

APES MATH TIPS for the AP Exam

Increasingly, students are asked to demonstrate their sense of math by calculating their answers by hand and showing work instead of merely using a calculator. Numbers lose their meaning too often when students become completely calculator-dependent.

- 1) **Show all work.** No work, no credit.
- 2) **Show all units.** Units provide valuable information.
- 3) **Be proficient at *unit manipulation*,** also called dimensional analysis or factor label. This is one of the most important math skills, because you will have to fit numbers with units together through multiplication and division to get the desired results.
- 4) **Add, subtract, multiply, and divide numbers without a calculator.** Multiplication and division are usually seen more than addition and subtraction. The math is able to be done without a calculator.
- 5) **Develop good “math sense” or “math literacy.”** The answers should make sense. If you calculate a cost of \$50 billion per gallon of water, does this seem right?
- 6) **Know simple conversion factors** such as the number of days in a year or hours in a day. Other good numbers to know:
U.S. population = approx. 300 million (300,000,000)
World population = approx. 6.8 billion (6,800,000,000)
- 7) **Know and convert metric prefixes.**

T	tera-	10^{12}	(trillion 1,000,000,000,000)
G	giga-	10^9	(billion 1,000,000,000)
M	mega-	10^6	(million 1,000,000)
k	kilo-	10^3	(1000)
h	hecto-	10^2	(100)
da	deka-	10^1	(10)
d	deci-	10^{-1}	(0.1)
c	centi-	10^{-2}	(0.01)
m	milli-	10^{-3}	(0.001)
μ	micro-	10^{-6}	(one-millionth 0.000001)
n	nano-	10^{-9}	(one-billionth 0.000000001)

- 8) Be comfortable working with *negative numbers*. Going from -8 °C to +2 °C is a 10° change.
- 9) Recognize units of *area* and *volume*, and be able to *convert volumes*.
- 10) Calculate *percentages* and *percent change*.
- 11) Put very large or very small numbers into *scientific notation*.
- 12) Work *scientific notation problems* without a calculator. Multiplication and division will be common. Multiplying numbers in scientific notation requires the exponents to be added. Dividing numbers in scientific notation requires exponents to be subtracted.
- 13) Know growth rate calculations. **Growth rate = [CRUDE BIRTH RATE + immigration] – [(CRUDE DEATH RATE + emigration)]**
CBR = crude birth rate = # births per 1000, per year
CDR = crude death rate = # deaths per 1000, per year
(CBR – CDR) / 10 = percent change
- 14) Know the *Rule of 70* to predict doubling time.
Doubling time = 70 / annual growth rate (in %)
- 15) Calculate *half-life*.

$$\text{AMOUNT REMAINING} = (\text{ORIGINAL AMOUNT})(0.5)^x$$

where x = number of half-lives x = time / half-life
- 16) Calculate pH using $-\log [\text{H}^+]$. $\text{Log}_{10} x = y$ and $10^y = x$.
Any pH problems are easily solved without a calculator. Remember that for every one-increment change in pH, the ions change by a factor of 10.
- 17) Know that “*per capita*” means per person; per unit of population.
- 18) Practice until you are confident in your skills, and then practice some more!

APES GRAPHING TIPS

- 19) Set both axes to scale with consistent increments.
- 20) Connect dots.
- 21) Interpolate and extrapolate.
- 22) Be comfortable with doing graphs by hand.
- 23) Include a title and a key.