CHAPTER TWO

CONVERSION FACTORS

CHAPTER TWO: CONVERSION FACTORS

OBJECTIVES

This chapter presents basic conversion factors and how to use them. Nearly all water math processes involve converting quantities from one form to another. Whether changing hours to minutes, cubic feet to gallons, or pounds per square inch to feet of head, making conversions quickly and accurately is the key to successful water math calculations. Upon completion of this chapter, the following shall be demonstrable:

- Identification of the common conversion factors used in water math processes.
- Familiarity with the proper use of basic water math conversion factors.
- The ability to identify when to use a particular conversion factor.
- Competency and accuracy in the performance of calculations using the conversion factors listed above.

WATER MATH ABBREVIATIONS

The water industry, like most career fields, has units of measurement that it uses repeatedly. Some are the same as those found in other fields, like feet per second or hours per day. Others are unique to the water industry, like gallons per cubic foot or million gallons per day. When doing calculations, it becomes unwieldy to write these out in their complete form each time they are used, so abbreviations have been developed for each unit. The following list is a summary of common water industry abbreviations.

A = area	ft = foot, feet	L = length	ppb = part(s) per billion
cfs = cubic feet per second	gal = gallon(s)	lbs = pounds	ppm = part(s) per million
cu.ft. = cubic foot/feet	GPD = gallons per day	mi = miles	Q = flow
cu.in. = cubic inch(es)	GPM = gallons per minute	min = minute(s)	sec = second(s)
cu.yd. = cubic yard(s)	H = height	MG = million gallons	sq.ft. = square feet
°C = degrees celsius	hr = hour(s)	MGD = million gallons per day	sq.in. = square inches
D = diameter	Hp = horsepower	µg/L = microgram(s) per liter	V = velocity
°F = degrees fahrenheit	in = inch(es)	mg/L = milligram(s) per liter	Vol = volume
fps = feet per second	kw-hr = kilowatt-hour(s)	PSI = pounds per square inch	W = Width

WATER VOLUME AND WEIGHT

7.48 gal/cu.ft.

Volume represents the amount of space a thing occupies. Volumes are measured in units like cu.in., cu.ft., or cu.yd. In water math, we usually want volume expressed in gallons. To change cu.ft. to gallons, the conversion factor 7.48 gal/cu.ft. is used. This factor represents the number of gallons of water it would take to fill a container one foot long, one foot wide, and one foot deep. To use 7.48 gal/cu.ft., multiply it by the number of cu.ft.

⇒ **Practice A:** To change 300 cu.ft. to gallons, use the following steps:

$$\begin{aligned} \text{Volume,gal} &= \text{Volume,cu.ft.} \times 7.48\,{}^{\text{gal}}\!/_{\text{cu.ft.}} \\ &= 300\,\text{cu.ft.} \times 7.48\,{}^{\text{gal}}\!/_{\text{cu.ft.}} \\ &= \underline{\qquad\qquad}\ \text{gal} \end{aligned}$$

On the calculator, push [$^{ON}/_{C}$]. Push [3] [0] [0] [x] [7] [.] [4] [8] [=]. The display shows 2244.

Exercise 1:

Find answers to the following questions. Round to the nearest full gallon.

1) How many gallons are contained in 420 cu.ft? _____

2) A 2,150 cu.ft. storage tank holds what number of gallons? _____

3) If a standpipe is filled with 88 cu.ft. of water, what is its capacity in gallons? _____

4) A flume has a total capacity of 6,370 cu.ft. How many gallons will it hold when full? _____

5) A 16-in pipeline with a volume of 359 cu.ft. is to be flushed with fresh water. How many gallons will be needed to completely replace the water already in the line? _____

8.34 lbs/gal

Water is heavy. Each gallon weighs 8.34 pounds. This means the one-foot by one-foot by one-foot box described above would hold more than 60 pounds of water. To calculate how much a volume of water weighs, the conversion factor 8.34 lbs/gal is used. The number of gallons is multiplied by 8.34 to determine the weight.

⇒ **Practice B:** To calculate the weight of 15 gallons of water, use the following steps:

$$\begin{aligned}\text{Water Weight, lbs} &= \text{Volume, gal} \times 8.34\ {}^{\text{lbs}}/_{\text{gal}} \\ &= 15\,\text{gal} \times 8.34\ {}^{\text{lbs}}/_{\text{gal}} \\ &= \underline{\qquad\qquad\ \text{lbs}}\end{aligned}$$

On the calculator, push [$^{ON}/_{C}$]. Push [1] [5] [x] [8] [.] [3] [4] [=]. The display shows 125.1

Exercise 2:

Find answers to the following questions. Round to the nearest full pound unless directed otherwise.

1) How much do 545 gallons of water weigh? _____

2) A 55-gallon barrel weighs 73 lbs when empty. How heavy is it when full of water? _____

3) What is the weight of the solution created when 12 lbs of dry chemical are added to 5 gallons of water? To the nearest tenth of a pound, what is the lbs/gal weight of the solution? _____

4) A clearwell has a 6,200 cu.ft. capacity. How much weight is resting on the bottom of the structure when it is full of water? _____

5) An elevated storage tank with a 25,000-gallon maximum volume must be engineered to support how many pounds of water in addition to the weight of the structure itself? _____

DISTANCE

There are many ways to express distance, but many water math calculations use feet as the basic distance measurement. Therefore, it is important to know how to change other units into feet. This section deals with the four most common units that operators will need to convert: inches, yards, miles and meters.

12 in/ft

Almost every pipeline and well has a diameter measured in inches. To do volume calculations, these diameters need to be converted to feet. The conversion factor used is 12 in/ft. The diameter, in inches, is divided by 12 to change it to feet.

⇒ **Practice C:** To change the diameter of a 6.0-in pipe to a diameter in feet, use the following steps:

$$\begin{aligned} D, ft &= \frac{D, in}{12\,{}^{in}/_{ft}} \\ &= \frac{6\,in}{12\,{}^{in}/_{ft}} \\ &= \underline{\underline{\qquad ft}} \end{aligned}$$

On the calculator, push [$^{ON}/_{C}$]. Push [6] [÷] [1] [2] [=]. The display shows 0.5.

⇒ **Practice D:** To change the diameter of an 8.0-in well to a diameter in feet, use the following steps:

$$\begin{aligned} D, ft &= \frac{D, in}{12\,{}^{in}/_{ft}} \\ &= \frac{8\,in}{12\,{}^{in}/_{ft}} \\ &= \underline{\underline{\qquad ft}} \end{aligned}$$

On the calculator, push [$^{ON}/_{C}$]. Push [8] [÷] [1] [2] [=]. The display shows 0.666666667.

⇒ **Practice E:** To change a 30-in trench width to an equivalent in feet, use the following steps:

$$W, ft = \frac{W, in}{12\,{}^{in}/_{ft}}$$
$$= \frac{30\,in}{12\,{}^{in}/_{ft}}$$
$$= \underline{\underline{\quad\quad ft}}$$

On the calculator, push [$^{ON}/_{C}$]. Push [3] [0] [÷] [1] [2] [=]. The display shows 2.5.

