

## Section 2.4 Dimensional Analysis

We will need to know a few equivalencies to do the problems in this section. I will give you all equivalencies from this list that you need on the test. There is no need to memorize these formulas.

<b>Length</b>	<b>Volume</b>	<b>Area</b>
1 in = 2.54 cm	1 tsp = 5 ml	1 in <sup>2</sup> = 6.5 cm <sup>2</sup>
1 ft = 30 cm	1 tbsp = 15 ml	1 ft <sup>2</sup> = 0.09 m <sup>2</sup>
1 yd = 0.9 m	1 fl oz = 30 ml	1 yd <sup>2</sup> = 0.8 m <sup>2</sup>
1 mi = 1.6 km	1 cup = 0.24 l	1 mi <sup>2</sup> = 2.6 km <sup>2</sup>
1 ft = 12 in	1 pint = 0.47 l	
1 yd = 3 ft	1 qt = 0.95 l	
1 mi = 5280 ft	1 gal = 3.8 l	
	1 ft <sup>3</sup> = 0.03 m <sup>3</sup>	<b>Weight</b>
	1 yd <sup>3</sup> = 0.76 m <sup>3</sup>	1 oz = 28 g
	1 cup = 8 oz	1 lb = 0.45 kg
	1 pint = 2 cups	1 Ton = 0.9 t (tonne)
	1 quart = 2 pints	1 lb = 16 oz
	7.48 gallons = 1 ft <sup>3</sup>	1 ton = 2000 lb

### Metric Length

millimeter	centimeter	decimeter	meter	dekameter	hectometer	kilometer
1000 (mm)	100 (cm)	10 (dm)	1 (m)	0.1 (dam)	0.01 (hm)	0.001 (km)

### Metric Weight

milligram	centigram	decigram	gram	dekagram	hectogram	kilogram
1000 (mg)	100 (cg)	10 (dg)	1 (g)	0.1 (dag)	0.01 (hg)	0.001 (kg)

### Metric Volume

milliliter	centiliter	deciliter	liter	dekaliter	hectoliter	kiloliter
1000 (ml)	100 (cl)	10 (dl)	1 (l)	0.1 (dal)	0.01 (hl)	0.001 (kl)

**Example:** Use dimensional analysis to find the missing quantity.

(If you already know how to do this by moving the decimal, you may use that method.)

$$2000 \text{ cm} = \underline{\hspace{2cm}} \text{ km}$$

I will use the metric length table. I find that

$$100 \text{ cm} = 0.001 \text{ km}$$

Now I will multiply 2000 cm by a “unit” with the units I desire in the numerator, and the units I am changing out of in the denominator.

$$2000 \text{ cm} * \frac{0.001 \text{ km}}{100 \text{ cm}} = \frac{2000 * 0.001 \text{ km}}{100} = 0.02 \text{ km} \text{ (I cancelled the cm.)}$$

Answer: 0.02 km

**Example:** Use dimensional analysis to find the missing quantity.

$$15 \text{ l} = \underline{\hspace{2cm}} \text{ cups}$$

I will use the top table and I find that:

$$1 \text{ cup} = 0.24 \text{ l}$$

I need to multiply by a unit. Cups will go in the numerator as that is the unit I want to end up with. Liters will go in the denominator as that is the unit I am getting rid of.

$$15 \text{ l} * \frac{1 \text{ cup}}{0.24 \text{ l}} = \frac{15 * 1 \text{ cup}}{0.24} = 62.5 \text{ cups} \text{ (I cancelled the l.)}$$

Answer: 62.5 cups

**Example:** Use dimensional analysis to find the missing quantity.

$$90 \text{ kg} = \text{_____ oz}$$

I searched my tables and I could not find a “unit” that compares kg to oz. I will need to use 2 “units” to solve this problem. One unit will convert from kg to lb, and the second will change from lb to oz.

These are the units I will use.

$$1 \text{ lb} = 0.45 \text{ kg}$$

$$1 \text{ lb} = 16 \text{ oz}$$

$$90 \text{ kg} * \frac{1 \text{ lb}}{0.45 \text{ kg}} * \frac{16 \text{ oz}}{1 \text{ lb}} = \frac{90 * 1 * 16 \text{ oz}}{0.45 * 1} = 3200 \text{ oz}$$

The both the kg and lb’s cancel, as there is one of each in a numerator and a denominator.

