

1 pt Which is Newton's Second Law?

1. A $F=GMm/R^2$
 B $F=ma$
 C $P^2=4\pi/(GM)R^3$
 D $P^2=R^3$, where P is in years and R is in AU.

1 pt The energy of levels 1-4 of hydrogen are 0, 10.2, 12.1, and 12.8 electron volts (eV), respectively. The hydrogen is so cool that the electrons are all in level 1. Does the hydrogen gas absorb photons with energy 1.9 eV? Does the gas absorb photons with energy 10.2 eV?

2. A No for 1.9-eV photons, and no for 10.2-eV photons.
 B No for 1.9-eV photons, and yes for 10.2-eV photons.
 C Yes for 1.9-eV photons, and yes for 10.2-eV photons.
 D Yes for 1.9-eV photons, and no for 10.2-eV photons.

1 pt The energy of levels 1-4 of hydrogen are 0, 10.2, 12.1, and 12.8 electron volts (eV), respectively. The hydrogen is so cool that the electrons are all in level 1. The hydrogen gas absorbs photons of energy 12.8 eV. When the electrons lose energy, light of ___ different energies will be emitted.

3. A 3
 B more than 3
 C 2
 D 1

1 pt Arrange these forms of light in order of increasing wavelength:

4. A x-ray, green, infrared
 B green, infrared, x-ray
 C infrared, x-ray, green
 D infrared, green, x-ray

1 pt Do light sources 1 and 2 (at the front of the room) emit thermal (black body) radiation?

5. A Neither emits thermal radiation.
 B Source 1 does emit thermal radiation; source 2 does not.
 C Both emit thermal radiation.
 D Source 2 does emit thermal radiation; source 1 does not.

1 pt The moon is accelerating primarily because

6. A its direction is changing.
 B it is speeding up.
 C The moon is not accelerating.
 D it is slowing down.

1 pt An apple is dropped from an airplane at an altitude of 30,000 feet, and another from a 20-foot apple tree. Compare their accelerations just before they hit the ground.

7. A The accelerations are the same.
 B The acceleration of the apple dropped from 20 feet is greater.
 C The acceleration of the apple dropped from 30,000 feet is greater.
 D The acceleration of whichever is the more massive apple is greater.

1 pt 186 days elapse from the spring equinox (20 March) to the fall equinox (22 September), whereas 179 days elapse from the fall equinox to the spring. The reason for the shorter winter and longer summer is

8. A the earth speeds up in its orbit in winter when it is closer to the sun.
 B the days are longer in summer.
 C the earth speeds up in its orbit in summer when it is closer to the sun.
 D the nights are longer in winter.

1 pt Mars is moving in retrograde motion when it is

9. A high in the sky at midnight.
 B in the east just before sunrise.
 C high in the sky just after sunset.
 D in the west just after sunset.

1 pt Today the most accurate description of the motion of planets uses the terms

10. A velocity, position, and acceleration.
 B circular orbits.
 C epicycles.
 D elliptical orbits.

1 pt Assume Venus moves around the sun in a circle at the same speed. Would Aristotle consider this motion natural and in need of no explanation?

11. A Yes, Venus is a heavenly object.
 B No, Venus is not at rest.
 C Yes, the speed is the same.
 D No, the direction is not always the same.

1 pt Does Kepler's Third Law $P^2 = \text{constant } R^3$, where P is the period and R is semi-major axis apply to the moons in orbit around Jupiter?

12. Yes. Physical laws are universal.
 No. Jupiter does not have enough mass.
 No. Kepler's Third Law applies only to planets in orbit around stars.
 No. The semi-major axis of the moons is not measured in AU.
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1 pt Moons of Jupiter, the rings of Saturn, and the planet Uranus: which of these did Galileo not discover?

13. Uranus
 Galileo discovered all of them.
 Rings of Saturn
 Moons of Jupiter
-

1 pt Why had no one observed the phases of Venus before Galileo?

