1. The temperature of object A is twice that of object B. Compared to object B, the amount of radiation emitted by object A is ________ times larger:

   (a) 32
   (b) 16
   (c) 4
   (d) 2

Stefan-Boltzmann law.

2. Consider the statement “warm air rises, cold air sinks”. This statement is:

   (a) always true
   (b) sometimes true, depending on the thermal inertia
   (c) sometimes true, depending on the pressure
   (d) never true

Ideal gas law.

3. Which of the following statements is FALSE?

   (a) water vapor is the most important greenhouse gas
   (b) argon is added to the atmosphere by soil bacteria
   (c) water vapor absorbs some shortwave radiation in the near infrared
   (d) radiation at 9 microns falls within the atmospheric window
   (e) the ozone hole gets largest in size above the south pole

The other statements are true.

4. You are stationary, looking directly at a distant traffic signal. When lit, it is easiest to see the red lamp, and hardest to see the green lamp. Other than their color, the lamps are identical. The best explanation involves:

   (a) differential scattering of visible light by air
   (b) differential absorption of visible light by air
   (c) differential reflection of visible light by air
   (d) both (a) and (c) are correct
   (e) (a), (b), and (c) are correct

Rayleigh scattering. Shorter wavelengths scattered more effectively.
5. Consider dry haze appearing along the seashore. This phenomenon best represents:

(a) emission of blue light by salt particles
(b) absorption of red light by cloud droplets
(c) scattering of blue light by cloud droplets
(d) **scattering of blue light by salt particles**
(e) scattering of all colors by cloud droplets

Another example of Rayleigh scattering.

6. An object has a temperature of 600 K. Its wavelength of maximum emission is:

(a) 0.5 microns
(b) 0.1 microns
(c) **5 microns**
(d) 10 microns
(e) insufficient information is provided

Wien’s law.

7. If air molecules were the size of cloud droplets, what would the color of the clear sky be during the day?

(a) **white**
(b) red
(c) more yellow-green than our present clear sky
(d) an even deeper shade of blue than our present clear sky
(e) grey, because it would always be raining!

Mie scattering. All colors scattered equally.

8. In the standard atmosphere, at which of these locations is the temperature highest?

(a) tropopause
(b) **stratopause**
(c) mesopause
(d) andropause
(e) mosopause

(d) and (e) are invented terms.
9. During a sunny day, the temperature of sand can reach as high as 130°F, but air several feet above the sand surface will remain much cooler. The best answer for explaining why the air doesn’t get that hot is:

(a) sand has a low thermal inertia
(b) **air is a poor conductor of heat**
(c) sand is an excellent emitter of LW radiation
(d) sand has a relatively high albedo
(e) nature abhors extremes

(a, c, d, and e) are true statements but do not address the question.

10. Bizzaro world is comparable to the Earth except its sun’s wavelength of maximum emission is about 0.7 microns. Which of these statements are true for Bizarro world?

(a) the Bizarro sun produces more green light than yellow
(b) **the Bizarro stratosphere is likely colder than ours**
(c) the Bizarro sun is hotter than our sun
(d) all of the above are true

The longer wavelength of maximum emission means Bizarro’s sun is cooler than our sun. Less UV produced likely means less absorbed, so stratosphere not as warm. (a) and (c) are false statements so (e) is also false.

11. You have a metal spoon and a glass both at room temperature, 20°C. Which of the following could/would lead to the glass feeling as cold to your touch as the metal spoon?

(a) increasing the heat conductivity of the glass
(b) decreasing the temperature of the glass
(c) leaving the glass in contact with the metal spoon for awhile
(d) **(a) and (b) will work**
(e) (a), (b), and (c) will work

(c) will not work since the spoon and glass are at the same temperature, so there’s no heat transfer.

12. The 750-100 mb layer is 10000 m thick. What is the layer’s mean temperature? You may presume that \( \ln(7.5) \approx 2 \) if you wish.

\[
\Delta Z = \frac{RT}{g} \ln \frac{p_0}{p_1}
\]

\[
10000 \text{ m} = \frac{287 \text{ K/kg/K} \cdot T}{9.81 \text{ m/s}^2} \ln \frac{750}{100} \approx 170 \text{ K}
\]