ASTR 100 - HW #4 Solutions
November 2, 2010

7.2 [b] Jovian planets are more massive than terrestrial planets or icy worlds, making them much easier to detect using the Doppler technique (more gravitational pull on the star), the transit method (larger shadow and more light) or direct detection (more light).

7.21

$$M_\star = M_\odot \;\rightarrow\; p^2 = a^3$$
$$P_{planet} = 4.23\ days = 1.16 \times 10^{-2}\ years$$
$$M_{planet} = 0.6\ M_{Jupiter}$$
$$a = p^{2/3} = (\tfrac{1.16\times10^{-2}\ yr}{1\ yr})^{2/3} = \boxed{5.12 \times 10^{-2}\ AU}$$

7.22

$$\lambda_{2\rightarrow1} = 121.6\ nm$$
$$\lambda_{obs,\,A} = 120.5\ nm$$
$$\lambda_{obs,\,B} = 121.2\ nm$$
$$\tfrac{v_{radial}}{c} = \tfrac{\lambda_{shift}-\lambda_{rest}}{\lambda_{rest}}$$
$$\rightarrow v_A = c\tfrac{\lambda_{obs,\,A}-\lambda_{2\rightarrow1}}{\lambda_{2\rightarrow1}} = \boxed{-2.712 \times 10^6\ m/s}$$
$$\rightarrow v_B = c\tfrac{\lambda_{obs,\,B}-\lambda_{2\rightarrow1}}{\lambda_{2\rightarrow1}} = \boxed{-9.862 \times 10^5\ m/s}$$

Since both stars are blueshifted, they are both moving towards the observer.

8.9 [c] The spectral types, going from hottest to coolest, are O B A F G K M. Therefore, a K-type star has the coolest surface temperature.

8.22

$$d_{earth} \approx 1.50 \times 10^8\ km = 1.50 \times 10^{11}\ m$$
$$m_\odot \approx 1300\ W/m^2$$
$$L_\odot = 4\pi \times {d_{earth}}^2 \times m_\odot = 3.7 \times 10^{26}\ W$$
$$\text{a) } m_a = \tfrac{L_\odot}{4\pi\times\left(\frac{1}{2}\times d_{earth}\right)^2} = \boxed{5200\ W/m^2}$$
$$\text{b) } m_b = \tfrac{L_\odot}{4\pi\times(2\times d_{earth})^2} = \boxed{330\ W/m^2}$$
$$\text{c) } m_c = \tfrac{L_\odot}{4\pi\times(5\times d_{earth})^2} = \boxed{52\ W/m^2}$$

***8.21**

$$M_\odot \approx 2 \times 10^{30}\ kg$$

$$M_{H\ tot} \approx 0.75 \times M_\odot = 1.5 \times 10^{30}\ kg$$

a) $M_{H\ fus} \approx 0.13 \times M_{H\ tot} = \boxed{1.95 \times 10^{29}\ kg}$

b) $t_{life} = \frac{M_{H\ fus}}{(600 \times 10^9\ kg/s)} = \boxed{3.25 \times 10^{17}\ s} = \boxed{1.03 \times 10^{10}\ yr}$

c) $t_{life} - 4.6 \times 10^9 yr = \boxed{5.70 \times 10^9 yr}$