APES MATH TIPS for the AP Exam – Bauck

1) **Show all *work*.** No work, no credit.

2) **Show all *units*** in each step and in the answer. 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) **Know *simple conversion factors*** such as the number of days in a year or hours in a day.

5) Approximate populations to know: World, U.S., China, India, Indonesia, Brazil (check general values for the top 10 countries in the world)

6) **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?

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)
p	pico-	10^{-12}	(one-trillionth 0.000000000001)

8) Understand common statistical terms. The **mean** is the mathematical average. The **median** is the 50^{th} percentile, which is the middle value in the distribution of numbers when ranked in increasing order. The **mode** is the number that occurs most frequently in the distribution.

9) **Recognize units of *area* and *volume*, and be able to *convert areas and volumes*.**

a) AREA = L x W
b) VOLUME = L x W x H

1 m = ____ mm… answer → 1000

1 m^3 = ____ mm^3 answer → 1^3 m^3 = 1000^3 mm^3 $(10^3)^3 = 10^9$ mm^3

For area conversions, square the number, square the unit. For volume conversions, cube the number, cube the unit.

10) **Density = mass / volume**
Calculate density; be able to recognize common units for mass and volume.

11) **Input *scientific notation* correctly** into your calculator. $M \times 10^n$
Scientific notation does not have to follow the strict format of M being between 1-9.9.
300 million can be written 300×10^6.

12) **Know *growth rate* calculations.** (see 2003 FRQ #2)
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

13) **Calculate *percentages.*** Example: 80/200 = 40%

14) **Calculate *percent change*:**
a) The rate of change (**percent change**, growth rate) from one period to another =
$[(V_{present} - V_{past}) / V_{past}] * 100$ (where V = value)

b) **Annual rate of change:** take answer from step a) and divide by the number of years between past and present values

Example: A particular city has a population of 800,000 in 1990 and a population of 1,500,000 in 2008. Find the growth rate of the population in this city.

Growth Rate = [(1,500,000 - 800,000) / 800,000] * 100 = 700,000/800,000 * 100 = 87.5% OR

$\frac{(1{,}500{,}000 - 800{,}000)}{800{,}000} \times 100 = \frac{15-8}{8} \times 100 = 7/8 \times 100 = 87.5\%$

Average Annual Growth Rate = 87.5% / 18 years = 4.86 %

15) **Calculate percent difference.**

$$\textbf{Percent Difference} = \frac{|\text{First Value} - \text{Second Value}|}{(\text{First Value} + \text{Second Value})/2} \times 100\%$$

16) **Know the *Rule of 70*** to predict doubling time.
Doubling time = 70 / annual growth rate (in %, not decimal!) Example: If a population is growing at a rate of 4%, the population will double in 17.5 years. (70 / 4 = 17.5)

17) **Determine *half-life*.**

Example: A sample of radwaste with a half-life of 10 years has an activity level of 2 Ci (curies). How many years will it take for the sample to have an activity level of 0.25 Ci?

Answer: 2 Ci → 1 Ci (one half-life = 10 yrs.)
1 Ci → 0.5 Ci (another half-life = 10 additional yrs.)
0.5 Ci → 0.25 Ci (another half-life = 10 additional yrs.) = 30 years

18) **Calculate pH using –log [H^+].** $\log_{10} x = y$ and $10^y = x$.

Remember that for every one-increment change in pH, the ions change by a factor of 10.
Example: If [H^+] is 10^{-6} M, the pH is 6 and the solution is a weak acid.

19) **Population density = number of individuals / unit area** (example: 200 people /mi^2)

20) **Know that "*per capita*" means per person; per unit of population.**

21) **NPP (Net Primary Productivity)**

NPP = GPP – R (net primary productivity = gross primary productivity – respiration)

22) **Graphing tips:** include a title and key; set consistent increments for both axes; connect dots for a smooth curve; show dots clearly; know how to use a scatterplot; interpolate and extrapolate; be comfortable with graphing by hand.
"TAILS" and "DRY MIX"

T = title
- -- descriptive
- -- written at the top, above the graph
- -- includes both the dependent and independent variables

A = axes
- -- Y is vertical axis and X is horizontal axis
- -- DRY MIX: Dependent Responding on Y; Manipulated Independent on X
- -- dependent or responding variable = what is observed/measured
- -- independent or manipulated variable = what is changed by you or the scientist

I = interval
- -- If an axis contains a number range, decide on an appropriate interval for the range of numbers you have chosen.
- -- It is highly recommended to use a common number for an interval (2, 5, 10, 25, 100, etc.)
- -- Intervals must be consistent within an axis. The same size space cannot represent 5 and 15.

L = labels
- -- Label units of each axis.
- -- Be sure labels are specific enough to tell the reader exactly what is being measured.
- -- Label multiple data sets with a key.

S = scale
- -- The scale refers to the minimum and maximum numbers used on each axis. They may or may not begin at zero.
- -- The minimum number used for the scale should be a little lower than the lowest value.
- -- The maximum number used or the scale should be a little higher than the highest value.