ASTR 310.   Oct 30/2013. 50 minutes
MIDTERM EXAMINATION

UBC Student ID # : _____

Family name : _____

First name : _____

DO NOT open the exam. You may fill in the blanks above and count pages without opening the exam.

1. Closed-book. Calculator allowed. NO SHARING calculators.
2. Formulae and constants are on 2nd-last page.
3. Insure your exam contains a total of **9** pages (this will include one final page of scrap paper); no other scrap paper will be allowed; the scrap pages will NOT be read when your exam is graded. No other paper may be used. You may CAREFULLY detach the formula sheet and scrap paper (try to leave staple intact); you do not need to hand in those 2 pages
4. You MUST write the exam in pen; if not, you may not request an exam regrade under any circumstances.
5. All caps or brimmed hats must be removed. Turn off cellphones.
6. In multiple-choice and true-false sections, choices which are not clearly indicated will result in zero points awarded on that question. Indicate your final response clearly if you erase.
7. Hint: Do NOT get stalled on any one question. If you get stuck, move on and come back to the question if time remains.
8. Your pages/questions may appear to be out of numerical order. This is normal and no cause for alarm...
9. You must IMMEDIATELY close your exam when instructed. Failure to do so will result in a penalty.

For Grader use :   MC _____ (/11)   T/F _____(/14)

                        SA _____ (/20)

                                        TOTAL: _____ (/45)

MULTIPLE CHOICE. (1 point each). CIRCLE THE LETTER of the one alternative that **best completes** the statement or answers the question. **Read all choices before responding.**

1. At latitude 60 degrees North, if the Sun is on the celestial equator then it crosses the meridian:

A) at a point 60 degrees altitude above the southern horizon
B) at a point 60 degrees altitude above the northern horizon
C) due west
D) 60 degrees south of the zenith along the local meridian
E) never, for it does not rise that day

2.   On March 21st next year, you watch the Sun rise. When you watch the sun rise above the horizon from the same location the next day, it will rise:

A) slightly to the left and earlier
B) slightly to the left and later
C) slightly to the right and earlier
D) slightly to the right and later

3. Which of the following is the reason for the leap years ?

A) the non-circular orbit of Earth around the Sun
B) the combined effect of the rotation of Earth and its orbit about the Sun
C) precession of Earth's axis
D) the tilt of Earth's axis
E) the Earth year being a non-integer number of Earth days

4. Why were ancient peoples unable to detect stellar parallax?
        A) They did not observe for long enough periods of time.
        B) They could not see stars close enough to measure parallax
        C) They did detect it, but they rejected the observations.
        D) They did not have the ability to measure very small angles.
        E) They did not look for it.

5.   Which of the following properties apply to Newton's theory of gravity?
        A) it cannot be proven
        B) it is incomplete
        C) it makes some predictions that will fail to be true
        D) all of the above apply
        E) none of the three items A-C apply

6.   If one observes an comet that takes 14 years to go around the Sun, then its orbital
        semimajor axis is:
        A)   52.4 AU
        B)   21 AU
        C)   9.33 AU
        D)   5.81 AU
        E)   14 AU

7. Which of the following is **NOT** a good reason to place observatories on remote mountain tops?

A) to reduce light absorption
B) to reduce light pollution
C) to be able to observe at radio wavelengths
D) to reduce light distortion
E) to observe at infrared wavelengths

8. Which of the following is **NOT** a pattern of motion in our solar system??

A) Giant planets all have many moons orbiting them.
B) Planets all rotate in the same direction.
C) Planets all orbit the same direction as the Sun's spin.
D) Planets all orbit in the same direction.

9. Where did comets that are now in the Oort cloud originally form?

A)   at the the Kuiper belt's current distance
B)   within the solar nebula, but far outside the orbit of Pluto
C)   near the jovian planets
D)   inside Jupiter's orbit

10. A major contribution of Brahe to the development of astronomy was to

A)   be the first astronomer since the Greeks to propose a heliocentric model
B)   be the first to detect stellar parallax
C)   make the most accurate astronomical observations before the telescope
D)   show that the planets orbited the Sun in ellipses
E)   first make reasonably accurate planetary predictions using epicycles

