

**2021A26****TRENCHING**

**Level 1:** First, let's calculate the volume of the trench. The trench is in the shape of a rectangular prism, so it's volume can be calculated with the following formula.

$$Volume = Length * Width * Depth$$

Let's ensure that all these measurements have the same units. We have the length at 100 feet, the depth at 4 feet, and the width at 10 inches. The only unit we need to change is the width's inches to feet.

$$10 \text{ inches} * \frac{1 \text{ foot}}{12 \text{ inches}} = \frac{10}{12} \text{ feet} = \frac{5}{6} \text{ feet}$$

Now, we can follow the volume formula.

$$Volume = 100 \text{ feet} * 4 \text{ feet} * \frac{5}{6} \text{ feet} = 333.33 \text{ ft}^3$$

We also know that the bucket can hold 0.66 cubic yards of dirt; we'll do a unit conversion on this as well. Remember, there's only 3 feet in a yard, but because we're discussing cubic feet and cubic yards, we need to factor that into our unit conversion. The cube of 3 is 27 ( $3^3 = 3 * 3 * 3 = 27$ ), so that becomes our conversion factor.

$$0.66 \frac{\text{yd}^3}{\text{bucket}} * \frac{27 \text{ ft}^3}{\text{yd}^3} = 18 \frac{\text{ft}^3}{\text{bucket}}$$

Now, we can calculate our answer!

$$\text{Number of Buckets of Dirt} = \frac{\text{Amount of Dirt}}{\text{Dirt per Bucket}}$$

$$\text{Number of Buckets of Dirt} = \frac{333.33 \text{ ft}^3}{18 \frac{\text{ft}^3}{\text{bucket}}}$$

$$\text{Number of Buckets of Dirt} = 18.5 \text{ buckets}$$

**Level 2:**

Let's start this problem by seeing if we can solve either of our unknowns immediately. We do know that  $x$  is four times the width of the trench, and we already know the width of the trench to be 10 inches!

$$x = 4 * \text{Base of Trench}$$

$$x = 4 * 10 \text{ inches} = 40 \text{ inches} = \text{Base of Stack of Dirt}$$

The problem states that all the dirt from the trench is stacked in the triangular shape shown in the diagram above. Therefore, the following is true:

$$Volume \text{ of Trench} = Volume \text{ of Stack of Dirt}$$

Cool! We already know that the volume of the trench from the Level 1 question:  $333.33 \text{ ft}^3$ . The problem also states that the stack of dirt has a triangular cross-section. Therefore, the whole stack is in the shape of a triangular prism. Replacing the volume of the trench with  $333.33 \text{ ft}^3$  and the volume of the stack of dirt with the equation for the volume of a triangular prism gets us the following:

$$333.33 \text{ ft}^3 = \frac{1}{2} * \text{Base} * \text{Length} * \text{Height}$$

$$333.33 \text{ ft}^3 = \frac{1}{2} * 40 \text{ inches} * 100 \text{ ft} * \text{Height}$$

Great! Now with some simple unit conversions, we can solve for our unknown: height!

$$333.33 \text{ ft}^3 = \frac{1}{2} * 3.33 \text{ ft} * 100 \text{ ft} * \text{Height}$$

$$333.33 \text{ ft}^3 = 166.7 \text{ ft}^2 * \text{Height}$$

$$2 \text{ ft} = \text{Height}$$

Our pile will be 2 feet high!

*Below is an OE trench in action! Piles of dirt line the left side of the trench, and some neatly bundled cable lays at the bottom.*

