Review Questions

These questions were taken or adapted from LHA chemistry Facebook book contest. I chose the ones relevant to what's in the January Exam. Notice that some of the answers are written by students, and they are really good.

The first set are all about conversions, 2 points each.

1. Show why 1 L*kPa = 1 J by using the basic unit definitions of Pa and so on; after all PV = work!)

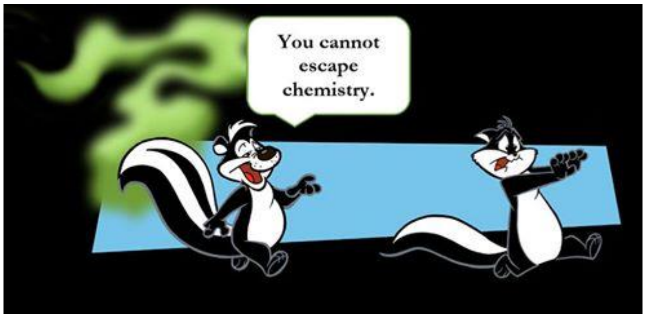
2. Express the density of oxygen at 25 ^oC and 101.3 kPa in mg/L.

3. If 400 ppm of CO_2 ---actual concentration in our atmosphere---is defined as 400 moles of CO_2 per million moles of air, convert it into a (mass over mass) % . (28.97 g/mole is air's average molar mass.)

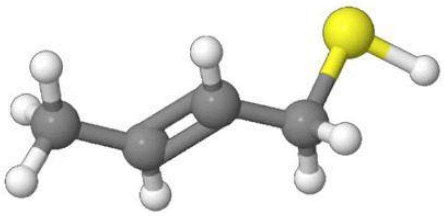
4. a) While a candle is burning, what is supplying the heat that's used to sustain the flame?

b) Why doesn't your hand burn from placing it on the side of the flame?

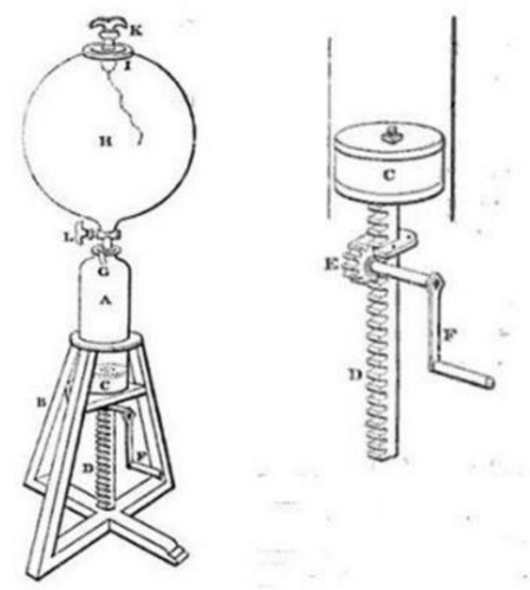
c) Why is most of the flame (orange part) highly polluting?



5. a) 2-butene-1-thiol (C_4H_8S) from skunk odor doesn't diffuse as fast as oxygen or nitrogen, but it evaporates very easily. Explain both parts of the statement.
b) Would the partial pressure of the vapor above the C_4H_8S liquid be high?



6. This 17th century apparatus has a bulb for gases whose volume can vary thanks to a piston. What transformation system is the piston operated by and what gas law was discovered thanks to this gadget?



7. This year (Feb 2015) NASA found alcohol(C_2H_6O=ethanol) streaming from Comet Lovejoy at a peak and equivalent rate of 500 wine bottles per second. You might wonder, how did they know it was alcohol?

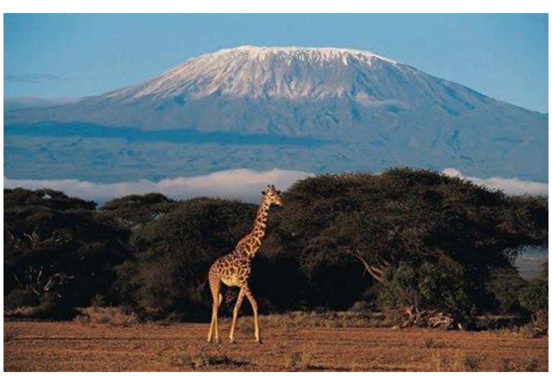
Polar(means that there is an electronegativity difference that doesn't cancel out) gaseous molecules emit energy when they go from a high rotational state to a lower one. As the comet approached the sun and molecules were being released from the comet's surface, a radio telescope on Earth equipped with a sensor picked up the characteristic frequencies of ethanol at 34.89, 9.35 and 8.14 gigahertz.

a) Convert the equiv. rate of 500 wine bottles (1. 0L each) per second to moles of C_2H_6O per second. (assume a one liter bottle) wine is 12% alcohol; density of alcohol = 0.789 g/ml
b) Why doesn't the ice of a comet melt as it approaches the sun? Why does it sublimate instead?

