

QUESTION 1:

The following weigh ticket, how many gallons of water are in the concrete mix?

	Weight (in pounds)
Cement	5,250.00
Coarse Aggregate	18,100.00
Fine Aggregate	12,700.00
Air Entraining Agent	5.00
Water	???
Total Concrete Mix Weight	38,355.00

SOLUTION:

First we calculate the weight of water in the concrete mix:

$$38,355.00 - 5,250.00 - 18,100.00 - 12,700.00 - 5.00 = 2,300 \text{ lbs}$$

Next, using the unit conversion on the formulas guide we convert the unit weight to gallons:

$$2,300 \text{ lbs} \times \frac{1 \text{ gal}}{8.33 \text{ lbs}} = 276.1 \text{ gal}$$

QUESTION 2:

Using the weight table in Question 1, what percent of the concrete mix is Fine Aggregate?

SOLUTION:

$$100 \times \frac{12,700.00}{38,355.00} = 100 \times 0.331 = 33.1\%$$

QUESTION 3:

The unit weight of the material is 3.3 megagrams/cubic meter. Convert this to pounds/cubic foot.

SOLUTION:

Using the unit conversions on the formulas guide we calculate the unit weight as follows:

$$\begin{aligned} & \frac{3.3 \text{ megagram}}{1 \text{ cubic meter}} \times \frac{1.102 \text{ tons}}{1 \text{ megagram}} \times \frac{2000 \text{ pounds}}{1 \text{ ton}} \times \frac{1 \text{ cubic meter}}{1.308 \text{ cubic yards}} \times \frac{1 \text{ cubic yard}}{27 \text{ cubic feet}} \\ &= \frac{(3.3 \times 1.102 \times 2000) \text{ pounds}}{(1.308 \times 27) \text{ cubic feet}} \\ &= 205.9 \text{ pounds / cubic feet} \end{aligned}$$

QUESTION 4:

An area 30' wide by 300' long is to be covered with fabric. Interior joints of fabric are to be joined by overlapping the fabric by 3'. The fabric is delivered in rolls 15' wide and 300' long. What is the minimum number of whole rolls of fabric required to complete the work?

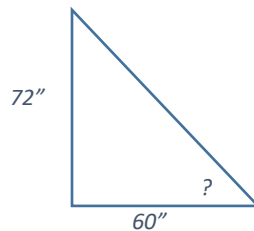
SOLUTION:

Note, 1 roll of fabric lays down at a 15' width and subsequent rolls only extend the width in 12' increments due to the 3' overlap. Therefore, 2 rolls only cover a 27' width and it follows that **3 rolls** are required to complete the work.

QUESTION 5:

A 72" tall person casts a shadow 60" long. Find the angle of the sun formed above the horizon.

First we draw a picture:



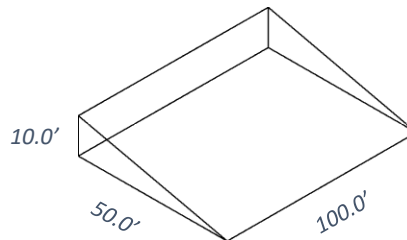
Note, that this is a right triangle and so we can use the trig relationships in the formulas guide.

Therefore,  $\tan(?) = \frac{72''}{60''}$  and so  $? = \tan^{-1}\left(\frac{72''}{60''}\right) = 50.2 \text{ degrees}$ .

QUESTION 6:

Calculate the volume in cubic yards.

SOLUTION:



Note, from the formulas guide Volume = Area x Length.

First we calculate Area of a Right Triangle =  $\frac{1}{2}$  base x height =  $\frac{1}{2} \times 10.0' \times 50.0' = 250.0 \text{ ft}^2$ .

Next, we calculate Volume = Area x Length =  $250.0 \text{ ft}^2 \times 100.0' = 25,000.0 \text{ ft}^3$ .

