# Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Test Form **A**

## INST 2403

## Our Place in the Universe

## Second Exam

## October 18, 2017

# Instructions

1. Use a number 2 pencil.
2. **Important:** Write your name on the computer form and fill in the appropriate circles. Bubble in your 8-digit ID number in the **Identification Number** field. Bubble in **A** in the **Key** field.
3. Select only the best answer to each question; multiple answers will be marked wrong. No points are taken off for wrong answers, so it is to your advantage to guess if you are unsure of the answer.
4. Mark your answers on the computer form. You may write in the exam booklet if you wish, but only the computer form will be graded.
5. You must **sign** and **return this exam booklet** in order to receive credit for the exam!
6. You will have a maximum of **70 Minutes** to complete the exam.
7. This exam contains **35 questions**.
8. Use the backside of this exam booklet to record the answers to the **last three questions,** which are **not** multiple-choice but short answer questions.
9. You should be able to answer all questions without using a calculator, but if you wish, you can use a scientific calculator. The following formulae might be useful:

c = λ f, E= hf, T λpeak = 0.003 K m, P = 4π σ R2T4 , B = L / (4 π r2)

Constants (approx.): c = 3 x 108 m/s, h= 7 x 10-34 Js, σ = 6 x 10-8 W m-2 K -4

1. How would the strength of the force between the Moon and Earth change if the mass of the Moon were somehow made two times smaller than its actual mass?
   1. It would not change.
   2. It would be half as large.
   3. It would be twice as large.
   4. It would be four times smaller.
   5. It would be four times bigger.
2. Which was the first observation that falsified the geocentric model?
   1. The eccentricity of Mars’ orbit.
   2. The discovery of Jupiter’s Galilean moons.
   3. The discovery of the sunspots.
   4. The discovery of a nova.
   5. The observation of Venus’ phases being similar to the Moon’s phases.
3. If the Earth is prolate ...
   1. The distance from 45N latitude to the pole is shorter than to the equator
   2. The distance from 45N latitude to the pole is the same as to the equator
   3. The distance from 45N latitude to the pole is longer than to the equator
   4. None of the above
4. The peak wavelength of an object A’s blackbody curve is half as long as the one of B’s curve, hence the temperatures of the objects are related by
   1. TA=TB
   2. 2TA=TB
   3. TA=2TB
   4. 4TA=16TB
5. Compare the power radiated by two stars A & B. The radii of the stars are related by rB = 2 rA, and they have the same surface temperature. How do the power outputs P of the stars compare?
   1. PA = 2 PB
   2. PA = 4 PB
   3. PB = 4 PA
   4. PB = 16 PA
   5. None of the above.
6. A hot, low density cloud of gas will produce what type of spectrum?
   1. Continuous spectrum
   2. Emission spectrum
   3. Absorption spectrum
   4. Fraunhofer spectrum
   5. Kirchhoff spectrum
7. How would the strength of the force between Jupiter and the Sun change if Jupiter were five times closer to the Sun?
   1. It would not change.
   2. It would be five times as large.
   3. It would be five times smaller
   4. It would be 11.82 times larger.
   5. It would be twenty-five times larger.
8. You are in a big but dark room and view a 400 W lightbulb from a distance of 10 m. A second lightbulb of unknown luminosity is placed somewhere the room and appears equally bright. Which of the following is a luminosity/distance combination that would “save the appearances”, i.e. reproduce the brightness pattern just described?
9. 1 W lightbulb at 1m distance.
10. 25 W lightbulb at 2m distance.
11. 100 W lightbulb at 5m distance.
12. 4000 W lightbulb at 20 m distance.
13. None of the above.
14. Kepler's second law, the "equal area" law, implies that planets move

a) faster when they are closer to the Sun.

b) faster when they are farther from the Sun.

c) at constant velocity.

d) in perfect circles.

e) on epicycles.

