

**Instructions**

This exam is **closed book and closed notes**, although you may use a calculator (much of the math on the exam may be easy enough to work without a calculator, but if you need to borrow one *please ask!*). Formulas and constants you might want during the exam are given on the last pages. The exam consists of 50 multiple choice questions. Please mark with a number 2 pencil your answers on a blue 5-answer scan sheet (only one answer per question). **Fill in the bubbles for your name!!!** Completely erase any stray marks. In the special code section please fill in "EXAM 1". Please don't cheat and make your best effort. Good luck!

**Multiple Choice (50 questions)**

1. Which of the following is largest?
  - a) 1 AU
  - b) 1 light-year
  - c) diameter of the Sun
  - d) a million miles
  - e) distance between the Sun and Jupiter
  
2. Which of the following is smallest?
  - a) Diameter of the Earth
  - b) 1 AU
  - c) 1 light-second
  - d) Diameter of the Sun
  - e) diameter of the Milky Way
  
3. About how many Earths could you fit between the Earth and the moon in its orbit?
  - a) 0.3
  - b) 1
  - c) 3
  - d) 10
  - e) 30
  
4. About how many Earths could you fit across the diameter of the Sun?
  - a) 1/10
  - b) 1
  - c) 10
  - d) 100
  - e) 1000

5. If you were at the South Pole during that hemisphere's winter, you would see:
- The sun rise in the east and set in the west.
  - The stars rise in the east and set in the west.
  - The stars spinning around you once per 24 hours, from left to right.
  - The stars spinning around you once per 24 hours, from right to left.
  - Stationary stars in the sky.
6. Which defines the Zodiac constellations?
- The constellations lie in the plane of the Milky Way
  - The constellations lie in the plane of the ecliptic
  - The constellations lie in the plane of the celestial equator
  - The constellations correspond to the same story in Greek mythology
  - The constellations were favored by astrologers
7. You are standing on Earth's North Pole. Which way is Polaris, the North star?
- Directly down, on the other side of Earth
  - on the southern horizon
  - directly overhead
  - The answer depends on whether it's winter or summer.
  - The answer depends on what time of day (or night) it is.
8. Pegasus is visible on summer evenings but not winter evenings because of
- daylight savings time.
  - the tilt of Earth's axis.
  - the precession of Earth's axis.
  - the location of Earth in its orbit.
  - interference from the full Moon.
9. Why do we have seasons on Earth?
- The tilt of Earth's axis constantly changes between 0 and  $23\frac{1}{2}$  degrees, giving us summer when Earth is tilted more and winter when it is straight up.
  - Earth's distance from the Sun varies, so that it is summer when we are closer to the Sun and winter when we are farther from the Sun.
  - Seasons are caused by the influence of the planet Jupiter on our orbit.
  - As Earth goes around the Sun and Earth's axis remains pointed toward Polaris, the Northern and Southern hemispheres alternately receive more and less direct sunlight.
  - The phase of the moon controls how much sunlight is reflected to heat the Earth.
10. What is the best explanation for why it is summer in the Northern Hemisphere when it is winter in the Southern Hemisphere?
- The Northern Hemisphere is tilted toward the Sun and receives more direct sunlight.
  - The Northern Hemisphere is closer to the Sun than the Southern Hemisphere.
  - The Northern Hemisphere is tilted away from the Sun and receives more indirect sunlight.
  - The Northern Hemisphere is "on top" of Earth and therefore receives more sunlight.
  - It isn't: both hemispheres have the same seasons at the same time.

11. Why do most houses in Wyoming feature south-facing windows?
- a) because in the winter the sun is very much toward the southern horizon
  - b) because of tradition
  - c) because the northern lights are too bright
  - d) to avoid the rising and setting sun
  - e) they're not south-facing, but actually north-facing
12. On the spring equinox, at noon, from Laramie, where could we expect to see the sun in the sky?
- a) directly overhead
  - b) to the east, partway up in the sky
  - c) to the west, partway up in the sky
  - d) to the north, partway up in the sky
  - e) to the south, partway up in the sky
13. In Laramie, how much time is an individual star above the horizon?
- a) Exactly 12 hours
  - b) Less than 12 hours in winter, more than 12 hours in summer
  - c) Less than 12 hours in summer, more than 12 hours in winter
  - d) It is different for different stars
  - e) The same as the Sun
14. What phase of the moon can be most easily seen during the daytime when the sun is up?
- a) full moon
  - b) waxing crescent moon
  - c) waning gibbous moon
  - d) waxing gibbous moon
  - e) none, because the moon is not in the sky during the daytime
15. If the Moon is setting at dawn, the phase of the Moon must be
- a) full.
  - b) first quarter.
  - c) waxing crescent.
  - d) waning crescent.
  - e) third quarter.
16. If the Moon is setting at midnight, the phase of the Moon must be
- a) waning crescent.
  - b) full.
  - c) first quarter.
  - d) third quarter.
  - e) waxing crescent.

