Pop Quiz 1

Precalculus: Functions, Geometry, Trigonometry, & Modelling

UCR Math-005-E01, Summer 2020

1. Suppose your favorite mug holds exactly 12 fl oz of coffee. As a gag your fairy godmother makes your coffee mug grow exactly three times bigger: that is the mug is now three times taller and the diameter of the mug is now three times bigger. About how many fluid ounces of wine can this giant mug hold?

   The linear dimensions of the mug scale by 3, so the three-dimensional measurements of the mug, like volume, will scale by a factor of $3^3 = 27$. So the larger mug can hold $27 \times 12\,\text{fl oz} = 324\,\text{fl oz}$ of coffee ... or wine.

2. Ginger beer is draining out of a barrel at a rate of one cubic foot per minute. How fast is the ginger beer draining in terms of cubic miles per decade?

   We've done this one in class. The calculation yields

$$\left(\frac{1\,\text{ft}^3}{1\,\text{mi}}\right)\left(\frac{1\,\text{mi}}{5280\,\text{ft}}\right)^3\left(\frac{60\,\text{min}}{1\,\text{hr}}\right)\left(\frac{24\,\text{hours}}{1\,\text{day}}\right)\left(\frac{365\,\text{days}}{\text{year}}\right)\left(\frac{10\,\text{years}}{1\,\text{decade}}\right)$$

$$= \frac{60 \times 24 \times 365 \times 10}{5280^3}\,\text{cubic miles per decade}$$

$$\approx 0.0000357\,\text{cubic miles per decade}$$

   (We really have to say *approximately* too because there are not always 365 days in a year, but trying to think about leap years would be too annoying.)

3. Let ℓ be the line segment in the plane having endpoints with coordinates $(2,5)$ and $(4,12)$.

(a) Write down an equation for the line that contains ℓ.

The slope of the line between those two points is $\frac{\Delta y}{\Delta x} = \frac{12-5}{4-2} = \frac{7}{2}$. Then using the point $(2,5)$ as an anchor point (x_0, y_0), an equation for the line is

$$\frac{\Delta y}{\Delta x} = \frac{y - y_0}{x - x_0} \quad \Longrightarrow \quad \frac{7}{2} = \frac{y-5}{x-2}.$$

(b) Find a point on ℓ that is three times the distance from $(2,5)$ as it is from the point $(4,12)$.

The vector from the point $(2,5)$ to the point $(4,12)$ is $\langle 2,7\rangle$. We can find the point on this line segment that is three times as far from $(2,5)$ as from $(4,12)$ by starting at $(2,5)$ and travelling $\frac{3}{4}$ of the distance along that vector. So the point we're looking for is

$$(2,5) + \frac{3}{4}\langle 2,7\rangle = \left(\frac{7}{2}, \frac{41}{4}\right).$$