

FREE AP BIOLOGY FORMULA SHEET

All the Essential Formulas You Need for Test Day

Unit 1: Chemistry of Life

Water Potential

- $\Psi = \Psi_s + \Psi_p$
- Ψ = total water potential
- Ψ_s = solute potential
- Ψ_p = pressure potential

Solute Potential

- $\Psi_s = -iCRT$
- i = ionization constant (1 for sucrose, 2 for NaCl, etc.)
- C = molar concentration (M)
- R = pressure constant = 0.0831 liter·bar/mole·K
- T = temperature in Kelvin ($K = ^\circ C + 273$)

Surface Area to Volume Ratio

- SA:V = Surface Area / Volume
- Used to compare efficiency of diffusion and transport in cells

Unit 2: Cell Structure and Function

Surface Area to Volume Ratio

- SA:V = Surface Area / Volume
- Cells with higher SA:V are more efficient at transport and diffusion.

Rate of Diffusion

- Rate = Distance Traveled / Time
- Sometimes expressed as rate of change in concentration over time.

Unit 3: Cellular Energetics

Gibbs Free Energy

- $\Delta G = \Delta H - T\Delta S$
- ΔG = change in free energy
 - ΔH = change in enthalpy (total energy)
 - T = temperature in Kelvin ($K = ^\circ C + 273$)
 - ΔS = change in entropy

ATP Yield (simplified for AP exam)

- Aerobic cellular respiration: ~36 to 38 ATP per glucose
- Anaerobic respiration (fermentation): ~2 ATP per glucose

Photosynthetic Rate

- Rate = $\Delta O_2 / \Delta t$ or Rate = $\Delta CO_2 / \Delta t$
- Measures oxygen production or carbon dioxide consumption over time

Enzyme Reaction Rate

- Rate = $\Delta \text{Product} / \Delta t$ or Rate = $-\Delta \text{Reactant} / \Delta t$
- Change in concentration per unit time

***Note: Units 4 (Cell Communication & Cell Cycle) and 6 (Gene Expression & Regulation) do not introduce unique equations, so they are not included on this sheet.**

Unit 5: Heredity

Probability Rules

- Multiplication Rule: $P(A \text{ and } B) = P(A) \times P(B)$
- Addition Rule: $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

Chi-Square Test

- $\chi^2 = \sum (O - E)^2 / E$
- O = observed value; E = expected value
 - Used to test if results deviate significantly from predicted ratios

Degrees of Freedom

- df = (number of categories - 1)
- Used with chi-square critical values

Mendelian Ratios (expected values)

- Monohybrid cross ($Aa \times Aa$): 1:2:1 genotype, 3:1 phenotype
- Dihybrid cross ($AaBb \times AaBb$): 9:3:3:1 phenotype

Unit 7: Natural Selection

Hardy-Weinberg Equilibrium

- $p + q = 1$
- p = frequency of dominant allele
 - q = frequency of recessive allele
- $p^2 + 2pq + q^2 = 1$
- p^2 = frequency of homozygous dominant
 - $2pq$ = frequency of heterozygotes
 - q^2 = frequency of homozygous recessive

Allele Frequency Change (simplified)

- Δp = change in allele frequency between generations
- Used to track evolution in populations (qualitative, not a fixed formula)

Fitness / Relative Fitness

- w = (number of offspring genotype produces) / (number of offspring produced by most successful genotype)

Unit 8: Ecology

Exponential Population Growth

- $N_t = N_0 * e^{(rt)}$
- N_t = population size at time t
 - N_0 = initial population size
 - r = intrinsic growth rate; t = time

Logistic Growth Model

- $dN/dt = rN (1 - N/K)$
- dN/dt = rate of population change
 - r = intrinsic growth rate; N = population size
 - K = carrying capacity

Mark-Recapture Method (population estimate)

- $N = (M \times C) / R$
- M = number of individuals marked initially
 - C = total number captured in second sample
 - R = number of marked individuals recaptured
 - N = estimated population size

Photosynthesis / Respiration Rate

- Rate = $\Delta O_2 / \Delta t$ or Rate = $\Delta CO_2 / \Delta t$
- Change in oxygen production or CO_2 consumption per unit time

Net Productivity

- $NPP = GPP - R$
- NPP = Net primary productivity
 - GPP = Gross primary productivity
 - R = Energy used in respiration

Need help mastering these formulas?

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