

Sample Test Problems for Chapter 9, Sections 9.1 – 9.3

1. Jenny wants to know what it means when we say that a tank is 284 cubic feet. What can you tell Jenny?
2. State the meaning of each of the following prefixes, which are used in the Metric System: kilo, deci, hecto, milli, centi, deka.
3. Give examples of two units in the Metric System that use the prefix milli. State the attributes that the units are used to measure. For each unit, give an example of some actual thing whose size could be appropriately described using that unit.
4. What is special about the way units in the Metric System are named? Give several examples to illustrate.
5. How is one milliliter related to one gram and to one centimeter?
6. What is the difference between an ounce and a fluid ounce?
7. When Joe was asked to draw a shape that has an area of 3 square centimeters, he drew a 3 cm by 3 cm square. Is Joe right or not? Explain.
8. The long, shaded line on the dial in Figure 1 indicates the weight of an object. How should you report the weight of the object? Explain briefly why you should report the weight that way and not some other way.

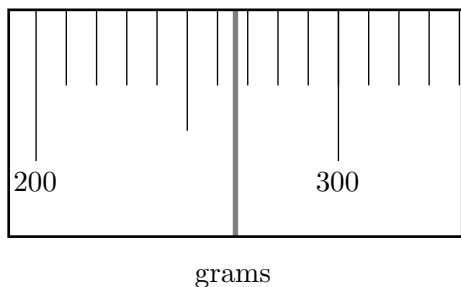


Figure 1: The Dial of a Scale

9. What is the difference between reporting that something weighs 2 pounds and that it weighs 2.0 pounds? Explain your answer in detail.
10. If the distance between two cities is reported as 3460 miles, does that mean that the distance is exactly 3460 miles? If not, what can you say about the exact distance?

11. Roger is calculating the distance from town A to town C. Roger is given that the distance from town A to town B is 240 miles, the distance from town B to town C is 350 miles, that town B is due east of town A, and that town C is due north of town B. Roger does some calculations and concludes that the distance from town A to town C is 430.116 miles. Should Roger leave his answer like that? Why or why not? If not, what answer should Roger give? Explain. (You may assume that Roger has done his calculations correctly.)
12. Describe one-dimensional, two-dimensional, and three-dimensional parts or aspects of a bottle. In each case, name an appropriate U.S. customary unit and an appropriate metric unit for measuring or describing the size of that part or aspect of the bottle. What are practical reasons for wanting to know the sizes of these parts or aspects of the bottle?
13. A child in your class wants to know why we multiply only two of the lengths of the sides of a rectangle in order to determine the rectangle's area. When we calculate the perimeter of a rectangle we add the lengths of the four sides of the rectangle, so why don't we multiply the lengths of the four sides in order to find the area? Explain to the child what perimeter and area mean and explain why we carry out the perimeter and area calculations for a rectangle the way we do.
14. A child in your class wants to know why we multiply only three of the lengths of the edges of a box in order to calculate the volume of the box. Why don't we have to multiply *all* the lengths of the edges? Explain to this child why it makes sense to calculate the volume of a box as we do.
15. (a) Explain how to see the area of the large rectangle in Figure 2 as consisting of $2\frac{1}{2}$ groups with $5\frac{1}{2}$ cm² in each group, thereby explaining why it makes sense to multiply

$$2\frac{1}{2} \times 5\frac{1}{2}$$

to determine the area of the rectangle in square centimeters.

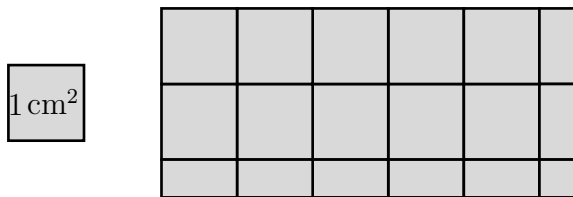


Figure 2: Explain Why the Area is $2\frac{1}{2} \times 5\frac{1}{2}$ cm²

- (b) Calculate $2\frac{1}{2} \times 5\frac{1}{2}$ without a calculator, showing your calculations. Then verify that this calculation has the same answer as when you determine the area of the rectangle in Figure 2 in square centimeters by counting full 1 cm by 1 cm squares and combining partial squares.
16. People often get confused between the *surface area* and the *volume* of a 3-dimensional object.
 - (a) Explain the difference between the surface area of a water tower and the volume of a water tower in a way that could help someone learn.

- (b) Determine the total surface area as well as the volume of a box that is 3 feet wide, 2 feet deep, and 4 feet tall. Explain why you calculate as you do.
17. Suppose there are two rectangular pools: one is 30 feet wide, 40 feet long, and 3 feet deep throughout, the other is 20 feet wide, 40 feet long, and 5 feet deep throughout. Compare the sizes of the pools in *two* meaningful ways *other than* by comparing one-dimensional aspects.
18. Explain why each one of the two blocks in Figure 3 can be considered the “biggest” of the two by first comparing the blocks’ surface areas and then comparing the blocks’ volumes.
19. Explain why each one of the two blocks in Figure 3 can be considered the “biggest” of the two by first comparing the blocks’ sizes with respect to a 2-dimensional aspect of the blocks, and then comparing the blocks’ sizes with respect to a 3-dimensional aspect of the blocks.

