Print name: __________________________ Sign name: __________________________ Student ID#: ____________
Print and sign your name on your SCAN-TRON 882 form. Under “subject,” please put your Student ID #.

THIS TEST IS CLOSED BOOK, CLOSED NOTES, AND NO CALCULATORS!

Mark all answers on a SCAN-TRON 882 form. Use a #2 pencil. Completely fill in the appropriate bubble. Be sure to properly erase all altered answers and stray marks!

For true/false questions, mark bubble A if the statement is true and bubble B if false. For multiple choice questions, mark the bubble corresponding to the answer you think best answers the question.

All 40 questions carry equal weight. Read each question carefully before answering. There is no penalty for guessing. If you need extra room for your work, you can use the last (blank) page.

Before leaving the classroom, be sure you turn in both your SCAN-TRON form and this multi-page set of questions. You have until 12 o’clock to complete the exam. Budget your time appropriately. Good luck!

Possibly Useful Information

\[ d = vt \quad \text{density} \ \rho = M/V \quad c = 3 \times 10^8 \text{ m/s} \]

For a sphere, \( V = \frac{4}{3} \pi R^3 \) and \( A = 4\pi R^2 \)

For a circle, \( A = \pi R^2, \ C = 2\pi R \quad \pi \approx 3.14 \)

There are about \( 3.2 \times 10^7 \) seconds in every year and \( 8.64 \times 10^4 \) (roughly \( 10^5 \)) seconds per day.

Kelvin = Celsius + 273 \hspace{1cm} \text{Fahrenheit} = \frac{9}{5} \text{Celsius} + 32

1 A. U. = \( 1.5 \times 10^8 \) km \hspace{1cm} 1 light year (ly) \approx 63,000 A. U. \approx 9.5 \times 10^{12} \text{ km} \approx 10^{13} \text{ km}

1 pc = 3.26 ly \approx 3 \times 10^{18} \text{ cm} \approx 3 \times 10^{13} \text{ km} \hspace{1cm} 1 \AA = 10^{-8} \text{ cm} = 10^{-10} \text{ m}

60" (arcsec) = 1’ (arcmin) \hspace{1cm} 60’ = 1° (degree) \hspace{1cm} 360° = \text{full circle} = 2\pi \text{ radians} = 24 \text{ hours}

\[ \lambda_{\text{peak}}T \approx 3 \times 10^7 \text{ Å K} = 0.3 \text{ cm K} \quad \lambda\nu = c \quad P = 1/\nu \quad \text{resolution} \propto \lambda/D \]

energy/area/sec = \( \sigma T^4 \)

luminosity = energy/sec = \( 4\pi R^2\sigma T^4 \) (for a sphere)

\[ E = h\nu \quad F = GM_1M_2/d^2 \quad (\lambda - \lambda_0)/\lambda_0 = \Delta\lambda/\lambda_0 = v/c \]

\[ P^2 = kR^3 \text{ where } k \approx \text{constant} \approx 4\pi^2/(GM_1) \text{ if } M_1 \gg M_2 \]

In general, \( P^2 = (4\pi^2 R^3)/[G(M_1 + M_2)] \quad \text{For planets, } v \propto 1/\sqrt{R} \]
(1) T or F. The planet Venus can be seen in a dark night sky, around midnight, from Berkeley during some portions of the year.

(2) If the Earth’s radius were increased by a factor of 3, and the Earth’s mass were increased by a factor of 3, how much would you weigh while standing on the new (larger) surface of the Earth?
   (a) 9 times as much
   (b) 3 times as much
   (c) 1/3 as much
   (d) 1/9 as much
   (e) You weight would remain unchanged

(3) Ultraviolet light from a star is measured to have a wavelength of 1500 Å. What is its approximate frequency?
   (a) $2 \times 10^{15}$ Hz
   (b) $2 \times 10^{7}$ Hz
   (c) $4.5 \times 10^{13}$ Hz
   (d) $4.5 \times 10^{11}$ Hz
   (e) $4.5 \times 10^{6}$ Hz

(4) Which one of the following statements is an advantage that reflecting telescopes have over refracting telescopes?
   (a) Reflecting telescopes can see farther than a refracting telescopes with the same diameter.
   (b) Reflecting telescopes magnify light from distant stars better than refracting telescopes.
   (c) Reflecting telescopes do not suffer from chromatic aberration.
   (d) Reflecting telescopes are less affected by dust in the atmosphere than refracting telescopes.
   (e) Reflecting telescopes are better for impressing girls.

(5) T or F. If you double a star’s radius and keep the temperature fixed, it will increase the luminosity more than if you double the star’s temperature and keep the radius fixed.