11. The devious spies have returned and knocked you out again; you wake up with a cell phone and a meter stick, with no idea where you are. You dial the phone number of your best friend, who ALSO happens to have a meter stick handy, and so you both stand them straight up in the ground to use as gnomons. You wait until your friend reports that their gnomon's shadow is pointing directly north, and she measures it to be 28 cm long. At that instant, your gnomon's shadow is pointing slightly to the west of due north, but one hour later your gnomon's shadow is pointing straight north and is 38 cm long. You can conclude that, *relative to your friend's position,* you are

A) northwest
B) northeast
C) southwest
D) southeast
E) due north (neither east or west in longitude)

(11 points available in multiple choice section)

TRUE/FALSE. (1 point each). Circle the "T" if the statement is true, or the "F" if the statement is false. **If you later change your response, write out the word "true" or "false" to the left of the statement to be completely clear.**

T   F   The largest asteroid is larger than Earth's Moon.

T   F   A mean solar day lasts longer than a sidereal day

T   F   Scientific theories related to climate change can be falsified

T   F   If you are on the lunar nearside when a solar eclipse happens in Cuba, you can see the Earth

T   F   If a source of light is moving away from you, the wavelengths of photons you get are shorter than they were when they were emitted by the source.

T   F   From Earth's equator, a waning gibbous moon always rises at night (rather than in daytime)

T   F   In the core-accretion model of giant planet formation, gas giant planets accrete many planetesimals, which then sink to the planet's center to make a silicate core.

T   F   Newton's second law is that planets orbit the Sun on ellipses with the Sun at one focus

T   F   Science progresses as more and more theories are proven true.

T   F   There are times that Ceres will exhibit retrograde motion

T   F   Asteroids have almost no water ice because the H_2O molecules remained as gas where the asteroids formed and then the gas was blown away by the young Sun

T   F   It is likely that a 1-meter impactor will strike Earth's atmosphere in the next 100 years.

T   F   The phenomenon of interference proves that light can only be thought of as a wave.

T   F   A reflectance spectrum of a comet's surface can tell us about the chemical composition of the ices on its surface


(14 points total this page)

Short answer section. Points are as indicated.

1. (1 point each, 6 points total) Fill in the blank.

(a) A Saros cycle explains patterns in the occurrence of _____

(b) The declination of the Sun on December 21st is _____ degrees.

(c) The _____ of a parabolic orbit is exactly one.

(d) The _____ are the constellations through which the ecliptic passes

(e) One third of one degree is _____ arcseconds

(f) The RA of stars crossing our southern meridian is also called the _____

2. (4 points) The diagram below shows the path of the Sun in the local sky for Vancouver on the fall equinox. Suppose you have a friend who lives in Hyderabad India (roughly latitude 15 degrees N and longitude 80 degrees East). On that same day, draw the path of the Sun in *your friend's* local sky, showing the **direction** to Polaris, the **sunrise and sunset locations** (but not times), and the **transit** *as points like the example.* Be as accurate as possible.
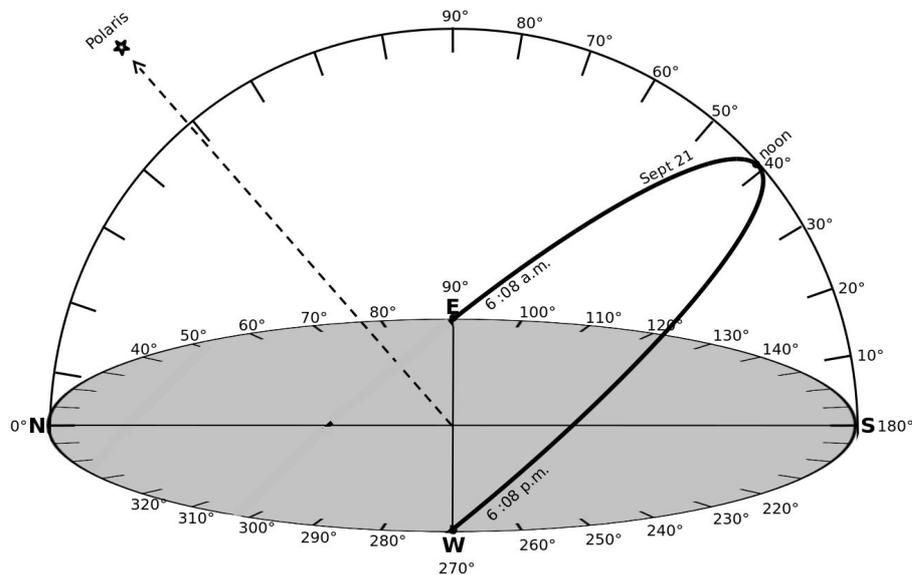
(10 points this page)

