

The King's University Astronomy 200 MidTerm Exam
October 19, 2017

Part A: 20 multiple choice questions: please record the best response on the separate score sheet provided. **DO NOT RECORD ANSWERS HERE!**

Part B: 3 long answer (5 marks each). Please write your answers on the sheets provided.

1. If star A is sixth magnitude and star B is fourth magnitude, then
 - a. star A is about 6 times brighter than star B
 - b. star A is about 100 times brighter than star B
 - c. star B is about 6 times brighter than star A
 - d. star B is about 100 times brighter than star A

2. Seen from northern latitudes, the star Polaris
 - a. is never above the horizon during the day
 - b. always sets directly in the west
 - c. is always above the northern horizon
 - d. is never visible in winter

3. The sun is on the celestial equator at the times of
 - a. the vernal equinox and summer solstice
 - b. the autumnal equinox and vernal equinox
 - c. the summer solstice and winter solstice
 - d. the autumnal equinox and winter solstice

4. Precession alters the location of the
 - a. celestial poles but not the celestial equator
 - b. celestial equator but not the celestial poles
 - c. celestial equator and the celestial poles
 - d. earth's axis but does not affect the celestial sphere

5. The first-quarter moon rises at
 - a. noon
 - b. sunset
 - c. midnight
 - d. sunrise

6. Total lunar eclipses always occur at the time
 - a. of new moon
 - b. of full moon
 - c. of either equinox
 - d. of either solstice

7. The Saros cycle
 - a. was used in ancient times to predict eclipses
 - b. is 18 years 11 $\frac{1}{3}$ days long
 - c. comes from a Greek word that means repetition
 - d. all of these

8. Ptolemy's model of the universe
 - a. was heliocentric
 - b. included elliptical orbits
 - c. contained epicycles
 - d. all of the above

9. The Copernican system was no more accurate than the Ptolemaic system in predicting the positions of the planets because
 - a. the Copernican system used the old value for the radius of the earth
 - b. the Copernican system included uniform circular motion
 - c. Copernicus had been unable to detect parallax
 - d. all of these

10. Galileo's telescopic discovery of mountains on the moon and spots on the sun was controversial because it suggested that the sun and moon
 - a. were the same kind of body
 - b. were inhabited
 - c. were not perfect
 - d. orbited each other

11. Galileo's telescopic discovery of moons orbiting Jupiter was important because it showed that
 - a. the universe could contain centers of motion other than the earth
 - b. the earth might move along an orbit and not leave the moon behind
 - c. both of these
 - d. none of these

12. Brahe's universe was the same as the Copernican universe except that
 - a. the earth did not move
 - b. the sun did not move
 - c. the moon orbited the sun
 - d. the orbits were elliptical with the sun at one focus

13. If a planet orbits the sun at an average distance of 4 AU, then its orbital period will be about
 - a. 8 years
 - b. 11 years
 - c. 25 years
 - d. 125 years

14. When Newton said that gravitation was universal, he meant that
- it was important in all parts of science
 - it was a property of all matter operating throughout the universe**
 - it could be deduced from the appearance of the universe
 - none of these
15. According to general relativity, gravity is caused by
- the equivalence between mass and energy
 - the curvature of space-time**
 - the change in mass of a moving body
 - the constant speed of light
16. A small comet is observed to have a period of 8 years. What is the average radius of this comet's orbit?
- 30 AU
 - 64 AU
 - 4 AU**
 - 16 AU
17. Suppose a comet has an aphelion distance of 19.5 AU and a perihelion distance of 0.5 AU. What is the eccentricity of its orbit?
- 0.0256
 - 0.950**
 - 0.512
 - 1.345
18. In Einstein's Special Theory of Relativity
- Time is only absolute quantity in the universe
 - Moving clocks always run fast
 - Moving clocks run slower than stationary clocks**
 - Mass is the only absolute quantity in the universe
19. Kepler's 2nd Law of planetary motions states:
- Planets move in elliptical paths
 - $P^2 = a^3$
 - Planets sweep out equal areas in equal times**
 - Planets orbit because they are deflected by the gravitational pull of the Sun
20. Gravity is an inverse-square law force. This means that if you tripled the distance between two bodies you would
- Triple the gravitational force between them
 - Increase the gravitational force between them by a factor of 9
 - Decrease the gravitational force between them by a factor of 3
 - Decrease the gravitational force between them by a factor of 9**

