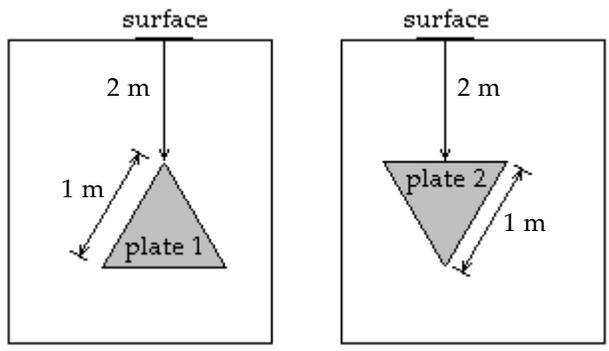
- 6) A private shipping company will accept a box for domestic shipment only if the sum of its length and girth (distance around) does not exceed 120 in. What dimensions will give a box with a square end the largest possible volume? 6) \_\_\_\_\_



7) An auxiliary fuel tank for a helicopter is shaped like the surface generated by revolving the curve  $y = 1 - \frac{x^2}{25}$ ,  $-5 \leq x \leq 5$ , about the x-axis (dimensions are in feet). How many cubic feet of fuel will the tank hold to the nearest cubic foot? 7) \_\_\_\_\_

8) A plate shaped like an equilateral triangle 1 m on a side is placed on a vertical wall 2 m below the surface of a pool filled with water. On which plate in the figure is the force greater? Try to anticipate the answer and then compute the force on each plate. Round to three decimal places when appropriate.

8) \_\_\_\_\_



- 9) A 200 gallon tank is filled with pure water. A salt solution with a concentration of 16 g/gal flows into the tank at a rate of 3 gal/min. The thoroughly mixed solution is drained from the tank at a rate of 3 gal/min. 9) \_\_\_\_\_
- (a) Write an initial value problem for the mass of the salt.
- (b) Solve the initial value problem.

10) The spread of a cold virus can be modeled using logistic equations. The key assumption is that at any given time, a fraction  $y$  of the population, where  $0 \leq y \leq 1$ , has the virus, while the remaining fraction  $1 - y$  does not. Furthermore, the cold virus spreads by interactions between those who have it and those who do not. The number of such interactions is proportional to  $y(1 - y)$ . Therefore, the equation that describes the spread of the virus is  $y'(t) = ky(1 - y)$ , where  $k$  is a positive real number. Assume  $k = 0.6$  and solve the initial value problem where the number of people who initially have the cold virus is  $y(0) = 0.4$ .

10) \_\_\_\_\_

## Answer Key

Testname: TECH FEST SPRING 2017 DOCS

- 1) 59 g
- 2) 9 in. by 9 in.
- 3) 72 days
- 4) Tension in right cable: 1098.08 kg; tension in left cable: 776.46 kg
- 5) 75.92 pounds
- 6) 20 in. x 20 in. x 40 in.
- 7) 17
- 8) plate 1  
plate 1: 10,937.049 N  
plate 2: 9712.049 N
- 9) (a)  $m'(t) = -0.015m + 48$ ,  $m(0) = 0$   
(b)  $m = -3200e^{-0.015t} + 3200$
- 10)  $y = \frac{0.4e^{0.6t}}{0.4(e^{0.6t} - 1) + 1}$