

Name _____

Please write and mark your name and student number in the Scantron answer sheet. FILL THE BUBBLE IN THE "TEST FORM" BOX CORRESPONDING TO YOUR TEST VERSION (listed as an alphabet prefix to the page number at the bottom). Mark all answers in the Scantron sheet. Answer the optional bonus questions in the space provided. When you are done, turn in your Scantron answer sheet and the bonus questions page. Please DO NOT staple the two pages.

Each multiple choice question carries 6 points. Each TRUE/FALSE question carries 3 points. For the TRUE/FALSE questions, answer (A) for TRUE and (B) for FLASE. Some questions will require calculations to determine the answer and you may use the space provided in this paper to work these out, but you need not turn this work in. You may use a calculator, but cannot use your notes, textbook, cell phones, neighbor, or any other source to help your work on this test.

Good Luck!

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 1) What do astronomers mean by *light pollution*?
 - A) Light pollution is another name for sunlight, which makes it impossible to see stars in the daytime.
 - B) Light pollution refers to light used for human activities that brightens the sky and hinders astronomical observations.
 - C) Light pollution refers to pollution caused by light industry as opposed to heavy industry
 - D) Light pollution refers to harmful gases emitted by common street lights.
 - E) Light pollution refers to the lights that must be used inside major observatories and that make it difficult for astronomers' eyes to adapt to darkness.
- 2) Which of the following statements best describes the two principal advantages of telescopes over eyes?
 - A) Telescopes have much more magnification and better angular resolution.
 - B) Telescopes can collect far more light with far better angular resolution.
 - C) Telescopes collect more light and are unaffected by twinkling.
 - D) Telescopes can collect far more light with far greater magnification.
 - E) Telescopes can see farther without image distortion and can record more accurate colors.
- 3) Which of the following is *not* a good reason to place observatories on remote mountain tops?
 - A) to reduce light pollution
 - B) to be able to observe at radio wavelengths
 - C) to reduce light absorption
 - D) to reduce light distortion
 - E) to be able to observe at infrared wavelengths
- 4) What does the technique of interferometry allow?
 - A) It allows the same telescope to make images with both radio waves and visible light.
 - B) It allows two or more telescopes to obtain a total light-collecting area much larger than the total light-collecting area of the individual telescopes.
 - C) It allows astronomers to make astronomical observations without interference from light pollution.
 - D) It allows two or more telescopes to obtain the angular resolution of a single telescope much larger than any of the individual telescopes.
 - E) It allows us to determine the chemical composition of stars.

- 5) Which of the following wavelength regions cannot be studied with telescopes on the ground?
- A) radio waves
 - B) X rays
 - C) ultraviolet
 - D) both B and C
 - E) both A and C
- 6) Which of the following is *not* an advantage of the Hubble Space Telescope over ground-based telescopes?
- A) Observers on the ground can use it at any time of day (*i.e.*, not only during their night).
 - B) Stars do not twinkle when observed from space.
 - C) It never has to close because of bad weather.
 - D) It is closer to the stars.
 - E) It can observe infrared and ultraviolet light, as well as visible light.
- 7) How does the Sun's mass compare with that of the planets?
- A) It is a hundred times more massive than the earth.
 - B) It is a thousand times more massive than the earth.
 - C) It is a hundred times more massive than all the planets combined.
 - D) It is about as massive as all the planets combined.
 - E) It is a thousand times more massive than all the planets combined.
- 8) Where does nuclear fusion occur in the Sun?
- A) in its core
 - B) on the surface
 - C) just above the visible surface
 - D) anywhere below the surface
 - E) all of the above
- 9) Which of the following is furthest from the Sun?
- A) an asteroid in the asteroid belt
 - B) Pluto
 - C) a comet in the Oort cloud
 - D) Neptune
 - E) a comet in the Kuiper belt
- 10) Which planet has the highest *average* surface temperature, and why?
- A) Mars, because of its red color
 - B) Mercury, because of its dense carbon dioxide atmosphere
 - C) Jupiter, because it is so big
 - D) Mercury, because it is closest to the Sun
 - E) Venus, because of its dense carbon dioxide atmosphere
- 11) Which is the densest planet in the solar system?
- | | | | | |
|----------|------------|----------|------------|---------|
| A) Earth | B) Jupiter | C) Venus | D) Mercury | E) Mars |
|----------|------------|----------|------------|---------|
- 12) The planet closest in size to Earth is
- | | | | | |
|-----------|----------|-----------|-------------|--------------|
| A) Venus. | B) Mars. | C) Pluto. | D) Mercury. | E) the Moon. |
|-----------|----------|-----------|-------------|--------------|