Finally, we convert to cubic yards using the conversion from the formulas guide:

$$25,000.0 \text{ ft}^3 \times \frac{1 \text{ cubic yard}}{27 \text{ cubic feet}} = \frac{25,000.0}{27} = 925.9 \text{ cubic yards}$$

QUESTION 7: The contractor places 75 tons of material every 50 feet of roadway. The contractor covered the roadway with the following loads of material: 24.5, 23.9, 24.0, and 24.3 tons. How many feet down the roadway will the material cover?

SOLUTION:

First we total up the placed tonnage:  $24.5 + 23.9 + 24.0 + 24.3 = 96.7 \text{ tons}$ .

Next we use the conversion given in the question to convert to feet:  $\frac{50 \text{ ft}}{75 \text{ tons}} \times 96.7 \text{ tons} = 64.5 \text{ ft}$

QUESTION 8:

The diameter of a cylindrical tank is 10.00'. The length of the tank is 25.00'. One cubic foot holds 7.56 gallons. What is the volume of the tank in gallons?

SOLUTION:

Note, from the formulas guide Volume = Area x Length and Area of a Circle =  $\pi r^2$ , where r = radius.

First we calculate the radius = diameter / 2 =  $10.00' / 2 = 5.00'$ .

Next we calculate Area of a Circle =  $\pi(5.00')^2 = 78.54 \text{ ft}^2$ .

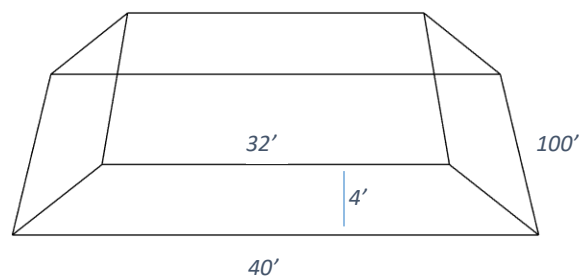
Next we calculate Volume = Area x Length =  $78.54 \text{ ft}^2 \times 25.00' = 1,963.5 \text{ ft}^3$ .

Finally, we convert to gallons using the given unit conversion:

$$1,963.5 \text{ ft}^3 \times \frac{7.56 \text{ gallons}}{1 \text{ cubic foot}} = 14,844.1 \text{ gallons}$$

QUESTION 9:

How many tons of gravel weighing 136.5 pounds/cubic foot can the shape hold?



SOLUTION:

First we calculate the volume of the shape:  $\frac{(32'+40')}{2} \times 4' \times 100' = 14,400 \text{ ft}^3$ .

Next we use the conversion given in the question and the formulas guide to convert to tons:

$$14,400 \text{ ft}^3 \times \frac{136.5 \text{ lbs}}{1 \text{ ft}^3} \times \frac{1 \text{ ton}}{2000 \text{ lbs}} = 982.8 \text{ tons}$$

QUESTION 10:

A box is 8' wide, 5' deep, and 70' long. The box contains a 24" diameter x 70' long solid cylinder. The cylinder is 18" from the bottom of the box and 36" from each wall of the box. Calculate the volume of the material needed to fill the box around the cylinder. Give your answer in cubic yards.

SOLUTION:

First we calculate the volume of the box:  $8' \times 5' \times 70' = 2,800 \text{ ft}^3$

Next we calculate the volume of the cylinder:  $\pi \left(\frac{24'}{2}\right)^2 \times 70' = 220 \text{ ft}^3$

Next, we subtract the cylinder from the box:  $2,800 - 220 = 2,580 \text{ ft}^3$

Finally, we convert to cubic yards using the conversion in the formulas guide:

$$2,580 \text{ ft}^3 \times \frac{1 \text{ CY}}{27 \text{ ft}^3} = 95.6 \text{ CY}$$

QUESTION 11:

A single lane of asphalt 2" thick and 16' wide is being placed. The asphalt has a unit weight of 1.8 tons per cubic yard. Trucks are hauling 14 tons of asphalt per load. How many loads of asphalt are required to pave 100 feet?