Exercise 3:

Find answers to the following questions. Round to the nearest hundredth.

1) What is the diameter, in feet, of a 10-in well? _____

2) Find the equivalent diameter in feet for a 16-in pipeline. _____

3) Calculate the height, in feet, of solution in a chemical feed tank when full. The tank height is 45 in, but the top eight inches must remain freeboard and not be filled. _____

4) The outer diameter of a pipe is 16 in. The pipe material is 1.0 in thick, and has scale covering the inner surface with an average thickness of 1.0 in. What is the useable diameter, in feet? _____

5) How wide, in feet, must a trench be to install pipeline with an outer diameter of 20 in, if both sides of the line need to have a clearance of 12 inches? _____

3.0 ft/yd

Sometimes, the state exams will give distance measurements in yards that will need to be changed to feet. To do this conversion, multiply the number of yards by 3.0 ft/yd.

⇒ **Practice F:** To convert a length of 14 yards to feet, use the following steps:

$$\begin{aligned} L, ft &= L, yd \times 3.0\ {}^{ft}/_{yd} \\ &= 14\ yd \times 3.0\ {}^{ft}/_{yd} \\ &= \underline{\quad\quad ft} \end{aligned}$$

On the calculator, push [$^{ON}/_{C}$]. Push [1] [4] [x] [3] [=]. The display shows 42.

Exercise 4:

Find answers to the following questions.

1) Convert 880 yards to feet. _____

2) A 360-yard long fence is made up of eight-foot sections. How many sections are there? _____

3) New main is being installed over a distance of 255 yards. Pipe is sold in 20-foot lengths. How many lengths must be purchased to complete the job? _____

5,280 ft/mi

Occasionally, lengths of pipe, trenches, or other structures are given in miles. The conversion factor used is 5,280 ft/mi. The length, in miles, is multiplied by 5,280 to change it to feet.

⇒ **Practice G:** To convert a length of 1.5 miles to feet, use the following steps:

$$\begin{aligned} L, ft &= L, mi \times 5{,}280\ {}^{ft}/_{mi} \\ &= 1.5\ mi \times 5{,}280\ {}^{ft}/_{mi} \\ &= \underline{\quad\quad\quad ft} \end{aligned}$$

On the calculator, push [$^{ON}/_{C}$]. Push [1] [.] [5] [x] [5] [2] [8] [0] [=]. The display shows 7920.

Exercise 5:

Find answers to the following questions.

1) Change ¾ mile into a distance in feet. _____

2) A ½ mile long pipeline reduces from 6-in to 4-in after 950 feet. What is the length of the 4-in section? _____

3) A chlorination station is 6.0 miles upstream from the first sampling location. When a change is made in the chlorine dosage, how far, in feet, does the water have to travel before the new residual can be measured? _____

3.28 ft/m

Although not very common, metric conversions do come up from time to time. To do this conversion, multiply the number of meters by 3.28 ft/m.

⇒ **Practice H:** To convert a length of 75 meters to feet, use the following steps:

$$\begin{aligned} L, ft &= L, m \times 3.28\ {}^{ft}/_{m} \\ &= 75\ m \times 3.28\ {}^{ft}/_{m} \\ &= \underline{\underline{\qquad ft}} \end{aligned}$$

On the calculator, push [$^{ON}/_{C}$]. Push [7] [5] [x] [3] [.] [2] [8] [=]. The display shows 246.

Exercise 6:

Find answers to the following questions.

1) How long is a 500-meter trench, in feet? _____

2) Find the diameter, in feet, of a basin that measures 9.15 meters across. _____

TIME

1,440 min/day

Some time conversions are not only well known, but also easy to do. Two examples include changing days to hours and hours to minutes. Yet, at times it may be necessary to go from days to minutes. In this case, a two-step process can be combined into one by using the factor 1,440 min/day. To do this conversion, multiply the number of days by 1,440.

⇒ **Practice I:** To change 1.2 days into minutes, use the following steps:

$$\begin{aligned} \text{Time, min} &= \text{Time, days} \times 1{,}440\ {}^{\text{min}}/_{\text{day}} \\ &= 1.2\ \text{days} \times 1{,}440\ {}^{\text{min}}/_{\text{day}} \\ &= \underline{\underline{\qquad\qquad \text{min}}} \end{aligned}$$

On the calculator, push [$^{ON}/_{C}$]. Push [1] [.] [2] [x] [1] [4] [4] [0] [=]. The display shows 1728.

⇒ **Practice J:** To change 250 GPM to GPD, use the following steps:

$$\begin{aligned} \text{Flow, GPD} &= \text{Flow, GPM} \times 1{,}440\ {}^{\text{min}}/_{\text{day}} \\ &= 250\ \text{GPM} \times 1{,}440\ {}^{\text{min}}/_{\text{day}} \\ &= \underline{\underline{\qquad\qquad \text{GPD}}} \end{aligned}$$

On the calculator, push [$^{ON}/_{C}$]. Push [2] [5] [0] [x] [1] [4] [4] [0] [=]. The display shows 360000.

Exercise 7:

Find answers to the following questions.

1) Find the number of minutes in 1¾ days. _____

2) Change 1,500 GPM to a flow in GPD. _____

3) How many GPM will result in a flow of 684,000 GPD? _____

4) If 2 pumps operate at an average flow of 400 GPM each, what is the total flow in GPD? _____

hr → hr & min

When taking state exams, it is important note what units the answer asks for. It is not uncommon for the exam writers to design a problem that will produce a result in hours while the answer is requested in hours and minutes. Therefore, a knowledge of how to convert time units is vital.

⇒ **Practice K:** To convert a time of 5.85 hr to hr & min, use the following steps:

$$\begin{aligned}\text{Time, hr \& min} &= \text{Time, hr} - \text{whole number, hr}\\ &= 5.85\ \text{hr} - \underline{\underline{5\ \text{hr}}}\\ &= 0.85\ \text{hr}\\ \text{Time, min} &= \text{Time, hr} \times 60\ {}^{\text{min}}\!/_{\text{hr}}\\ &= 0.85\ \text{hr} \times 60\ {}^{\text{min}}\!/_{\text{hr}}\\ &= \underline{\underline{\quad\text{min}}}\end{aligned}$$

On the calculator, push [$^{ON}/_{C}$]. Push [5] [.] [8] [5] [–] [5] [=]. The display shows 0.85. Push [x] [6] [0] [=]. The display shows 51.

min → hr & min

Sometimes a problem is written in such a way that the answer comes out in minutes, but is required to be in hr & min form. In this case, an extra step is added to the process in Practice I.

