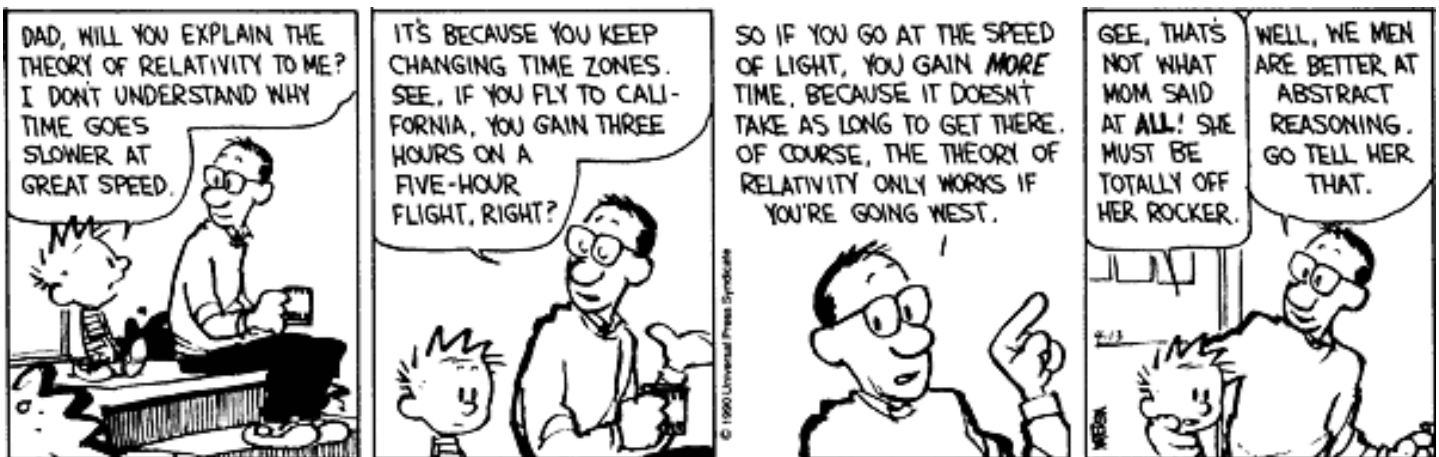


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PHYS 1040 – ELEMENTARY ASTRONOMY EXAM 3: FALL 2011

EXAM VERSION: 0001
PLEASE ENTER THIS ON YOUR SCANTRON



EXAM RULES

Welcome to Exam 3! Take a deep breath, relax. You know how to do astronomy — this is simply covering material you already know how to do.

- * DO NOT begin this exam until you are instructed to do so.
- * This is a closed book exam.
- * You are allowed a pencil and a scientific calculator.
- * **Cell phones are NOT a substitute for a calculator.**

Please ask any questions you have. **Good luck!**

[1] Which of the following statements is not true about the planets so far discovered around other stars?

- (A) Many of them orbit closer to their star than Jupiter orbits the Sun.
- (B) Many of them have been discovered by observing Doppler shifts in the spectra of the stars they orbit.
- (C) Photographs reveal that most of them have atmospheres much like that of Jupiter.
- (D) Most of them are much more massive than Earth.

[2] The terrestrial planets are made almost entirely of elements heavier than hydrogen and helium. According to modern science, where did these elements come from?

- (A) They were produced by stars that lived and died before our solar system was born.
- (B) They were produced by gravity in the solar nebula as it collapsed.
- (C) They have been present in the universe since its birth.
- (D) They were made by chemical reactions in interstellar gas.

[3] What do we mean by the frost line when we discuss the formation of planets in the solar nebula?

- (A) It is another way of stating the temperature at which water freezes into ice.
- (B) It is a circle at a particular distance from the Sun, beyond which the temperature was low enough for ices to condense.
- (C) It is the altitude in a planet's atmosphere at which snow can form.
- (D) It marks the special distance from the Sun at which hydrogen compounds become abundant; closer to the Sun, there are no hydrogen compounds.