8. a) Good practice for a possible pressure flashback question (of course the actual test question will be different!) If you fire these at a wall, why do they stick to it?

b) Why do the darts eventually fall of the wall, and what would be different(if anything) in a pure-oxygen atmosphere?

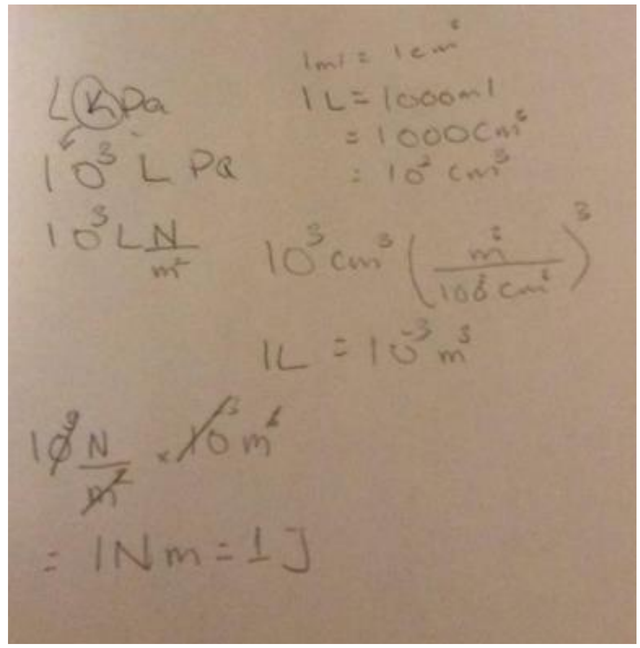
9. To get extra practice for what's needed to calculate bond energies in the upcoming test, draw the structural formula (show bonds) for this ester found in pears $CH_3COOC_3H_7$



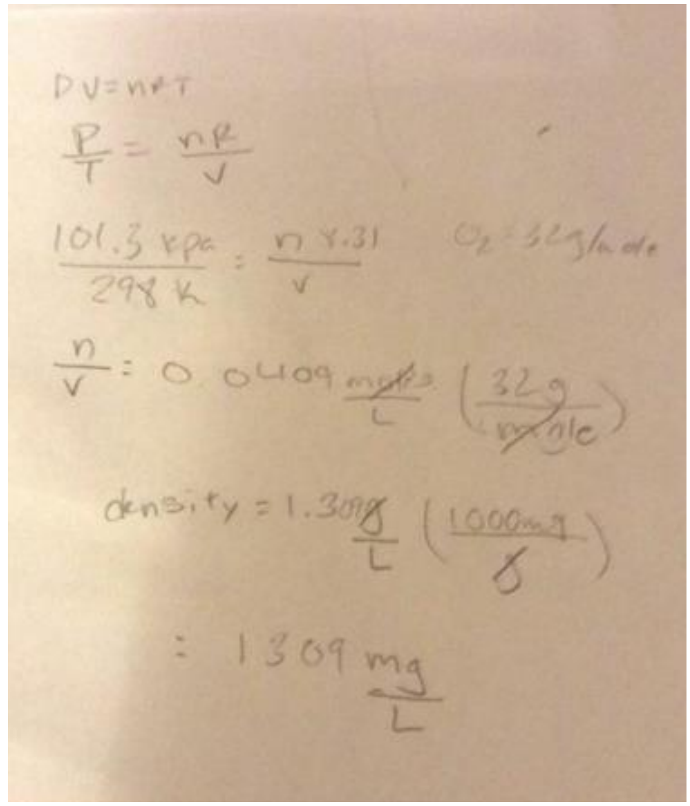
10. If heat rises, then why is it colder on a mountain? Give two reasons. (Students have occasionally asked that question, and it's one of my all-time favorites.)

ANSWERS

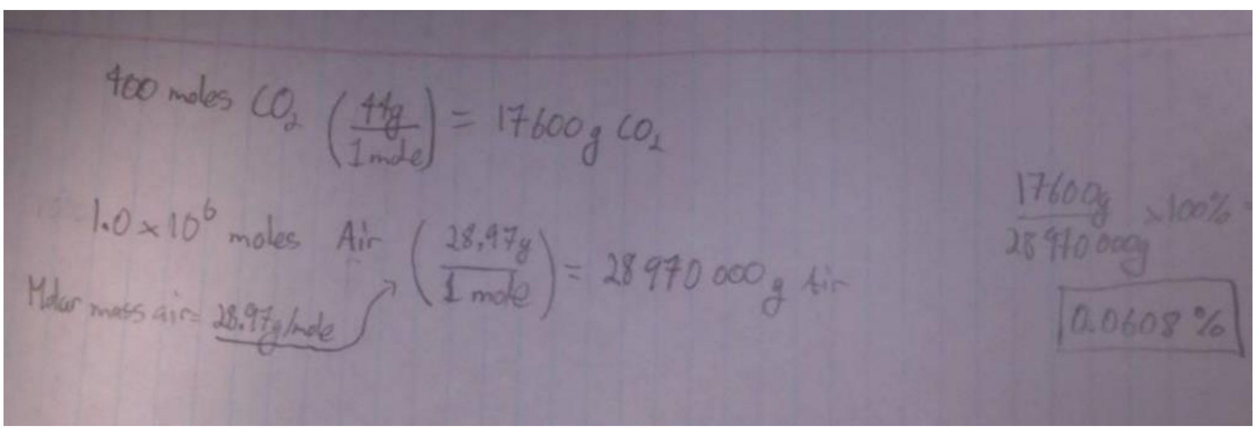
(1) Dylan's correct answer:



