1. How many kilograms does a 1.0-pound stick of butter weigh? Note, 1 lb = 16 oz and 1 oz = 28 g.

$$m = 1\ lb \times \frac{16\ oz}{1\ lb} \times \frac{28\ g}{1\ oz} \times \frac{1\ kg}{1000\ g}$$

$$m = 0.45\ kg$$

2. If one drop of water has a volume of 0.05 mL, how many drops of water are required to reach 1.00 mL?

$$N = 1.00\ mL \times \frac{1\ drop}{0.05\ mL}$$

$$N = 20.0\ drops$$

3. When the height of a horse is recorded, the height is measured from the base of the front foot to the highest point of the withers (shoulder area). The unit used for this measurement in the U.S. in the unit "hand". One hand equals four inches. Note, the recording is read as follows. A horse that is "15.2 hands" is read as 15 hands followed by a period. The period then signifies the number of inches. Thus a reading of 15.2 hands means the horse is 15 hands plus 2 inches. If a horse is 15.2 hands in height, how many tall is the horse? Report your answer in feet and inches. Example: a human may be 5 feet tall and 10 inches or 5'10".

$$Height = 15\ h \times \frac{4\ in}{1\ h} \times \frac{1\ ft}{12\ in}$$

$$Height = 5\ ft$$

Therefore, the horse is 5 feet tall plus an additional 2 inches. Therefore, the horse is 5 feet and 2 inches tall!!

4. The unit of length dates back to antiquity. The Romans and Greeks preferred the foot while the Egyptians, Ancient Indians, and Mesopotamians prefered the cubit. How many feet equal one cubit given the following conversion factors?

1 meter = 3.28 feet
1 meter = 2.19 cubits

$$\frac{3.28\ feet}{1\ meter} \times \frac{1\ meter}{2.19\ cubit} = 1.50\ {}^{feet}\!/_{cubit}$$

Therefore, 1.50 feet = 1 cubit.

5. In a speed run, a video gamer runs through a video game to beat it in the shortest time possible. A speed run for the game *Super Mario Odyssey* requires collecting 500. moons and typically runs a little under 3 hours and 20 minutes. If Mario takes damage, collecting a moon will replenish his health. However, a short animation showing this restoration to full health adds an additional 2.2 s to the "You Got a Moon!" animation. If Mario takes damage before collecting every moon, how much time will be added (in minutes) to the 500.-moon speed run?

(3 points)

$$t = 500 \text{ moons} \times \frac{2.2 \text{ s}}{1 \text{ moon}} \times \frac{1 \text{ min}}{60 \text{ s}}$$

$$t = 18.3 \text{ min}$$

Therefore, taking damage continually throughout the speed run will add over 18 minutes to the speed run time and the gamer will not win!

6. In the video game *Zelda: Breath of the Wild*, an important building in the game is the Temple of Time. On one side of the building is a ladder. As you can see, the main character (Link) has a height of four ladder rungs.

The full ladder extends to the top of the Temple of Time and has a total of 45 rungs: the last rung is at the very top of the building.

Link is 5 feet 7 inches tall. How tall is the Temple of Time? Report your answer in feet.

First, we must convert Link's height to inches.

$$h_{\text{ft}} = 5\text{ ft} \times \frac{12\text{ in}}{1\text{ ft}}$$

$$h_{\text{ft}} = 60\text{ in}$$

Now we can calculate Link's height in inches!!

$$h = h_{\text{ft}} + h_{\text{in}}$$

$$h = 60\text{ in} + 7\text{ in}$$

$$h = 67\text{ in}$$

Now we can calculate the height for the Temple of Time!!