(6) If you are in Berkeley in the winter and you see that the Moon is full, then at what time did the Moon rise that day?
   (a) 6 am
   (b) 6 pm
   (c) 9 am
   (d) 9 pm
   (e) noon

(7) According to Kepler’s first law, the orbits of planets are ellipses with the Sun at one focus. In the case of Jupiter, what is at the other focus?
   (a) Nothing
   (b) Jupiter’s moon, Io
   (c) Mars
   (d) Saturn
   (e) The asteroid belt

(8) If you wanted to prevent the Earth from having seasons, what could you do?
   (a) Align the Earth’s rotation axis to be perpendicular with respect to its orbital plane.
   (b) Align the Earth’s rotation axis to be parallel with respect to its orbital plane.
   (c) Change the Earth’s orbit to be circular.
   (d) Increase the semimajor axis of Earth’s orbit.
   (e) None of the above.
(9) T or F. If the surface temperature of Star Harpo is 3 times that of Star Zeppo, then the frequency at which Star Harpo’s spectrum peaks is 1/3 the frequency at which Star Zeppo’s spectrum peaks.

(10) Which one of the following statements about the terrestrial planets is FALSE?
   (a) They are denser than water.
   (b) They have radii that are equal to or less than Earth.
   (c) They all appear in the sky within 1 to 2 hours before sunrise or after sunset.
   (d) They have masses that are equal to or less than Earth.
   (e) They have rocky outer parts and iron cores.

(11) If the age of the Earth (about 5 billion years) were compressed into one day, the length of time since early hominids have been around (about 5 million years ago) would be approximately
   (a) 100 seconds
   (b) 1 hour
   (c) 12 hours
   (d) $10^4$ seconds
   (e) 30 minutes

(12) T or F. A light year is a unit of distance.

(13) Which one of the following statements about light (electromagnetic waves) is TRUE?
   (a) Different wavelengths of light move at different speeds within a prism.
   (b) X-rays move at higher speeds than ultraviolet radiation in a vacuum.
   (c) Light emitted from source moving toward you is blueshifted and travels faster than redshifted light.
   (d) Red light has the same frequency but a different wavelength than blue light.
   (e) Infrared radiation has the longest wavelength possible for light.

(14) Saturn is approximately 9 times farther from the Sun than the Earth. By what factor is Saturn’s velocity different than the Earth’s velocity?
   (a) 1/3
   (b) 3
   (c) 1/9
   (d) 9
   (e) 4.5

(15) T or F. The Moon is able to cover the Sun and create a total solar eclipse because the Moon’s angular size, with respect to the Earth, is much less than the Sun’s angular size.

(16) Which one of the following statements about twinkling is FALSE?
   (a) Stars twinkle more when they are near the horizon than when they are high in the sky.
   (b) Stars would twinkle if viewed by an observer on the surface of Mars.
   (c) A star twinkles more than a planet because the star is brighter.
   (d) Twinkling is mainly caused by turbulence in the Earth’s atmosphere.
   (e) Mercury is often seen to twinkle because it is usually observed close to the horizon.

(17) Which one of the following statements was conclusive proof that the Earth goes around the Sun (the heliocentric picture) and not vice versa?
   (a) A Earth’s northern and southern hemispheres experience opposite seasons.
   (b) From Earth we see Venus go through a whole cycle of phases.
   (c) The stars are seen in different positions in the sky from night to night.
   (d) Mars is sometimes observed to move retrograde.
   (e) Moons are observed to be orbiting Jupiter.

(18) T or F. The primary purpose of astronomical telescopes is to magnify pictures of stars.
(19) The primary reason why the Moon doesn’t eclipse the Sun during each and every one of its orbits is because
(a) the Earth is tilted at 23.5° with respect to the perpendicular to its orbital plane around the Sun.
(b) the Moon moves in an ellipse around the Earth.
(c) the Earth moves in an ellipse around the Sun.
(d) the Earth-Moon orbit is tilted at 5° with respect to the plane of the Earth’s orbit around the Sun.
(e) None of the above

(20) Consider yourself as an observer on the Moon, on the hemisphere that is facing the Earth. If the Moon is currently in the gibbous phase, what phase do you see for the Earth?
(a) Full
(b) Quarter
(c) Crescent
(d) New
(e) The answer depends on what time of day it is.

(21) T or F. The radius of a star can be estimated purely from knowing both the star’s temperature and its luminosity.

(22) Two planets orbit a star that has the same mass as the Sun. Planet Harpo’s orbits at a distance of 8 AU, while Planet Zeppo’s orbits at a distance of 2 AU. What is Planet Harpo’s orbital period in comparison to Planet Zeppo’s orbital period?
(a) 8 times longer
(b) \(3\sqrt{16}\) times longer
(c) 4 times longer
(d) \(3\sqrt{2}\) times longer
(e) \(\sqrt{8}\) times longer

(23) Which one of the following statements about planetary rings in our Solar System is FALSE?
(a) Only the gaseous jovian planets have rings.
(b) Sometimes we can barely see Saturn’s rings when they appear edge on because they are so thin.
(c) Uranus’ rings are held in place by “shepherding moons.”
(d) We think Saturn’s rings formed fairly recently, within the past few hundred million years.
(e) The same planet cannot have both rings and moons.

(24) T or F. During the course of Halley’s Comet’s orbit, it moves with a larger speed when it is near the Sun than when it is near Neptune’s orbit.

