Orgoman's Formula Math Destroyer Work Sheet

Logarithm Rules

$$\log(x \bullet y) = \log(x) + \log(y)$$
$$\log\left(\frac{x}{y}\right) = \log(x) - \log(y)$$
$$\log_a x^b = b * \log_a x$$
$\log_a x = b$ expressed in exponential form is $a^b = x$

Exponent Rules

$$a^n \bullet a^k = a^{n+k}$$

$$\frac{a^n}{a^k} = \mathrm{a}^{n-k}$$

$$(a^n)^k = a^{n \bullet k}$$

$$a^{-n} = \frac{1}{a^n}$$

$$\sqrt[k]{a^n} = a^{\frac{n}{k}}$$

$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$$

$$(a \bullet b)^n = a^n \bullet b^n$$

Conversions

K = °C + 273 and °F =1.8C+32
0°C = 32°F
1 inch = 2.54 centimeters; 1 mile = 5280 feet
1 foot = 12 inches; 1 yard = 3 feet
1 meter ≈ 1.1 yards; 1 kilogram ≈ 2.2 pounds
1 pound = 16 ounces ≈ 454 grams

$$\text{Percent Change} = \frac{\text{(New value – Old value)}}{\text{Old value}} * 100\%$$

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How to convert a simple percent word problem to an equation:

'What number' translates to 'x', the unknown.

'is' translates to an equal sign. '='

'of' translates to multiplication

Example: What number is 30% of 90?

$$x = \frac{30}{100} \bullet (90)$$

$$\mathrm{x} = 0.3 \times 90$$

$$\mathrm{x} = 27$$

Example: 60 is 40% of what number?

$$60 = \frac{40}{100} * \mathrm{x}$$

$$150 = \mathrm{x}$$

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<u>Dilutions</u>

$$\% \text{ of pure substance in a mixture} = \frac{\text{Amount of pure substance}}{\text{Total volume of liquid}} \bullet 100\%$$

$$\text{Amount of pure substance mixed} = \% \text{ concentration} \bullet \text{Total Volume of Liquid}$$

Distance/Rate

Velocity = V Distance = D Time = T

$$D = V \bullet T \qquad V = \frac{D}{T} \qquad T = \frac{D}{V}$$

<u>When two objects are traveling toward each other, each at its own constant velocity, the rate at which they are approaching each other is the sum of their velocities.</u>

Example: Two cars 180 miles apart are traveling towards each other. Car A is traveling at 60 mph, Car B is traveling at 30 mph. How long will it take them to meet?

$$T = \frac{D}{V}$$

$$\text{Time} = \frac{180}{60+30} = 2 \text{ hours}$$

$$\textbf{Average speed} = \frac{\text{Total distance}}{\text{Total time}}$$

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Set Operations

∪ = union. A ∪ B is the set of all elements contained in either A or B, that is, the combined elements of each set taken together with duplicates eliminated.

∩ = intersection. A ∩ B is the set of elements that are contained in both A and B.

Example: A = {1,2,3}, B = {1,3,4}

A ∪ B= {1,2,3,4}

A ∩ B= {1,3}

Simple vs Compounded interest

Simple Interest	Compounded interest
I = P•r•t	$I = P \bullet \left(1 + \frac{r}{n}\right)^{n \bullet t}$
P = Principal (initial amount)	P = Principal (initial amount)
I = interest accrued after time t	I = interest accrued after time t
r = rate of interest	r = rate of interest
t = time the money is invested for	t = time the money is invested for
	n = number of times interest is compounded per unit time

Example: If interest is compounded semi-annually (every 6 months), that is, n = 2 times per year, at 3.6 % annual rate. In 4 years (t = 4), it will be compounded 8 times. (n•t = 2•4 = 8).

Combined Work Problems

Rates are combined when the parties involved are cooperatively working on one and the same project.

[Equation] T_1, T_2, T_3, … represents the time it takes each of the contributing workers to complete the job while working alone. Their respective rates are then 1/ T_1, 1/ T_2, 1/ T_3, etc. The total time T it takes for the entire job to be completed with all contributing workers working simultaneously is given by:

$$\frac{1}{T_1} + \frac{1}{T_2} + \frac{1}{T_3} \;\ldots\ldots\; = \frac{1}{Total\ time}$$

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Example: John can paint a Room in 5 hours, Sam can paint the same room in 2.5 hours and Meredith can paint the same room in 3 hours. How long will it take to paint the room if all three work together?

$\frac{1}{5}+\frac{1}{2.5}+\frac{1}{3}=\frac{1}{T}$; $\frac{14}{15}=\frac{1}{T}$; $T=\frac{15}{14}$ hrs. ; $\frac{15}{14}*60 \approx 1$ hr and $4 mins$

Combinatorics

Combinations and Permutations are used when counting the number of ways to select a subset of objects from a total number of objects.