$$h = 45\text{ rungs} \times \frac{67\text{ in}}{4\text{ rungs}} \times \frac{1\text{ ft}}{12\text{ in}}$$

$$h = 62.81\text{ ft}$$

$$h = 63\text{ ft}$$

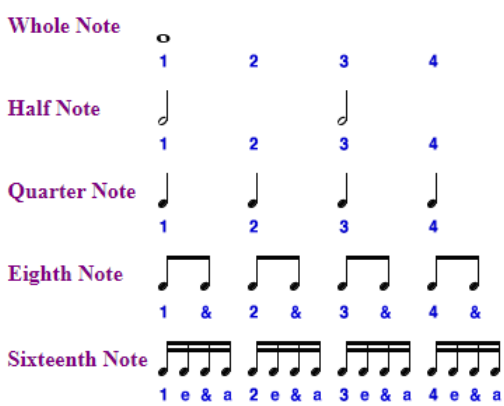
7. In music, beats are used to measure time and specific notes are defined by how many beats they are held for. Shown below is a table defining note when in 4/4 time (the most common time definition in music):

Note	Symbol	Number of Beats
Whole Note	𝅝	4
Half Note	𝅗𝅥	2
Quarter Note	♩	1
Eighth Note	♪	0.5

How many eighth notes are in one half note? Make sure to show your work.

$$N_{\text{♪}} = 1\ \text{𝅗𝅥} \times \frac{2\text{ beats}}{1\ \text{𝅗𝅥}} \times \frac{1\ \text{♪}}{0.5\text{ beats}}$$

$$N_{\text{♪}} = 4\ \text{♪}$$

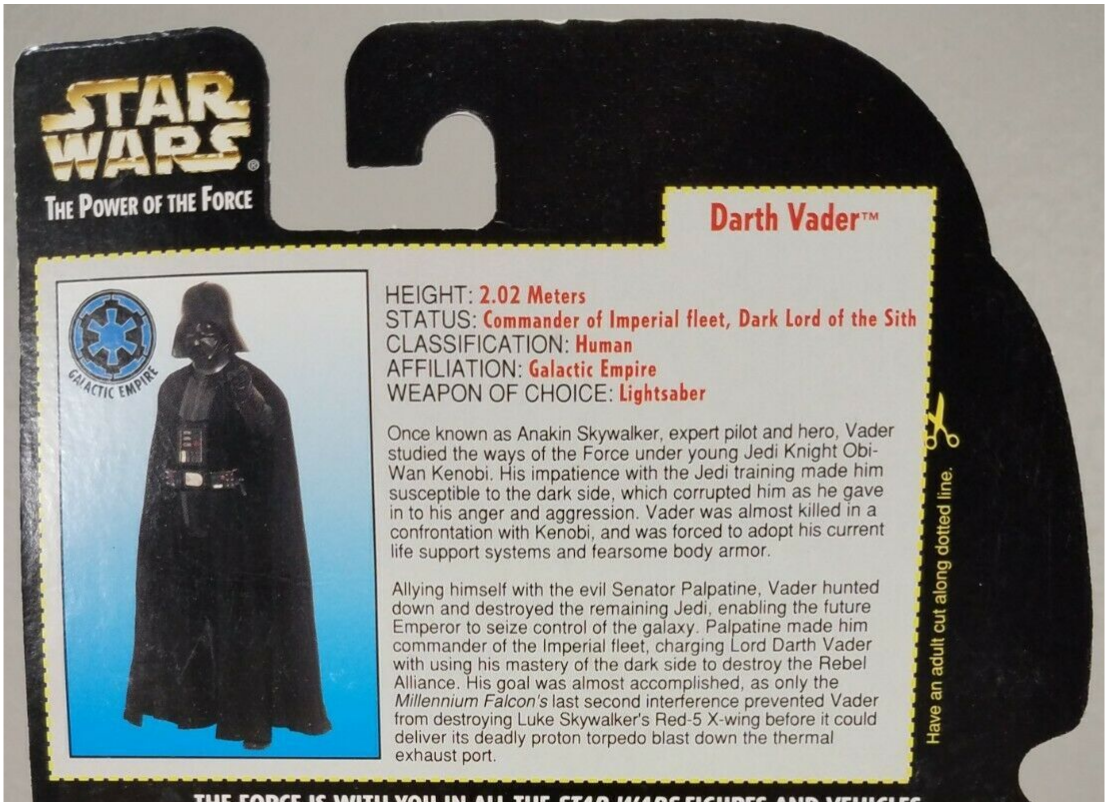


8. A glass of wine at the SRJC Culinary Cafe costs \$6.00. The average glass of wine is 5 oz. How many glasses of wine can be poured from a bottle of wine (750. mL)? Note, 1 oz = 30 mL.