(25) If the Earth’s gravity suddenly turned off, what would happen to the Moon?
(a) The Moon would immediately spiral into the Sun.
(b) The Moon would be captured by Venus and begin orbiting Venus.
(c) The Moon will spiral away from the Earth in ever increasing large circles.
(d) The Moon will speed away on a radial trajectory.
(e) The Moon will speed away on a trajectory that is tangent its orbit.

(26) A star is moving at a speed of 200 km/s in a straight line. After 1 day, approximately how far has the star travelled?
(a) \(2 \times 10^6\) km
(b) \(2 \times 10^{12}\) cm
(c) \(2 \times 10^{-2}\) m
(d) \(2 \times 10^{11}\) mm
(e) \(2 \times 10^{14}\) Å

(27) T or F. Venus is at its maximum angular size in the sky (as viewed from the Earth) when it is in the crescent phase.
(28) Which one of the following statements is a reason why we say that the surface of the Earth is “younger” than the Moon’s surface?
   (a) The Moon protects the Earth’s surface from colliding with asteroids.
   (b) The Earth’s magnetic field protects life on Earth from energetic particles from the Sun.
   (c) The Earth was formed after the Moon was formed.
   (d) Plate tectonics recycle the Earth’s surface.
   (e) The Moon orbits the Earth instead of the Earth orbiting the Moon.

(29) Which one of the following statements about the tides on Earth is TRUE?
   (a) The tides are mostly caused by the gravitational force of the Sun on the Earth.
   (b) The tides are largest when the Moon and Sun are aligned.
   (c) There is one high tide a day and one medium tide roughly twelve hours later.
   (d) The tides are causing the Moon to slowly spiral closer to the Earth.
   (e) The tides are causing the Earth to slowly spin up.

(30) T or F. If photon A has an associated wavelength that is 10 times longer than photon B, then photon A is 10 times as energetic as photon B.

(31) Which one of the following statements about the jovian planets is TRUE?
   (a) All of the jovian planets could float in water (if you had a sufficiently large bathtub).
   (b) Only some of the jovian planets have rings.
   (c) The jovian planets have fewer moons than the terrestrial planets.
   (d) The jovian planets have atmospheres that are primarily composed of hydrogen and helium.
   (e) All of the jovian planets are completely liquid.

(32) Which one of the following statements about the greenhouse effect, Venus, and Earth is FALSE?
   (a) No greenhouse effect currently occurs on Earth.
   (b) The greenhouse effect occurs when an atmosphere is transparent to optical light but opaque to infrared light.
   (c) If we dump much more carbon dioxide into Earth’s atmosphere, Earth might become significantly hotter due to the greenhouse effect.
   (d) Venus’ atmosphere is much thicker than that of Earth, but some of Earth’s gases are trapped in rocks and oceans.
   (e) A runaway greenhouse effect may have occurred on Venus, which made its planetary surface the hottest in the Solar System.

(33) T or F. As observed from Earth, Saturn sometimes appears to experience “retrograde motion.”

(34) As Jupiter orbits the Sun, which one of the following statements is TRUE?
   (a) Jupiter feels a larger gravitational force on it from the Sun than the Sun feels from Jupiter.
   (b) The Sun feels a larger gravitational force on it from Jupiter than Jupiter feels from the Sun.
   (c) Since Jupiter is approximately 5 AU from the Sun, it’s orbital period is 5 years.
   (d) Jupiter is moving at a slower speed than the planets that are orbiting interior to it.
   (e) Jupiter’s orbit is a perfect circle.

(35) Which one of the following statements about Pluto is FALSE?
   (a) Pluto is not a planet.
   (b) Pluto has a moon.
   (c) Pluto is a member of the Kuiper belt.
   (d) Pluto is a member of the Oort cloud.
   (e) Pluto is smaller than the Earth’s moon.
(36) As a comet orbits the Sun, in which direction does its tail always point?
   (a) Backward from its direction of motion.
   (b) Toward its direction of motion.
   (c) Toward the Earth.
   (d) Away from the Sun.
   (e) Toward Halley’s comet.

(37) T or F. Copernicus is famous for first presenting a geocentric theory for our Solar System.

(38) A spectral line from a certain atom is measured to have a wavelength of 6000 Å in a laboratory. When you observe a certain star, you measure that this same spectral line has a wavelength of 5940 Å. Which one of the following statements are TRUE?
   (a) The star is moving away from you at a speed of 1/1000 the speed of light.
   (b) The star is moving away from you at a speed of 1/100 the speed of light.
   (c) The star is moving away from you at exactly the speed of light.
   (d) The star is moving toward you at a speed of 1/1000 the speed of light.
   (e) The star is moving toward you at a speed of 1/100 the speed of light.

(39) T or F. Jupiter appears as a crescent from the Earth at least once per year.

(40) A comet is at a distance of 8 AU from the Sun, and moving directly at the Sun with a speed of 40 km/s. Approximately how long will it take for the comet to hit the Sun?
   (a) $3 \times 10^7$ s
   (b) $4.8 \times 10^{10}$ s
   (c) $3 \times 10^9$ s
   (d) $4.8 \times 10^7$ s
   (e) $4.8 \times 10^9$ s