Name _____

Astronomy 161 – Introduction to Solar System Astronomy
Winter Quarter 2010 – 9:30-10:18 M-F – Prof. Martini
Homework #3

Due Friday, February 19 in class

Instructions

Answer the following five questions (and optionally the extra credit question) by circling the correct answer. Each question has equal weight.

No late homework will be accepted.

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1. Meteors heat up significantly due to friction caused by the Earth's atmosphere. They can get as hot as 2000 K and many completely burn up before they hit the ground. If the meteor were a perfect blackbody, what would be the peak wavelength (in units of nm) of its electromagnetic radiation? *(Hint: use Wien's Law)*

   a) 725nm
   b) 800nm
   c) 1450nm
   d) 1600nm
   e) 16000nm

2. *Radioactive decay*. You seal a sample of pure radioactive Eggium into a jar and leave it alone for 16 days. After 16 days you open the jar and find that 15/16 of the Eggium has changed into Chickenium. What is the half-life of Eggium in days?

   a) 1 day
   b) 2 days
   c) 4 days
   d) 8 days
   e) 16 days

3. Newton's original reflecting telescope had a primary mirror 33 mm in diameter. If a dark-adapted human eye has a diameter of 8mm, how many more photons per second could Newton detect with the telescope compared to without (assuming 100% reflectivity of the mirror and that he used just one eye)?

   a) 8 times more
   b) 17 times more
   c) 33 times more
   d) 38 times more
   e) 1089 times more

4. The discovery of the dwarf planet Eris in the outer reaches of the Solar System ultimately led to the development of the dwarf planet class. While Eris has a very elliptical orbit, it is currently near perihelion at a distance of only 38 AU from the Sun. At this point in its orbit, how much fainter does the Sun appear to be from the surface of Eris compared to what we see here on Earth?

    a) Twice as faint
    b) 37 times fainter
    c) 38 times fainter
    d) 1369 times fainter
    e) 1444 times fainter

Tides of the Future: The Moon currently orbits the Earth with a sidereal period of 27.3 days at an average distance of 384,400 km. Over the next several billion years, tidal braking and lunar recession will slow the Earth's rotation and move the Moon further from the Earth. Ultimately, the Earth will become tidally locked to the Moon just as the Moon is tidally locked to the Earth. When this happens the same side of the Earth will always face the Moon, just as the same side of the Moon always faces the Earth today. *(Use this information to answer the next two questions.)*

5. Tides on the Earth today are mostly due to the Moon's gravity. Tides caused by the Sun are about 50% weaker. When the Earth and Moon are both tidally locked to each other in the future, how will the tides be different?

    a) The Moon will still exert a differential gravitational force on the Earth
    b) Tides will still occur about twice per 'day,' but the day will be much longer
    c) The tidal forces exerted by the Sun and Moon will be more nearly the same
    d) None of a) through c) will be true
    e) All of a) through c) will be true

6. *Extra Credit*: If Earth's rotation rate has slowed to one rotation every 54.6 days (rather than once every 24 hours as it is today) when it becomes tidally locked, how far away will the Moon be from the Earth? Note that the present average distance is 384,400 km.

    a) 384,400 km
    b) 484,300 km
    c) 512,500 km
    d) 610,200 km
    e) 968,600 km