$$N_{\text{Glasses}} = 750.\text{ mL} \times \frac{1\text{ oz}}{30\text{ mL}} \times \frac{1\text{ glass}}{5\text{ oz}}$$

$$N_{\text{Glasses}} = 5.00$$

9. The back of a Darth Vader action figure box from 1997 gives a biographical sketch of the Star Wars character where his height is reported as 2.02 meters. How tall is Darth Vader? Report his height in the format x'y", where x is the height in feet, and y is the height in inches (y is the decimal part of Vader's height converted to inches). You may round y to one digit. Note, 1 in = 2.54 cm.



$$h = 2.02 \text{ m} \times \frac{100 \text{ cm}}{1 \text{ m}} \times \frac{1 \text{ in}}{2.54 \text{ cm}} \times \frac{1 \text{ ft}}{12 \text{ in}}$$

$$h = 6.63 \text{ ft}$$

We now know that Darth Vader is over six feet tall. Now, we need to convert 0.63 feet to inches.

$$h = 0.63 \text{ ft} \times \frac{12 \text{ in}}{1 \text{ ft}}$$

$$h = 7.56 \text{ in}$$

Therefore, Darth Vader is 6'8"!

10. This ***double-sided*** exam was brought to by the following: five pages of paper, 10 copies (printed pages), and one staple.

(a) A box of 5,000. staples costs SRJC $3.19. What is the cost for one staple? Report your answer in cents and to the hundredth place.

(b) A ream (500. pages) of colored paper costs SRJC $4.00. What is the cost per page of colored paper? Report your answer in cents and to the hundredth place.

(c) It costs SRJC 0.04 cents per page to make a photocopy. Note, a double-sided photocopy counts as two pages. What is the material cost of the exam (combined cost of the paper, copies, and staple)? Report your answer in cents and to the nearest hundredth place.

(a)

Calculating the cost of one staple.

$$C_{\text{staple}} = 1 \text{ staple} \times \frac{\$3.19}{5{,}000. \text{ staples}} \times \frac{100 \text{ cents}}{\$1}$$

$$C_{\text{staple}} = 0.0638 \; {}^{cents}\!/_{\text{staple}}$$

$$C_{\text{staple}} = 0.06 \; {}^{cents}\!/_{\text{staple}}$$

(b)

Calculating the cost per page of paper.

$$C_{\text{page}} = 1 \text{ page} \times \frac{1 \text{ ream}}{500. \text{ pages}} \times \frac{\$4.00}{1 \text{ ream}} \times \frac{100 \text{ cents}}{\$1}$$

$$C_{\text{page}} = 0.80 \; {}^{\text{cents}}\!/_{\text{page}}$$

(c)

The cost of the exam is defined as:

$$C_{\text{exam}} = n_{\text{page}}C_{\text{page}} + n_{\text{copy}}C_{\text{copy}} + n_{\text{staple}}C_{\text{staple}}$$

where C_{exam} is the exam cost, C_{page} is the cost for each sheet of paper, C_{copy} is the cost to make a copy on one page, C_{staple} is the cost of one staple, n_{page} is the number of pages in the exam, n_{copy} is the number of copies, and n_{staple} is the number of staples.

