

# Midterm 1 - Ay2 Fall 08 - Final version

## Key

Select the \*best\* answer to each question.

You must turn in this exam with your scantron in order to get credit for the exam. You may write your name on this exam if you want to get it back next week.

1. Which of the following objects is obeying Newton's laws of motion?

- A. A sleeping cat
- B. A communications satellite orbiting the Earth
- C. A skydiver falling under the force of gravity
- D.** A, B, and C are correct
- E. B and C are correct

2. Star A is blue, Star B is yellow, and Star C is red. Which one of these is the hottest star?

- A. Star C
- B. Star B
- C.** Star A
- D. From color, temperature cannot be predicted

3. In the Northern Hemisphere, between what dates does the location of the Sun's rising and setting shift a little farther north each day?

- A. From September 23 until March 21
- B. From June 21 until September 21
- C.** From December 21 until June 21
- D. From March 21 until June 21
- E. From December 21 until March 21

4. \_\_\_\_\_ spectrum has bright lines on dark background.

- A. Absorption
- B.** Emission
- C. Continuous
- D. None of these

5. The Lorentz factor,  $\gamma$ , is \_\_\_\_\_ for a stationary object. In the equation,  $V$  is the velocity of an object and  $c$  is the speed of light (300,000 km/s).

- A. Unknown
- B.** One
- C. Infinity
- D. Zero

6. A gas emits a spectral line at 100 nm and another spectral line at 1000 nm. Which of the following statements

regarding the origin of the two lines is correct?

- A. The 100 nm line is produced by a colder atom
- B. The 1000 nm line is emitted by an atom moving away 10 times faster than the atom emitting the 100 nm line
- C. The energy change producing the 1000 nm line is 10 times larger than the change producing the 100 nm line
- D.** The energy change producing the 100 nm line is 10 times larger than the change producing the 1000 nm line

7. Which of the following statements is true?

- A. X-rays have higher energy, hence they move faster than visible light
- B. X-rays have higher energy, but still they move slower than visible light
- C.** Even though X-rays have higher energy, they move with the same speed as that of visible light
- D. None of the above

8. Solar eclipses can occur during \_\_\_\_ Moon.

- A.** The new
- B. Any phase of the
- C. The waxing crescent
- D. The waning crescent
- E. The full

9. The identity of a chemical element is determined by...

- A.** The number of protons in the nucleus of the atom.
- B. The number of electrons orbiting the nucleus of the atom.
- C. The number of neutrons in the nucleus of the atom.
- D. All of the above
- E. Only A and B above

10. Suppose that the Earth's spin would suddenly reverse direction, but the direction of the Earth's motion around the Sun was preserved. Which of the following changes would you expect to observe?

- A. The Sun would rise in the West and set in the East
- B. The stars would rise in the West and set in the East
- C. The planets would rise in the West and set in the East
- D.** All of the above would be observed
- E. Only A and B are correct

11. Which of the following can be determined from Wien's law, which states that ?

- A.** The temperature of the surface of the Sun
- B. The chemical composition of the surface of the Sun
- C. The temperature of a hot, transparent gas cloud.
- D. All of the above
- E. Only A and C are correct

12. Which of the following statements describes the ecliptic?

- A. The path of the Moon on the celestial sphere
- B. The extension of the Earth's equator on the celestial sphere.
- C. The apparent path of the Earth across the celestial sphere when viewed from the Moon.
- D.** The apparent path of the Sun across the celestial sphere.
- E. None of the above.

13. If you push with equal force on a car that weighs 5000 lbs and a car that weighs 9000 lbs, which car will have a higher rate of acceleration? (Assume the parking breaks are off and both cars are in neutral!)

- A.** The 5000 lbs car.
- B. The 9000 lbs car.
- C. Both will accelerate equally

14. An astronaut feels weightless while she is in orbit around Earth because...

- A. she has zero mass in orbit.
- B.** she is moving freely under the force of gravity.
- C. she is outside the gravitational field of the Earth.
- D. she is not accelerating.