Answer: 3200 oz

#1-30: Use dimensional analysis to find the missing quantity. Round to 2 decimals when appropriate.

1) 10 m = \_\_\_\_\_ cm

2) 500 ml = \_\_\_\_\_ l

3) 45 mg = \_\_\_\_\_ g

4) 20 kl = \_\_\_\_\_ l

5) 5 kl = \_\_\_\_\_ l

6) 8 kg = \_\_\_\_\_ g

7) 0.25 kl = \_\_\_\_\_ cl

8) 50 dm = \_\_\_\_\_ dam

9) 5 ft = \_\_\_\_\_ in

10) 6 ft = \_\_\_\_\_ cm

11) 3 mi = \_\_\_\_\_ ft

12) 4 yd = \_\_\_\_\_ m

13) 4 l = \_\_\_\_\_ cups

14) 40 oz = \_\_\_\_\_ cups

15) 3 fl oz = \_\_\_\_\_ l

16) 8 fl oz = \_\_\_\_\_ l

17) 400 oz = \_\_\_\_\_ kg

18) 6 kg = \_\_\_\_\_ oz

19) 10000 oz = \_\_\_\_\_ tons

20) 300 yd = \_\_\_\_\_ km

21) 21 l = \_\_\_\_\_ fl oz

22) 6 l = \_\_\_\_\_ fl oz

23) 10 kg = \_\_\_\_\_ oz

24) 220 oz = \_\_\_\_\_ kg

25) 3 tons = \_\_\_\_\_ oz

26) 2 km = \_\_\_\_\_ yd

27) 10 cups = \_\_\_\_\_ quarts

28) 8 quarts = \_\_\_\_\_ cups

29) 100 tsp = \_\_\_\_\_ l

30) 2 l = \_\_\_\_\_ tsp

**Example:** Two cities 1000 miles apart. How many kilometers are they apart?

This problem wants me to convert 1000 miles to kilometers.

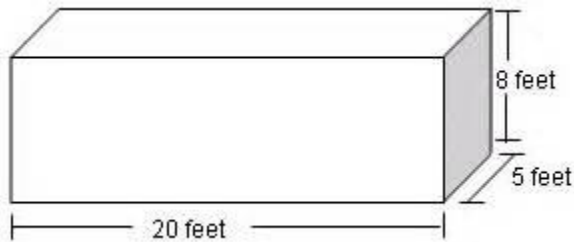
I need to find a unit that does this.

$$1.6 \text{ km} = 1 \text{ mile}$$

$$1000 \text{ miles} * \frac{1.6 \text{ km}}{1 \text{ mile}} = \frac{1000 * 1.6 \text{ km}}{1} = 1600 \text{ km}$$

Answer: The cities are 1600 km apart.

**Example:** Consider the rectangular prism below.



a) Find the volume in cubic feet.

I will use the volume formula:  $V = lwh$

$$V = (20\text{ft})(5\text{ft})(8\text{ft})$$

Answer: Volume 800 cubic feet

b) How many gallons of liquid will it hold?

I will use the unit  $7.48 \text{ gallons} = 1 \text{ cubic foot}$ .

$$800 \text{ ft}^3 * \frac{7.48 \text{ gallons}}{1 \text{ ft}^3} = 800 * 7.48 \text{ gallons} = 5984 \text{ gallons}$$

Answer: 5984 gallons

**Example:** A car has an empty 11 gallon gas tank.

a) Assume gas is selling for \$3.00 per gallon. How much will it cost to fill up the gas tank?

This is hardly worth unit analysis.

11 gallons \* \$3.00 per gallon

Answer: \$33.00

b) Assume gas is selling for \$1.50 per liter. How much will it cost to fill up the gas tank?

I need to find out the capacity of the gas tank in liters. Then I can multiply by \$1.50 per liter.