From the question, we know the cost to make a photocopy is as follows:

$$C_{\text{copy}} = 0.04 \; {}^{\text{cents}}\!/_{\text{copy}}$$

Now, we can calculate the cost of the exam!!

$$C_{\text{exam}} = n_{\text{page}}C_{\text{page}} + n_{\text{copy}}C_{\text{copy}} + n_{\text{staple}}C_{\text{staple}}$$

$$C_{\text{exam}} = (5 \text{ pages})\left(0.800 \; \frac{\text{cents}}{\text{page}}\right) + (10 \text{ copies})\left(0.04 \; \frac{\text{cents}}{\text{copy}}\right) + (1 \text{ staple})\left(0.06 \; \frac{\text{cents}}{\text{staple}}\right)$$

$$C_{\text{exam}} = 8 \text{ cents} + 0.4 \text{ cents} + 0.06 \text{ cents}$$

$$C_{\text{exam}} = 8.46 \text{ cents}$$

11.

Bowser attacks with red flames and Dry Bowser (a skeleton or lich version of Bowser) attacks with a blue flame.

The blue flame is likely due to an acetylene fuel source. Shown below is the ***balanced*** chemical equation for the combustion of acetylene (C_2H_2).

$$2\,C_2H_2\,(g) + 5\,O_2\,(g) \longrightarrow 4\,CO_2\,(g) + 2\,H_2O\,(g)$$

(a) Calculate the molar mass for O_2.

(b) Calculate the molar mass for C_2H_2.

(c) Calculate the molar mass for H_2O.

(d) One deep breath of Dry Bowser has a volume of 2,000. mL. The density of O_2 in the air is 0.0014 $^{g}/_{mL}$. Calculate the mass of O_2 in one deep breath of Dry Bowser.

(e) Assuming Dry Bowser has an infinite supply of acetylene on hand, how many moles of H_2O can he produce given that the oxygen available to him comes only from the oxygen received in one deep breath [value from part (d)]?

(a)

$$M_{O_2} = m_O$$

$$M_{O_2} = (2)\,(16.00\ ^{g}/_{mol})$$

$$M_{O_2} = 32\ ^{g}/_{mol}$$

(b)

$$M_{C_2H_2} = m_C + m_H$$

$$M_{C_2H_2} = (2)\,(12.01\ ^{g}/_{mol}) + (2)\,(1.01\ ^{g}/_{mol})$$

$$M_{C_2H_2} = 26.04\ ^{g}/_{mol}$$

(c)

$$M_{H_2O} = m_H + m_O$$

$$M_{H_2O} = (2)(1.01\ ^{g}/_{mol}) + (1)(16.00\ ^{g}/_{mol})$$

$$M_{H_2O} = 18.02\ ^{g}/_{mol}$$

(d)

$$m_{O_2} = 2,000.\ \text{mL} \times \frac{0.0014\ \text{g}}{\text{mL}}$$

$$m_{O_2} = 2.8\ \text{g}\ O_2$$

(e)

$$n_{H_2O} = 2.8\ \text{g}\ O_2 \times \frac{1\ \text{mol}\ O_2}{32.00\ \text{g}\ O_2} \times \frac{2\ \text{mol}\ H_2O}{5\ \text{mol}\ O_2}$$

$$n_{H_2O} = 0.035\ \text{mol}\ H_2O$$

12.
In the book and movie *Howl's Moving Castle*, Calcifer is a fallen star who makes a deal with the wizard Howl, who gives Calcifer his heart. Once the contract is made, Calcifer becomes a fire demon.

Assuming Calcifer's mass and elemental composition are the same as the sun, it can be calculated that Calcifer's mass due to hydrogen is 1.46×10^{33} g. How many hydrogen atoms does Calcifer have (convert the mass of H to atoms of H)?

$$N_H = 1.46 \times 10^{33}\ \text{g H} \times \times \frac{1\ \text{mol H}}{1.01\ \text{g H}} \times \frac{6.023 \times 10^{23}\ \text{H atoms}}{1\ \text{mol H}}$$

$$N_H = 8.53 \times 10^{56}\ \text{H atoms}$$