• Use the combination formula when order does not matter.

For example, {B, C, A}, {A, B, C}, {C, B, A} represent one and the same selection

• Use the permutation formula when order matters.

{B, C, A}, {A, B, C}, {C, B, A} represent three different selections

Out of a total of n things, a subset of r things is considered.

Use the Combination formula, nCr, when order does not matter.

$$_nC_r = \frac{n!}{(n-r)!r!}$$

Use the Permutation formula, nPr, when order matters.

$$_nP_r = \frac{n!}{(n-r)!}$$

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Dice Problems

There are 6 sides to a fair die, numbered 1, 2, 3, 4, 5, 6.

The probability of any one of these outcomes turning out is 1/6.
The sample space of rolling two dice is 6•6 = 36 possible outcomes.

What is the probability of obtaining a sum of 5 by rolling two dice?
Note that there are 4 ways to roll a sum of 5 with two dice, as follows:
(1, 4), (2, 3), (3, 2), (4, 1).
Since there are only 4 favorable outcomes out of a total of 36 outcomes, the probability of rolling a sum of 5 is:

4• (1/36) = 4/36 = 1/9

Letter Rearrangement Problems
Example: How many ways can the letters in a word "Vermont" be rearranged?
Answer is 7! = 7*6*5*4*3*2*1 =
If there are no repeating letters, the result is N! where N is the number of letters in the word.

If repeated letters appear, N! is then divided by a! •b! •c! •…, etc., where a, b, c, etc., represents the number of times each letter is repeated.

How many ways can the letters in the word "Accommodate" be rearranged?
Since there are a total of N = 11 letters in the word, with A, C, M and O each appearing twice,

The formula is $\frac{\text{(Total number of letters)!}}{\text{(repeating number of letters)!}}$

$$\frac{11!}{2!2!2!2!} = \frac{11\cdot 10\cdot 9\cdot 8\cdot 7\cdot 6\cdot 5\cdot 4\cdot 3\cdot 2\cdot 1}{2\cdot 1\cdot 2\cdot 1\cdot 2\cdot 1\cdot 2\cdot 1} = 2{,}494{,}800$$

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Card Problems
A standard deck consists of:
52 cards (without jokers)
4 suits (hearts, clubs, aces, diamonds)
13 cards per suit

Choosing a card with Replacement: After picking a card, it is put back without changing the total number of cards

Choosing a card without Replacement: After picking a card, one is subtracted from the total number of cards and from the set of cards of interest.

Example: What is the probability of drawing two hearts from a standard deck without replacement?

$$\frac{13}{52} * \frac{12}{51} = 0.24$$

Example: What is the probability of drawing a heart and a spade, in any order, out of a standard deck without replacement?
Solution: Since order is not specified, we must consider two outcomes: heart then spade; spade then heart.

$$\frac{13}{52} * \frac{13}{51} + \frac{13}{52} * \frac{13}{51} = 0.12745$$

Statistics
[Basic concepts]
Measures of Central Tendency: Mean, Median, Mode.
• Mean: the arithmetic average
• Median: the value that divides an ordered dataset in half, such that there are as many numbers greater as there are less than the median value in the dataset.
• Mode: the number that occurs most often in a dataset

Measures of Dispersion: Range, Percentile Rank, Standard Deviation, Variance. These statistics measure the degree to which a dataset is dispersed or spread out on the number line.

• Range: The highest score minus the lowest score in a dataset.

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• Percentile Rank: The percent of scores in a dataset that are equal to or less than a given score
• Standard deviation: The established value used to quantify the degree of dispersion or variation of a dataset. See formula below.
• Variance: The square of the standard deviation.

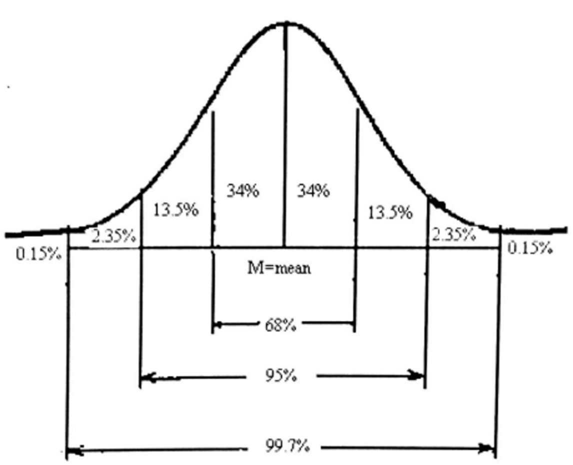
Mean of n scores $\mu = \sum x_i/n$

Variance $\sigma^2 = \sum(x_i - \mu)^2/n$

Standard Deviation $\sigma = \sqrt{\left[\Sigma(x_i - \mu)^2 / n\right]}$

Notation:
The population mean is represented by the Greek letter mu: μ
The sum of numbers is represented by the Greek letter, capital sigma: Σ
Individual numbers in the set are represented by x_i
The total number of datapoints in the dataset is n
The standard deviation is represented by the Greek letter, small case sigma: σ

Empirical Rule, also known as the "68%-95%-99.7% rule", which says that in a standard normal distribution 68% of the population fall within 1 s.d. of the mean, 95% fall within 2 s.d. of the mean, 99.7% within three s.d. of the mean.



