Blackbody Radiation

Link to simulation: https://physics.bu.edu/~duffy/HTML5/blackbody_radiation.html

This simulation shows the blackbody curve for objects of different temperatures. The horizontal axis indicates the wavelength of light in microns ("μm" or "um") – the visible range of light is indicated with the rainbow (purple/blue on the left at 0.4 μm, to red at the right at 0.7 μm). The vertical axis is the intensity of light emitted at each wavelength (in arbitrary units).

There are two important features of blackbodies: 1) the maximum energy output (the height of the peak intensity), 2) the *wavelength* where the maximum energy output (intensity) occurs (call it λ_{peak}). The wavelength where the maximum energy output occurs (λ_{peak}) is related to the object's temperature (T): long wavelength is a cooler object, short wavelength is a hotter object.

If two objects have the same temperature and same size, they will have identical blackbody curves. If two objects are the same size, but one is hotter, then the hotter object will give off more light at all wavelengths (a taller graph), and the peak of the hotter object's blackbody curve will be at a shorter wavelength (toward the purple/blue).

1) Set the temperature slider in the simulation to 8000K.
   a) What is the value of the maximum intensity of the blackbody (the height of the curve)?

   b) At what wavelength does the maximum intensity occur?

   c) What is the value of the intensity of the light at the purple/blue end of the spectrum (0.4 μm)?

   d) What is the value of the intensity of the light at the red end of the spectrum (0.7 μm)?

   e) What visible light color has the highest intensity?
      - ☐ Purple/blue (0.4 μm)
      - ☐ Green (0.5 μm)
      - ☐ Red (0.7 μm)

2) Set the temperature slider in the simulation to 4000K.
   a) What is the value of the maximum intensity of the blackbody (the height of the curve)?

   b) At what wavelength does the maximum intensity occur?

   c) What is the value of the intensity of the light at the purple/blue end of the spectrum (0.4 μm)?

   d) What is the value of the intensity of the light at the red end of the spectrum (0.7 μm)?

   e) What visible light color has the highest intensity?
      - ☐ Purple/blue (0.4 μm)
      - ☐ Green (0.5 μm)
      - ☐ Red (0.7 μm)

3) Which object gives off *more purple/blue* (0.4 μm) light (has a higher intensity of purple/blue)?
   - ☐ 8000K
   - ☐ 4000K

4) Which object gives off *more red* (0.7 μm) light (has a higher intensity of red)?
   - ☐ 8000K
   - ☐ 4000K

5) Based on the relative intensities of red and purple/blue light, which object would you expect to *look* redder to our eyes?
   - ☐ 8000K
   - ☐ 4000K

6) On the right side of the graph is a colored circle representing what an object of this temperature would look like to our eyes in visible light.
   a) Which object actually *looks* redder?
      - ☐ 8000K
      - ☐ 4000K

   b) Does this agree with what you answered in problem 5? If not, what error did you make?

c) Which object actually *looks* bluer?
   - ☐ 8000K
   - ☐ 4000K

7) For blackbodies, the temperature of the blackbody (T) times the wavelength of the peak intensity (λ_{peak}) is equal to a *constant*, or: $T \times \lambda_{peak}$ = constant. What values did you get for the constant ($T \times \lambda_{peak}$)?

Temperature (K)	**Wavelength of peak intensity, λ_{peak} (μm)**	**$T \times \lambda_{peak}$ = Constant (K×μm)**
8000		
4000		

8) Are your "constants" approximately the same? If not, what errors might you have made?

9) If a 8000K blackbody peaks at 0.35 μm, at what wavelength would a 7000K blackbody peak at?

10) If a 8000K blackbody peaks at 0.35 μm, what is the temperature of a blackbody that peaks at 0.5 μm?