Some Questions from a past International Astronomy Olympiad. Can you answer the questions?

1) Some star is visible in a Moscow sky on the night of December 22-23 from 10 PM till 6 AM, Moscow time. What time can you see that star in Moscow on the night of April 22-23?

2) An astronomer on Mars, working in Mars' North Hemisphere, recorded days when Sun's inclination is maximum and days when Sun crosses Mars' sky equator, i.e. days of solstice and equinox. Using those data (recounted on Earth chronology) determine during what Mars season and what part of that season (beginning, end) Mars is in perigee and apogee of its orbit.

Winter solstice	October 1, 2003
Spring equinox	March 5, 2004
Summer solstice	September 20, 2004
Fall equinox	March 22, 2005
Winter solstice	August 18, 2005

3) A red star has a diameter twice as big as a nearby blue star in their double star system. What star radiates more energy and by how many times? Please explain your answer.

4) Determine the total magnitude of a triple star system that consists of stars of 5, 6 and 8 magnitude.

5) On January 15, 2009 Venus was in the greatest eastern elongation (47°). In what constellation was Venus? What day in the nearest future will Venus be next to the Moon if it is known that on January 26, 2009 there will be ring-type solar eclipse on the Earth?

6) In which case is the duration of the central covering of a star by the Moon (occultation) is higher – if the Moon is at the perigee (visual diameter 33.5') or apogee (visual diameter 29.5') of its orbit and for how long? Neglect the effect of Earth axis rotation.

You Have Three Hours! Good Luck!

Answers to The Olympiad Questions

1) In a technical sense, it is above the horizon from 2PM to 10pm but it is only VISIBLE from somewhere near the end of twilight until 10PM.

2) It is at perigee during its fall season, near the end. Apogee is during its spring. This is an application of Kepler's Second Law.

3) Remember that each magnitude is about 2.5x as much light as the magnitude smaller than it. If 8th magnitude = 1 unit, then the 6th mag star is 6.25 times brighter, and the 5th mag star is 15.6 times more bright. Adding these gets the combined light as 22.875 times more than an 8th mag star; 2.5 raised to the 3.4 power approximately equals this value so the combined light is 3.4 mags brighter or mag 4.6.

4) Near the Capricorn/Aquarius border. The conjunction is approx. Jan 29th.

5) There is no real significant difference.

6) If the red star has a temperature (T) of 3000 degrees and blue has 30,000, and the Luminosity is proportional to radius (R) squared * T^4, then $L_{blue} \sim (1/2)^2 * 10^4$ or the blue star has more energy by about 2.5×10^3 times.