- 13) Which of the following is *not* a characteristic of the inner planets?
- A) They all have substantial atmospheres.
 - B) They are relatively smaller than the outer planets.
 - C) Their orbits are relatively closely spaced.
 - D) They all have solid, rocky surfaces.
 - E) They have very few, if any, satellites.
- 14) Which of the following is *not* a characteristic of the outer planets?
- A) They all have rings.
 - B) They have very few, if any, satellites.
 - C) They are primarily made of hydrogen and helium.
 - D) They are all large balls of gas.
 - E) Their orbits are separated by relatively large distances.
- 15) What happened during the *accretion* phase of the early solar system?
- A) Atoms and molecules in the gas bonded together and solidified.
 - B) Earth gained its oceans from icy planetesimal capture.
 - C) Particles grew by colliding and sticking together.
 - D) Large planetesimals captured atmospheres from the solar nebula.
 - E) The solar nebula differentiated into metals inside of the frost line and ices beyond.
- 16) Where are most of the known asteroids found?
- A) between the orbits of Mars and Jupiter
 - B) in the Kuiper belt
 - C) between the orbits of the jovian planets
 - D) between the orbits of the terrestrial planets
 - E) in the Oort cloud
- 17) Some astronomers suggest that, rather than being a planet, Pluto is really just a large member of
- A) the Oort cloud.
 - B) an extrasolar planetary system.
 - C) the Kuiper belt.
 - D) the moon system around Neptune.
 - E) the asteroid belt.
- 18) Suppose you find a rock that contains some potassium-40 (half-life of 1.3 billion years). You measure the amount and determine that there are 10 grams of potassium -40 in the rock. By measuring the amount of its decay product (argon-40) present in the rock, you realize that there must have been 40 grams of potassium -40 when the rock solidified. How old is the rock?
- A) 5.2 billion years
 - B) 1.3 billion years
 - C) 2.6 billion years
 - D) 3.9 billion years
 - E) none of the above

- 19) Since all stars begin their lives with the same basic composition, what characteristic most determines how they will differ?
- A) mass they are formed with
 - B) time they are formed
 - C) color they are formed with
 - D) luminosity they are formed with
 - E) location where they are formed
- 20) The age of our solar system is approximately
- A) 10,000 years.
 - B) 4.6 billion years.
 - C) 3.8 million years.
 - D) 14 billion years.
 - E) 4.6 million years.
- 21) What two forces are balanced in helping stars maintain a stable size?
- A) outward pressure and gravity
 - B) the strong force and gravity
 - C) the strong force and kinetic energy
 - D) the electromagnetic force and gravity
 - E) outward pressure and the strong force
- 22) Why is the spectral sequence of stars (OBAFGKM) not alphabetical?
- A) Because there is still uncertainty over what generates the energy in stellar cores.
 - B) The original alphabetical labeling did not correspond to surface temperature and thus had to be reordered.
 - C) The letters refer to the initials of the original discoverers.
 - D) They were chosen to fit a mnemonic.
 - E) Because it refers to stellar masses and these were difficult to measure accurately.
- 23) Suppose that, for some unknown reason, the core of the Sun suddenly became hotter. Which of the following best describes what would happen?
- A) Higher temperature would cause the rate of fusion to fall, decreasing the internal pressure and causing the core to collapse until the rate of fusion returned to normal.
 - B) Higher temperature would cause the rate of nuclear fusion to rise, which would increase the internal pressure, causing the core to expand and cool until the fusion rate returned to normal.
 - C) Higher temperature would cause the rate of nuclear fusion to rise, which would increase the internal pressure, causing the core to expand and turn the Sun into a giant star.
 - D) The higher temperature would not affect the fusion rate but would cause the core to expand and cool until the temperature returned to normal, with the core at a new, slightly larger size.
- 24) The core of the Sun is
- A) composed of iron.
 - B) at the same temperature but denser than the surface.
 - C) hotter and denser than the surface.
 - D) constantly rising to the surface through convection.
 - E) at the same temperature and density as the surface.