⇒ **Practice L:** To convert a time of 212 min to hr & min, use the following steps:

$$\begin{aligned}\text{Time, hr} &= \frac{\text{Time, min}}{60\ {}^{\text{min}}\!/_{\text{hr}}}\\ &= \frac{212\ \text{min}}{60\ {}^{\text{min}}\!/_{\text{hr}}}\\ &= \underline{\quad\quad}\ \text{hr} - \underline{\underline{3\ \text{hr}}}\\ \text{Time, min} &= 0.53\ \text{hr} \times 60\ {}^{\text{min}}\!/_{\text{hr}}\\ &= \underline{\underline{\quad\text{min}}}\end{aligned}$$

On the calculator, push [$^{ON}/_{C}$]. Push [2] [1] [2] [÷] [6] [0] [=]. The display shows 3.53. Push [–] [3] [=]. The display shows 0.53. Push [x] [6] [0] [=]. The display shows 42.

Exercise 8:

Find answers to the following questions.

1) What is 4.72 hours in hr & min? _____

2) Change a time of 1.17 hours to an equivalent number of hr & min. _____

3) The result comes up as 985 minutes. The answer needs to be in hr & min form. What is the answer? _____

4) Convert 333 minutes to hr & min form. _____

PRESSURE ⇔ HEAD

2.31 ft/PSI **0.433 PSI/ft**

Like volume calculations, the ability to convert pressure to head and head to pressure is frequently tested on state exams. The two conversion factors used are 2.31 ft/PSI and 0.433 PSI/ft. Both are correct, so at OCT Inc., we recommend learning to use just one, rather than trying to learn both. In the following examples, 2.31 will be used. To use 0.433, do the opposite (i.e., multiply instead of divide or divide instead of multiply.)

⇒ **Practice M:** To change 45 PSI to feet of head, use the following steps:

$$\begin{aligned} \text{Head, ft} &= \text{Pressure, PSI} \times 2.31\ \text{ft/PSI} \\ &= 45 \times 2.31\ \text{ft/PSI} \\ &= \underline{\underline{\qquad\qquad \text{ft}}} \end{aligned}$$

On the calculator, push [$^{ON}/_{C}$]. Push [4] [5] [x] [2] [.] [3] [1] [=]. The display shows 103.95.

⇒ **Practice N:** To change 85.5 feet of head to pressure in PSI, use the following steps:

$$\text{Pressure, PSI} = \frac{\text{Head, ft}}{2.31\ ^{\text{ft}}/_{\text{PSI}}}$$
$$= \frac{85.5\ \text{ft}}{2.31\ ^{\text{ft}}/_{\text{PSI}}}$$
$$= \underline{\underline{\quad\quad \text{psi}}}$$

On the calculator, push [$^{\text{ON}}/_{\text{C}}$]. Push [8] [5] [.] [5] [÷] [2] [.] [3] [1] [=]. The display shows 37.01298701.

Exercise 9:

Find answers to the following questions. Round to the nearest tenth.

1) Find the number of feet of head available from a pipeline charged with 62 PSI. _____

2) What pressure, in PSI, is needed to overcome a total dynamic head (T.D.H.) of 161 feet. _____

3) Atmospheric pressure at sea level is 14.7 PSI. How many feet of water is this equivalent to? _____

4) A reservoir is elevated 73¼ feet above a water treatment plant. How much pressure, in PSI, is the water under coming into the plant? _____

5) An elevated storage tank has a pressure gauge located five feet above ground. It shows 12.5 PSI. What is the height of the surface of the water above ground? _____

6) An operator reads 11.1 PSI on a tank pressure gauge at 7:30 AM. After the water level has decreased by 10 feet, what pressure will the gauge show? _____

FLOW RATES

There are three main flow (Q) units used in water math: GPM, MGD, and CFS. This section shows how to quickly make conversions between these three.

694.4 GPM/MGD

Plant flows are commonly given in MGD, while flow in a pipeline is usually expressed in GPM. To change from one to the other, the factor 694.4 GPM/MGD is used.

⇒ **Practice O:** To convert 2.5 MGD to GPM, use the following steps:

$$\begin{aligned}\text{Flow, GPM} &= \text{Flow, MGD} \times 694.4\ {}^{\text{GPM}}\!/_{\text{MGD}} \\ &= 2.5\ \text{MGD} \times 694.4\ {}^{\text{GPM}}\!/_{\text{MGD}} \\ &= \underline{\underline{\qquad\qquad \text{GPM}}}\end{aligned}$$

On the calculator, push [$^{\text{ON}}/_{\text{C}}$]. Push [2] [.] [5] [x] [6] [9] [4] [.] [4] [=]. The display shows 1736.

⇒ **Practice P:** To convert 250 GPM to MGD, use the following steps:

$$\begin{aligned}\text{Flow, MGD} &= \frac{\text{Flow, GPM}}{694.4\ {}^{\text{GPM}}\!/_{\text{MGD}}} \\ &= \frac{250\ \text{GPM}}{694.4\ {}^{\text{GPM}}\!/_{\text{MGD}}} \\ &= \underline{\underline{\qquad\qquad \text{MGD}}}\end{aligned}$$

On the calculator, push [$^{\text{ON}}/_{\text{C}}$]. Push [2] [5] [0] [÷] [6] [9] [4] [.] [4] [=]. The display shows 0.360023041.

Exercise 10:

Find answers to the following questions. Round the answers to questions 3 & 4 to the nearest hundredth.

1) Convert 6.4 MGD to GPM? _____

2) Find the discharge flow in GPM for a treatment plant that disinfects 21 MG every 24 hours. _____

3) How many MGD are produced by a flow of 1,200 GPM? _____

4) Two discharge pumps are operating at 750 and 1,100 GPM. What is plant production, in MGD. _____

448.8 GPM/CFS

Although flow of any kind can be represented by Q, this designation is mostly used to denote flow in CFS. Pipeline velocity calculations require a flow in CFS, so if it is given in GPM, the factor 448.8 GPM/CFS is used.

⇒ **Practice Q:** To convert 2.23 CFS to GPM, use the following steps:

$$\begin{aligned} \text{Flow, GPM} &= \text{Flow, CFS} \times 448.8\ {}^{\text{GPM}}\!/_{\text{CFS}} \\ &= 2.23\ \text{CFS} \times 448.8\ {}^{\text{GPM}}\!/_{\text{CFS}} \\ &= \underline{\underline{\qquad\qquad \text{GPM}}} \end{aligned}$$

On the calculator, push [$^{\text{ON}}/_{\text{C}}$]. Push [2] [.] [2] [3] [x] [4] [4] [8] [.] [8] [=]. The display shows 1000.824.

⇒ **Practice R:** To convert 450 GPM to CFS, use the following steps:

$$\begin{aligned} \text{Flow, CFS} &= \frac{\text{Flow, GPM}}{448.8\ {}^{\text{GPM}}\!/_{\text{CFS}}} \\ &= \frac{450\ \text{GPM}}{448.8\ {}^{\text{GPM}}\!/_{\text{CFS}}} \\ &= \underline{\underline{\qquad\qquad \text{CFS}}} \end{aligned}$$

On the calculator, push [$^{\text{ON}}/_{\text{C}}$]. Push [4] [5] [0] [÷] [4] [4] [8] [.] [8] [=]. The display shows 1.002673797.