14. The phases of Venus are not visible without a telescope.
 Galileo invented a device to block the sunlight.
 Galileo was the first to think to look.
 Galileo had exceptionally good eyes.
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1 pt Xproposed the sun-centered solar system.Y made accurate observations of the planets.Z analyzed the observations of the planets. In order, X, Y, and Z are

15. Copernicus, Kepler, & Tycho.
 Copernicus, Tycho, & Kepler.
 Tycho, Kepler, & Copernicus.
 Kepler, Tycho, & Copernicus.
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1 pt The same comet was seen in 1531, 1607, and 1682. Its semi-major axis is about

16. 9 AU.
 662 AU.
 76 AU.
 18 AU.
-

1 pt Suppose a new comet is discovered with a period of 29.5 years, which is the same as that of Saturn. The orbit of the comet is highly elliptical. Saturn is 9.5 AU from the sun. When the comet is farthest from the sun, it will be about ___ AU from the sun.

17. 9.5
 29
 15
 19
-

1 pt The constellation Orion is not visible in the Fall because

18. it is below the southern horizon.
 some constellations are circumpolar.
 on any particular night, we can only see stars that are directly opposite (180 degrees away from) the Sun in the sky.
 Orion is nearly in the direction of the sun.
-

1 pt Suppose it is new moon. What phase of the Earth would someone on the Moon see at this time?

19. Full Earth
 New Earth
 The Earth does not go through phases as seen from the Moon.
 First quarter Earth
-

1 pt How did the Ptolemaic model explain retrograde motion of the planets?

20. It held that the planets moved along small circles that moved on larger circles around the Earth, and that the combined motion sometimes resulted in backward motion.
 It held that sometimes the planets moved backwards along their circular orbits.
 It held that the planets resided on giant spheres that sometimes turned clockwise and sometimes turned counterclockwise.
 It held that this motion occurs as Earth passes by another planet in its orbit of the Sun.
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1 pt If a giant hand removed earth and put Jupiter in its place in the same path, Jupiter would

21. go around the sun in one year.
 eventually stabilize with a larger semimajor axis.
 go around the sun much faster.
 eventually stabilize in a more circular orbit.
-

Name:

1 pt A net force acting on an object will always cause a change in the object's

- 22. A velocity
- B speed
- C mass
- D direction

1 pt Newton showed that Kepler's laws are

- 23. A natural consequences of the laws of gravitation and motion
- B seriously in error
- C the key to proving that the Earth orbits our Sun
- D actually only three of seven distinct laws of planetary motion

1 pt Which of the following statements about X rays and radio waves is NOT true?

- 24. A X rays have higher frequency than radio waves.
- B X rays and radio waves are both forms of light, or electromagnetic radiation.
- C X rays have shorter wavelengths than radio waves.
- D X rays travel through space faster than radio waves.

1 pt Which of the following conditions lead you to see an absorption line spectrum from a cloud of gas in interstellar space?

- 25. A The cloud is visible primarily because it reflects light from nearby stars.
- B The cloud is cool and very dense, so that you cannot see any objects that lie behind it.
- C The cloud is extremely hot.
- D The cloud is cool and lies between you and a hot star.

1 pt Which of the following has your "cosmic address" in the correct order?

- 26. A You, Earth, Local Group, solar system, Milky Way Galaxy, universe.
- B You, Earth, Milky Way Galaxy, solar system, Local Group, universe.
- C You, Earth, solar system, Local Group, Milky Way Galaxy, universe.
- D You, Earth, solar system, Milky Way Galaxy, Local Group, universe.

Name:

1 pt Thermal radiation is

- 27. A radiation produced by a hot object.
- B radiation in the infrared part of the spectrum.
- C radiation that is felt as heat.
- D radiation that depends only on the temperature and emissivity of the emitting object.

1 pt Visible light can be spread into a spectrum by using

- 28. A a flat mirror.
- B a telescope.
- C a curved mirror.
- D a grating.

1 pt Suppose you know the frequency of a photon. Then you can calculate

- 29. A its acceleration.
- B its temperature.
- C the composition of the object that emitted it.
- D its wavelength.

1 pt When did Johannes Kepler live?

- 30. A About 100 years ago.
- B About 1000 years ago.
- C About 1900 years ago.
- D About 400 years ago.

5 pt Draw a model of the Sun, Earth, and Mars at a time when Mars can be seen at midnight. Draw another model to show the motion over a 9-hour period according to Ptolemy.

31. Leave blank on scoring form

4 pt

A hot, black object does not necessarily emit more thermal radiation than a cool, black one. Explain (in one sentence) how this is possible.

32. Leave blank on scoring form