AOS 100/101
Spring 2018
HMWK #1
Solutions

1)

Had life never evolved on Earth, the current atmospheric composition would be vastly different today. The photosynthesis reaction released enormous amounts of O_2 (oxygen) into the atmosphere - so much so that it now represents nearly 22% of every breath you take. The presence of so much O_2 resulted in the creation of the ozone layer (O_3). Once the ozone shield was in place, much of the deadly ultra-violet radiation from the sun was prevented from penetrating to the surface of the Earth. The presence of these two oxygen species in our atmosphere is a ***direct*** result of the presence of life on Earth.

2)

This problem involves consideration of the kinetic energy (KE) and the fact that energy is the ability to do work on some form of matter. Ripping twigs and branches off of a tree (or blowing the tree over) are clearly examples of work – and the work is being done by the wind. Thus, we have to consider the KE of the wind. Recall KE is the product of the MASS of the moving object and its VELOCITY squared (divided by 2). For the situation when twigs are being blown off of trees, the KE of the wind is given by

$KE_{twigs} = (1/2)\ M\ (20\ m\ s^{-1})^2$. The energy required to blow the tree over can be written as

$KE_{tree} = (1/2)\ M\ (V)^2$ where V is the unknown velocity of the wind strong enough to topple the tree. We know that $KE_{tree} = 3\ (KE_{twig})$ from what is given. Thus, we can solve for V without ever knowing M, the mass of the air, since M is the same for both cases.

The relationship between the KEs is

$3\ \{(1/2)\ M\ (20\ m\ s^{-1})^2\} = (1/2)\ M\ (V)^2$

which reduces to $1200 = V^2$ so that $V = 34.6\ m\ s^{-1}$.

3)

The Ideal Gas Law dictates that if the pressure is constant, then a sample of gas at a relatively high temperature will have a relatively low density and, conversely, that at a relatively low temperature it will have a high density. You are likely to sleep more comfortably if the environment is as O_2 rich as possible. Thus, you want every lungful of breath you take to have as many O_2 molecules as possible. More dense air has more molecules in each lungful by definition. Consequently, you would be more comfortable on the colder night.