Exercise 11:

Find answers to the following questions. Round the answers to questions 3 & 4 to the nearest hundredth.

1) Change 3.5 CFS to a flow in GPM? _____

2) A stream flowing at a rate of 2.77 CFS is filling a reservoir with how many gallons each minute? _____

3) What is the CFS flow equivalent to 750 GPM? _____

4) A 16-in pipe carrying 2,000 GPM has a flow of what number of cubic feet every second? _____

1.55 CFS/MGD

Though not as common, sometimes a flow in MGD will need to be converted to CFS or vice versa. The factor 1.55 CFS/MGD does in one step what would take four or five steps otherwise.

⇒ **Practice S:** To convert 5.0 MGD to CFS, use the following steps:

$$\begin{aligned} \text{Flow, CFS} &= \text{Flow, MGD} \times 1.55\ {}^{\text{CFS}}\!/_{\text{MGD}} \\ &= 5.0\ \text{MGD} \times 1.55\ {}^{\text{CFS}}\!/_{\text{MGD}} \\ &= \underline{\underline{\qquad\qquad \text{CFS}}} \end{aligned}$$

On the calculator, push [$^{\text{ON}}/_{\text{C}}$]. Push [5] [x] [1] [.] [5] [5] [=]. The display shows 7.75.

⇒ **Practice T:** To convert 3.75 CFS to MGD, use the following steps:

$$\begin{aligned} \text{Flow, MGD} &= \frac{\text{Flow, CFS}}{1.55\ {}^{\text{CFS}}\!/_{\text{MGD}}} \\ &= \frac{3.75\ \text{CFS}}{1.55\ {}^{\text{CFS}}\!/_{\text{MGD}}} \\ &= \underline{\underline{\qquad\qquad \text{MGD}}} \end{aligned}$$

On the calculator, push [$^{\text{ON}}/_{\text{C}}$]. Push [3] [.] [7] [5] [÷] [1] [.] [5] [5] [=]. The display shows 2.419354839.

Exercise 12:

Find answers to the following questions. Round to the nearest hundredth.

1) Find the CFS equivalent to a flow of 8.4 MGD? _____

2) If a plant is treating 15.8 MGD, determine the number of CFS it draws from its river source. _____

3) Convert a flow of 6.65 CFS to MGD. _____

4) During peak demand, a distribution system gets 2.0 CFS from storage in addition to the treatment plant effluent. If peak demand is 2.99 MGD, calculate the plant effluent, in MGD. _____

METRIC VOLUMES

The water industry is made somewhat more complicated by the blend of English and metric measurements used. Because of this, it is necessary to make conversions between the two. The conversion factor for length is shown in Exercise 6. This section deals with metric volume conversions.

3.785 L/gal **3,785 mL/gal**

Chemical feed tanks are sometimes calibrated in L and/or mL, even though the solutions they hold are usually sold in gallons. Therefore, the state exams have a few questions on how to make these conversions. To change gallons to liters, use 3.785 L/gal.

⇒ **Practice U:** To convert 25 gallons to liters, use the following steps:

$$\begin{aligned}\text{Volume, L} &= \text{Volume, gal} \times 3.785\,{}^{\text{L}}\!/_{\text{gal}} \\ &= 25\text{gal} \times 3.785\,{}^{\text{L}}\!/_{\text{gal}} \\ &= \underline{\qquad\qquad\text{L}}\end{aligned}$$

On the calculator, push [$^{ON}/_{C}$]. Push [2] [5] [x] [3] [.] [7] [8] [5] [=]. The display shows 94.625.

⇒ **Practice V:** To change 17 liters to gallons, use the following steps:

$$\begin{aligned}\text{Volume, gal} &= \frac{\text{Volume, L}}{3.785\,{}^{\text{L}}\!/_{\text{gal}}} \\ &= \frac{17\,\text{L}}{3.785\,{}^{\text{L}}\!/_{\text{gal}}} \\ &= \underline{\qquad\qquad\text{gal}}\end{aligned}$$

On the calculator, push [$^{ON}/_{C}$]. Push [1] [7] [÷] [3] [.] [7] [8] [5] [=]. The display shows 4.491413474.

To change from gallons to milliliters, use 3,785 mL/gal.

⇒ **Practice W:** To convert 3.5 gallons to milliliters, use the following steps:

$$\begin{aligned}\text{Volume, mL} &= \text{Volume, gal} \times 3{,}785\,{}^{\text{mL}}\!/_{\text{gal}} \\ &= 3.5\ \text{gal} \times 3{,}785\,{}^{\text{mL}}\!/_{\text{gal}} \\ &= \underline{\qquad\qquad\ \text{mL}}\end{aligned}$$

On the calculator, push [$^{ON}/_{C}$]. Push [3] [.] [5] [x] [3] [7] [8] [5] [=]. The display shows 13247.5.

⇒ **Practice X:** To change 9,570 milliliters to gallons, use the following steps:

$$\begin{aligned}\text{Volume, gal} &= \frac{\text{Volume, mL}}{3{,}785\,{}^{\text{mL}}\!/_{\text{gal}}} \\ &= \frac{9{,}570\ \text{mL}}{3{,}785\,{}^{\text{mL}}\!/_{\text{gal}}} \\ &= \underline{\qquad\qquad\ \text{gal}}\end{aligned}$$

On the calculator, push [$^{ON}/_{C}$]. Push [9] [5] [7] [0] [÷] [3] [7] [8] [5] [=]. The display shows 2.528401585.

Exercise 13:

Find answers to the following questions. Round to the nearest tenth.

1) How many liters are in 150 gallons? _____

2) Find the number of gallons in 720 liters. _____

3) A 55-gallon barrel holds what volume in liters? _____

4) Change 2.25 gallons to milliliters. _____

5) 750 mL is equivalent to how many gallons? _____

6) A piston type chemical pump is feeding 120 milliliters every minute. At this rate, how many gallons of chemical would be used in an hour? _____

Chapter Two Exercise Answers

Exercise 1
1) 3,142 gal
2) 16,082 gal
3) 658 gal
4) 47,648 gal
5) 2,685 gal

Exercise 2
1) 4,545 lbs
2) 532 lbs
3) 54 lbs; 10.7 lbs/gal
4) 386,776 lbs
5) 208,500 lbs