17. At approximately what time would the first quarter Moon be on your meridian?
- a) midnight
  - b) 6 A.M.
  - c) 9 A.M.
  - d) 6 P.M.
  - e) noon
18. At approximately what time would the 3<sup>rd</sup> quarter Moon rise?
- a) midnight
  - b) 6 A.M.
  - c) 9 A.M.
  - d) 6 P.M.
  - e) noon
19. In which general direction does a full Moon set?
- a) north
  - b) west
  - c) south
  - d) east
  - e) The full Moon never sets.
20. If it's 9pm in Laramie and the moon is full, where would you look to see it?
- a) Toward the East, low on the horizon.
  - b) Toward the West, low on the horizon.
  - c) Toward the South, high up in the sky.
  - d) Toward the Southeast, moderately high in the sky.
  - e) Toward the Southwest, moderately high in the sky.
21. Suppose you lived on the Moon. How long is a day (i.e., from sunrise to sunrise)?
- a) 24 hours
  - b) about two weeks
  - c) a year
  - d) about month
  - e) about 18 years
22. How many arc seconds are in 1 degree?
- a) 60
  - b) 120
  - c) 90
  - d) 1800
  - e) 3600
23. Which of the following is one of Kepler's Laws of Planetary Motion?
- a) The square of a planet's period is proportional to its distance from the sun cubed.
  - b) Planets move around the sun at a constant speed.
  - c) The cube of a planet's size is inversely proportional to its period.
  - d) Planets move around the sun in circular orbits.
  - e) Planets orbit in 3:2 resonances with each other.

24. From Kepler's third law, an asteroid with an average distance from the sun of 0.5 AU has a period of:
- a) 1 Earth year.
  - b) 1/2 Earth year.
  - c) less than 1/2 Earth year.
  - d) 2 Earth years.
  - e) It depends on the planet's mass.
25. Which of the following is an example in which you are traveling at constant speed but not at constant velocity?
- a) jumping up and down, with a period of exactly 60 hops per minute
  - b) driving backward at exactly 50 km/hr
  - c) driving around in a circle at exactly 100 km/hr
  - d) rolling freely down a hill in a cart, traveling in a straight line
  - e) none of the above
26. In which of the following cases would you feel weightless?
- a) while traveling through space in an accelerating rocket
  - b) while falling from an airplane with your parachute open
  - c) while walking on the Moon
  - d) while falling off a building
  - e) while taking an exam
27. According to the universal law of gravitation, if you cut the masses of BOTH attracting objects in half, then the gravitational force between them will
- a) not change at all.
  - b) increase by a factor of 2.
  - c) increase by a factor of 4.
  - d) decrease by a factor of 2.
  - e) decrease by a factor of 4.
28. According to the universal law of gravitation, if you double the distance between two objects, then the gravitational force between them will
- a) decrease by a factor of 2.
  - b) increase by a factor of 2.
  - c) decrease by a factor of 4.
  - d) increase by a factor of 4.
  - e) decrease by a factor of 8.
29. If you're in an elevator and the cable breaks such that it begins to free fall, beside the fact that you may be in trouble, which is true?
- a) Your weight drops to zero.
  - b) Your mass drops to zero.
  - c) Your weight stays the same.
  - d) Your mass increases.
  - e) Your weight increases.

30. Galileo observed all of the following. Which observation offered direct proof of a planet orbiting the Sun?
- patterns of shadow and sunlight near the dividing line between the light and dark portions of the Moon's face
  - phases of Venus
  - four moons of Jupiter
  - The Milky Way is composed of many individual stars
31. In science, a broad idea that has been repeatedly verified so as to give scientists great confidence that it represents reality is called \_\_\_\_\_.
- a Ptolemaic model
  - a hypothesis
  - a theory
  - a paradigm
  - a wild-ass guess
32. What can we say about comets with very eccentric orbits?
- They spend most of their time far from the sun.
  - They spend most of their time close to the sun.
  - They spend equal amounts of time close to and far from the sun.
  - We cannot conclude any of the above.
33. Which statement is most correct?
- The Earth goes around the sun.
  - The sun goes around the Earth.
  - The Earth is stationary and the stars move around it.
  - Both the Earth and the sun orbit around a common center of mass.
  - Both the Earth and the sun orbit around the focus of Earth's elliptical orbit.
34. Suppose you drop a 10-pound weight and a 5-pound weight on the Moon, both from the same height at the same time. What will happen?
- The 5-pound weight will hit the ground before the 10-pound weight.
  - The 10-pound weight will hit the ground before the 5-pound weight.
  - Both will hit the ground at the same time.
  - Both weights will float freely, since everything is weightless on the Moon.
  - It depends on the density, not the weight, what will happen on the Moon.
35. The acceleration of gravity on Earth is approximately  $10 \text{ m/s}^2$  (more precisely,  $9.8 \text{ m/s}^2$ ). If you drop a blood-filled pumpkin from a tall building, about how fast will it be falling after 3 seconds?
- 30 m/s
  - 10 m/s
  - $30 \text{ m/s}^2$
  - 20 m/s
  - $10 \text{ m/s}^2$