15. Why do we see a different set of constellations overhead at night during the different seasons?

- A. Because the celestial sphere revolves around the Earth
- B.** Because the Earth revolves around the Sun
- C. Because the Earth rotates about an axis
- D. Because the Earth is a sphere

16. Due to what property does a body display the tendency to stay in the state of rest or motion?

- A. Acceleration
- B. Pressure
- C. Temperature
- D.** Inertia
- E. Volume

17. Lunar eclipses do not occur every full Moon, because the plane of the orbit of the \_\_\_\_ is tilted relative to the \_\_\_\_\_.

- A. Earth; ecliptic
- B.** Moon; ecliptic
- C. Moon; equator
- D. Sun; ecliptic

18. The \_\_\_\_\_ attraction holds the electron in orbit around the nucleus of the hydrogen atom.

- A. Gravitational
- B. Centrifugal
- C. Nuclear
- D.** Electrical

19. If you double the distance between two bodies, the force of gravity between them would become

- A. One half
- B. Four times

- C.** One fourth
- D. Double too

20. Projected onto the sky, directly above the Earth's equator, lies the \_\_\_\_\_ .

- A. South celestial pole
- B. Ecliptic
- C.** Celestial equator
- D. North celestial pole

21. Mars completes one orbit around the Sun in approximately two Earth years. Mars orbits at an average distance to the Sun of about 1.5 AU, and Mars' mass is about 1/10 of the Earth's mass. Therefore Mars' orbital speed is \_\_\_\_\_ the orbital speed of the Earth.

- A.** About 0.75 times
- B. 1.5 times larger than
- C. About 1/10 of
- D. About 3 times

22. Which of the following statements is true for an object moving away from you at 90% of the speed light?

- A. Any light emitted by that object will be redshifted from your perspective.
- B. The object will become shorter from your perspective.
- C. The clock attached with the object will tick very slowly from your perspective.
- D. It will become harder for the object to accelerate from your perspective.
- E.** All of the above

23. The speed with which an object needs to move in order to become free of the gravitational pull of the Earth is called

- A. Rotational velocity
- B. Orbital velocity
- C.** Escape velocity
- D. Random velocity

24. When a bus makes a sudden stop the passengers lurch forward as a consequence of \_\_\_\_\_ law.

- A.  $a = v^2/R$
- B.  $V = \sqrt{GM/R}$
- C.  $F = GMm/R^2$
- D.**  $F = ma$ . (The law of inertia)

25. A \_\_\_\_\_ is a particle of light.

- A.** Photon
- B. Proton
- C. Electron

26. An atom consists of

- A. Electrons in the nucleus and protons in the orbits
- B. Negatively charged protons in the nucleus and positively charged electrons in the orbit
- C. Positively charged protons in the nucleus and negatively charged neutrons in the orbit
- D.** None of the above

27. The electron energies are quantized in an atom. This means

- A. The electrons are in bulk
- B.** The electrons can stay only in discrete orbits
- C. The quantity of electrons keep changing
- D. All of the above

28. \_\_\_\_\_ major contribution to astronomy is his extensive series of measurements of planetary positions.

- A. Galileo's
- B. Newton's
- C.** Tycho Brahe's

29. When an object moves at speeds that are close to that of light, its length \_\_\_\_\_.

- A. Changes randomly
- B. Remains the same
- C. Grows
- D.** Contracts

30. An object is moving very fast perpendicular to (across) your line of sight . What shift will you observe in its spectrum?

- A.** No shift
- B. Yellow shift
- C. Blue shift
- D. Red shift

31. When the Moon and the Sun lie exactly in the same direction in the sky from our perspective on Earth, what phase of the Moon would you see?

- A. Half
- B.** New
- C. Crescent
- D. Gibbous
- E. Full

32. The Alpha star in the constellation of Orion shifts its position on the celestial sphere by 0.03 arc seconds per year and the Beta star shifts by 0.001 arc seconds per year. Based on this observation, which of the following conclusions is justifiable?