Exercise 3
1) 0.83 ft
2) 1.33 ft
3) 3.08 ft
4) 1.0 ft
5) 3.67 ft

Exercise 4
1) 2,640 ft
2) 135 sections
3) 39 lengths

Exercise 5
1) 3,960 ft
2) 1,690 ft
3) 31,680 ft

Exercise 6
1) 1,640 ft
2) 30 ft

Exercise 7
1) 2,520 min
2) 2,160,000 GPD
3) 475 GPM
4) 1,152,000 GPD

Exercise 8
1) 4 hr 43 min
2) 1 hr 10 min
3) 16 hr 25 min
4) 5 hr 33 min

Exercise 9
1) 143.2 ft
2) 69.7 PSI
3) 34 ft
4) 31.7 PSI
5) 33.9 ft
6) 6.8 PSI

Exercise 10
1) 4,444 GPM
2) 14,582 GPM
3) 1.73 MGD
4) 2.66 MGD

Exercise 11
1) 1,571 GPM
2) 1,243 GPM
3) 1.67 CFS
4) 4.46 CFS

Exercise 12
1) 13.02 CFS
2) 24.49 CFS
3) 4.29 MGD
4) 1.70 MGD

Exercise 13
1) 567.8 L
2) 190.2 gal
3) 208.2 L
4) 8,516.3 mL
5) 0.2 gal
6) 1.9 gal

CHAPTER TWO EXERCISE SOLUTIONS

Exercise 1

1) $\text{Volume, gal} = \text{Volume, cu. ft.} \times 7.48\ {}^{\text{gal}}/_{\text{cu. ft.}}$
$= 420\ \text{cu. ft.} \times 7.48\ {}^{\text{gal}}/_{\text{cu. ft.}}$
$= \underline{\underline{3{,}141.6\ \text{gal}}}$

2) $\text{Volume, gal} = \text{Volume, cu. ft.} \times 7.48\ {}^{\text{gal}}/_{\text{cu. ft.}}$
$= 2{,}150\ \text{cu. ft.} \times 7.48\ {}^{\text{gal}}/_{\text{cu. ft.}}$
$= \underline{\underline{16{,}082\ \text{gal}}}$

3) $\text{Volume, gal} = \text{Volume, cu. ft.} \times 7.48\ {}^{\text{gal}}/_{\text{cu. ft.}}$
$= 88\ \text{cu. ft.} \times 7.48\ {}^{\text{gal}}/_{\text{cu. ft.}}$
$= \underline{\underline{658.24\ \text{gal}}}$

4) $\text{Volume, gal} = \text{Volume, cu. ft.} \times 7.48\ {}^{\text{gal}}/_{\text{cu. ft.}}$
$= 6{,}370\ \text{cu. ft.} \times 7.48\ {}^{\text{gal}}/_{\text{cu. ft.}}$
$= \underline{\underline{47{,}647.6\ \text{gal}}}$

5) $\text{Volume, gal} = \text{Volume, cu. ft.} \times 7.48\ {}^{\text{gal}}/_{\text{cu. ft.}}$
$= 359\ \text{cu. ft.} \times 7.48\ {}^{\text{gal}}/_{\text{cu. ft.}}$
$= \underline{\underline{2{,}685.32\ \text{gal}}}$

Exercise 2

1) $\text{Water Weight, lbs} = \text{Volume, gal} \times 8.34\ {}^{\text{lbs}}/_{\text{gal}}$
$= 545\ \text{gal} \times 8.34\ {}^{\text{lbs}}/_{\text{gal}}$
$= \underline{\underline{4{,}545.3\ \text{lbs}}}$

2) $\text{Total Weight, lbs} = (\text{Volume, gal} \times 8.34\ {}^{\text{lbs}}/_{\text{gal}}) + \text{barrel weight, lbs}$
$= (55\ \text{gal} \times 8.34\ {}^{\text{lbs}}/_{\text{gal}}) + 73\ \text{lbs}$
$= 458.7\ \text{lbs} + 73\ \text{lbs}$
$= \underline{\underline{531.7\ \text{lbs}}}$

3) $\text{Total Weight, lbs} = \left(\text{Volume, gal} \times 8.34\ {}^{\text{lbs}}/_{\text{gal}}\right) + \text{chemical weight, lbs}$

$= \left(5\ \text{gal} \times 8.34\ {}^{\text{lbs}}/_{\text{gal}}\right) + 12\ \text{lbs}$

$= 42\ \text{lbs} + 12\ \text{lbs}$

$= \underline{\underline{53.7\ \text{lbs}}}$

$$\text{Weight, } {}^{\text{lbs}}/_{\text{gal}} = \frac{\text{Weight, lbs}}{\text{Volume, gal}}$$

$$= \frac{53.7\ \text{lbs}}{5.0\ \text{gallons}}$$

$= \underline{\underline{10.74\ {}^{\text{lbs}}/_{\text{gal}}}}$

4) $\text{Volume, gal} = \text{Volume, cu. ft.} \times 7.48\ {}^{\text{gal}}/_{\text{cu. ft.}}$

$= 6{,}200\ \text{cu. ft.} \times 7.48\ {}^{\text{gal}}/_{\text{cu. ft.}}$

$= 46{,}376\ \text{gal}$

$\text{Water Weight, lbs} = \text{Volume, gal} \times 8.34\ {}^{\text{lbs}}/_{\text{gal}}$

$= 46{,}376\ \text{gal} \times 8.34\ {}^{\text{lbs}}/_{\text{gal}}$

$= \underline{\underline{386{,}775.84\ \text{lbs}}}$

5) $\text{Water Weight, lbs} = \text{Volume, gal} \times 8.34\ {}^{\text{lbs}}/_{\text{gal}}$

$= 25{,}000\ \text{gal} \times 8.34\ {}^{\text{lbs}}/_{\text{gal}}$

$= \underline{\underline{208{,}500\ \text{lbs}}}$

Exercise 3

1) $$\text{D, ft} = \frac{\text{D, in}}{12\ {}^{\text{in}}/_{\text{ft}}}$$

$$= \frac{10\ \text{in}}{12\ {}^{\text{in}}/_{\text{ft}}}$$

$= \underline{\underline{0.83\ \text{ft}}}$

2) $$\text{D, ft} = \frac{\text{D, in}}{12\ {}^{\text{in}}/_{\text{ft}}}$$

$$= \frac{16\ \text{in}}{12\ {}^{\text{in}}/_{\text{ft}}}$$

$= \underline{\underline{1.33\ \text{ft}}}$

3) $$\text{H, ft} = \frac{\text{H, in}}{12\ ^{\text{in}}/_{\text{ft}}}$$
$$= \frac{45\text{ in} - 8\text{ in}}{12\ ^{\text{in}}/_{\text{ft}}}$$
$$= \frac{37\text{ in}}{12\ ^{\text{in}}/_{\text{ft}}}$$
$$= \underline{\underline{3.08\text{ ft}}}$$

4) $$\text{Useable D, ft} = \frac{\text{Useable D, in}}{12\ ^{\text{in}}/_{\text{ft}}}$$
$$= \frac{16\text{ in} - 2\text{in} - 2\text{ in}}{12\ ^{\text{in}}/_{\text{ft}}}$$
$$= \frac{12\text{ in}}{12\ ^{\text{in}}/_{\text{ft}}}$$
$$= \underline{\underline{1.0\text{ ft}}}$$

