Solution Key for Chemistry Workshop 1

1. The patient needs 0.2 mg/Kg*75 Kg = 15 mg at each dosing interval. This is 3 5-mg capsules 4 times a day, or 12 capsules/day.
2. 16 gal * 3.78 L/gal = 60.48 L. If this was water (with a density of 1 g/ml or 1 Kg/L) it would have a mass of 60.48 Kg. However, the density of gasoline is only 0.75 that of water (the meaning of specific density), so the mass of gasoline is 60.48 kg * 0.75 = 45 Kg.
3. The amount of base pairs is 3 Gigabase pairs, or 3 x 10^9 bp. Each base pair takes up 0.34 nm (0.34 x 10^{-9} m) of length. For total length, 3 x 10^9 bp * 0.34 x 10^{-9} m = 1.02 x 10^0 m or 1 meter in total length. If we were to assume that this was evenly divided between 25 chromosomes, there would be 1 m/25 =0.04 m or 4 cm of DNA in each chromosome. A typical mammalian cell has dimensions of tens of micrometers in size, or about 1 x 10^{-5} m. It's an interesting packaging problem- the length of the DNA (if fully extended) is very large compared to the linear dimensions of the cell.
4. One cup of water is 240 mL. The density of water is 1.0 g/ml, so a cup of water contains 240 g or water. It's probably easiest to think of this problem as a ratio, if we can detect 1/100000, then we need to find a value of x (in g) such that x/240 g =1/100000. This comes out to 0.0024 g, or (rounding correctly) 2 mg. Similarly, if you keep the same ratio (1/100000), a ppm is the value if 1 million (10^6) is the denominator. This detection limit corresponds to 10 ppm.
5. ^{o} F = 9/5 (^{o} C) + 32. Substituting in the value in C, ^{o} F = 9/5 (175 ^{o} C) + 32 = 347 ^{o} F, or rounding to the value of the stove 345 ^{o} F
6. a. Co is the symbol for the element cobalt. CO represents a molecule made of one atom of carbon combined with one atom of oxygen.

b. Cs is the symbol for the element cesium. CS_2 represents a molecule in which one atom of carbon and 2 atoms of sulfur are combined.

c. S_8 represents a molecule composed on 8 atoms of sulfur hooked together. 8 S represents 8 individual sulfur atoms, not connected together.

d. ^{12}C represents the isotope carbon-12, in which the nucleus has 6 protons and 6 neutrons. ^{13}C represents the isotopes carbon-13 (a stable isotope, about 1 % of naturally occurring carbon). This also has 6 protons in the nucleus (what makes it carbon) and 7 neutrons. Thus the nuclei have the same charges but different masses.

7. You could have ^{35}Cl-^{35}Cl, ^{35}Cl-^{37}Cl, and ^{37}Cl-^{37}Cl. The probability of ^{35}Cl-^{35}Cl is ¾* 3/4 =9/16. The probability of ^{37}Cl-^{37}Cl is ¼* ¼ = 1/16. The probability of ^{35}Cl-^{37}Cl is ¾*1/4*2=6/16. (It needs the two because there are two possible ways in which to get one of each element.) If correct, this is an exhaustive list so that the probabilities should total 1. 9/16 + 1/16 + 6/16 =16/16=1