- A.** The shifts in direction do not provide information on the speed along the line of sight, therefore we cannot draw any conclusion on the shift of the spectral lines

- B. The spectral lines from the Alpha star are more red-shifted
- C. The spectral lines from the Beta star are more red-shifted

33. Full Moon rises at

- A.** Sunset
- B. Sunrise
- C. Noon
- D. Midnight

34. Astronomers observe a star with two planets orbiting around it. Planet A completes a full orbit much faster than Planet B. From Kepler's Laws, we know immediately that

- A.** Planet A is orbiting the star at a much smaller radius than Planet B.
- B. Planet B has more kinetic energy than Planet A.
- C. Planet B is orbiting the star at a much smaller radius than Planet A.

35. What causes the seasons?

- A. The changing distance between the Earth and the Sun
- B. The Earth's spin axis is tilted from the poles of the celestial sphere
- C. The elliptical shape of the Earth's equator
- D.** The tilt of the Earth's spin axis relative to the Earth's orbit

36. You are watching a spaceship moving away from you at 100 km/s. The light coming from its rear will appear to move at the speed of \_\_\_\_\_. Speed of light is 300,000 km/s.

- A. 100 km/s
- B. 300,100 km/s
- C. 299,900 km/s
- D.** 300,000 km/s

37. All the celestial objects appear to rise in the East and set in the West because

- A. The Earth is rotating from east to west
- B. The objects on the celestial sphere are actually moving from east to west around the Earth.
- C.** The Earth is rotating from west to east
- D. The Earth is orbiting around the Sun from east to west

38. Equinox is the time when

- A.** Day and night are equal everywhere on the Earth
- B. All the nights are equally long through out the month
- C. Day is longest in the Northern hemisphere
- D. Day is shortest in the Northern hemisphere

39. Speed of light is about \_\_\_\_\_ cm/s.

- A. 300,000
- B.** 30,000,000,000
- C. 30,000,000
- D. 300

40. What happens when an electron in an atom absorbs a photon?

- A.** The electron moves to a higher energy level
- B. The electron moves to a lower energy level
- C. The electron moves to the nucleus
- D. Both B and C above

41. In Copernicus' model of the solar system, the planets orbited the \_\_\_\_\_ in \_\_\_\_\_ orbits.

- A. Sun, elliptical
- B. Earth, circular
- C.** Sun, circular

42. A star's emission line of 400 nm appeared shifted to 404 nm in the spectrum. What will you conclude from this shift?

- A.** The star is receding from you with the speed of 3000 km/s
- B. The star is receding from you with the speed of 30300 km/s
- C. The star is approaching you with the speed of 30300 km/s
- D. The star is approaching you with the speed of 3000 km/s

43. Suppose that a planet was discovered that has twice the mass and twice the diameter of the Earth. What would be the escape velocity for this planet? (Assume that for Earth the escape velocity is 11000 m/s)

- A. 15.6 km/s
- B.** 11 km/s
- C. 7.8 km/s
- D. 22 km/s

44. An object is 1 meter long when standing still. The speed of light is  $c$ . The length of the object when it is moving at speed  $V$  is observed to be \_\_\_\_\_ meters long.

- A.  $1 / \sqrt{1 - (v/c)^2}$
- B.  $1 / \sqrt{1 - (c/v)^2}$
- C.**  $\sqrt{1 - (v/c)^2}$
- D.  $\sqrt{1 - (c/v)^2}$

45. Spectral lines shifted toward higher frequencies are called \_\_\_\_\_.

- A. Red-shifted
- B.** Blue-shifted

46. What is the average orbital speed of the Earth around the Sun? (Note:  $r = 1.5 \times 10^8$  km and  $P = 3.14 \times 10^7$  s)

- A.** About 30 km/s
- B. 365 days
- C. About  $9.8 \text{ m/s}^2$
- D. About 4.7 km/s

E. 1,000 km/s

47. According to Newton's laws of motion if a body is **not** moving in a straight line at a constant speed,

A. Some net force is acting on it

B. The body is accelerating

C. The body has no inertia.

D. A, B, and C are correct

**E.** A and B are correct.

48. Michelson-Morley experiment was successful in showing that

A. Light travels with different speeds in different directions

B. The space is filled with the transparent substance called ether

C. Light has a dual nature of wave and particle

**D.** The speed of light is constant, irrespective of the velocity of the light source.

E. None of the above