[4] Based on everything you have learned about the formation of our solar system, which of the following statements is probably not true?

- (A) Only a tiny percentage of stars are surrounded by spinning disks of gas during their formation.
- (B) Other solar systems will also have planets in the two basic categories of terrestrial and jovian.
- (C) A star system's planets generally tend to orbit their star in the same direction and approximately the same plane.
- (D) Other planetary systems will have far more numerous asteroids and comets than actual planets.

[5] In essence, the Kepler mission is searching for extrasolar planets by _____.

- (A) monitoring stars for slight dimming that might occur as unseen planets pass in front of them
- (B) obtaining high-resolution photographs of other star systems
- (C) observing a star carefully enough to notice that it is experiencing a gravitational tug caused by an unseen planet
- (D) identifying spectral lines that look like what we expect to see from a planet rather than a star

- [6] Which of the following methods has led to the most discoveries of massive planets orbiting near their parent stars?
- (A) detecting the starlight reflected off the planet
 - (B) detecting the infrared light emitted by the planet
 - (C) detecting a planet ejected from a binary star system
 - (D) detecting the gravitational effect of an orbiting planet by looking for the Doppler shifts in the star's spectrum
- [7] Why are many of the newly detected extrasolar planets called "hot Jupiters"?
- (A) Their masses and composition are similar to what we would expect if Jupiter were hotter.
 - (B) Their masses are similar to Jupiter but they are very close to the central star and therefore hot.
 - (C) The planets tend to be detected around more massive, hotter stars than our Sun.
 - (D) Because the discovery of other planets is very exciting.
 - (E) Their masses are similar to Jupiter but their composition is similar to Mercury.
- [8] According to our theory of solar system formation, what are asteroids and comets?
- (A) Chunks of rock or ice that condensed after the planets and moons finished forming
 - (B) The shattered remains of collisions between planets
 - (C) Leftover planetesimals that never accreted into planets
 - (D) Chunks of rock or ice that were expelled from planets by volcanoes
- [9] Where are most of the known asteroids found?
- (A) in the Kuiper belt
 - (B) between the orbits of the terrestrial planets
 - (C) in the Oort cloud
 - (D) between the orbits of the jovian planets
 - (E) between the orbits of Mars and Jupiter
- [10] Which of the following is furthest from the Sun?
- (A) Pluto
 - (B) an asteroid in the asteroid belt
 - (C) a comet in the Kuiper belt
 - (D) Neptune
 - (E) a comet in the Oort cloud
- [11] When you see the bright flash of a meteor, what are you actually seeing?
- (A) A star that has suddenly shot across the sky
 - (B) Emission of visible light from a particle that has not yet entered Earth's atmosphere
 - (C) The glow from a pea-size particle and the surrounding air as the particle burns up in our atmosphere
 - (D) The flash that occurs when a speeding rock from space hits the ground

[12] Suppose there were no solar wind. How would the appearance of a comet in our inner solar system be different?

- (A) It would not have a coma.
- (B) It would have only one tail instead of two.
- (C) It would not have a nucleus.
- (D) It would be much brighter in appearance.

[13] When we see a meteor shower, it means that _____.

- (A) you should duck and run for cover to avoid being blasted on the head by a rock from space
- (B) an Earth-approaching asteroid has recently come very close to our planet
- (C) Earth is crossing the orbit of a comet
- (D) the solar wind is unusually strong

[14] A rock found on Earth that crashed down from space is called _____.

- (A) a meteorite
- (B) a meteor
- (C) an asteroid
- (D) an impact

[15] The asteroid belt is located _____.

- (A) between the orbits of Mars and Jupiter
- (B) beyond the orbit of Neptune
- (C) between the orbits of Earth and Mars
- (D) between the orbits of Jupiter and Saturn

[16] When a comet passes near the Sun, part of it takes on the appearance of a large, bright ball from which the tail extends. This part is called _____.