SOLUTION:

First we calculate the volume of 100' of paved roadway:

$$2" \times \frac{1'}{12"} \times 16' \times 100' = \frac{(2 \times 16 \times 100)}{12} = 266.67 \text{ ft}^3.$$

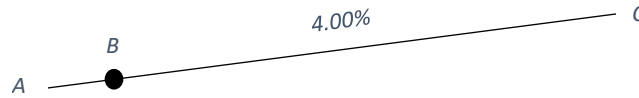
Next, we convert volume to tons asphalt using the given unit conversion and the formulas guide:

$$266.67 \text{ ft}^3 \times \frac{1 \text{ cubic yard}}{27 \text{ cubic feet}} \times \frac{1.8 \text{ tons asphalt}}{1 \text{ cubic yard}} = \frac{(266.67 \times 1.8)}{27} = 17.8 \text{ tons asphalt}$$

Since the trucks are hauling 14 tons of asphalt per load, it follows that it would require at least 2 loads of asphalt to pave 100 ft.

**QUESTION 12:**

Referring to the diagram below: At Point B, the elevation is 100.00' and the horizontal distance is 10.15' from point A. The slope of the line between Point B and Point C is 4.00%. The horizontal distance between Point A and Point C is 120.15'. What is the elevation at Point C?



SOLUTION:

Note, from the formulas guide the equation of a line is  $y=mx+b$  and where  $m= 4.00\% = 0.04$ . Also, note that Point B (10.15', 100.00') is a point on the line.

First we determine  $b$ , the  $y$  coordinate where the line crosses the  $y$  axis:

$$b = y - mx = 100.0' - 0.04 \times 10.15' = 99.59' \quad \text{therefore,} \quad y = 0.04x + 99.59$$

Note, that the horizontal distance between Point A and Point C is 120.15' and so Point C = (120.15',  $y$ ).

Hence,

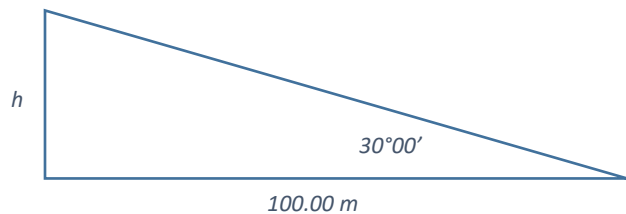
$$y = 0.04x + 99.59 = 0.04(120.15) + 99.59 = \mathbf{104.40'}$$

**QUESTION 13:**

A surveyor is standing 100.00 meters from the foot of a tower and at the same elevation as the base of the tower. The angle between the ground and the line that goes from the top of the tower to where the surveyor is standing is  $30^{\circ}00'$ . Find the height from the ground to the top of the tower.

SOLUTION:

First we draw a picture:



Note, that this is a right triangle and so we can use the trig relationships in the formulas guide.

$$\text{Therefore, } \tan 30^{\circ}00' = \frac{h}{100.00 \text{ meters}} \text{ and so } h = 100.00 \tan 30^{\circ}00' = \mathbf{57.74 \text{ meters.}}$$

**QUESTION 14:**

Calculate the volume of the figure in QUESTION 9 in cubic yards.

SOLUTION:

We convert the volume we calculated previously to cubic yards using the conversion in the formulas

$$\text{guide: } 14,400 \text{ ft}^3 \times \frac{1 \text{ CY}}{27 \text{ ft}^3} = \mathbf{533.3 \text{ CY}}$$

QUESTION 15:

A foreslope runs 12' horizontally and 4' vertically. What is the slope ratio of the foreslope?