1. Kepler's third law

a) relates a planet's orbital period to the size of its orbit around the Sun.

b) relates a body's mass to its gravitational attraction.

c) allowed him to predict when eclipses occur.

d) allowed him to measure the distance to nearby stars.

e) allowed him to determine the shape of Mars’ orbit.

1. The mass of the Sun is 300,000 times that of Earth. How does the strength of the gravitational force that the Earth exerts on the Sun compare to the gravitational force that the Sun exerts on Earth?

a) It is 300,000 times smaller.

b) It is 300,000 times bigger.

c) It is 9 x 1010 times smaller.

d) None of the above.

1. The strength of the gravitational force between two objects

a) increases with the mass of the objects and decreases with the distance between them.

b) decreases with the mass of the objects and increases with the distance between them.

c) increases with the mass of the objects and the distance between them.

d) decreases with the mass of the objects and the distance between them.

e) stays constant and does not depend on distance.

13. Which quantity is associated with the size of an ellipse?

* 1. Eccentricity
  2. Focus
  3. Position
  4. Period
  5. Semi-major axis

14. The resolution of a telescope goes down when the wavelength of the observed light goes up. Based in this, which are the biggest telescopes in the world?

* 1. X ray telescopes
  2. Ultraviolet telescopes
  3. Optical telescopes
  4. Infrared telescopes
  5. Radio telescopes

15. Which is the correct order of electromagnetic radiation types starting with highest energy?

1. X rays, Ultraviolet(UV) light , visible light, radio waves
2. Gamma rays, radio waves, microwaves, visible light
3. radio waves, visible light, UV light, X rays
4. Microwaves, infrared light, radio waves, gamma rays
5. None of the above

16. Stellar aberration is easily confused with stellar parallax. Which is **not** a statement that applies to both patterns?

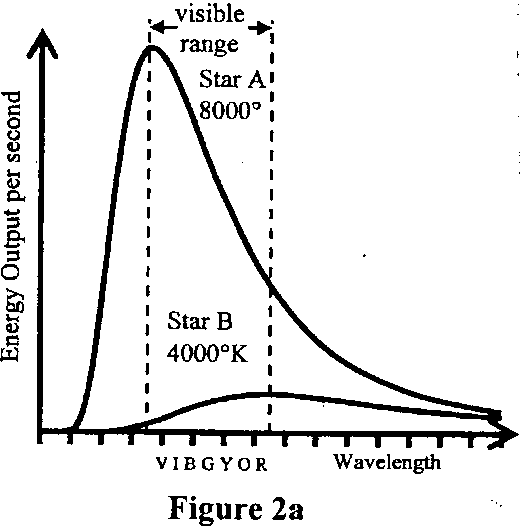
1. Both are due to the orbital motion of the Earth.
2. In both cases stars appear to move in a circle or ellipse around their average positions within a year.
3. Both are about apparent motion of stars in the sky, not about motion of the stars in space.
4. Both are very small effects that cannot be discovered without precise instruments such as dedicated telescopes (e.g. transit instruments).
5. Both are independent of the distance to those stars exhibiting aberration or parallax

17. What are the optical components of the simplest possible telescopes?

1. two mirrors
2. two lenses
3. three lenses
4. 1 lens, 1 prism
5. None of the above