Useful Chart and Formulae

$$G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$$

$$\text{Mass Earth} = 5.97 \times 10^{24} \text{ kg}$$

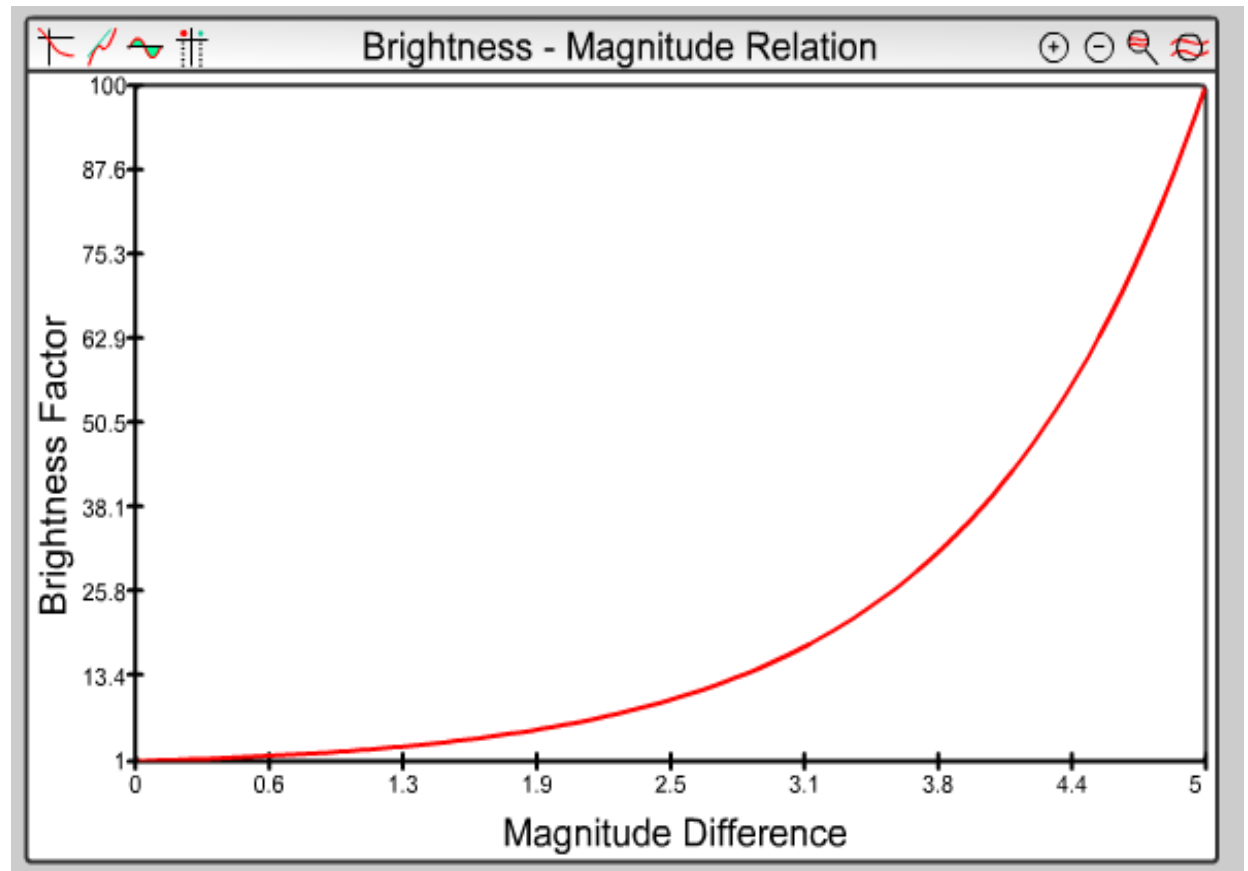
$$\text{Radius Earth} = 6.37 \times 10^3 \text{ km}$$

$$\text{Earth-Sun Distance} = 149 \text{ million km}$$

$$C = 300\,000 \text{ km/s}$$

$$P^2 = a^3 \quad F = -G \frac{Mm}{r^2} \quad \frac{I_1}{I_2} = (2.512)^{(m_2 - m_1)}$$

$$(m_2 - m_1) = 2.5 \log\left(\frac{I_1}{I_2}\right)$$



Part B: Long Answer: (5 marks each) please record answer in the space below - you may use reverse side if needed.

1. Suppose that you were marooned on a desert island. You have a protractor(you never leave home without one!) and a short-wave radio in your navigational gear. You also have an emergency radio with just enough power to send one message. How could you use the supplies on hand to send a useful distress signal pin-pointing your location? Which hemisphere should you be in for this to work best?

For full marks your answer needs to include:

- *Angle of Polaris above N-horizon (altitude) = geographics latitude (2)*
- *How you found time of local noon measured in UT (Greenwich Time) – your shortwave radio would allow you to listen to a world time service (2)*
- *Not easy in southern hemisphere because there are no obvious pole stars (1)*

2. Galileo devised an ingenious argument to demonstrate that if one took Joshua 10 literally:

***Stand still, O sun, at Gibeon,
O moon, in the valley of Aijalon!
And the sun stood still,
and the moon stayed,***

then the geocentric model of Aristotle would contradict scripture's claim that God made the day last longer than 24 hours! Reconstruct Galileo's argument . (Hint – it has to do with the two “motions” of the Sun) .

Your answer needs to include:

According to the Aristotelian (geocentric) view two motions of the sun are:

1. *the sun's apparent motion due to rotation of the celestial sphere around the earth (1)*
2. *the Sun's true motion which is an eastward drift on the celestial sphere (1)*
3. *Galileo required complete acceptance of the scripture which DID NOT SAY celestial sphere (ie stars) stand still (1)*
4. *If only the sun stopped then it would no longer have an eastward drift and the westward motion of the celestial sphere would cause it to set even quicker thus making the day SHORTER! (2)*

3. Discuss briefly the conditions under which eclipses can occur, what we mean by the term Saros and why the Saros is approximately 18 years 11 days 8 hours.
(2 mark bonus: A total solar eclipse occurred October 24 1995 (this week!) and was visible in India. When will the next eclipse from this cycle occur and approximately where will it be visible?)

Your answer needs to include:

1. Eclipses can be either Lunar or Solar (1)
2. Moon must be either Full (lunar) or New (solar) (1)
3. Moon must be at one of the nodes in the earth-moon orbit and Line of nodes of the earth-moon orbit must point toward the sun (1)
4. Moon-earth and earth-sun distances must be correct to make the apparent size of both sun and moon the same or moon slightly larger than sun. (1)
5. Saros is the 18 y 11d 8h repetition of the conditions listed above (1)

Bonus – to be part of the same solar eclipse cycle you must be 1 Saros (or multiples) away in time. So just at 18y11d8h (or multiples of this) to get the next one. Next eclipse I this cycle will be in November 3, 2013, 1/3 of the way around the world – west of India – (Atlantic regions)