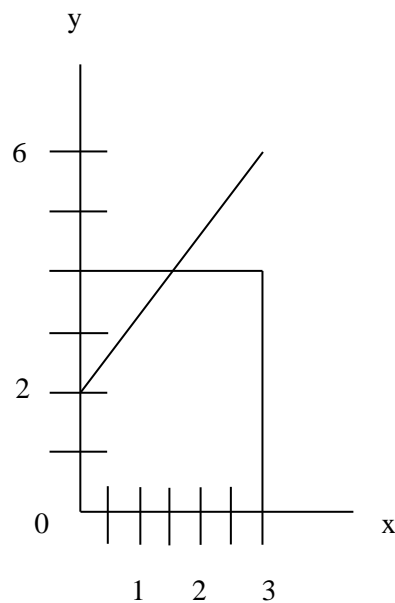
SOLUTION:

Given the definition of Slope Ratio in the formulas guide, the easiest way to calculate slope ratio is to divide the horizontal element by the vertical element:

$$\frac{12'}{4'} = 3 \text{ and so the slope ratio is } 3:1$$

QUESTION 16:

What is the slope of the line in the diagram below?



SOLUTION:

Note,

$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{4}{3} = 1.\bar{3}$$

QUESTION 17:

The unit weight of the soil is 90 lbs. / cubic foot. How many lbs. of material will it take to fill a volume 24' wide, 0.66' high and 1,200 ft long?

SOLUTION:

First we calculate the volume:  $24' \times 0.66' \times 1,200' = 19,008 \text{ ft}^3$

Next we convert to lbs using the conversion given in the question:

$$19,008 \text{ ft}^3 \times \frac{90 \text{ lbs}}{1 \text{ ft}^3} = 1,710,720 \text{ lbs}$$

QUESTION 18:

Marie is driving from Boolie to Coolie, a 60.0 mile drive, averaging 45 mph. Scott is driving from Doolie to Coolie, a 125.0 mile drive, averaging 50 mph. Both Marie and Scott are leaving at the same time. How much sooner will one arrive to Coolie before the other?

SOLUTION:

We calculate how long it takes Marie to drive from Boolie to Coolie:

$$\frac{60 \text{ mile}}{45 \frac{\text{mile}}{\text{hr}}} = 1.3\bar{3} \text{ hrs}$$

We calculate how long it takes Scott to drive from Doolie to Coolie:

$$\frac{125 \text{ mile}}{50 \frac{\text{mile}}{\text{hr}}} = 2.50 \text{ hrs}$$

Now we calculate the difference:

$$2.50 \text{ hrs} - 1.3\bar{3} \text{ hrs} = 1.1\bar{6} \text{ hrs} = 1.1\bar{6} \text{ hrs} \times \frac{60 \text{ min}}{\text{hr}} = 70 \text{ min}$$

Hence Marie arrives  $1.1\bar{6} \text{ hrs} = 70 \text{ min}$  earlier than Scott.

QUESTION 19:

A box holds one cubic foot. 30% of the box contains gravel that is 150.00 pounds/cubic foot. 20% of the box contains sand that is 145 pounds/cubic foot. The rest of the box contains clay that is 130.00 pounds/cubic foot. How much does the box weigh?

SOLUTION:

Note that the box is one cubic foot and so 30% of the box is 0.30 cubic feet. We now convert each material to pounds given the unit conversions listed in the Question.

$$0.30 \text{ cubic foot} \times \frac{150.00 \text{ pounds}}{1 \text{ cubic foot}} = 45.00 \text{ pounds gravel}$$

$$0.20 \text{ cubic foot} \times \frac{145.00 \text{ pounds}}{1 \text{ cubic foot}} = 29.00 \text{ pounds sand}$$

Note,  $0.30 + 0.20 = 0.50$  and so  $0.50 = 50\%$  of the box remains, hence:

$$0.50 \text{ cubic foot} \times \frac{130.00 \text{ pounds}}{1 \text{ cubic foot}} = 65.00 \text{ pounds clay}$$

Hence, the box weighs  $45.00 + 29.00 + 65.00 = 139.00 \text{ pounds}$ .

QUESTION 20:

The horizontal distance from Point A to Point B is 50.02'. Point B is 25.01' lower than Point A. Calculate the slope ratio between Point A and Point B.

SOLUTION:

Note,

$$\frac{50.02}{25.01} = 2 \text{ and so the slope ratio is } 2:1.$$