APES MATH REVIEW

1. Iron ores are rocks from which metallic iron can be extracted for steel production. This process involves several steps. Iron ore is first mined and then turned into pig iron in a blast furnace, and some rock waste such as silicon dioxide is separated out. In the final step, the pig iron is refined into steel using a process that includes reacting the molten pig iron with oxygen to remove impurities.

    a. Use the data below to respond to the following. For each calculation, show all your work.

Global Iron and Steel Data
1.6 billion tons of iron ore are used yearly to make pig iron.
1.2 billion tons of pig iron are produced each year.
Iron ore reserves are estimated to be 800 billion tons.
95% of iron ore that is mined is used in steel production.

    i. **Calculate** the weight (in tons) of rock waste produced globally each year when iron ore is converted to pig iron.

    ii. **Calculate** the weight (in tons) of pig iron that could be produced if all of the estimated global iron ore reserves were used for pig iron production.

    iii. **Calculate** the weight (in tons) of the current global iron ore reserves that would be used to make steel if the current trends continue.

AP Environmental Science Exam 2016

2. Approximately 30 million mobile devices were sold in 1998 in the United States. The number sold increased to 180 million devices in 2007.

a. **Calculate** the percent increase of mobile device sales from 1998 to 2007.

b. Each mobile device sold in 2007 contained an average of 0.03 gram of gold. **Calculate** the number of grams of gold that were used in the production of the mobile devices sold in 2007.

c. Assume that the average mass of each mobile device was 0.1 kilogram. The United States Environmental Protection Agency estimates that about 10 percent of the mobile devices sold in 2007 were recycled. **Calculate** the mass (in kilograms) of the mobile devices sold in 2007 that were <u>not</u> recycled.

AP Environmental Science Exam 2015

3. Like many communities, Fremont has a combined sewer system that collects both sewage and storm water. When storm water runs into storm drains that connect to the city's sanitary sewer system, the storm water and sewage flow together to the Fremont Wastewater Treatment Plant (FWTP). During a major storm event, however, the combined volume of storm water and sewage may exceed the plant's capacity, and the overflow bypasses the FWTP. The untreated overflow is discharged into Fremont Creek along with the treated waste.

    Recently parts of Fremont received 5 cm of rain in 60 minutes. The storm caused widespread flooding in the northeast section of town. Especially hard hit was the Shoppes at Fremont shopping center.

    Use the data from the table below to answer the questions that follow. Show all calculations.

Fremont Water Data
The shopping center's parking lot is 200 meters long and 100 meters wide.
Fremont has an area of 10 km^2.
Impervious surfaces cover 20 percent of Fremont's area.
The FWTP typically treats 5,000 m^3 of domestic sewage per day.
The FWTP has the capacity to treat 10,000 m^3 of combined sewage and storm water per day.

a. **Identify** TWO specific pollutants in storm-water runoff that degrade the quality of surface water.

b. **Calculate** the volume of water (in m^3) that runs off the Shoppes at Fremont parking lot after a 5 cm rainfall event. Assume that all the water that falls on the parking lot runs off.

c. **Calculate** the volume of storm-water runoff (in m^3) generated in all of Fremont by the 5 cm rainfall event. Assume that only the impervious surfaces generate runoff.

d. Assume that all the runoff that you calculated in part (c) is captured by the storm sewers in one day. **Calculate** the volume of untreated water (in m^3) that bypasses the plant as a result of the storm. (Note that the plant still receives 5,000 m^3 of domestic sewage per day.)

AP Environmental Science Exam 2014

4. A natural gas power plant is 60% efficient. If one cubic meter of natural gas provides 1000 BTUs of electricity, how many BUTs of waste heat are produced?

5. If 35% of a natural area is to be developed, leaving 500 acres untouched, how many acres are to be developed?

6. A sample of radioactive waste has a half-life of 10 years and an activity level of 2 curies. After how many years will the activity level of this sample be 0.25 curies?

7. Plutonium- 239 has a half-life of 24,000 years. How much of the sample will remain after 96,000 years?

8. Calculate the population density of a herd of 630 deer living in Hollywood Park (1260 square meters).

9. What is the growth rate of a town that adds 20 individuals by birth and immigration and loses 10 individuals by death if the original population size is 10,000?

10. A population with a crude birth rate of 46 and crude death rate of 12 is growing at what annual percentage rate?
    a. How many years will it take for this population to double?

11. The current world population is 7.2 billion and is growing at an annual rate of 1.35 percent. If the world population were to grow at the same rate over the next year, how many individuals will be added to the population?

12. If the population of a country grows at a rate of approximately 5% per year, the number of years required for the population to double is approximately-----

13. If the annual consumption of petroleum in the US is about 23 barrels per capita, the total annual consumption of petroleum in the US is closest to----

14. The world's population in 2000 was approximately 6 billion. Assuming a constant growth rate of 2%, in what year would the world's population reach 12 billion?

15. The combustion of one gallon of automobile fuel produces about 5 pounds of carbon (in CO_2). Two cars are making a trip of 600 miles. The first car gets 20 miles per gallon and the second car gets 30 miles per gallon. Approximately how much less carbon will be produced by the second car on this trip?

16. In the earth's crust the temperature increases about 2 degrees for each 100 meters below the surface. If the surface temperature in 30 degrees, a temperature of 100 degrees can be reached at a depth of ----

17. The Greenland Ice Sheet contains 2,850,000 cubic kilometers of ice. It is melting at a rate of .006% per year. How many cubic kilometers are lost each year?

18. In a small oak tree, the biomass of insects makes up 3000 kilograms. This is 4% of the total biomass of the tree. What is the total biomass of the tree?

19. A large, coal-fired electric power plant produces 12 million kilowatt-hours of electricity each day. Assume that an input of 10,000 BTUs of heat is required to produce an output of 1 kWh of electricity.
    a. Calculate the number of BTUs of heat needed to generate the electricity produced by the power plant each day.

    b. Calculate the number of pounds of coal consumed by the power plant each day, assuming that one pound of coal yields 5,000 BTUs of heat. (Pick up where you left off! Let the problem lead you!)

    c. Calculate the number of pounds of sulfur released by the power plant each day, assuming that the coal contains one percent sulfur by weight.

20. Answer the questions below regarding the heating of a house in the Midwestern United States. Use the assumptions below to perform the calculations that follow.
    - The house has 2,000 square feet of living space.
    - 80,000 BTUs of heat per square foot are required to heat the house for the winter.
    - Natural gas is available at a cost of $5.00 per thousand cubic feet.
    - One cubic foot of natural gas supplies 1,000 BTUs of heat energy.
    - The furnace in the house is 80 percent efficient.

    a. Calculate number of cubic feet of natural gas required to heat the house for one winter. Show all the steps of your calculations, including units.
    b. Calculate the cost of heating the house for one winter.