Ten points for each question:

1. In a certain year, a full moon happens when the sun is at the summer solstice. What is the right ascension of the moon at that time? What is the possible range of the moon's declination at that time?

2. A small object is found to orbit the sun with an orbital semimajor axis of 49 AU. How long is its orbital period?

3. The $H_\alpha$ line in a star's spectrum occurs at 6568 Å. What is the speed of the star in the line of sight?

4. How large a telescope do you need to spatially resolve a Sun-Jupiter-like system at 100 pc away if the observation is performed in space and in the red light at 6000 Å? That is, what is the smallest apeture of the telescope that you need?

5. Which ones are not one of the evolution stages of the sun? (A) a black hole, (B) a red dwarf, (C) a red giant, (D) helium flash, (E) an AGB star, (F) a white dwarf.

6. An A0V star has an apparent magnitude $m_v = 10$. What is the distance to the star?

7. The brightness of a certain Cepheid variable star increases and decreases with a period of 10 days. (a) What must this star's luminosity be if its spectrum has a strong absorption lines of hydrogen and helium, but no strong absorption lines of heavy elements? (b) Repeat part (a) for the case in which the star's spectrum also has strong absorption lines of heavy elements. Express all the luminosity in units of the solar luminosity.

8. Among the following spectral types, which stars are intrinsically brighter than the Sun? (A) G0V, (B) O2I, (C) M3I, (D) K3V, (E) B9V, (F)M0V.

9. In July 1997, a supernova named SN 1997cw exploded in the galaxy NGC 105 in the constellation Cetus (the Whale). It reached an apparent magnitude of +16.5 at maximum brilliance, and its spectrum showed an absorption line of ionized silicon. Use this information to find the distance to NGC 105.

10. Which statements are impossible? – according to our current knowledge, of course – (A) $\eta$ Carina may explode next year; (B) The sun may explode next year; (C) Vega is less massive than the sun; (D) A 10-$M_\odot$ star has a spectral type M0; (E) The sun will become a neutron star eventually; (F) A white dwarf has a mass of 2 $M_\odot$.

11. What mass of hydrogen will the Sun convert into helium during its entire main-sequence lifetime of ~~1010~~ $10^{10}$ years? What fraction does this represent of the total mass of hydrogen that was originally in the Sun? Assume that the Sun's luminosity remains nearly constant during the entire $10^{10}$ years and the PP-I chain is the only reaction, which releases an energy of 26.2 MeV for 4 protons to convert into an $\alpha$ particle.

12. How long is the core-hydrogen-burning life time of a main sequence star with a luminosity of 3000 $L_\odot$?

$5 \times 10^9$