- (A) the nucleus
- (B) the plasma tail
- (C) the Oort core
- (D) the coma

[17] Which of the following is furthest from the Sun?

- (A) Neptune
- (B) a comet in the Kuiper belt
- (C) an asteroid in the asteroid belt
- (D) Pluto
- (E) a comet in the Oort cloud

[18] Which of the following is not a major difference between the terrestrial and jovian planets in our solar system?

- (A) Terrestrial planets contain large quantities of ice and jovian planets do not.
- (B) Jovian planets have rings and terrestrial planets do not.
- (C) Terrestrial planets orbit much closer to the Sun than jovian planets.
- (D) Terrestrial planets are higher in average density than jovian planets.

[19] Which jovian planet does not have rings?

- (A) Jupiter
- (B) Uranus
- (C) All the jovian planets have rings.
- (D) Neptune
- (E) Mars

[20] Which moons are sometimes called the Galilean moons?

- (A) The moons orbiting Uranus, which was once named "planet Galileo"
- (B) The moons that orbit their planet "backward" compared to their planet's rotation, such as Neptune's moon Triton
- (C) The four largest moons of Jupiter: Io, Europa, Ganymede, and Callisto
- (D) The two largest moons in the solar system: Ganymede and Titan

[21] Which jovian planet should have the most extreme seasonal changes?

- (A) Jupiter
- (B) Neptune
- (C) Saturn
- (D) Uranus

[22] Which of the following is most unlikely to be found on Titan?

- (A) Lakes of liquid methane ethane
- (B) Volcanic outgassing of methane and other gases
- (C) Lakes of liquid water in the warmer equatorial regions
- (D) Rain or snow consisting of methane or ethane droplets or ice crystals

[23] Which of the following is not a general characteristic of the four jovian planets in our solar system?

- (A) They are higher in average density than are the terrestrial planets.
- (B) They lack solid surfaces.
- (C) They are composed mainly of hydrogen, helium, and hydrogen compounds.
- (D) They are much more massive than any of the terrestrial planets.

[24] What is the Great Red Spot?

- (A) A region on Jupiter where the temperature is so high that the gas glows with red visible light
- (B) A place where reddish particles from Io impact Jupiter's surface
- (C) A long-lived, high-pressure storm on Jupiter
- (D) A hurricane that comes and goes on Jupiter

- [25] Which of the following statements about the moons of the jovian planets is not true?
- (A) One of the moons has a thick atmosphere.
 - (B) Some of the moons are big enough that we'd call them planets (or dwarf planets) if they orbited the Sun.
 - (C) Many of the moons are made largely of ices.
 - (D) Most of the moons are large enough to be spherical in shape, but a few have the more potato-like shapes of asteroids.
- [26] Which statement about Io is true?
- (A) It is thought to have a deep, subsurface ocean of liquid water.
 - (B) It is the only moon in the solar system with a thick atmosphere.
 - (C) It is the largest moon in the solar system.
 - (D) It is the most volcanically active body in our solar system.
- [27] In what way is Venus most similar to Earth?
- (A) Both planets have warm days and cool nights.
 - (B) Both planets are nearly the same size.
 - (C) Both planets have very similar atmospheres.
 - (D) Both planets have similar surface geology.
- [28] Mars has two moons that are most similar in character to:
- (A) Earth's Moon.
 - (B) small asteroids.
 - (C) comets.
 - (D) particles in the rings of Saturn.
- [29] Which of the following statements about Mars is not true?
- (A) We could survive on Mars without spacesuits, as long as we brought oxygen in scuba tanks.
 - (B) It is considered part of our inner solar system.
 - (C) We have landed spacecraft on its surface.
 - (D) It is frozen today, but once had flowing water.
- [30] What is the giant impact hypothesis for the origin of the Moon?
- (A) The Moon formed from material blasted out of the Earth's mantle and crust by the impact of a Mars-size object.
 - (B) The Moon formed when two gigantic asteroids collided with one another.
 - (C) The Moon formed just like the Earth, from accretion in the solar nebula.
 - (D) The Moon originally was about the same size as Earth, but a giant impact blasted most of it away so that it ended up much smaller than Earth.
- [31] Why is Venus so much hotter than the Earth?
- (A) Because it is closer to the Sun.
 - (B) Because its clouds have a very high reflectivity.
 - (C) Because it has much more carbon dioxide in its atmosphere.
 - (D) Because it rotates backwards compared to its orbital rotation.

