Task Title: Formulas in Plumbing

OALCF Cover Sheet – Practitioner Copy

Learner Name: _____

Date Started: _____

Date Completed: _____

Successful Completion: Yes ☐ No ☐

Goal Path: Employment ☐ Apprenticeship ■

Secondary School ☐ Post Secondary ☐ Independence ☐

Task Description: The learner will use formulas to calculate pipe ratios and determine the water pressure in water tanks.

Main Competency/Task Group/Level Indicator:

- Find and Use Information/Read continuous text/A1.2
- Understand and Use Numbers/Use measures/C3.3

Materials Required:

- Pen/pencil and paper and/or digital device
- Calculator or digital device with calculator function (optional)

Learner Information

Plumbers use formulas to determine the amount of force exerted on water tanks and understand the volume capacity of pipes being used.

Read “Formulas Used in Plumbing”.

Formulas Used in Plumbing

Pipe Size Capacity Ratio

An important plumbing concept is to understand the ratio between pipe size and volume output. For example; how many one-inch pipes would it take to provide the same volume of water as a two inch pipe?

The formula below is used to find the capacity of larger pipes in relation to smaller pipes, however, this does not take into consideration the friction loss.

Pipe Size Ratio Formula

D^2 - Diameter of larger pipe squared

d^2 - diameter of smaller pipe squared

N - number of smaller pipes

$N = D^2 \div d^2$

Example: How many 1 ½" pipes would be required to provide the volume of one 3" pipe?

$N = (3 \times 3) \div (1.5 \times 1.5)$

$N = 4$ Four 1 ½" pipes are needed

Finding Pressure in Depths of Water

The importance of pressurized systems is the pressure exerted by water. Water pressures are directly related to both the height (depth) and density of water. Pressure is defined as the amount of force acting (pushing) on a unit area.

The term Kpa (kilopascals) is a measure of force per unit area, defined as one Newton per square metre.

A cubic meter of water has a mass of 1000 kg. The force acting downward will be 1000 x 9.8 or 9800 Newton. As this force is acting on 1.0 M^2 the pressure on the base of the cube will be 9800 N or 9.8 kPa per 1.0 m^2.

It follows that at a depth of 2.0 m the pressure will be 2 x 9.8 or 19.6 kPa and 3.0 m it will be 3 x 9.8 or 29.4 kPa. Therefore, to find the pressure in

water simply multiply 9.8 by the depth in meters. Remember that the result of this calculation will give you kilopascals (kPa).

Formula

Pressure (P) = 9.8 x depth (m) = kPa

Depth = Pressure (P) ÷ 9.8

If working with substances other than water their specific gravity (SG) must be factored in.

P = 9.8 x depth (m) x SG = kPa

Example: Find the pressure in water at a depth of 150m. P = 9.8 x 150 P= 1470 kPa	Example 2: If a pressure gauge on a non-pressurized tank reads 24.3 kPa, how many meters of water are there in the tank? Depth= 24.3 ÷ 9.8 Depth= 2.48 m

Work Sheet

Task 1: Determine the number of pipes required to equal the volume capacity of a 6" pipe for the following pipe sizes.

a) 1½" pipe

Answer:

b) 2" pipe

Answer:

c) 3" pipe

Answer:

d) What type of pattern emerges?

Answer:

Task 2: What does kPa stand for and how is it defined?

Answer:

Task 3: There are 2 tanks to be installed. Determine the amount of pressure for each tank.

1.5 metre depth tank

6 metre depth tank

Answer:

Task 4: You have a tank that is only .5 meters in depth. Determine the pressure for this tank.

Answer:

Task 5: There is a pressure gauge on a tank that reads 41.6 kPa. What is the depth of the water in the tank?

Answer:

Answers

Task 1: Determine the number of pipes required to equal the volume capacity of a 6" pipe for the following pipe sizes.

a) 1½" pipe

Answer: (6 x 6) ÷ (1.5 x 1.5) = 36 ÷ 2.25 = 16

b) 2" pipe

Answer: (6 x 6) ÷ (2 x 2) = 36 ÷ 4 = 9

c) 3" pipe

Answer: (6 x 6) ÷ (3 x 3) = 36 ÷ 9 = 4

d) What type of pattern emerges?

Answer: The pattern that emerges is the larger the pipe size, the fewer pipes required.

Task 2: What does kPa stand for and how is it defined?

Answer: Kilopascal. It is a measure of force per unit area, defined as one newton per square meter.

Task 3: There are 2 tanks to be installed. Determine the amount of pressure for each tank.

Answer:

1.5 metre depth tank	**6 metre depth tank**
1.5 x 9.8 = 14.7	6 x 9.8 = 58.8
14.7 kPa	58.8 kPa

Task 4: You have a tank that is only .5 meters in depth. Determine the pressure for this tank.

Answer: .5 x 9.8 = 4.9 4.9 kPa of pressure

Task 5: There is a pressure gauge on a tank that reads 41.6 kPa. What is the depth of the water in the tank?

Answer: 41.6 ÷ 9.8 = 4.24 m 4.24 m in depth

Performance Descriptors

Levels	Performance Descriptors	Needs Work	Completes task with support from practitioner	Completes task independently
A1.2	scans text to locate information			
	locates multiple pieces of information in simple texts			
	makes low-level inferences			
	follows the main events of descriptive, narrative and informational texts			
C3.3	calculates using numbers expressed as whole numbers, fractions, decimals, percentages and integers			
	understands and uses formulas for finding the perimeter, area and volume of non-rectangular, composite shapes			
	manages unfamiliar elements (e.g. context, content) to complete tasks			
	chooses and performs required operations; makes inferences to identify required operations			
	interprets, represents and converts measures using whole numbers, decimals, percentages, ratios and fractions			

Levels	Performance Descriptors	Needs Work	Completes task with support from practitioner	Completes task independently
	selects appropriate steps to solutions from among options			
	uses strategies to check accuracy (e.g. estimating, using a calculator, repeating a calculation, using the reverse operation)			

This task: Was successfully completed ☐ Needs to be tried again ☐

Learner Comments:

Instructor (print): _____

Learner (print): _____