HOMEWORK FOR QUIZ 5 Spring 2008

Possibly useful formulae: $\omega_{final} = \omega_{initial} \times (\frac{R_{initial}}{R_{final}})^2$; where R = radius, ω = spin rate

$V_{escape} = \sqrt{2GM/R}$

$R = 2GM/V_{escape}^2$
where V_{escape} = escape velocity, M = mass of the object from which you are trying to escape, R = radius from which you are trying to escape and G is the gravitational constant.

$T = \frac{T_0}{(\sqrt{1-(\frac{v}{c})^2}}$

1. **We have identified neutron stars in which of the following ways?**
   - ___As the secondary in Algol systems
   - X As pulsars
   - X Via x-rays from the hot surface of nearby neutron stars
   - X As the source of energetic cosmic rays

2. **What is the evidence for black holes (the 3 – 10 $M_\odot$ variety)?**
   When a stellar-mass B.H. orbits a companion (a close binary system) it can accrete material from the companion. This material will form an accretion disk, which is visible in the X-rays. Also, from microlensing events.

3. **If the Earth shrank to 1/4 of its current radius, what would the escape velocity be from its new surface? (the current V_{escape} is 25,000 mph)**
   $V_{esc} \propto \frac{1}{\sqrt{R}} \Rightarrow \frac{V_{new}}{V_{old}} = \sqrt{\frac{R_{old}}{R_{new}}} = \sqrt{\frac{R_E}{\frac{1}{4}R_E}} = 2 \Rightarrow V_{new} = 2 \cdot V_{old} = 2 \cdot 25000 \frac{m}{h}$
   $\Rightarrow$ $V_{new} = 50,000$ mph

4. **Which of the following would be expected to be left behind after a SNII explosion?**
   - ___A massive white dwarf
   - ___A massive Fe core of a former high-mass star
   - ___A neutron star with M< 1$M_\odot$
   - X A rapidly-spinning neutron star

5. **Algol is a binary system with a 3.7$M_\odot$ main-sequence star and a 0.8$M_\odot$ red giant.**
   (a) Explain why this is unexpected if the two stars formed at the same time.
   The more massive ★ should have left the main sequence & started up the Red Giant Branch before the lower mass ★ (More mass ⇒ shorter life time)
   (b) What is the explanation to resolve this paradox?
   The red giant ★ expanded past its Roche Radius. This allowed the M.S. ★ to accrete material from the red giant.