APES Mathematics Review

The APES Examination will require you to do mathematical calculations. Occasionally these calculations may be somewhat esoteric, and you may find it possible to do them in your head; nonetheless, it is mandatory to show all work for all calculations on the free-response section of the APES exam. This worksheet is designed help to prepare you for the type of calculations you may encounter on this year's APES exam.

Use a separate piece of paper, show every step of your work, and cancel of all units. No Calculators!!

Scientific Notation — All APES students should be able to work comfortably with numbers in scientific notation

Place the following numbers into scientific notation.

1. one billion
2. twenty three thousand
3. 70 trillion

Do the following calculations in scientific notation.

4. five hundred billion times thirty five thousand
5. six thousand divided by 300 billion
6. one ten thousandth of three million

Unit conversions — All APES students should be able to convert from one system of units to another.

- Given: 1 square mile = 640 acres, 1 hectare = 2.5 acre, 1 km = .6 mi

7. A 100 square mile area of national forest is how many acres? How many hectares?
8. If a tectonic plate moved 25 km in a million years, how cm does it move each year?
9. The speed limit is 50 km/hr but your speedometer only reads in mph. How fast can you legally travel in mph?

Percentages — All APES students should be able to work comfortably with percentages.

10. A natural gas power plant is 60% efficient. If one cubic meter of natural gas provides 1000 BTUs of electricity. How many BTUs of waste heat were produced?
11. If 35% of a natural area is to be developed, leaving 500 acres untouched, how many acres are to be developed?
12. If the concentration of mercury in a water supply changes from 65 ppm to 7 ppm in a ten-year period, what is the percentage change of the mercury concentration?

Energy — The APES exam always has questions about energy use. Be prepared!

- Given: 1 barrel of oil = 150 L, 1 kWh = 3,400 BTU

13. A city that uses ten billion BTUs of energy each month is using how many kilowatt-hours of energy?
14. If a barrel of crude oil provides six million BTUs of energy, how many BTUs of energy in one liter of crude oil?
15. For crude oil, if 150 pounds of CO_2 is released per million BTUs of energy, how much CO_2 is produced by each barrel of crude oil? (use information from the previous problem)

Population — The APES exam always has questions about population. Be prepared!

16. Calculate the percentage growth rate for a country with a population of 6 million: in a year in which it had 100,000 births, 70,000 deaths, 30,000 immigrants, and 50,000 emigrants.
17. If a town's growth rate is 1% and the population size is 10,000, how long until the population to grows to 40,000?
18. If it took a country 40 years to double its population, what was its growth rate?

Half-life — All APES students should be able to work comfortably with half-life.

Half-lives elapsed	0	1	2	3	4	5	6	7	8	9	10
Fraction remaining	1/1	½	¼	1/8	1/16	1/32	1/64	1/128	1/256	1/512	1/1024
Percentage remaining	100%	50%	25%	12.5%	6.25%	3.12%	1.56%	0.78%	0.4%	0.2%	0.1%

19. Radium has a half-life of 1500 years. How long will it take for 250kg of Radium to decay down to less than 10kg?
20. The half-life of Pa-234 is 6.75 hr. How much of a sample of this isotope remains after 20.25 hr?
21. Plutonium-239 has a half life of 24,000 years and is considered safe only when its radioactivity has dropped to 1% of the original level. Approximately how long must the Pu-239 be stored securely to be considered safe?