1. It takes an astronomer 4 hours to observe a certain galaxy on a 4-m telescope. How long would it take her to make the same observation on an 8-m telescope?

A 8-m telescope is 2 times bigger in diameter than a 4-m telescope, so it has $2^2 = 4$ times the light-gathering power. The larger telescope will gather light 4 times faster than the smaller telescope, so what the 4-m telescope can accomplish in 4 hours, the 8-m can accomplish in $\frac{1}{4} \times 4$ hours or 1 hour.

2. Name two methods for detecting extrasolar planets:
   - radial velocities
   - transits

3. List two differences between the terrestrial and jovian planets.

   Must include two of the following:
   (1) location in the solar system: terrestrial are the inner planets out to 1.5 AU, jovian planets range from 5 to 30 AU
   (2) size: jovian planets are much larger than the terrestrial planets
   (3) density: Terrestrial planets have a much higher density than do the jovian planets, which indicates a fundamental difference in composition. Terrestrial planets are rocky; jovian planets are made up of light elements.
   (4) composition: for same reason as 3

4. A telescope that is designed to use lenses to focus the image is called a:
   - refractor or refracting telescope

   A system that allows telescopes to correct for much of the atmospheric seeing effects in their images in the infrared is called:
   - adaptive or active optics
5. An observer takes a spectrum of two stars. Star A has a spectrum that peaks at a wavelength that is twice the peak wavelength of Star B’s spectrum. How much hotter (or colder) is the effective temperature of Star A compared to Star B? (NOTE: effective temperature is the temperature a star would have if it were a perfect blackbody)?

This is a case where we can again use ratios. We know for the max wavelengths, \( \lambda_A = 2\lambda_B \). So, using \( \lambda_{\text{max}} \text{(cm)} = \frac{0.29}{T(K)} \) we can write two equations and take their ratio:

\[
\frac{T_B}{T_A} = \frac{2\lambda_B}{\lambda_A} = 2 \quad \text{and} \quad T_B = 2T_A.
\]

Thus, Star B is twice as hot as Star A.

**Formulae**

\[
S = d\theta, \theta \text{ in radians} \\
\dot{v} = \frac{\Delta d}{t} \\
F = ma \\
F = \frac{GM_1M_2}{r^2} \\
\lambda f = v \quad \text{for waves} \\
\lambda_{\text{max}} \text{(cm)} = \frac{0.29}{T(K)} \quad \text{for blackbody} \\
\frac{\lambda_{\text{obs}} - \lambda_0}{\lambda_0} = \frac{v}{c} \\
E = hf \\
E_n = 13.6 \left(1 - \frac{1}{n^2}\right) \text{eV}
\]

angular resolution (\( " \)) = 0.25 \times \frac{\text{wavelength (\( \mu \)m)}}{\text{diameter (m)}}

**Numbers and Constants**

\[
\begin{align*}
\pi &= 3.14 & 100 \text{ cm} &= 1 \text{ m} \\
1000 \text{ m} &= 1 \text{ km} & 10^{-6} \text{ m} &= 1 \text{ \( \mu \)m} \\
1 \text{ degree} &= 60' & 1 \text{ radian} &= 57.3 \text{ degrees} \\
1 \text{ AU} &= 1.5 \times 10^8 \text{ km} & c &= 3.0 \times 10^5 \text{ km/s} \\
\sigma &= 5.67 \times 10^{-8} \text{ W/m}^2 \text{K}^4 & h &= 6.63 \times 10^{-34} \text{ J s} \\
G &= 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2 &
\end{align*}
\]