5) $$\text{W, ft} = \frac{\text{OD, in} + \text{Clearance, in}}{12\ ^{\text{in}}/_{\text{ft}}}$$
$$= \frac{20\text{ in} + 12\text{ in} + 12\text{ in}}{12\ ^{\text{in}}/_{\text{ft}}}$$
$$= \frac{44\text{ in}}{12\ ^{\text{in}}/_{\text{ft}}}$$
$$= \underline{\underline{3.67\text{ ft}}}$$

Exercise 4

1) $$\text{L, ft} = \text{L, yd} \times 3.0\ ^{\text{ft}}/_{\text{yd}}$$
$$= 880\text{ yd} \times 3.0\ ^{\text{ft}}/_{\text{yd}}$$
$$= \underline{\underline{2{,}640\text{ ft}}}$$

2) $$\begin{aligned} \text{L, ft} &= \text{L, yd} \times 3.0\ {}^{\text{ft}}/_{\text{yd}} \\ &= 360\ \text{yd} \times 3.0\ {}^{\text{ft}}/_{\text{yd}} \\ &= 1{,}080\ \text{ft} \end{aligned}$$

$$\begin{aligned} \#\ \text{sections} &= \frac{\text{L, ft}}{8\ {}^{\text{ft}}/_{\text{section}}} \\ &= \frac{1{,}080\ \text{ft}}{8\ {}^{\text{ft}}/_{\text{section}}} \\ &= \underline{\underline{135\ \text{sections}}} \end{aligned}$$

3) $$\begin{aligned} \text{L, ft} &= \text{L, yd} \times 3.0\ {}^{\text{ft}}/_{\text{yd}} \\ &= 255\ \text{yd} \times 3.0\ {}^{\text{ft}}/_{\text{yd}} \\ &= 765\ \text{ft} \end{aligned}$$

$$\begin{aligned} \#\ \text{lengths} &= \frac{\text{L, ft}}{20\ {}^{\text{ft}}/_{\text{length}}} \\ &= \frac{765\ \text{ft}}{20\ {}^{\text{ft}}/_{\text{length}}} \\ &= \underline{\underline{38.25, \text{ so buy } 39\ \text{sections}}} \end{aligned}$$

Exercise 5

1) $$\begin{aligned} \text{L, ft} &= \text{L, mi} \times 5{,}280\ {}^{\text{ft}}/_{\text{mi}} \\ &= 0.75\ \text{mi} \times 5{,}280\ {}^{\text{ft}}/_{\text{mi}} \\ &= \underline{\underline{3{,}960\ \text{ft}}} \end{aligned}$$

2) $$\begin{aligned} \text{L, ft} &= \text{L, mi} \times 5{,}280\ {}^{\text{ft}}/_{\text{mi}} \\ &= 0.5\ \text{mi} \times 5{,}280\ {}^{\text{ft}}/_{\text{mi}} \\ &= 2{,}640\ \text{ft} \end{aligned}$$

$$\begin{aligned} 4\ \text{in L, ft} &= \text{L, ft} - 950\ \text{ft} \\ &= 2{,}640\ \text{ft} - 950\ \text{ft} \\ &= \underline{\underline{1{,}690\ \text{ft}}} \end{aligned}$$

3) $$\begin{aligned} \text{L, ft} &= \text{L, mi} \times 5{,}280\ {}^{\text{ft}}/_{\text{mi}} \\ &= 6.0\ \text{mi} \times 5{,}280\ {}^{\text{ft}}/_{\text{mi}} \\ &= \underline{\underline{31{,}680\ \text{ft}}} \end{aligned}$$

Exercise 6

1) $$\text{L, ft} = \text{L, m} \times 3.28\ {}^{\text{ft}}/_{\text{m}}$$
$$= 500\ \text{m} \times 3.28\ {}^{\text{ft}}/_{\text{m}}$$
$$= \underline{\underline{1{,}640\ \text{ft}}}$$

2) $$\text{L, ft} = \text{L, m} \times 3.28\ {}^{\text{ft}}/_{\text{m}}$$
$$= 9.15\ \text{m} \times 3.28\ {}^{\text{ft}}/_{\text{m}}$$
$$= \underline{\underline{30\ \text{ft}}}$$

Exercise 7

1) $$\text{Time, min} = \text{Time, days} \times 1{,}440\ {}^{\text{min}}/_{\text{day}}$$
$$= 1.75\ \text{days} \times 1{,}440\ {}^{\text{min}}/_{\text{day}}$$
$$= \underline{\underline{2{,}520\ \text{min}}}$$

2) $$\text{Flow, GPD} = \text{Flow, GPM} \times 1{,}440\ {}^{\text{min}}/_{\text{day}}$$
$$= 1{,}500\ \text{GPM} \times 1{,}440\ {}^{\text{min}}/_{\text{day}}$$
$$= \underline{\underline{2{,}160{,}000\ \text{GPD}}}$$

3) $$\text{Flow, GPM} = \frac{\text{Flow, GPD}}{1{,}440\ {}^{\text{min}}/_{\text{day}}}$$
$$= \frac{684{,}000\ \text{GPD}}{1{,}440\ {}^{\text{min}}/_{\text{day}}}$$
$$= \underline{\underline{475\ \text{GPM}}}$$

4) $$\text{Flow, GPD} = \text{Flow, GPM} \times 1{,}440\ {}^{\text{min}}/_{\text{day}}$$
$$= 400\ \text{GPM} \times 2 \times 1{,}440\ {}^{\text{min}}/_{\text{day}}$$
$$= \underline{\underline{1{,}152{,}000\ \text{GPD}}}$$

Exercise 8

1) $\text{Time, hr \& min} = \text{Time, hr} - \text{whole number, hr}$

$= 4.72\ \text{hr} - \underline{4\ \text{hr}}$

$= 0.72\ \text{hr}$

$\text{Time, min} = \text{Time, hr} \times 60\ {}^{\text{min}}/_{\text{hr}}$

$= 0.72\ \text{hr} \times 60\ {}^{\text{min}}/_{\text{hr}}$

$= \underline{43\ \text{min}}$

2) $\text{Time, hr \& min} = \text{Time, hr} - \text{whole number, hr}$

$= 1.17\ \text{hr} - \underline{1\ \text{hr}}$

$= 0.17\ \text{hr}$

$\text{Time, min} = \text{Time, hr} \times 60\ {}^{\text{min}}/_{\text{hr}}$

$= 0.17\ \text{hr} \times 60\ {}^{\text{min}}/_{\text{hr}}$

$= \underline{10\ \text{min}}$

3) $\text{Time, hr} = \dfrac{\text{Time, min}}{60\ {}^{\text{min}}/_{\text{hr}}}$

