Astronomy 192 Quiz 6: February 25, 2005

Name (please print)_____
Student Number (Last 4 digits only!) _____

Part I. Short Answer. (40 points) More than one answer may be reasonable. If this occurs, circle ONLY the BEST response.

1. As the temperature of a thermal emitter increases, it
   A. emits more red light
   B. emits more blue light
   C. emits more infrared light
   D. emits more ultraviolet light
   E. all of the above

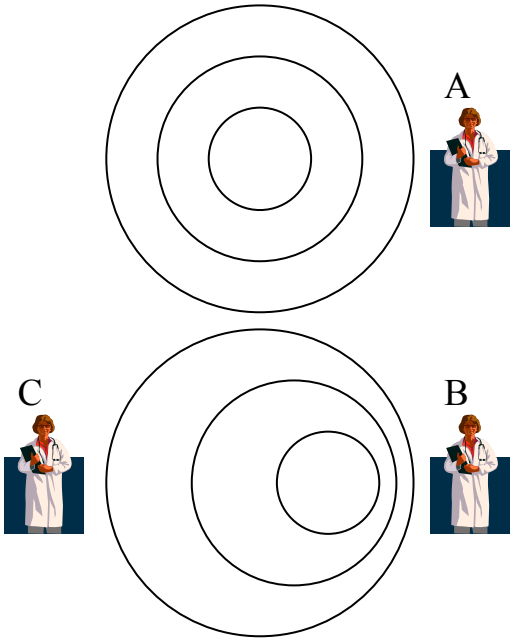
2. Star A and Star B have the same surface temperature. If star B appears brighter than Star A, then
   A. Star A has the greater surface area
   B. Star B has the greater surface area
   C. Star A is closer to the observer
   D. Star B is closer to the observer
   E. Either or both of B and D

3. True or false. A star that appears blue to the naked eye may emit more red light than a star that appears red to the naked eye.

   True

4. Two stars have the same luminosity. It necessarily follows that
   A. they have the same surface temperature
   B. they have the same surface area
   C. they have the same apparent brightness
   D. they are at the same distance from the observer
   E. none of the above

Part II. (40 points) The Doppler Effect is the change in observed frequency of light that results from the motion of the source. Let's compare light waves emitted by identical sources, one of which is moving, and the other stationary.



Here, the source is stationary.

Here, the wave source is moving to the right.

The following questions refer to the above figure.

1. Which observer (A, B, or C) observes waves of the highest frequency?

B

2. Which observer observes waves of the longest wavelength?

C

3. Which observer observes waves with the largest speed?

None, same speed.

4. Which observer observes photons of the highest energy?

B

Part III. Putting it all together. (20 points)

The Dog Star, Sirius, is the brightest star in our nighttime sky. It's luminosity is 26 times that of the Sun. It's surface temperature is 12,000 Kelvin. The Sun's surface temperature is 5,800 Kelvin. Which star has the greater surface area, and by how much?

Which is larger?	***Sirius***
By how much?	***1.42 x*** $Area_{sun}$

Potentially useful information:

Conversion factors:

1 kilometer (km) = 1000 meters (m)
1 nanometer (nm) = 10^{-9} meters (m)
1 light-year (ly) = 9.46×10^{12} kilometers (km)
1 astronomical unit (AU) = 1.5×10^{8} kilometers(km)

Universal Constants:

c = Speed of light = 3×10^{8} m/s
$G = 6.67 \times 10^{-11}$ $m^3/(kg \times s^2)$
$\sigma = 5.7 \times 10^{-8}$ Watt/$(m^2 \times K^4)$

Interesting Facts:

Radius of Sun = 696,000 km
Mass of Sun = 1.99×10^{30} kg
Circumference of circle = $2 \pi R$
Surface Area of Sphere = $4 \pi R^2$

Basic Laws:

Kepler's 3rd : $M = (4\pi^2/G)(D^3/T^2)$
Newton's 2nd Law: $F_{total} = M a$
Newton's Gravity Law: $F_g = GM_1M_2/R^2$
Stefan-Boltzmann Law: $L = \sigma$ (Surface Area) T^4
Wien's Law: $\lambda_{max} = (2{,}900{,}000/T)$ nm

Definitions:

Luminosity = emitted power
Power = rate of energy production = E/t
1 Newton = 1 kg m/s^2
1 Joule = 1 kg m^2/s^2
1 Watt = 1 Joule/second