- 25) The spectral sequence sorts stars according to
- A) surface temperature.
 - B) core temperature.
 - C) mass.
 - D) radius.
 - E) luminosity.
- 26) Which of the following best describes the axes of a Hertzsprung–Russell (H–R) diagram?
- A) surface temperature on the horizontal axis and radius on the vertical axis
 - B) mass on the horizontal axis and stellar age on the vertical axis
 - C) mass on the horizontal axis and luminosity on the vertical axis
 - D) surface temperature on the horizontal axis and luminosity on the vertical axis
 - E) interior temperature on the horizontal axis and mass on the vertical axis
- 27) On the main sequence, stars obtain their energy
- A) by converting hydrogen to helium.
 - B) from gravitational contraction.
 - C) from nuclear fission.
 - D) by converting helium to carbon, nitrogen, and oxygen.
 - E) from chemical reactions.
- 28) Which of the following best describes *convection*?
- A) It is the process in which warm material expands and rises while cool material contracts and falls.
 - B) It is the process in which a liquid separates according to density, such as oil and water separating in a jar.
 - C) It is the process in which warm material gets even warmer and cool material gets even cooler.
 - D) It is the process by which rocks sink in water.
 - E) It is the process in which bubbles of gas move upward through a liquid.
- 29) Which of the following most likely explains why Venus does *not* have a strong magnetic field?
- A) It is too close to the Sun.
 - B) It is too large.
 - C) Its rotation is too slow.
 - D) It has too thick an atmosphere.
 - E) It does not have a metallic core.
- 30) Which of the following does *not* have a major effect in shaping planetary surfaces?
- A) erosion
 - B) impact cratering
 - C) tectonics
 - D) magnetism
 - E) volcanism
- 31) What type of stresses broke the earth's lithosphere into *plates*?
- A) cooling and contracting of the planet's interior, which caused the mantle and lithosphere to be compressed
 - B) the circulation of convection cells in the mantle, which dragged against the lithosphere
 - C) internal temperature changes that caused the crust to expand and stretch
 - D) impacts of asteroids and planetesimals
 - E) volcanism, which produced heavy volcanoes that bent and cracked the lithosphere

- 32) How did the lunar *maria* form?
- A) The early bombardment created heat that melted the lunar surface in the regions of the *maria*.
 - B) The *maria* are the result of gradual erosion by micrometeorites striking the Moon.
 - C) The giant impact that created the Moon left smooth areas that we call the *maria*.
 - D) Large impacts fractured the Moon's lithosphere, allowing lava to fill the impact basins.
 - E) Volatiles escaping from the Moon's interior heated and eroded the surface in the regions of the *maria*.
- 33) Why does the Moon have a layer of powdery "soil" on its surface?
- A) It's the result of gradual erosion by micrometeorites striking the Moon.
 - B) Large impacts shattered lunar rock to make this soil.
 - C) The soil exists because the Moon accreted from powdery material after a giant impact blasted the earth.
 - D) The soil is the result of the same processes that make powdery sand on Earth.
 - E) Volatiles escaping from the Moon's interior bubble upward and make the soil.
- 34) Which planet experiences the greatest change between its actual day temperature and actual night temperature?
- A) Mars B) Venus C) Mercury D) Earth E) Moon
- 35) How does the greenhouse effect work?
- A) Greenhouse gases absorb infrared light from the Sun, which then heats the atmosphere and the surface.
 - B) Greenhouse gases transmit visible light, allowing it to heat the surface, but then absorb infrared light from the earth, trapping the heat near the surface.
 - C) The higher pressure of the thick atmosphere at lower altitudes traps heat in more effectively.
 - D) Greenhouse gases absorb X rays and ultraviolet light from the Sun, which then heat the atmosphere and the surface.
 - E) Ozone transmits visible light, allowing it to heat the surface, but then absorbs most of the infrared heat, trapping the heat near the surface.
- 36) Which of the following planets has a stratosphere?
- A) Venus
 - B) Mercury
 - C) Mars
 - D) Earth
 - E) all of the above
- 37) The sky is blue because
- A) molecules scatter red light more effectively than blue light.
 - B) the atmosphere absorbs mostly blue light.
 - C) the Sun mainly emits blue light.
 - D) the atmosphere transmits mostly blue light.
 - E) molecules scatter blue light more effectively than red light.
- 38) The strength of the Coriolis effect depends on
- A) a planet's distance from the Sun.
 - B) the tilt of a planet's axis.
 - C) a planet's size and rotation rate.
 - D) a planet's temperature.
 - E) the amount of greenhouse gases in the atmosphere.