$= \dfrac{985\ \text{min}}{60\ {}^{\text{min}}/_{\text{hr}}}$

$= 16.42\ \text{hr}$

$= 16.42\ \text{hr} - \underline{16\text{hr}}$

$= 0.42\ \text{hr}$

$\text{Time, min} = \text{Time, hr} \times 60\ {}^{\text{min}}/_{\text{hr}}$

$= 0.42\ \text{hr} \times 60\ {}^{\text{min}}/_{\text{hr}}$

$= \underline{25\ \text{min}}$

4) $$\text{Time, hr} = \frac{\text{Time, min}}{60\ ^{\text{min}}/_{\text{hr}}}$$
$$= \frac{333\ \text{min}}{60\ ^{\text{min}}/_{\text{hr}}}$$
$$= 5.55\ \text{hr}$$
$$= 5.55\ \text{hr} - \underline{5\ \text{hr}}$$
$$= 0.55\ \text{hr}$$
$$\text{Time, min} = \text{Time, hr} \times 60\ ^{\text{min}}/_{\text{hr}}$$
$$= 0.55\ \text{hr} \times 60\ ^{\text{min}}/_{\text{hr}}$$
$$= \underline{33\ \text{min}}$$

Exercise 9

1) $$\text{Head, ft} = \text{Pressure, PSI} \times 2.31\ \text{ft/PSI}$$
$$= 62 \times 2.31\ \text{ft/PSI}$$
$$= \underline{143.22\ \text{ft}}$$

2) $$\text{Pressure, PSI} = \frac{\text{Head, ft}}{2.31\ ^{\text{ft}}/_{\text{PSI}}}$$
$$= \frac{161\ \text{ft}}{2.31\ ^{\text{ft}}/_{\text{PSI}}}$$
$$= \underline{69.7\ \text{PSI}}$$

3) $$\text{Head, ft} = \text{Pressure, PSI} \times 2.31\ \text{ft/PSI}$$
$$= 14.7 \times 2.31\ \text{ft/PSI}$$
$$= \underline{34\ \text{ft}}$$

4) $$\text{Pressure, PSI} = \frac{\text{Head, ft}}{2.31\ ^{\text{ft}}/_{\text{PSI}}}$$
$$= \frac{73.5\ \text{ft}}{2.31\ ^{\text{ft}}/_{\text{PSI}}}$$
$$= \underline{31.8\ \text{PSI}}$$

5) $\text{Head, ft} = \text{Pressure, PSI} \times 2.31\ {}^{\text{ft}}/_{\text{PSI}}$

$= 12.5 \times 2.31\ {}^{\text{ft}}/_{\text{PSI}}$

$= 28.875$ ft

$\text{Water level, ft} = \text{Head, ft} + \text{Gauge height, ft}$

$= 28.9\text{ ft} + 5.0\text{ ft}$

$= \underline{33.9\text{ ft}}$

6) $\text{Pressure, PSI} = \dfrac{\text{Head, ft}}{2.31\ {}^{\text{ft}}/_{\text{PSI}}}$

$= \dfrac{10\text{ ft}}{2.31\ {}^{\text{ft}}/_{\text{PSI}}}$

$= 4.33$ PSI

$\text{End Pressure, PSI} = \text{Starting, PSI} - \text{Loss, PSI}$

$= 11.1\text{ PSI} - 4.33\text{ PSI}$

$= \underline{6.77\text{ PSI}}$

Exercise 10

1) $\text{Flow, GPM} = \text{Flow, MGD} \times 694.4\ {}^{\text{GPM}}/_{\text{MGD}}$

$= 6.4\text{ MGD} \times 694.4\ {}^{\text{GPM}}/_{\text{MGD}}$

$= \underline{4{,}444\text{ GPM}}$

2) $\text{Flow, GPM} = \text{Flow, MGD} \times 694.4\ {}^{\text{GPM}}/_{\text{MGD}}$

$= 21\text{ MGD} \times 694.4\ {}^{\text{GPM}}/_{\text{MGD}}$

$= \underline{14{,}582\text{ GPM}}$

3) $\text{Flow, MGD} = \dfrac{\text{Flow, GPM}}{694.4\ {}^{\text{GPM}}/_{\text{MGD}}}$

$= \dfrac{1{,}200\text{ GPM}}{694.4\ {}^{\text{GPM}}/_{\text{MGD}}}$

$= \underline{1.73\text{ MGD}}$

4) $$\text{Flow, MGD} = \frac{\text{Flow, GPM}}{694.4\ ^{\text{GPM}}/_{\text{MGD}}}$$
$$= \frac{1{,}100\ \text{GPM} + 750\ \text{GPM}}{694.4\ ^{\text{GPM}}/_{\text{MGD}}}$$
$$= \frac{1{,}850\ \text{GPM}}{694.4\ ^{\text{GPM}}/_{\text{MGD}}}$$
$$= \underline{\underline{2.66\ \text{MGD}}}$$

Exercise 11

1) $$\text{Flow, GPM} = \text{Flow, CFS} \times 448.8\ ^{\text{GPM}}/_{\text{CFS}}$$
$$= 3.5\ \text{CFS} \times 448.8\ ^{\text{GPM}}/_{\text{CFS}}$$
$$= \underline{\underline{1{,}571\ \text{GPM}}}$$

2) $$\text{Flow, GPM} = \text{Flow, CFS} \times 448.8\ ^{\text{GPM}}/_{\text{CFS}}$$
$$= 2.77\ \text{CFS} \times 448.8\ ^{\text{GPM}}/_{\text{CFS}}$$
$$= \underline{\underline{1{,}243\ \text{GPM}}}$$

3) $$\text{Flow, CFS} = \frac{\text{Flow, GPM}}{448.8\ ^{\text{GPM}}/_{\text{CFS}}}$$
$$= \frac{750\ \text{GPM}}{448.8\ ^{\text{GPM}}/_{\text{CFS}}}$$
$$= \underline{\underline{1.67\ \text{CFS}}}$$

4) $$\text{Flow, CFS} = \frac{\text{Flow, GPM}}{448.8\ ^{\text{GPM}}/_{\text{CFS}}}$$
$$= \frac{2{,}000\ \text{GPM}}{448.8\ ^{\text{GPM}}/_{\text{CFS}}}$$
$$= \underline{\underline{4.46\ \text{CFS}}}$$

Exercise 12

1) $$\text{Flow, CFS} = \text{Flow, MGD} \times 1.55\ ^{\text{CFS}}/_{\text{MGD}}$$
$$= 8.4\ \text{MGD} \times 1.55\ ^{\text{CFS}}/_{\text{MGD}}$$
$$= \underline{\underline{13.02\ \text{CFS}}}$$

2) $$\text{Flow, CFS} = \text{Flow, MGD} \times 1.55\ {}^{CFS}/_{MGD}$$
$$= 15.8\ \text{MGD} \times 1.55\ {}^{CFS}/_{MGD}$$
$$= \underline{\underline{24.49\ \text{CFS}}}$$

3) $$\text{Flow, MGD} = \frac{\text{Flow, CFS}}{1.55\ {}^{CFS}/_{MGD}}$$
$$= \frac{6.65\ \text{CFS}}{1.55\ {}^{CFS}/_{MGD}}$$
$$= \underline{\underline{4.29\ \text{MGD}}}$$