- [32] Rank these planets in order of the strength of the greenhouse effect on the planet, from the least to the greatest.
- (A) Mercury, Earth, Mars, Venus
 - (B) Mercury, Mars, Earth, Venus
 - (C) Mars, Earth, Venus, Mercury
 - (D) Mercury, Venus, Earth, Mars
 - (E) Mars, Mercury, Earth, Venus
- [33] Which of the following best describes how the Drake equation is useful?
- (A) It tells us what wavelengths of light will be most useful to examine in the search for extraterrestrial intelligence.
 - (B) It helps us understand what we need to know in order to determine the likelihood of finding other civilizations.
 - (C) It has allowed us to determine the number of civilizations in the Milky Way Galaxy.
 - (D) It allows us to calculate the masses of planets orbiting other stars.
- [34] Which of the following describes a major danger of interstellar travel at near-light speed?
- (A) Atoms and ions in interstellar space will hit a fast-moving spacecraft like a flood of dangerous cosmic rays.
 - (B) Asteroid fields floating in interstellar space will present a navigational challenge.
 - (C) Time dilation will slow the heart beats of the crew to a dangerously low rate.
 - (D) Any interstellar journey will take much longer than the lives of the crew members.
- [35] The Sun's habitable zone _____.
- (A) extends from the orbit of Earth to the orbit of Jupiter
 - (B) extends from some place a little beyond the orbit of Venus to some place near the orbit of Mars
 - (C) consists only of Earth, since Earth is the only planet known to be inhabited
 - (D) extends from just beyond the orbit of Mercury to just beyond Earth's orbit
- [36] The "rare Earth hypothesis" holds that Earth-like planets will prove to be quite rare. Which of the following statements best sums up the current status of the debate over this hypothesis?
- (A) The debate raged for a while, but is now settled. We are now quite certain that Earth-like planets are common.
 - (B) It is no longer discussed, because as part of its broad cover-up of UFOs, the United States government has classified all the material relating to this debate as Top Secret.
 - (C) The debate raged for a while, but is now settled. We are now quite certain that Earth-like planets are rare.
 - (D) We do not have enough data to settle the debate, because counterarguments can be made for each argument suggesting Earth-like planets may be rare.

[37] At present, what is the primary way that the search for extraterrestrial intelligence (SETI) is carried out?

- (A) By searching for planets around distant stars
- (B) By using radio telescopes to search for signals from extraterrestrial civilizations
- (C) By seeking access to the secret records and alien corpses kept at the military's Area 51 in Nevada
- (D) By analyzing high-resolution images of nearby stars in search of evidence for structures that could not have developed naturally
- (E) By using X-ray telescopes to search for exhaust from interstellar spacecraft

[38] Einstein's theory of relativity tells us that travelers who make a high-speed trip to a distant star and back will _____.

- (A) have more fun than people who stay behind on Earth
- (B) never be able to make the trip within their lifetimes
- (C) age less than people who stay behind on Earth
- (D) age more than people who stay behind on Earth

[39] The only place outside of Earth for which there is irrefutable evidence for ancient, microbial life is

- (A) the Moon.
- (B) Mars.
- (C) Titan.
- (D) Europa.
- (E) None of the above - there is no irrefutable evidence for life beyond Earth.

[40] The analysis of Martian meteorites found on the Earth show that they contain

- (A) bacteria with DNA very different from bacteria on Earth.
- (B) fossilized remains of small, mammal-like creatures.
- (C) only tantalizing hints of possible life.
- (D) fossilized remains of multi-cellular insects.
- (E) bacteria with DNA closely related to bacteria on Earth.

