Name: *Caleb McWhorter — Solutions*
MATH 101
Fall 2023
HW 7: Due 10/02

"If we hit that bullseye, the rest of the dominoes should fall like a house of cards. Checkmate."
–Zapp Brannigan, Futurama

Problem 1. (10pt) Express the following decimal numbers in scientific notation:

(a) 5

(b) 10.3

(c) 0.000000123

(d) 159000000

(e) 0.4

Solution.

(a)
$$5 = 5 \cdot 10^0$$

(b)
$$10.3 = 1.03 \cdot 10^1$$

(c)
$$0.000000123 = 1.23 \cdot 10^{-7}$$

(d)
$$159000000 = 1.59 \cdot 10^8$$

(e)
$$0.4 = 4 \cdot 10^{-1}$$

Problem 2. (10pt) Express the following numbers in scientific notation as decimal numbers:

(a) $5.23 \cdot 10^5$

(b) $1.3 \cdot 10^0$

(c) $9.7 \cdot 10^{-8}$

(d) $4.0 \cdot 10^3$

(e) $5.782 \cdot 10^{10}$

Solution.

(a)

$$5.23 \cdot 10^5 = 523{,}000$$

(b)

$$1.3 \cdot 10^0 = 1.3$$

(c)

$$9.7 \cdot 10^{-8} = 0.000000097$$

(d)

$$4.0 \cdot 10^3 = 4{,}000$$

(e)

$$5.782 \cdot 10^{10} = 57{,}820{,}000{,}000$$

Problem 3. (10pt) Showing all your work and expressing the result in scientific notation with three significant figures, convert the following:

(a) 0.008 megagrams to centigrams

(b) 120 oz to stones [1 oz = 28.35 g, 1 stone = 6.35 kg]

(c) 3 gallons to milliliters [1 gal = 3.785 L]

(d) $2.16 \cdot 10^9$ ft^3 to mi^3 [5,280 ft = 1 mi.]

(e) 3.72 meters per square second to feet per square minute [0.3048 m = 1 ft]

Solution.

(a)

$$\frac{0.008 \text{ Mg} \left\| \frac{10^6 \text{ g}}{1 \text{ Mg}} \right| \frac{100 \text{ cg}}{1 \text{ g}}}{} = 800{,}000 \text{ cg} = 8.00 \cdot 10^5 \text{ cg}$$

(b)

$$\frac{120 \text{ oz} \left\| \frac{28.35 \text{ g}}{1 \text{ oz}} \right| \frac{1 \text{ kg}}{1000 \text{ g}} \left| \frac{1 \text{ stone}}{6.35 \text{ kg}} \right.}{} = 0.535748 \text{ stone} \approx 5.36 \cdot 10^{-1} \text{ stone}$$

(c)

$$\frac{2.16 \cdot 10^9 \text{ ft}^3 \left\| \frac{1 \text{ mi}}{5280 \text{ ft}} \right| \frac{1 \text{ mi}}{5280 \text{ ft}} \left| \frac{1 \text{ mi}}{5280 \text{ ft}} \right.}{} = 0.0146741 \text{ mi}^3 = 1.47 \cdot 10^{-2} \text{ mi}^3$$

(d)

$$\frac{3 \text{ gal} \left\| \frac{3.785 \text{ L}}{1 \text{ gal}} \right| \frac{1000 \text{ ml}}{1 \text{ L}} \right.}{} = 11{,}355 \text{ ml} = 1.14 \cdot 10^4 \text{ ml}$$

(e)

$$\frac{3.72 \text{ m}}{1 \text{ s}^2} \left\| \frac{1 \text{ ft}}{0.3048 \text{ m}} \right| \frac{60 \text{ s}}{1 \text{ min}} \left| \frac{60 \text{ s}}{1 \text{ min}} \right. = 43{,}937.01 \text{ ft/min}^2 = 4.39 \cdot 10^4 \text{ ft/min}^2$$

Problem 4. (10pt) Suppose you are talking with your friend who has moved to Italy. The conversation has drifted to Miami housing. Currently, the cost of space in Miami is approximately $464 per square foot.

(a) For your friend, convert this to Euros per square meter. [€1= $1.07; 1 ft = 0.3048 m]

(b) Using (a), find the conversion factor from dollars per square foot to Euros per square meter.

(c) Use your answer from (b) to convert $500 per square foot to Euros per square meter.

Solution.

(a) We have...

$$\frac{\$464}{1\text{ ft}^2} \left\| \frac{€1}{\$1.07} \right| \frac{1\text{ ft}}{0.3048\text{ m}} \left| \frac{1\text{ ft}}{0.3048\text{ m}} = €4{,}667.71 \text{ per square meter}$$

(b) From the work above, we can see that the conversion factor is...

$$\frac{1}{1.07} \cdot \frac{1}{0.3048} \cdot \frac{1}{0.3048} = 10.059729361$$

(c) We have...

$$\$500 \text{ per square foot } \cdot 10.059729361 \approx €5,029.86 \text{ per square meter}$$

We can also check this directly:

$$\frac{\$500}{1\text{ ft}^2} \left\| \frac{€1}{\$1.07} \right| \frac{1\text{ ft}}{0.3048\text{ m}} \left| \frac{1\text{ ft}}{0.3048\text{ m}} = €5{,}029.86 \text{ per square meter}$$