4) $$\text{Plant Flow, MGD} = \text{Peak Flow, MGD} - \left(\frac{\text{Stroage Flow, CFS}}{1.55\ {}^{CFS}/_{MGD}}\right)$$
$$= 2.99\ \text{MGD} - \left(\frac{2.0\ \text{CFS}}{1.55\ {}^{CFS}/_{MGD}}\right)$$
$$= 2.99\ \text{MGD} - 1.29\ \text{CFS}$$
$$= \underline{\underline{1.7\ \text{MGD}}}$$

Exercise 13

1) $$\text{Volume, L} = \text{Volume, gal} \times 3.785\ {}^{L}/_{gal}$$
$$= 150\ \text{gal} \times 3.785\ {}^{L}/_{gal}$$
$$= \underline{\underline{567.75\ \text{L}}}$$

2) $$\text{Volume, gal} = \frac{\text{Volume, L}}{3.785\ {}^{L}/_{gal}}$$
$$= \frac{720\ \text{L}}{3.785\ {}^{L}/_{gal}}$$
$$= \underline{\underline{190.2\ \text{gal}}}$$

3) $$\text{Volume, L} = \text{Volume, gal} \times 3.785\ {}^{L}/_{gal}$$
$$= 55\ \text{gal} \times 3.785\ {}^{L}/_{gal}$$
$$= \underline{\underline{208.2\ \text{L}}}$$

4) $$\text{Volume, mL} = \text{Volume, gal} \times 3,785\ {}^{mL}/_{gal}$$
$$= 2.25\ \text{gal} \times 3,785\ {}^{mL}/_{gal}$$
$$= \underline{\underline{8,516.3\ \text{mL}}}$$

5) $$\text{Volume, gal} = \frac{\text{Volume, mL}}{3{,}785\ ^{\text{mL}}/_{\text{gal}}}$$

$$= \frac{750\ \text{mL}}{3{,}785\ ^{\text{mL}}/_{\text{gal}}}$$

$$= \underline{\underline{0.2\ \text{gal}}}$$

CHAPTER TWO PRACTICE PROBLEMS

MULTIPLE CHOICE QUESTIONS

Instructions: Circle the letter in front of the one statement you believe is most nearly correct.

1. A fire hydrant has a head of 115 feet. What is the corresponding pressure, in psi?

   a) 266 PSI
   b) 133 PSI
   c) 77 PSI
   d) 50 PSI

2. 70 yards of 6-inch main need to be replaced. How many 15-foot lengths of pipe are required to complete the job?

   a) 5
   b) 7
   c) 14
   d) 21

3. A pump runs for an average of 814 minutes each day. How many hours and minutes does it operate?

   a) 10 hr 54 min
   b) 12 hr 14 min
   c) 13 hr 34 min
   d) 13 hr 57 min

4. If a flume has a capacity of 25,000 cu.ft., what is the number of gallons it holds?

   a) 208,500 gal
   b) 187,000 gal
   c) 57,750 gal
   d) 49,250 gal

5. A treatment plant produces 5.4 MGD that it discharges through two pumps. What is the average flow in GPM for each pump?

   a) 1,212 GPM
   b) 3,750 GPM
   c) 2,424 GPM
   d) 1,875 GPM

6. What is the force, in pounds, of 43,150 cu.ft. of water on the bottom of a clearwell that holds it?

   a) 19,365,720 lbs
   b) 2,691,835 lbs
   c) 29,963,360 lbs
   d) 4,579,221 lbs

7. What is the diameter, in feet, of a 12-inch pipeline that has an average of 1.0 inches of scale built up on its interior surface?

   a) 1.17 ft
   b) 1.0 ft
   c) 0.92 ft
   d) 0.83 ft

8. A standpipe 70 feet high is connected to a pipeline pressurized at 30 psi. If the standpipe is open at the top, is it overflowing?

   a) Yes!
   b) No, not even close to overflowing.
   c) No, but the water is less than a foot from the top.
   d) Not enough information given.

9. If a pump is producing 525 GPM, how many gallons will it put out over 24 hours?

   a) 756,000 GPD
   b) 1,890,000 GPD
   c) 364,560 GPD
   d) 235,620 GPD

10. A treatment plant that disinfects 0.84 MG every 24 hours is drawing how many CFS from its river source?

    a) 1.3 CFS
    b) 0.54 CFS
    c) 583 CFS
    d) 377 CFS

11. What is the weight of a solution created by adding 10 lbs of dry chemical to 25 gallons of water?

    a) 193.5 lbs
    b) 218.5 lbs
    c) 250 lbs
    d) 291.9 lbs

12. The distance between two fire hydrants is listed as 147 meters. Does this exceed the maximum allowed distance of 500 feet?

    a) Yes, by almost 10 feet.
    b) It is exactly 500 feet.
    c) No, it is only about half the maximum allowable distance.
    d) No, it makes it with 15 feet to spare.

13. If 24-inch ID (inner diameter) pipe has a thickness of 1.5 inches, what is its OD (outer diameter) in feet?

    a) 2.25 ft
    b) 2.125 ft
    c) 2.0 ft
    d) 1.125 ft

14. If a chemical feed pump is set to deliver 115 mL every minute, how many gallons of solution are being fed each day?

    a) 32.9 gal
    b) 43.75 gal
    c) 47.4 gal
    d) 47,395 gal

15. A pump discharges 50 PSI into a 12-inch main. If the supply reservoir is 100 ft. above the pump, how much head, in ft., is the pump producing?

    a) 115.5 ft
    b) 21.65 ft
    c) 15.5 ft
    d) 6.7 ft

16. A gauge three feet above the bottom of a storage tank shows 4.9 PSI. What is the depth of the water in the tank in feet and inches?

    a) 14 ft 3 in
    b) 14 ft 4 in
    c) 14.3 ft
    d) All of the above.

17. What is the total weight of a 55-gallon barrel full of water if the barrel weighs 26.8 lbs. when empty?

    a) 485.5 lbs
    b) 438.2 lbs
    c) 431.9 lbs
    d) 81.8 lbs

18. How many 8-foot sections are there in a fence that is 48 yards long?

    a) 6
    b) 8
    c) 16
    d) 18

19. If it took 267 minutes (including breaks) to paint a pump house and the crew started at 7:45 AM, when was the job finished?

    a) 10:52 AM
    b) 12:30 PM
    c) 12:30 AM
    d) 12:12 PM

20. A stream flowing at 4.0 CFS is equivalent to a 12-inch main with a flow of how many GPM?

    a) 1,795 GPM
    b) 2,778 GPM
    c) 2,994 GPM
    d) 620 GPM

Chapter Two Practice Problem Answers

1. D
2. C
3. C
4. B
5. D
6. B
7. D
8. C
9. A
10. A
11. B
12. D
13. A
14. B
15. C
16. B
17. A
18. D
19. D
20. A