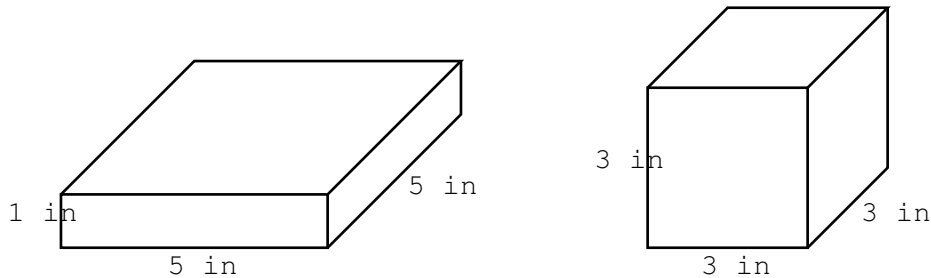


Figure 3: Two Blocks

20. Explain why either of the two rectangles in Figure 4 can be considered the larger of the two.

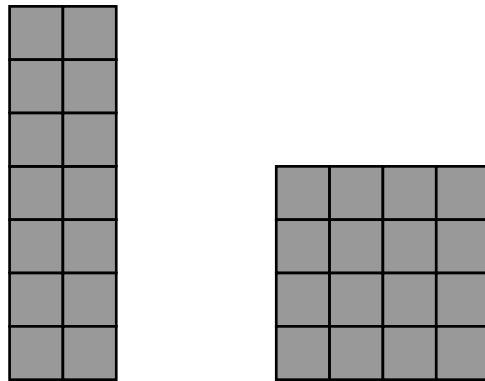


Figure 4: Two Rectangles

21. Sam is confused about why we *multiply* by 3 to convert 6 yards to feet. Sam thinks we should *divide* by 3 because feet are *smaller* than yards. Explain in several different ways why we multiply by 3 to convert 6 yards to feet.
22. Many children have difficulty understanding when we multiply and when we divide in order to convert measurements from one unit to another. For each of the following conversions, show how to convert without using dimensional analysis, as if you were showing a child. In each case, give a simple and clear explanation for why it makes sense to convert in that way.

- (a) Convert 5 feet to inches.
- (b) Convert 12 feet to yards.
- (c) Convert 2 gallons to pints. (Assume that your audience knows how gallons and quarts are related and how quarts and pints are related.)
- (d) Convert 52 inches to feet. Describe all the different correct ways to write the answer to this conversion problem. Explain briefly why these different ways of writing the answer mean the same thing.
- (e) Convert 11 quarts to gallons. Describe all the different correct ways to write the answer to this conversion problem. Explain briefly why these different ways of writing the answer mean the same thing.

23. One yard is 3 feet. Does it therefore follow that one square yard is 3 square feet? Explain.

24. One yard is 3 feet. Does it therefore follow that one cubic yard is 3 cubic feet? Explain.

25. Use the basic fact 1 inch = 2.54 cm in order to determine what 1 cubic yard is in terms of cubic meters.

26. Use the basic fact 1 inch = 2.54 cm in order to determine what 100 square meters is in terms of square feet.

27. The distance between two cities is described as 370 kilometers. What is this distance in miles? Calculate your answer in two ways: 1) using dimensional analysis and 2) using logical thinking about multiplication and division. In both cases, use the basic fact that 1 inch = 2.54 cm.

28. The area of land is often measured in acres. One acre is 43,560 square feet.

(a) What is a square mile in acres? Explain.

(b) What is a square kilometer in acres? Explain.

29. The floor area of a house is 2500 square feet. Find the floor area of the house in square meters, using the fact that 1 inch = 2.54 cm. Show your work, taking care to use correct notation.

30. Analyze the following calculations which intend to convert 900 square meters to square feet. Which ones use legitimate methods and are correct, and which are not? Explain.

(a)

$$900 \text{ m}^2 = 900 \text{ m} \times \frac{100 \text{ cm}}{1 \text{ m}} \times \frac{1 \text{ in}}{2.54 \text{ cm}} \times \frac{1 \text{ ft}}{12 \text{ in}} = 2953 \text{ ft}^2.$$

(b)

$$900 \text{ m}^2 = 900 \text{ m}^2 \times \frac{100 \times 100 \text{ cm}^2}{1 \text{ m}^2} \times \frac{1 \text{ in}^2}{2.54 \times 2.54 \text{ cm}^2} \times \frac{1 \text{ ft}^2}{12 \times 12 \text{ in}^2} = 9688 \text{ ft}^2.$$

(c)

$$900 \text{ m} = 900 \text{ m} \times \frac{100 \text{ cm}}{1 \text{ m}} \times \frac{1 \text{ in}}{2.54 \text{ cm}} \times \frac{1 \text{ ft}}{12 \text{ in}} = 2953 \text{ ft}$$

Therefore,

$$900 \text{ m}^2 = 2953^2 \text{ ft}^2 = 8,718,767 \text{ ft}^2$$

(d) 900 square meters is the area of a square that is 30 meters wide and 30 meters long.

$$30 \text{ m} = 30 \text{ m} \times \frac{100 \text{ cm}}{1 \text{ m}} \times \frac{1 \text{ in}}{2.54 \text{ cm}} \times \frac{1 \text{ ft}}{12 \text{ in}} = 98.43 \text{ ft}$$

Therefore,

$$30 \text{ m}^2 = 98.43 \times 98.43 \text{ ft}^2 = 9688 \text{ ft}^2.$$