ASTR 101 — Midterm 1

Introduction to Astronomy — Spring 2026

San Diego State University

Instructor: Dr. Anna Rosen

Name: _____ **Date:** Friday, March 6, 2026

Instructions:

- **25 questions, 50 minutes.** Choose the single best answer (A–D) for each question.
- A scientific or graphing calculator is allowed but should not be needed — all quantitative questions are designed for ratio reasoning.
- An **equation sheet** is provided separately. You may not use notes or textbooks.
- Mark your answers clearly. Ambiguous marks will not receive credit.

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1. Australia has summer in December while the Northern Hemisphere has winter. This best supports which explanation of seasons?

A. Earth's axial tilt changes Sun angle and daylight length differently by hemisphere.
B. Earth is farther from the Sun in Northern Hemisphere winter, so both hemispheres cool together.
C. Seasons are caused by periodic changes in the Sun's luminosity.
D. Seasons are caused by the Moon's changing phase.

Answer: _____

2. Astronauts aboard the International Space Station appear to float. The best explanation is:

A. There is no gravity at the altitude of the ISS.
B. The ISS is beyond Earth's gravitational pull.
C. The ISS engines cancel out gravity.
D. The astronauts and the station are in free fall together around Earth.

Answer: _____

3. Star A's blackbody spectrum peaks at 500 nm and Star B's peaks at 1000 nm. Star A's surface temperature is:

A. Half of Star B's
B. The same as Star B's
C. Twice Star B's
D. Four times Star B's

Answer: _____

4. A research paper states that a star is receding from Earth at 50 km/s. The quantity the astronomer actually measured at the telescope is:

A. The star's speed through space
B. A shift in the star's spectral lines
C. The star's mass
D. The star's distance

Answer: _____

5. Why is there not a solar eclipse at every new Moon?

A. The Moon's orbit is tilted, so most new Moons miss exact node alignment.
B. Earth's shadow is too small most months.
C. The Moon only reflects enough light for eclipses in summer.
D. Solar eclipses require a full Moon, not a new Moon.

Answer: _____

6. A planet orbits a Sun-like star at 4 AU. Its orbital period is closest to:

A. 4 yr
B. 8 yr
C. 16 yr
D. 64 yr

Answer: _____

7. A star is moving sideways relative to Earth, with no motion toward or away from us. The observed Doppler shift is:

A. Strong blueshift
B. Strong redshift
C. Alternating red/blue each day
D. Zero Doppler shift

Answer: _____

8. Why does the shorthand $P^2 = a^3$ (where P is in years and a in AU) not work unchanged for every orbiting system?

A. It is a special unit/central-mass form; the general form includes M and constants.
B. It fails because gravity is not inverse-square outside the Solar System.
C. It works only for circular orbits and fails for all ellipses.
D. It requires no central mass at all.

Answer: _____

9. Why can astronomers determine the chemical composition of distant stars?

A. Stars emit sound waves that encode composition
B. Different elements absorb and emit at specific wavelengths
C. Stars reflect sunlight, revealing their makeup
D. Stars contain the same elements as Earth, so no measurement is needed

Answer: _____

10. Two identical stars are observed. Star B is 4 times farther away than Star A. How bright does Star B appear compared with Star A?

A. 1/16 as bright
B. 1/8 as bright
C. 1/4 as bright
D. 1/2 as bright

Answer: _____

11. During a total lunar eclipse, the Moon often appears reddish. This is best explained by:

A. The Moon's surface minerals glow red when cold.
B. Earth's atmosphere scatters blue light away, so mainly red light reaches the Moon.
C. The Sun emits only red light during an eclipse.
D. Mars reflects red light onto the Moon during alignment.

Answer: _____

12. Which statement best captures "Kepler vs. Newton"?

A. Kepler explained gravity; Newton found only observational patterns.
B. Both Kepler and Newton gave only geometric descriptions with no mechanism.
C. Kepler found empirical orbital patterns; Newton explained them with gravity.
D. Newton's laws apply only to the Solar System; Kepler's apply universally.

Answer: _____

13. A spectral line at 500.000 nm oscillates by ± 0.005 nm over several nights. The radial velocity amplitude is closest to:

A. $0.3\ \mathrm{km/s}$
B. $3\ \mathrm{km/s}$
C. $30\ \mathrm{km/s}$
D. $300\ \mathrm{km/s}$

Answer: _____

14. Which of the following is a quantity that astronomers can *directly measure* for a distant star?

A. Surface temperature
B. Mass
C. Distance in parsecs
D. Apparent brightness (flux)

Answer: _____

15. Two stars have the same surface temperature, but Star P has 3 times the radius of Star Q. Star P's luminosity is:

A. 3 times Star Q's
B. 6 times Star Q's
C. 9 times Star Q's
D. 27 times Star Q's

Answer: _____

16. Two planets orbit the same star of mass M. Planet A has mass m at distance r; Planet B has mass $3m$ at distance r (where $m \ll M$). The gravitational force on B compared to A is:

A. 1/3 as large
B. The same
C. 3 times larger
D. 9 times larger

Answer: _____

17. A cool gas cloud lies between you and a hot, bright star. The spectrum you observe is best described as:

A. A continuous spectrum with no features
B. Bright emission lines on a dark background
C. No light at all, because the cloud blocks everything
D. Dark absorption lines superimposed on a continuous spectrum

Answer: _____

18. Which statement about constellations is most accurate?

A. Stars in a constellation are usually at the same distance from Earth.
B. Constellations are physical star clusters bound by gravity.
C. Constellations are line-of-sight patterns; stars can be at very different distances.
D. Constellations are caused by Earth's shadow on distant stars.

Answer: _____

19. If you move from distance R to $2R$ from a planet's center, gravitational force becomes:

A. 1/4 as strong
B. 1/2 as strong
C. Unchanged
D. 2 times as strong

Answer: _____

20. A press release states: "Astronomers have observed that Galaxy X is 200 million light-years away." What is misleading about this statement?

A. Distance is inferred from brightness or redshift, not directly observed.
B. Light-years are not a valid distance unit.
C. Galaxies cannot be that far away.
D. Only nearby stars have measurable distances.

Answer: _____

21. A radio station broadcasts at a frequency of 3×10^8 Hz. The wavelength of this signal is:

A. 10 m
B. 1 m
C. 0.1 m
D. 0.01 m

Answer: _____

22. Star X and Star Y have the same luminosity, but Star X is twice as hot as Star Y. Compared to Star Y, Star X must be:

A. One-quarter the radius
B. Half the radius
C. The same radius
D. Twice the radius

Answer: _____

23. Which statement correctly distinguishes Moon phases from eclipses?

A. Phases are caused by Earth's shadow; eclipses are caused by reflected sunlight.
B. Phases are due to changing Sun–Earth–Moon geometry; eclipses need special alignment near nodes.
C. Phases and eclipses are the same event observed from different places.
D. Phases occur only when the Moon is closest to Earth.

Answer: _____

24. According to Kepler's second law (equal areas in equal times), a planet on an elliptical orbit moves *fastest* when it is:

A. At its farthest point from the Sun
B. Halfway between closest and farthest
C. At the same speed everywhere in its orbit
D. At its closest point to the Sun

Answer: _____

25. Which photon carries the most energy?

A. A radio photon with wavelength 1 m
B. An infrared photon with wavelength 10,000 nm
C. A visible photon with wavelength 500 nm
D. An X-ray photon with wavelength 1 nm

Answer: _____

End of exam. Please check that you have answered all 25 questions.