First convert 11 gallons to liters. I will use 1 gallon = 3.8 l

$$11 \text{ gallons} * \frac{3.8 \text{ l}}{1 \text{ gallon}} = 11 * 3.8 \text{ l} = 41.8 \text{ l}$$

41.8 liters \* \$1.50 per liter

Answer: \$62.70

Homework # 31 – 50: Solve, round to 2 decimals when appropriate.

31) The distance from Cincinnati, Ohio to Columbus, Ohio is about 110 miles. What is the distance in kilometers?

32) The distance from Phoenix to Flagstaff is about 140 miles. What is the distance in kilometers?

33) Two cities 400 km apart. How many miles are they apart?

34) Two cities 1000 km apart. How many miles are they apart?

35) A swimming pool holds 12,500 gallons of water. How many cubic feet of water does it hold? (round to 2 decimals)

36) A bath tub holds 50 gallons of water. How many cubic feet of water does it hold? (round to 2 decimals)

37) A pool is 20 ft long, 15 ft wide and 4 ft deep.

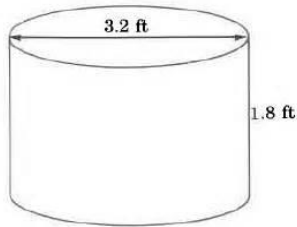
a) What is the volume of the pool in cubic feet?

b) How many gallons of water can it hold?

38) A pool is 25 ft long, 18 ft wide and 5 ft deep.

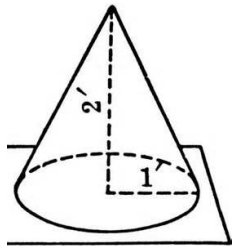
- What is the volume of the pool in cubic feet?
- How many gallons of water can it hold?

39) Consider the cylinder below.



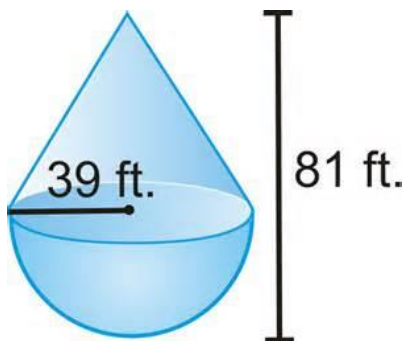
- What is the volume of the cylinder?
- How many gallons of water can it hold? (Leave your answer in terms of  $\pi$ .)

40) Consider the cone below.



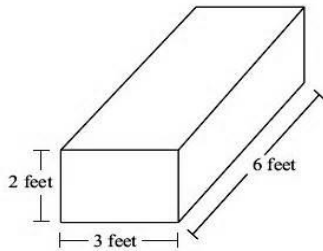
- What is the volume of the cylinder?
- How many gallons of water can it hold?

41) Consider the figure below.



- What is the volume of the shape?
- How many gallons of water can it hold? (use 3.14 for  $\pi$  and round your answer to 2 decimals.)

42) Consider the figure below.



- a) What is the volume of the shape?
- b) How many gallons of water can it hold?

43) Part of the Queen Elizabeth Way in Canada has a speed limit of 80 kph. What is the speed limit in mph?

44) The speed limit on much of I-17 is 75 miles per hour. What is the speed in kilometers per hour?

45) One gram is the same as 5 carats. David's new ring contains a precious stone that is 2 carats. Find the weight of the stone in grams.

46) One gram is the same as 5 carats. David's new ring contains a precious stone that is 1/8 carat. Find the weight of the stone in grams.

Answers: 1) 1000 cm 3) 0.045 g 5) 5,000 l 7) 25,000 cl 9) 60 in 11) 15,840 ft

13)  $16\frac{2}{3}$  cups 15) 0.09 l 17) 11.2 kg 19) .3125 T 21) 700 fl oz 23) 357.14 oz

25) 96,000 oz 27) 2.5 qt 29) 0.5 l 31) 176 km 33) 250 mi 35)  $1671.12 \text{ ft}^3$

37a)  $1200 \text{ ft}^3$  37b) 8976 gallons 39a)  $4.608\pi \text{ ft}^3$  39b)  $34.46784\pi$  gallons

41a)  $60840\pi \text{ ft}^3$  41b) 1,428,961.25 gallons 43) 50 miles per hour 45) 2/5 gram or 0.40 gram