3. (6 points)   Suppose alien astronomers on the airless galilean moon Callisto were trying to use telescopes to examine Earth's Moon. These aliens can only see infrared light and thus build telescopes that use that wavelength. In the most favorable viewing geometry, estimate the minimum size of a telescope they would have to build in order to resolve Earth's Moon as a disk. You must show your work and explain reasoning, but only need 2 significant figure precision.

4. (4 points) The image shows a sunrise with a variety of planets visible in the dawn sky, along with a crescent Moon. Assuming Mercury is near its greatest western elongation of roughly 20°, draw a diagram below showing a view looking down on the Solar System at the time of this image, and label the locations along their orbits of the Moon and the planets shown. The orbits will not be to scale, but must be in the right relative position. Venus is in gibbous phase in this image.
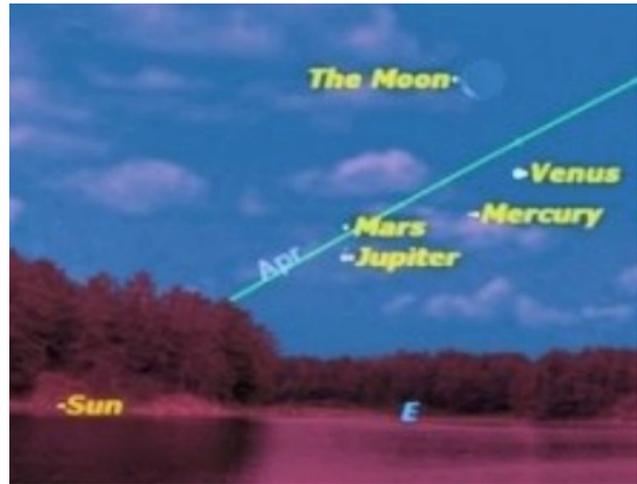
POSSIBLY USEFUL FORMULAE AND CONSTANTS.

$$P^2 = \frac{4\pi^2}{GM}a^3 \qquad P_{yr}^2 = a_{AU}^3 \qquad F = \frac{G\,M_1 M_2}{r^2} \qquad f\lambda = c \qquad \frac{v}{c} = \frac{\Delta\lambda}{\lambda}$$

$$angular\ diameter^{(o)} = \frac{360}{2\pi}\frac{diameter}{distance} \qquad angular\ separation^{(o)} = \frac{360}{2\pi}\frac{separation}{distance}$$

$$Vol(sphere) = \frac{4}{3}\pi r^3 \qquad Area(sphere) = 4\pi r^2 \qquad Area(circle) = \pi r^2$$

$$Circumference(circle) = 2\pi r \qquad Perihelion = a(1-e) \qquad Aphelion = a(1+e)$$

$$speed = \frac{distance}{time} \qquad diffraction\ limit('') = 250{,}000\frac{\lambda}{D} \qquad \lambda_{max}(nm) = \frac{2.9\,x\,10^6}{T_K}$$

Constants

G= 6.67x10 $^{-11}$ m^3/(kg s^2)   c=3x10^8 m/s   1 AU = 1.50x10^8 km

Diameters: Earth=12,800 km   Moon=3474 km   Mercury=4880 km   Saturn=120 000 km

Semimajor axes (in AU): Mercury=0.4, Venus=0.71, Earth=1.0, Mars=1.52,
Jupiter=5.2, Saturn=9.5, Uranus=19.2, Neptune=30.0, Pluto=39.4
semimajor axis (in km) of Moon around Earth: 385,000 km

Mass (Earth) = 6.0 x 10^{24} kg
Masses (relative to Earth) : Jupiter = 317, Saturn=95, Earth's Moon = 1/81

1 degree = 60 arc minutes (')   1 arcminute = 60 arc seconds (")

Obliquity of the ecliptic: 23.5 degrees.

Approximate densities (g/cm^3) : rock = 3, metal = 6, water = 1

Approximate wavelengths : visible : 500 nm. Infrared 10 micrometers. Radio 1 m

SCRAP PAPER (this page will not be examined by the grader)