

2.2.5: Formulas

You may use a calculator throughout this module if needed.

Formulas



A formula is an equation or set of calculations that takes a number (or numbers) as input, and produces an output. The output is often a number, but it could also be a decision such as yes or no. The numbers in a formula are usually represented with letters of the alphabet, which are called **variables** because their values can vary. To evaluate a formula, we substitute a number (or numbers) into the formula and then perform the steps using the order of operations.

Note: When a number is written directly next to a variable, it indicates multiplication. For example, $2H$ means $2 \cdot H$.

? Exercises 2.2.5.1

The cost, in dollars, of mailing a large envelope weighing w ounces is calculated by the formula $C = 0.20w + 0.80$.^[1]

- Find the cost of mailing a 3-ounce envelope.
- Find the cost of mailing a 9-ounce envelope.

Radio Cab charges the following rates for a taxi ride: a fixed fee of \$ 3.50 plus a rate of \$ 2.60 per mile. The total cost, in dollars, of a ride m miles long can be represented by the formula $C = 3.50 + 2.60m$.^[2]

- Find the cost of a 5-mile ride.
- Find the cost of a 7.5-mile ride.
- Find the cost of getting in the taxi, then changing your mind and getting out without riding anywhere.

The number of members a state has in the U.S. House of Representatives can be approximated by the formula $R = P \div .7$,^[3] where P is the population in millions. The 2010 populations of three states are as follows:^[4]

Oregon	3.8 million
Washington	6.7 million
California	37.2 million

Round all answers to the nearest whole number.

- How many U.S. Representatives does Oregon have?
- How many U.S. Representatives does Washington have?
- How many U.S. Representatives does California have?

The number of electoral votes a state has can be approximated by the formula $E = P \div 0.7 + 2$, where P is the population in millions.

- How many electoral votes does Oregon have?
- How many electoral votes does Washington have?
- How many electoral votes does California have?

Answer

1. \$ 1.40
2. \$ 2.60
3. \$ 16.50
4. \$ 23.00
5. \$ 3.50
6. 5 representatives (rounded down from 5.43)
7. 10 representatives (rounded up from 9.57)
8. 53 representatives (rounded down from 53.14)
9. 7 electoral votes
10. 12 electoral votes
11. 55 electoral votes

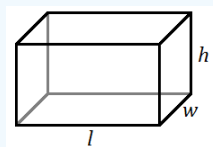
Some formulas require more than one number for the input.

? Exercises 2.2.5.1

When a patient's blood pressure is checked, they are usually told two numbers: the systolic blood pressure (SBP) and the diastolic blood pressure (DBP). The mean arterial pressure (MAP) can be estimated by the following formula:

$MAP = \frac{SBP + 2 \cdot DBP}{3}$. (The units are mm Hg, or millimeters of mercury.) Calculate the mean arterial pressure for each patient.

12. SBP = 120, DBP = 75
13. SBP = 140, DBP = 90



UPS uses this formula to determine the “measurement” of a package with length l , width w , and height h : $m = l + 2w + 2h$.

[5] Determine the measurement of a package with the following dimensions.

14. length 18 inches, width 12 inches, height 14 inches
15. length 16 inches, width 14 inches, height 15 inches

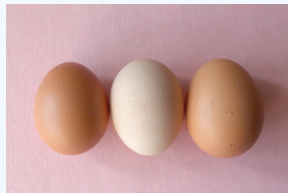
Answer

12. 90 mm Hg
13. around 107 mm Hg
14. 70 in
15. 74 in

The next set of exercises involves a formula that gives a yes or no answer.

? Exercises 2.2.5.1

In Australia, a chicken egg is designated “large” if its mass, in grams, satisfies the following formula: $|m - 54.1| \leq 4.1$. Determine whether each egg qualifies as large.^[6]



- 16. Egg 1’s mass is 57.8 grams.
- 17. Egg 2’s mass is 58.3 grams.
- 18. Egg 3’s mass is 49.8 grams.
- 19. Egg 4’s mass is 50.0 grams.

Answer

- 16. yes
- 17. no; too large
- 18. no; too small
- 19. yes

Temperature

The Celsius temperature scale is based on the freezing point of water ($0^{\circ}\text{C} = 32^{\circ}\text{F}$), and the boiling point of water ($100^{\circ}\text{C} = 212^{\circ}\text{F}$). By subtracting these numbers, we can see that a difference of 180°F is equivalent to 100°C . The ratio $\frac{180}{100}$ reduces to $\frac{9}{5}$, which means that 9 degrees on the Fahrenheit scale is equivalent to 5 degrees on the Celsius scale. (Of course, $\frac{180}{100}$ is also equal to 1.8, which means that 1 degree Celsius is equivalent to 1.8 degrees Fahrenheit.) Because Fahrenheit and Celsius do not have the same zero point, however, we must add or subtract 32 as well. See the formulas below.

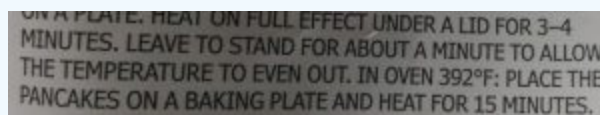
Temperature Formulas

$$F = \frac{9}{5}C + 32 \text{ or } F = 1.8C + 32$$

$$C = \frac{5}{9}(F - 32) \text{ or } C = (F - 32) \div 1.8$$

? Exercises 2.2.5.1

- 20. The temperature on a cool day is 10°C . Convert this temperature to Fahrenheit.
- 21. Normal body temperature is 98.6°F . What is this temperature in Celsius?
- 22. The FDA recommends that a freezer be set below -18°C . What is the Fahrenheit equivalent?
- 23. A package of frozen pancakes from IKEA calls for the oven to be set to 392°F . Clearly, this was originally calculated in Celsius. What is the corresponding Celsius temperature?



Answer

20. 50°C
21. 37°C
22. -0.4°F
23. 200°C

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1. pe.usps.com/text/dmm300/Notice123.htm#_c037 ↗
 2. <https://www.radiocab.net/services-radio-cab/> ↗
 3. <https://www.pewresearch.org/fact-tank/2018/05/31/u-s-population-keeps-growing-but-house-of-representatives-is-same-size-as-in-taft-era/> ↗
 4. https://en.Wikipedia.org/wiki/List_of_states_and_territories_of_the_United_States_by_population ↗
 5. www.ups.com/us/en/help-center/packaging-and-supplies/prepare-overize.page ↗
 6. https://en.Wikipedia.org/wiki/Chicken_egg_sizes ↗
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