

Astronomy 103

Midterm 1

October 1, 2014

Instructions:

No books, notes or calculator are allowed. You have 50 minutes to complete the exam, and please do not turn to the next page until instructed to do so.

You may find the following information helpful:

- 1 AU = 3×10^8 km

- speed of light $c = 3 \times 10^5$ km/s

- Kepler's 3rd law:

$$a^3 = P^2$$

with the period P in years and semi-major axis a in AU.

- Newton's law of gravity:

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

- Peak wavelength and temperature of blackbody radiation:

$$\lambda = \frac{3 \times 10^6}{T} \text{ nm}$$

with wavelength λ in nm ($1 \text{ nm} = 10^{-9} \text{ m}$) and temperature T in Kelvin.

- Relationship between frequency f and wavelength λ of light:

$$\lambda = \frac{c}{f}$$

1. The distance from Milwaukee to Seattle is about 3,000 km. What is the distance in meters?
 - a) 3 m
 - b) 3×10^3 m
 - c) 3×10^5 m
 - d) 3×10^6 m
 - e) 3×10^8 m

2. Evaluate $3 \times 10^4 \times 2 \times 10^7$
 - a) 5×10^{11}
 - b) 6×10^{11}
 - c) 5×10^{28}
 - d) 6×10^{28}

3. A cheetah runs in a straight line at 20 m/s (meters per second) How many meters can it travel in 5 seconds?
 - a) 4 meters
 - b) 5 meters
 - c) 40 meters
 - d) 50 meters
 - e) 100 meters

4. The Earth revolves around the Sun once each
 - a) day
 - b) month
 - c) year

5. The average temperature is hotter in summer than winter. This is ultimately caused by
 - a) the greenhouse effect that warms the Earth by trapping infrared radiation.
 - b) the fact that the Earth is closer to the Sun in summer.
 - c) the tilt of the Earth's axis relative to the Earth's orbit.
 - d) the fact that the Sun emits more energy per second in the summer than it does in the winter

6. Describe the daily motion of Polaris:
 - a) It rises due east and sets due west once in every 24-hour period.
 - b) It stays nearly fixed in the northern sky above our North Pole.
 - c) It rises due west and sets due east once in every 24-hour period.
 - d) It moves eastward by slightly less than 1 degree per day.

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7. How many days during each year is the Sun directly over the equator?
- a) 1
 - b) 2
 - c) 182 or 183
 - d) 365
8. The shortest night in Milwaukee is on
- a) the winter solstice
 - b) the spring equinox
 - c) the autumn equinox
 - d) the summer solstice
9. Where on Earth are you if Polaris is on your horizon?
- a) north pole
 - b) south pole
 - c) Tropic of Cancer
 - d) Tropic of Capricorn
 - e) equator
10. A rover exploring a planet rolls north from the equator to a point whose latitude is 45 degrees north. If the rover has traveled 1,000 km, what is the circumference of the planet?
- a) 450 km
 - b) 1,000 km
 - c) 2,000 km
 - d) 4,000 km
 - e) 8,000 km
11. You are on the asteroid Willis. (Asteroids are very small rocky planets.) You start from one pole of Willis and walk without turning until you reach a place where the stars appear to move in horizontal circles, never rising or setting. If you have walked 50 km, what is the circumference of Willis in km?
- a) 25 km
 - b) 50 km
 - c) 100 km
 - d) 200 km
 - e) 400 km

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12. If the Moon's orbit were exactly in the plane of the Earth's orbit about the Sun, one would expect an eclipse of the Moon to occur about once every
- a) week
 - b) 2 weeks
 - c) month
 - d) year
 - e) never
13. At full moon, as seen from the Earth, the Moon lies
- a) opposite the Sun
 - b) 90 degrees east of the Sun
 - c) 90 degrees west of the sun
 - d) close to the Sun in the sky
14. There is an eclipse on a day when the Moon rises at 6 pm. Is it an eclipse of the Sun or of the Moon?
- a) Sun
 - b) Moon
 - c) It is not possible to have an eclipse when the Moon rises at 6 pm
15. If the Moon rises at 4 am, what is its phase?
- a) new
 - b) waxing crescent
 - c) waning crescent
 - d) waxing gibbous
 - e) waning gibbous
16. What causes the Moon's phases?
- a) The Earth's shadow covers part of the Moon.
 - b) As the Moon orbits the Earth, the part of the Moon that is lit is a changing fraction of the part that faces the Earth.
 - c) Depending on where the Moon is in its orbit, light from the Sun lights up a larger or smaller part of the Moon's surface.
 - d) The Earth interferes with the Sun's rays in a way that depends on where the Moon is in its orbit.
 - e) None of the above

17. A confused polar bear wakes up 15° south of the North Pole on December 22. She looks up and sees Polaris:
- a) 15° from zenith
 - b) directly overhead
 - c) 75° from zenith
 - d) she doesn't see it because the sun is out
18. Pluto's orbit about the Sun has what shape?
- a) ellipse
 - b) circle
 - c) parabola
 - d) hyperbola
 - e) straight line
19. From the following names, who first discovered the moons of Jupiter?
- a) Eratosthenes
 - b) Newton
 - c) Ptolemy
 - d) Copernicus
 - e) Galileo
20. From the following names, who first found that gravity could account for the motion of the planets?
- a) Ptolemy
 - b) Copernicus
 - c) Newton
 - d) Galileo
 - e) Eratosthenes
21. The apparent retrograde motion of Jupiter is caused by the:
- a) real motion of Jupiter's moons
 - b) real motion of Jupiter along its epicycle
 - c) real revolution of the Earth about the Sun
 - d) real motion of our Moon