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Geometry

r = radius
D = diameter = 2r
Circumference of a circle = $2\pi r$, or πD
Area of a circle = πr^2
Volume of a cylinder = πr^2h , where h= height

Surface Area of a cylinder = Lateral area + twice the area of the base
= $2\pi r$h + $2\pi r^2$;

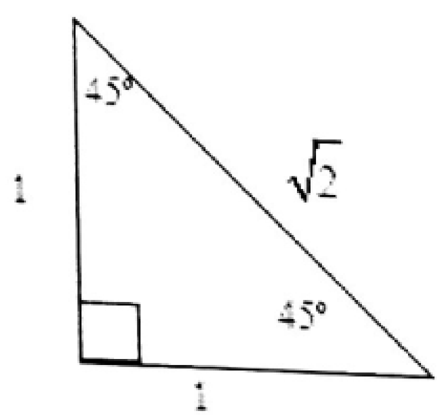
Area of the base of a cylinder = πr^2

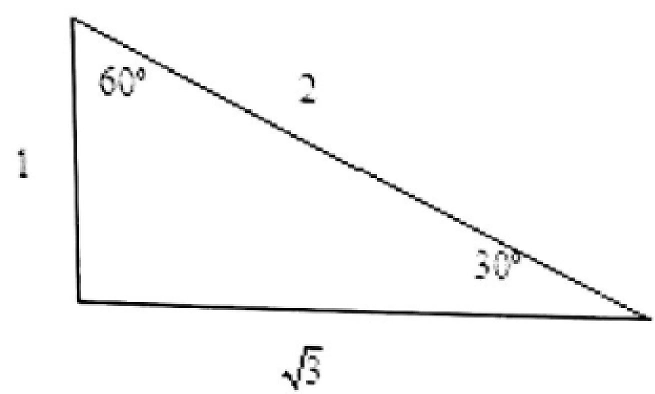
Volume of a sphere = $\frac{4}{3}\pi r^3$

Area of a triangle = $\frac{1}{2}b$h , where b = base, h = height

Area of an equilateral triangle = $\frac{s^2\sqrt{3}}{4}$ where S is the side of the triangle

Special Right triangles: the 45°-45°-90° triangle and the 30°-60°-90° triangle. These values are the measures of the angles within each triangle. The sum of the internal angles of a triangle is always 180°.





For the 30°-60°-90° triangle, the ratio of the length of the sides is 1:$\sqrt{3}$:2
For the 45°-45°-90° triangle, the ratio of sides is $1:1:\sqrt{2}$

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Coordinate Geometry

Equation of a straight line: $y = mx+b$,
where m = slope and b is the y-intercept, located at the point (0, b)

Formula for the slope connecting two points, (x_1, y_1) and (x_2, y_2):

$$m = \frac{y_2-y_1}{x_2-x_1}$$

Formula for the Distance between two points, (x_1, y_1) and (x_2, y_2):

$$D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

To find the midpoint between two points, (x_1, y_1) and (x_2, y_2):

$$(x_m, y_m) = \left((x_1+x_2)/2, (y_1+y_2)/2\right)$$

Quadratic Equations

$$(a + b)^2 = a^2 + 2ab + b^2$$

$$(a - b)^2 = a^2 - 2ab + b^2$$

$$(a - b) \bullet (a + b) = a^2 - b^2$$

Equations of a Parabola:

General Form: $F(x) = ax^2 + bx + c$

When $a > 0$ the parabola is concave up. When $a < 0$ it is concave down.

The vertex of the parabola is located at $(x_v, y_d) = (-\frac{b}{2a}, F\left(\frac{-b}{2a}\right))$

Standard Form of a parabola: $F(x) = a(x - h)^2 + k$

Where the vertex is located at (h, k)

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Quadratic formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4}ac}{2a}$$

Representing the solutions to the Quadratic equation

$$ax^2 + bx + c = 0,$$

Sum of the roots of a quadratic equation: $\frac{-b}{a}$

Product of the roots of a quadratic equation: $\frac{c}{a}$