- 39) Why isn't the earth's atmosphere mostly hydrogen?
- A) Earth formed too close to the Sun for any planetesimals to have hydrogen.
 - B) All the hydrogen reacted with oxygen and formed the oceans.
 - C) All the hydrogen was blasted away during the early bombardment stage of the solar system.
 - D) Light gases such as hydrogen move faster than heavier gases and escape from the earth's gravitational field.
 - E) The hydrogen is frozen in the polar ice caps.
- 40) Of the four gases CO₂, H₂O, N₂, and O₂, which are greenhouse gases?
- A) CO₂ and N₂
 - B) CO₂ and H₂O
 - C) only CO₂
 - D) all except O₂
 - E) all four

TRUE/FALSE. Mark answer as (A) if TRUE, and (B) if FALSE.

- 41) A radio telescope and an optical telescope of the same size have the same angular resolution.
- 42) Most astronomical objects emit light over a broad range of wavelengths.
- 43) Improvements in technology will eventually allow the entire electromagnetic spectrum to be observed from high mountaintop observatories.
- 44) All four of the giant outer planets—Jupiter, Saturn, Uranus, and Neptune—have rings.
- 45) All the planets in the solar system have at least one moon.
- 46) The more massive planets in the solar system tend to be *less* dense than the lower mass planets.
- 47) As viewed from above the earth's North Pole, all of the planets orbit the Sun in the same (counterclockwise) direction.
- 48) Earth's atmosphere resulted from the impact of icy planetesimals that originated in the outer regions of the Solar System.
- 49) The Moon probably formed at the same time that the earth formed, rather like the formation of a double planet.
- 50) Based on our theory of how our own solar system formed, we would expect that other solar systems would be quite common.
- 51) Smaller worlds generally have thinner lithospheres.
- 52) Earth is the only planet in the solar system known to have plate tectonics.
- 53) Erosion is the most important geological process on Venus.

- 54) Without greenhouse gases, Earth's surface would be frozen over.
- 55) The Coriolis effect is very important to the weather of Venus.
- 56) Earth outgassed as much carbon dioxide as Venus, but it is locked up in the oceans and rocks.
- 57) The chromosphere is the layer of the Sun that we see as its visible surface.
- 58) Sunspots are cooler than the surrounding region of the Sun's surface.
- 59) The apparent brightness of a star depends only on its luminosity.
- 60) If the distance between us and a star is doubled, the apparent brightness is decreased by a factor of four.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

61) List at least 2 unique characteristics (e.g. about the size, surface, atmosphere etc.) of the following places in the solar system: (10 points)

a) Sun

b) Mercury

c) Venus

d) Earth

e) Moon

62) Venus and Earth are both of similar size, internal structure, and distance from the Sun. Why then, did Venus end up so hot as a result of the runaway greenhouse effect, and Earth end up with a regulated greenhouse effect and conditions perfect for life? Explain briefly with short sentences or bullet points covering topics such as: comparison of lithosphere, volcanic activity, and fate of outgassed CO₂ and H₂O on each planet. What key factor made Venus too hot and Earth just right for life? Use the back of this page as you will likely need more space. (10 points)

Answer Key

Testname: EXAM 2

- 1) B
- 2) B
- 3) B
- 4) D
- 5) D
- 6) D
- 7) E
- 8) A
- 9) C
- 10) E
- 11) A
- 12) A
- 13) A
- 14) B
- 15) C
- 16) A
- 17) C
- 18) C
- 19) A
- 20) B
- 21) A
- 22) B
- 23) B
- 24) C
- 25) A
- 26) D
- 27) A
- 28) A
- 29) C
- 30) D
- 31) B
- 32) D
- 33) A
- 34) C
- 35) B
- 36) D
- 37) E
- 38) C
- 39) D
- 40) B
- 41) FALSE
- 42) TRUE
- 43) FALSE
- 44) TRUE
- 45) FALSE
- 46) TRUE
- 47) TRUE
- 48) TRUE
- 49) FALSE
- 50) TRUE

Answer Key

Testname: EXAM 2

51) FALSE

52) TRUE

53) FALSE

54) TRUE

55) FALSE

56) TRUE

57) FALSE

58) TRUE

59) FALSE

60) TRUE

61) Sun: Most of the mass in SS, almost all light output in SS

Mercury: Most extreme temps (coldest place until Saturn's orbit), Huge core, virtually no atmosphere, most e, i of all planets

Venus: Densest atmosphere, hottest, runaway greenhouse effect, closest/brightest planet from Earth, highest albedo

Earth: Life!, densest, largest moon of terrestrial planets, oxygen in atmos

Moon: formed by collision, visited by alien life, synchronous rotation

62)