Plant Operator in Training Mathematics and Science Study Guide

An Operator-in-training is responsible for learning to operate all areas of a water or wastewater treatment plant.

MATHEMATICS

We suggest you are familiar with multiplication, division, fractions, average and median, and basic algebraic formulas, in addition to the items listed below in order to be properly prepared for the math section of this exam.

Note the abbreviations used:

A – Area   l – length   V – Volume
b – base   r -radius
h – height   w – width

Area Formulas - Circle $A = \pi r^2$ Rectangle $A = lw$ Triangle $A = \frac{1}{2} bh$

Volume and Surface Area Formulas

	Volume	**Surface Area**
Cube	$V = A^3$	$S.A. = 2wl + 2lh + 2hw$
Rectangular Prism	$V = lwh$	$S.A. = 2(lw + lh + wh)$
Cylinder	$V = \pi r^2 h$	$S.A. = 2\pi rh + 2\pi r^2$

Example: A tank 4 feet wide, 7 feet long, and 10 feet high is filled with water to the exact top. The volume in cubic feet is

    A. 70
    B. 120
    C. 280 <u>Correct answer</u>
    D. 360

In algebraic equations, the Order of Operations is, in this order; **P**arenthesis, **E**xponents, **M**ultiplication, **D**ivision, **A**ddition, and **S**ubtraction. An easy way to remember this is the Acronym **PEMDAS.**

Example: In the equation (CxD)+(AxB)-F, the first mathematical operation performed is

    A. subtraction
    B. multiplication <u>Correct answer</u>
    C. addition
    D. division

Types of slope
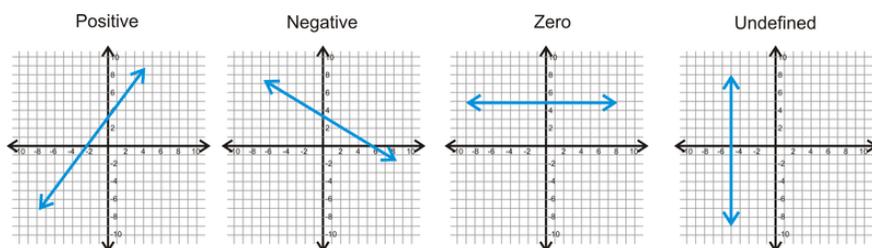
SCIENCE

We suggest you are familiar with atoms, their charges, nuclear change, chemical formulas, plant cells and their components, in addition to the items listed below in order to be properly prepared for the science section of this exam.

Atoms

Components of an atom - electrons, protons, and neutrons. Electrons are the smallest of the three particles that make up atoms. Electrons are found in shells or orbitals that surround the nucleus of an atom. Protons and neutrons are found in the **nucleus**. They group together in the center of the atom.

Atomic Number - the number of protons in the nucleus of an atom, which determines the chemical properties of an element and its place in the periodic table.

Atomic Charge - Electrical **charge** density due to gain or loss of one or more electrons.

Types of reactions

Chemical Reaction - a process in which one or more substances, the reactants, are converted to one or more different substances, the products.

Physical Reaction - occurs when molecules undergo a molecular rearrangement to produce a physical change. The molecules are not chemically altered.

Nuclear reaction - a change in the identity or characteristics of an atomic nucleus that results when it is bombarded with an energetic particle, as in fission, fusion, or radioactive decay.

States of matter

Some Characteristics of Gases, Liquids and Solids and the Microscopic Explanation for the Behavior

gas	liquid	solid
assumes the shape and volume of its container particles can move past one another	assumes the shape of the part of the container which it occupies particles can move/slide past one another	retains a fixed volume and shape rigid - particles locked into place
compressible lots of free space between particles	not easily compressible little free space between particles	not easily compressible little free space between particles
flows easily particles can move past one another	flows easily particles can move/slide past one another	does not flow easily rigid - particles cannot move/slide past one another

Photosynthesis - the process by which green plants and some other organisms use sunlight to synthesize foods from carbon dioxide and water. Photosynthesis in plants generally involves the green pigment chlorophyll and generates oxygen as a byproduct.

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MATHEMATICS FORMULAS

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Area Formulas

Parallelogram   A= bh   Trapezoid   A= ½ h(b_1+b_2)   Circle   A= πr^2

Rectangle   A= lw   Triangle   A= ½ bh

Circumference of a circle

C= πd   or   C= 2πr   (note: π= *3.14 or 22/7*)

Volume and Surface Area Formulas

	Volume	Surface Area
Cube	V= A^3	S.A. = 2wl + 2lh + 2hw
Sphere	V= $^4/_3\ \pi\ r^3$	S.A. = $4\pi r^2$
Rectangular Prism	V= lwh	S.A. = 2(lw + lh + wh)
Pyramid	V= ⅓ bh	S.A. = ½ pl (p = perimeter, l = slant)
Cone	V= ⅓ $\pi\ r^2$h	S.A. = πr(r + $\sqrt{h^2 + r^2}$)
Cylinder	V= $\pi\ r^2$h	S.A. = 2πrh + $2\pi r^2$

U.S. Customary Measure

Length	Liquid	Weight
1 foot = 12 inches	1 cup = 8 fluid ounces	1 pound = 16 ounces
1 yard = 3 feet	1 pint = 2 cups	1 ton = 2000 pounds
1 mile = 5280 feet	1 quart = 2 pints	
	1 gallon = 4 quarts	

Metric Measurement

Length	Liquid	Weight
1 centimeter = 10 millimeters	1 centiliter = 10 milliliters	1 centigram = 10 milligrams
1 meter = 100 centimeters	1 liter = 100 centiliters	1 gram = 100 centigrams
1 kilometer = 1000 meters	1 kiloliters = =1000 liters	1 kilogram = 1000 grams

Selected Conversions of U.S. Customary Units to Metric Units

Length	Liquid	Weight
1 inch = 2.54 centimeters	1 quart = .95 liters	1 ounce = 28.35 grams
1 mile = 1.61 kilometers	1 gallon = 3.79 liters	1 ton = 907.18 kilograms

Temperature Conversion: **Centigrade**   **Fahrenheit**

$^0C = {}^5/_9\ (^0F\text{-}32)$ $^0F = {}^9/_5\ (^0C\text{+}32)$