18. Where in Newton's famous book "Principia" are his three axioms of physics? *(Hint: You can reason this out!)*

1. At the beginning
2. In the middle
3. At the end
4. They are actually not in the book
5. Which advantage did Copernicus’s theory of planetary motion have over Ptolemy’s?
   1. It is more accurate.
   2. It explains retrograde motion as relative motion of two planets.
   3. It is more precise.
   4. It has the Earth at its center.
   5. None of the above.
6. An 8-inch telescope collects how many more times the light collected by a two-inch telescope? (Hint: the amount of light collected scales like the area of the telescope.)
   1. 2
   2. 4
   3. 8
   4. 16
   5. 64
7. Which of the following phases of Venus is observed, but cannot be predicted by the geocentric model of the solar system?
   1. Crescent Venus
   2. Fat Crescent Venus
   3. Gibbous Venus
   4. New Venus
   5. None of these contradict Ptolemy’s theory
8. Galileo's observation of sunspots discredited Aristotle's teachings, because they showed
   1. that planets move on epicycles
   2. change in the heavens without uniform circular motion
   3. the Earth's orbit is elliptical
   4. the Sun isn't perfectly spherical
   5. None of the above
9. In antiquity, astronomers used observation and reasoning to make astonishing advances in the understanding of astronomy. Whose name is related to the first (and pretty accurate) measurement of the earth's radius?
   1. Aristotle
   2. Aristarchus
   3. Archimedes
   4. Ptolemy
   5. Eratosthenes
10. Approximately how long is a Jupiter year, i.e. the time that it takes Jupiter to orbit once around the sun? *(Hint: Jupiter is 5.2 AU from the sun; Kepler’s 3rd law states that P2/a3=1.)* 
    1. 2 years
    2. 5 years
    3. 12 years
    4. 29 years
    5. 84 years
11. Consider the two blackbody spectra shown in Figure 2a, where the energy output per second is plotted as a function of the wavelength. The colors in the visible range are represented by their first letter (v=violet, r=red, etc.) What can we conclude about the properties of stars A and star B?



1. Star A is hotter, larger, and looks redder than star B.
2. Star A is cooler, looks redder, and smaller than star B.
3. Star A is hotter and looks bluer than star B.
4. Star A has a longer peak wavelength than star B.
5. Star A and star B have the same temperature.
6. Compare radiowaves of wavelength 1 km with visible light (wavelength about 5 x 10-7m). Which is a true statement?

a. Radiowaves are less energetic and have higher frequency

b. Radiowaves are slower and less energetic

c. Visible light is more energetic and has a higher frequency  
 d. Visible light is faster and has lower frequency

e. Both types of electromagnetic radiation have the same frequency and energy.

27. How do we know that the earth is not going around the sun in a perfectly circular orbit?

1. The earth's axis is tilted.
2. We experience seasons on earth.
3. The seasons have different lengths.
4. The days have different lengths.
5. The amount of daylight is different at different days.

28. Why did Ptolemy have to use epicycles?

1. Due to the different distances of different planets from the earth
2. Due to different axis tilts of the planets
3. To explain the seasons
4. To explain retrograde motion
5. None of the above

29. Why did Copernicus have to use epicycles?

* 1. Due to the different distances of different planets from the earth
  2. To explain that planets sometimes move faster along in their circular orbits
  3. To explain the seasons
  4. To explain retrograde motion
  5. He did not use epicycles

30. Why was Galileo's discovery of the four big moons of Jupiter so important?

1. It showed that objects rotate around planets other than the earth.
2. It proved that Copernicus is correct.
3. It falsified Ptolemy’s geocentric model.
4. None of the above.

31. William Herschel made many important contributions to astronomy and physics. Which is not one of them?

1. Finding and explaining stellar aberration
2. Measuring the motion of the sun within the Milky Way.
3. Finding infrared radiation
4. Discovering the planet Uranus
5. All of them were discovered by Herschel.

32. Plato introduced an important if misleading prejudice into early astronomy. Which one was it?

1. Planets move around the Earth on epicycles.
2. Celestial objects must move in uniform circular motion.
3. Eccentric circles can be used to mimic elliptic motion.
4. None of the others is correct.

**Short Answer Questions [3 points each]**

***(Please use the back side of the Scantron sheet to record your answers)***

33. What was the biggest advantage of the Copernican system vs. the Ptolemaic system in explaining the apparent motion of the planets? (*Hint: Stating that the Sun is at the center or that the Earth is moving will not garner any points, as this is just the definition of the Copernican system.)*

34. How did Galileo’s observation of the phases of Venus enable him to rule out the geocentric theory?

35. Explain **in words** how, if at all, the following properties of electromagnetic waves are related: wavelength, frequency, energy, velocity, color.