(2) Dylan's correct answer:



(3) Julian 's correct answer: (we would have given you air's average molar mass; he looked it up)



4. a) The heat comes from the exothermic reaction between the wax vapour and the oxygen.

b) The air warmed by the burning candle is less dense and it rises. Circulation from differences in pressure brings in cooler air at the base of the flame.

c) There isn't enough oxygen to break up the large paraffin molecules (wax), producing soot. The soot glows (incandescence) and gives the candle flame its characteristic color.

5. a) O_2 diffuses faster than C_4H_8S due to oxygen's lower molar mass. More precisely it diffuses $\sqrt{\frac{88.0}{32.0}}$ = 1.66 times faster. But C_4H_8S it evaporates very easily due to its weak intermolecular bonds.

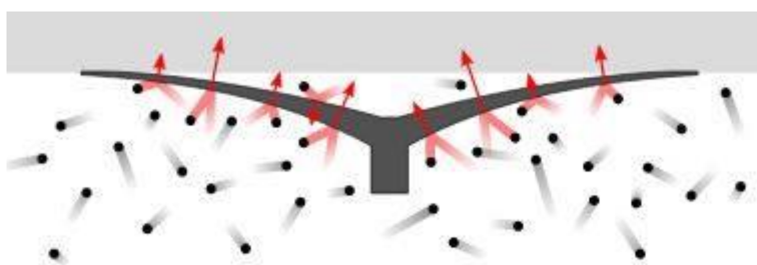
b) Yes. Due to the weak bonds, at 25 C we normally find a partial pressure of 50 kPa for the vapor of C_4H_8S. By comparison water's vapor pressure is only 2.0 kPa, due to its strong hydrogen (a type of intermolecular) bonds.

6. Rack and pinion and $P_1V_1=P_2V_2$ at constant temp and moles. (Boyle's Law)

7. a) 500 L bottles*12% *1000ml/L * 0.789 g/ml = 47430 g

47430 g C_2H_6O (mole/46.0 g) = 1.03 X 10^3 mole/s

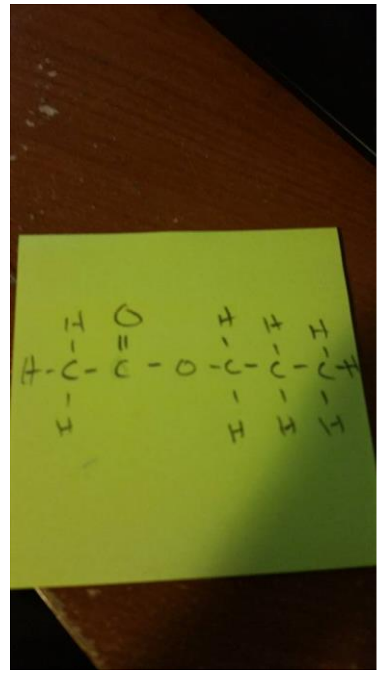
b) The pressure in space is low so it makes it easier for the solid molecules to pick up both rotations and translations.



8. a) **Dylan Patel** They push the air out of the way in the space between the wall and the tip of the dart and therefore, the pressure inside the space is lower as the volume increases slightly. The atmosphere can push with a stronger force because of the imbalance.

b) **Ian Phillips** (1) Air can still find its way into the space, due to bumps and grooves. (so the pressure will go back to normal and there won't be any force to hold it against the wall.)

(2) oxygen gas has a greater molar mass than nitrogen gas, which means the former travels slower. With oxygen gas traveling slower, it would take more time for the air to get through the gap. It acts off the same principle of reaction rates, and the example you gave us last year when you tried jamming your fist into a small space, demonstrating that if you moved your fist more rapidly, essentially you would get more tries to get the correct orientation.



9. Peter T's answer

10. **Thomas Lo** Hot air rises and as the air rises it is subjected to less pressure so the air will expand, doing work, and lose kinetic energy. Less kinetic energy means lower temperature. Also since the air is thinner, there are less particles which means a lower mass and lower heat content.