

AP BIOLOGY EQUATIONS AND FORMULAS

Statistical Analysis and Probability

Mean

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

Standard Deviation*

$$S = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$$

Standard Error of the Mean*

$$SE_{\bar{x}} = \frac{S}{\sqrt{n}}$$

Chi-Square

$$\chi^2 = \sum \frac{(o-e)^2}{e}$$

Chi-Square Table

p value	Degrees of Freedom							
	1	2	3	4	5	6	7	8
0.05	3.84	5.99	7.82	9.49	11.07	12.59	14.07	15.51
0.01	6.64	9.21	11.34	13.28	15.09	16.81	18.48	20.09

\bar{x} = sample mean

n = size of the sample

s = sample standard deviation (i.e., the sample-based estimate of the standard deviation of the population)

o = observed results

e = expected results

Degrees of freedom are equal to the number of distinct possible outcomes minus one.

Laws of Probability

If A and B are mutually exclusive, then:

$$P(A \text{ or } B) = P(A) + P(B)$$

If A and B are independent, then:

$$P(A \text{ and } B) = P(A) \times P(B)$$

Hardy-Weinberg Equations

$$p^2 + 2pq + q^2 = 1 \quad p = \text{frequency of the dominant allele in a population}$$

$$p + q = 1 \quad q = \text{frequency of the recessive allele in a population}$$

Metric Prefixes

Factor	Prefix	Symbol
10^9	giga	G
10^6	mega	M
10^3	kilo	k
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

Mode = value that occurs most frequently in a data set

Median = middle value that separates the greater and lesser halves of a data set

Mean = sum of all data points divided by number of data points

Range = value obtained by subtracting the smallest observation (sample minimum) from the greatest (sample maximum)

** For the purposes of the AP Exam, students will not be required to perform calculations using this equation; however, they must understand the underlying concepts and applications.*

INSERT E (continued)

<p style="text-align: center;">Rate and Growth</p> <p>Rate $\frac{dY}{dt}$</p> <p>Population Growth $\frac{dN}{dt} = B - D$</p> <p>Exponential Growth $\frac{dN}{dt} = r_{\max} N$</p> <p>Logistic Growth $\frac{dN}{dt} = r_{\max} N \left(\frac{K - N}{K} \right)$</p> <p>Temperature Coefficient Q_{10}[†] $Q_{10} = \left(\frac{k_2}{k_1} \right)^{\frac{10}{T_2 - T_1}}$</p> <p>Primary Productivity Calculation $\frac{\text{mg O}_2}{\text{L}} \times \frac{0.698 \text{ mL}}{\text{mg}} = \frac{\text{mL O}_2}{\text{L}}$ $\frac{\text{mL O}_2}{\text{L}} \times \frac{0.536 \text{ mg C fixed}}{\text{mL O}_2} = \frac{\text{mg C fixed}}{\text{L}}$ (at standard temperature and pressure)</p>	<p>dY = amount of change</p> <p>dt = change in time</p> <p>B = birth rate</p> <p>D = death rate</p> <p>N = population size</p> <p>K = carrying capacity</p> <p>r_{\max} = maximum per capita growth rate of population</p> <hr/> <p>T_2 = higher temperature</p> <p>T_1 = lower temperature</p> <p>k_2 = reaction rate at T_2</p> <p>k_1 = reaction rate at T_1</p> <p>Q_{10} = the factor by which the reaction rate increases when the temperature is raised by ten degrees</p>	<p>Water Potential (Ψ) $\Psi = \Psi_p + \Psi_s$</p> <p>Ψ_p = pressure potential</p> <p>Ψ_s = solute potential</p> <p>The water potential will be equal to the solute potential of a solution in an open container because the pressure potential of the solution in an open container is zero.</p> <p>The Solute Potential of a Solution $\Psi_s = -iCRT$</p> <p>i = ionization constant (this is 1.0 for sucrose because sucrose does not ionize in water)</p> <p>C = molar concentration</p> <p>R = pressure constant ($R = 0.0831$ liter bars/mole K)</p> <p>T = temperature in Kelvin ($^{\circ}\text{C} + 273$)</p>
<p style="text-align: center;">Surface Area and Volume</p> <p>Volume of a Sphere $V = \frac{4}{3} \pi r^3$</p> <p>Volume of a Rectangular Solid $V = lwh$</p> <p>Volume of a Right Cylinder $V = \pi r^2 h$</p> <p>Surface Area of a Sphere $A = 4\pi r^2$</p> <p>Surface Area of a Cube $A = 6s^2$</p> <p>Surface Area of a Rectangular Solid $A = \sum$ surface area of each side</p>	<p>r = radius</p> <p>l = length</p> <p>h = height</p> <p>w = width</p> <p>s = length of one side of a cube</p> <p>A = surface area</p> <p>V = volume</p> <p>Σ = sum of all</p>	<p>Dilution (used to create a dilute solution from a concentrated stock solution) $C_i V_i = C_f V_f$</p> <p>i = initial (starting) C = concentration of solute f = final (desired) V = volume of solution</p> <hr/> <p>Gibbs Free Energy $\Delta G = \Delta H - T\Delta S$ ΔG = change in Gibbs free energy ΔS = change in entropy ΔH = change in enthalpy T = absolute temperature (in Kelvin)</p> <hr/> <p>$\text{pH}^* = -\log_{10} [\text{H}^+]$</p>
<p><i>* For the purposes of the AP Exam, students will not be required to perform calculations using this equation; however, they must understand the underlying concepts and applications.</i></p> <p><i>† For use with labs only (optional).</i></p>		