22. A planet in the solar system whose period is 1 year is what distance from the Sun?
- a) 12 AU
 - b) 8 AU
 - c) 2 AU
 - d) 1 AU
23. The force on a particle traveling at constant speed in a circle points
- a) away from the center of the circle
 - b) tangent to the circle
 - c) toward the center of the circle
 - d) there is no force since the particle is traveling at constant speed
24. Which of the following objects has an apparent motion with retrograde loops?
- a) the Sun
 - b) the Moon
 - c) Polaris
 - d) none of these
 - e) all of these
25. The Earth moves fastest in its orbit when it is
- a) closest to the Sun
 - b) farthest from the Sun
 - c) the speed is constant
26. A rock is in circular orbit about the Sun with a radius 4 AU. What is its period?
- a) 1/16 year
 - b) 1 year
 - c) 2 years
 - d) 4 years
 - e) 8 years

27. The ice planet Hoth has the same radius as the earth but has only half the Earth's mass. If you weigh 100 pounds on Earth, how many pounds would you weigh on Hoth?
- a) 25
 - b) 50
 - c) 100
 - d) 200
 - e) 400
28. You are in a spacecraft orbiting 1,000 km above the surface of a planet that is 1,000 km in radius. How strong is the force of gravity on your spacecraft compared to its force on the surface of the planet?
- a) 4 times weaker
 - b) 2 times weaker
 - c) the same
 - d) 2 times stronger
 - e) 4 times stronger
29. Which of the following objects can never be seen in an opposite direction in the sky from the Sun?
- a) The Moon
 - b) Mars
 - c) Mercury
 - d) Jupiter
30. A comet orbits the Sun with a period of 1,000 years. What is the semi-major axis of its orbit in AU?
- a) 1 AU
 - b) 10 AU
 - c) 100 AU
 - d) 1,000 AU
 - e) 10,000 AU
31. In the Copernican system, the apparent size of Venus is largest when its phase is
- a) crescent
 - b) gibbous
 - c) full
 - d) The apparent size of Venus never changes.

32. The planet Mote Prime has 2 times the radius of Earth, but has the same mass. If you weigh 20 pounds on Mote Prime, how many pounds would you weigh on Earth?
- a) 5 pounds
 - b) 10 pounds
 - c) 20 pounds
 - d) 40 pounds
 - e) 80 pounds
33. The planet Beylix has the same mass as the Earth but only half the radius. A large cat weighs 50 pounds on Earth; how much does it weigh on Beylix?
- a) 25 pounds
 - b) 50 pounds
 - c) 100 pounds
 - d) 200 pounds
 - e) 400 pounds
34. The absorption lines of helium have the same wavelength as its emission lines.
- a) true
 - b) false
35. Match each action of an electron in an atom to its corresponding process.
- A an electron jumps to a lower energy level
 - B an electron leaves its atom
 - C an electron jumps to a higher energy level and
- and
- 1 atom is ionized
 - 2 atom absorbs light
 - 3 atom emits light
- a) A and 1, B and 2, C and 3
 - b) A and 2, B and 1, C and 3
 - c) A and 2, B and 3, C and 1
 - d) A and 3, B and 2, C and 1
 - e) A and 3, B and 1, C and 2

36. What is the wavelength of light with a frequency of 3 MHz? (3 MHz = 3 megahertz = 3×10^6 waves per second.)
- a) 0.1 m
 - b) 1 m
 - c) 10 m
 - d) 100 m
 - e) 1,000 m
37. When an electron emits light, it moves
- a) closer to the nucleus
 - b) further from the nucleus
38. When an object is heated, the light it emits is:
- a) brighter and with longer average wavelength
 - b) dimmer and with longer average wavelength
 - c) brighter and with shorter average wavelength
 - d) dimmer and with shorter average wavelength
39. An element can be identified by looking at its:
- a) spectral lines
 - b) continuous spectrum
 - c) temperature
 - d) gamma-ray bursts
40. When a light source moves away from you, the wavelength of the light you see is:
- a) longer
 - b) shorter
 - c) the same length
41. Aldebaran is a red star, while the Sun's peak wavelength is in the green part of the visible spectrum. (The Sun's blue light is scattered by the air, giving us a blue sky and leaving the Sun looking yellow.) Compared to the Sun's surface, Aldebaran's surface is
- a) hotter
 - b) cooler
 - c) the same
 - d) there is not enough information given to answer this question

42. When light passes you, the number of crests that pass per second is called the of the wave.
- a) wavelength
 - b) frequency
 - c) amplitude
 - d) period
43. What kinds of particles comprise the nucleus of an atom?
- a) electrons and protons
 - b) protons and neutrons
 - c) electrons and neutrons
 - d) none of these
44. Human body temperature is about 310 K. At what wavelength is most of the light we emit?
- a) radio
 - b) infrared
 - c) visible
 - d) x-ray
 - e) gamma ray
45. A star emits light with a blackbody spectrum and a peak wavelength of 3×10^3 nm. What is the temperature of the star's surface?
- a) 100 K
 - b) 1,000 K
 - c) 3,000 K
 - d) 10,000 K
 - e) 30,000 K