Astronomy 1140 Quiz 1 Review

Anil Pradhan

September 13, 2016

I What is Science?

1. Explain the difference between astronomy and astrology.

   Astronomy is science, which is built on verifiable theories, observations and measurements; while astrology is pseudo-science, which is mostly unverified beliefs.

2. What number is the metric system based around? What are some of the more widely-used prefixes?

   Usually humans interpret numbers on the base of 10, while for computers it is 2. There are many widely used prefixes, such as milli-(10^{-3}), micro-(10^{-6}), nano-(10^{-9}), kilo-(10^{3}), mega-(10^{6}).

3. What special attribute of certain constellation puts them in the zodiac?

   They are on the apparent path of the sun, i.e. the ecliptic.

II Observational Astronomy: the Night Sky

1. What is the ecliptic plane?

   The plane of the sun's path projected in all direction onto the sky.

2. Why is the ecliptic titled with respect to the celestial equator? How big is the titlt in degrees?

   Because by our daily observation the axis around which the sun is revolving around the earth is not parallel with that the earth is spinning around. The angle is 23.5°.

3. Where does the ecliptic plane intersect the celestial equator?

   At equinoxes, i.e. autumnal equinox and vernal equinox.

4. What are the primary coordinates for finding a place on Earth? How about the celestial sphere?

On earth: latitude and longitude; on celestial sphere: right ascension and declination.

5. In what constellation would you find Polaris?

   Ursa Minor.

6. What is the angular size of an object? What is it for the moon? The sun? Which is actually bigger? How do you reconcile this?

   The angular size of an object is the angle subtended by the object into our eyes. The angular sizes of the moon and the sun are both about one half degree. The angular size depends on the distance of the object from the observer and its real size, so even though the sun is much larger than the moon, the much longer distance of the sun from us makes it look the similar size as the moon.

7. Why does the moon have phases?

   Because the moon is revolving around the earth, and the plane where its orbit lies in is slightly tilted from the ecliptic. So the position of the moon in the sky determines how mcuh of it we can see, i.e. phase.

8. Why don't we have an eclipse every month?

   Because the plane in which the moon's orbit lies in is slightly tilted with respect to the ecliptic.

9. How big is an arcminute? An arcsecond?

   $1'=(\frac{1}{60})^\circ$, $1''=(\frac{1}{60})'$

10. What is the stellar parallax? Why is it useful? Does a nearby star have a larger or smaller parallex than one that is farther away?

    The stellar parallax is the apparent displacement of a nearby star (or a foreground object) relative to the faraway stars (or the background objects) as the observer's location changes (one can be due to the earth's revolution around the sun). Stellar parallax is useful because it can be used to measure the distance from the star. A nearby star has a larger parallax than a faraway star does, because geometrically it's easy to see that the angle subtended by the change in the observer's position is larger when the distance from the star is nearer.

11. Why couldn't the Greeks see parallax?

    Because the stars are very far, they did not have good enough instruments to measure the tiny parallax.

12. What is a parsec? How many light years are in a parsec?

    A parsec is the distance at which one astronomical unit subtends an angle of one arcsecond. It's equal to 3.26 ly.

13. How close is the nearest star to the sun? What does this imply about the space?

Alpha Centauri is the closest one, about 4.3 ly away. This implies that the space is very sparsely distributed with stars.

III The Heliocentric Model

1. In simple terms, what are the geocentric and heliocentric models?

   Geocentric model: the planets and the sun all revolve around the earth; heliocentric model: the earth and the other planets all revolve around the sun.

2. Who was the first major proponent of the heliocentric model? What were the key facets of his model?

   Copernicus. His model had the sun as the center of other planets' orbits. The moon revolves around the earth. The stars are much farther away than the sun, and the motion of the stars including the sun is the reult of the motion of the earth. Also the retrograde motion of some planets is a consequence of the earth's motion.

3. Explain the main observational problem that mars presented for the geocentric and the early heliocentric models.

   It's the retrograde motion, which describes the back and forth motion of the mars observed from the earth.

4. What did Ptolemy add to the geocentric model to explain the above problem ?

   Epicycles.

5. Who correctly solved the problem? How? Using whose data?

   Kepler solved the problem. The earth and the mars both revolve around the sun and the earth moves faster than the mars does. So every time the earth overtakes the mars, the mars appears to move backward in the sky. He used Brahe's data.

6. Which of Galileo's observations supported the heliocentric model?

   Another planet has moons, and venus has phases like the moon.

7. Define: superior planet, inferior planet, conjunction, opposition, quadrature, perihelio, aphelion and eccentricity.

   Superior planet is a planet whose orbit is outside of that of the earth's;

   Inferior planet is a planet whose orbit is inside that of the earth's;

   A conjunction occurs when a planet and the sun are on the same side of the earth, also on the same line.

   Opposition occurs when the sun and a superior planet are on the opposite sides of the earth, and also on the same line.

Quadrature occurs when the line connecting the earth and a planet (or the moon) makes 90° with the line connecting the earth and the sun.

Perihelio is the position where a planet (or a comet) is nearest to the sun.

Aphelio is the position where a planet (or a comet) is farthest to the sun.

Eccentricity is the ratio of the distance between the foci of a ellipse to the length of the major axis.

8. Venus is on the opposite side of the sun compared with the earth. What is the name for this configuration of an inferior planet?

Superior conjunction.

9. What is a synodic period of a planet? Sidereal period?

Synodic period is the apparent orbital period of a planet, viewed from the earth, when the earth-planet-sun are in the successive conjunction or opposition. Sidereal period is the real orbital period around the sun.

10. Are planetary orbits as perfectly circular as proposed by Copernicus?

No, they are clliptical.

11. Explain Kepler's 3 laws.

1. The orbital paths of the planets are elliptical with the sun at one focus.

2. An imaginary line connecting the sun to any planet sweeps out equal areas of the ellipse in equal intervals of time.

3. The square of a planet's orbital period is proportional to the cube of its semimajor axis.

12. What is the proportionality between period and semimajor axis in Kepler's 3rd law?

The square of a planet's orbital period is proportional to the cube of its semimajor axis.

13. What is the semimajor axis of a comet whose period is 8 years?

$(\frac{1AU}{a})^3$=$(\frac{1y}{8y})^2$, so the semimajor axis is a=4AU.

IV Newton's laws and motion

1. What are the Newton's 3 laws of motion?

1.Every body continues in a state of rest or in a state of uniform motion in a straight line, unless it is compelled to change that state by a force acting on it.

2. The acceleration of an object is directly proportional to the applied force and inversely proportional to its mass.

3. To every action, there is an equal and opposite reaction.

2. What is inertia?

The tendency of an object to keep moving (or rotating) at the same velocity unless acted upon by a force (or a torque).

3. What formula did Newton write down for the magnitude of the force of gravity?

$F = \frac{GmM}{r^2}$

4. If I drop a bowling ball and a pencil, which will hit the ground first? Why?

They hit the ground at the same time if they are realeased at the same height (neglect other forces except gravity). Because acceleration due to gravity is the same for both the bowling ball and the pencil, they will always have the same velocity at the same height.

5. Why do tides occur? When do the largest tides occur?

They are due to the differential pull of gravity by the moon and the sun across the earth. At new moon and the full moon when the sun, the moon and the earth are in the same line, the strongest tides occur.

6. How are the kinetic energy and potential energy converted to each other when a stone is tossed up and then falls down?

When it's tossed up the kinetic energy is converted to potential energy, while it's falling down, the potential energy is converted to kinetic energy.