36. Each of the following lists two facts. Which pair of facts can be used with Newton's version of Kepler's third law to determine the mass of the Sun?
- a) Earth is 150 million km from the Sun and orbits the Sun in one year.
  - b) Mercury is 0.387 AU from the Sun and Earth is 1 AU from the Sun.
  - c) Earth rotates in one day and orbits the Sun in one year.
  - d) The mass of Earth is  $6 \times 10^{24}$  kg and Earth orbits the Sun in one year.
  - e) The Moon orbits the Earth once a month at a distance of 384,000 km.
37. The tides are largest when...
- a) The Moon is at new or full phase.
  - b) The Moon is at first or third quarters.
  - c) The Moon is at a node in its orbit.
  - d) The Moon is the Constellation Aquarius.
  - e) There is not a relationship between lunar phase and tides.
38. Which is true about radio waves?
- a) They travel at the speed of sound.
  - b) They travel at the speed of light.
  - c) They don't travel at all, just resonate in infinite space.
  - d) They have higher energies than gamma rays.
  - e) They have higher frequencies than X-rays.
39. Which part of the electromagnetic spectrum has the highest energy photons?
- a) Gamma Rays
  - b) X-rays
  - c) Far-Ultraviolet
  - d) Far infrared
  - e) Radio Waves
40. Which part of the electromagnetic spectrum do YOU emit light at?
- a) Gamma Rays
  - b) X-rays
  - c) Ultraviolet
  - d) Optical
  - e) Infrared
41. If two objects have the same temperature, but one has half the surface area, how much blackbody radiation does it emit compared to the other?
- a) the same
  - b) 1/2x
  - c) 1/4x
  - d) 1/8x
  - e) 1/16x

42. If the light from a distant star is redshifted due to the Doppler effect, how must the frequency change?
- It doesn't. It stays the same.
  - It must increase.
  - It must decrease.
  - Light doesn't have frequency.
43. Which of the following is impossible to learn from the spectrum of a star?
- Its temperature.
  - Its speed toward/away from us.
  - Its chemical composition.
  - Its total speed in space relative to us.
  - Its color.
44. When something is moving toward you very fast, how does its spectrum change?
- It is shifted to the blue (higher energies)
  - It is shifted to the red (lower energies)
  - It doesn't change at all.
  - It becomes polarized.
  - It develops absorption lines.
45. Why isn't there an eclipse of the sun every month?
- There is one, but just not always over the same location on Earth.
  - There is one, but it is often cloudy and hard to tell.
  - The Moon's orbit is in the plane of the Milky Way.
  - The Moon's orbit is in the plane of the celestial equator.
  - The Moon's orbit is tilted relative to the Ecliptic.
46. What phase must the moon be in for there to be a total lunar eclipse?
- Full
  - New
  - First Quarter
  - Third Quarter
  - It can be in any phase.
47. What principle causes a skater to spin faster when he pulls in his arms?
- Conservation of angular momentum.
  - Conservation of energy.
  - The first law of thermodynamics.
  - Kepler's second law.
  - Newton's first law of motion.
48. The Sun's path, as viewed from the equator, is highest in the sky on \_\_\_\_\_.
- the day when Earth is closest to the Sun
  - the winter solstice
  - the summer solstice
  - the spring and fall equinoxes
  - it's the same maximum height in the sky (overhead) every day there



49. Which of the following correctly lists our "cosmic address" from small to large?  
Which of the following correctly lists our "cosmic address" from small to large?

- a) Earth, solar system, Milky Way Galaxy, Local Group, Local Supercluster, universe.
- b) Earth, solar system, Local Group, Local Supercluster, Milky Way Galaxy, universe.
- c) Earth, Milky Way Galaxy, solar system, Local Group, Local Supercluster, universe.
- d) Earth, solar system, Local Group, Milky Way Galaxy, Local Supercluster, universe.
- e) Earth, solar system, Milky Way Galaxy, Local Supercluster, Local Group, universe.

50. The universe is...

- a. Big. Really big.
- b. Not so big.
- c. Easy to comprehend.
- d. Devoid of light and matter.
- e. A smile on a dog.

## Potentially Useful Relationships/Formulas/Figures

$$\frac{\text{Angular diameter}}{206265 \text{ arcsec}} = \frac{\text{linear diameter}}{\text{distance}}$$

Kepler's third law:  $P^2$  is proportional to  $a^3$ ; specifically  $a^3 = (GM/4\pi^2)P^2$

$c$  = speed of light =  $3 \times 10^8$  m/s; 1 AU =  $1.5 \times 10^{11}$  m;  $g = 10$  m/s/s

Photon Energy:  $E = hc/\lambda$ , where Planck's Constant is  $h = 6.63 \times 10^{-34}$  J s

Classical Doppler shift:  $V/c = \Delta\lambda/\lambda_0$ , where  $\lambda$  is wavelength

Wien's Law:  $\lambda_{\text{max}} = 3000000/T$  ( $\lambda$  in nm, T in degrees Kelvin)

Steffan-Boltzmann Law:  $E = \sigma T^4$ , where  $\sigma = 5.7 \times 10^{-8}$  J/m<sup>2</sup> deg<sup>4</sup>