[41] Which of the following are the best candidates to search for planets that might harbor extraterrestrial life?

- (A) Massive stars (greater than twice the mass of the Sun) because they provide more energy to promote biology.
- (B) Binary stars because they provide twice as much energy to promote biology.
- (C) Low mass stars (less than one-tenth of the mass of the Sun), because these are the most common stars in our galaxy.
- (D) Solar-mass stars because they have both a large habitable zone and a long stellar lifetime.

[42] What defines the habitable zone around a star?

- (A) the region around a star outside of its hot, tenuous corona
- (B) the region around a star where its ultraviolet radiation is too weak to destroy biological organisms on a planetary surface
- (C) the region around a star where liquid water can exist on planetary surfaces
- (D) the region around a star where humans can survive
- (E) the region around a star where rocky planets can form

[43] In 1974, a radio message was sent out from the Arecibo observatory in Puerto Rico towards a globular cluster, 21,000 light-years away. Approximately how far has this message gotten as of today?

- (A) It's just passing stars that are close neighbors to the Sun in the Milky Way.
- (B) It's already arrived at the globular cluster.
- (C) It's just beyond the Neptune in our solar system.
- (D) It's just passing through the Oort cloud surrounding our solar system.
- (E) It's almost at the center of the Milky Way.

[44] Which of the following statements about our Sun is not true?

- (A) The Sun is a star.
- (B) The Sun's diameter is about 5 times that of Earth.
- (C) The Sun is made mostly of hydrogen and helium.
- (D) The Sun contains more than 99% of all the mass in our solar system.

[45] Which of the following puzzles in the solar system cannot be explained by a giant impact event?

- (A) the large metallic core of Mercury
- (B) the orbit of Triton in the opposite direction to Neptune's rotation
- (C) the backward rotation of Venus
- (D) the formation of the Moon
- (E) the extreme axis tilt of Uranus

[46] Why does the plasma tail of a comet always point away from the Sun?

- (A) Gases from the comet, heated by the Sun, push the tail away from the Sun.
- (B) The solar wind blows the plasma ions directly away from the Sun.
- (C) It is allergic to sunlight.
- (D) Radiation pressure from the Sun's light pushes the ions away.

[47] We have sent several spacecraft on trajectories that will ultimately take them into interstellar space (Pioneer 10 and 11, Voyager 1 and 2, New Horizons). How long will it take these spacecraft to travel as far as the nearest stars?

- (A) A few hundred years
- (B) Tens of thousands of years
- (C) About a thousand years
- (D) Never, because they will rust and fall apart
- (E) A few decades

- [48] How does the Kepler mission plan to detect Earth-like planets around other stars?
- (A) by observing the spectrum of the planet
 - (B) by directly imaging the planet in the infrared
 - (C) by measuring the slight shift in position of the central star as it is tugged to and fro by the planet
 - (D) by observing the slight dip in brightness of the central star as the planet transits
 - (E) by measuring the Doppler shift in spectral lines as the central star is tugged to and fro by the planet

[49] You observe a star very similar to our own Sun in size and mass. This star moves very slightly back and forth in the sky once every 4 months, and you attribute this motion to the effect of an orbiting planet. What can you conclude about the orbiting planet?

- (A) The planet must be closer to the star than Earth is to the Sun.
- (B) The planet must be farther from the star than Neptune is from the Sun
- (C) You do not have enough information to say anything at all about the planet
- (D) The planet must have a mass about the same as the mass of Jupiter

[50] In essence, the nebular theory holds that _____.

- (A) the planets each formed from the collapse of its own separate nebula
- (B) our solar system formed from the collapse of an interstellar cloud of gas and dust.
- (C) nebulae are clouds of gas and dust in space
- (D) The nebular theory is a discarded idea that imagined planets forming as a result of a near-collision between our Sun and another star.