ASTR 001 – Introduction to the Cosmos
Practice Problem Set for Final Exam Review (no credit)
SOLUTION SET

Name: _____

- Circle the answer (letter choices A–E or A–D) that BEST fits the question.
- Write your name on this exam script.
- This practice exam is about half the length of the actual final exam
- There are no points/credit for this practice exam, but it will be useful practice for the actual final exam

1. At a certain point in the Universe's past, the average distance between galaxies was 7 times smaller than it is today and the density of matter in the Universe was 343 times larger than it is today. At that point in time, the energy density of radiation in the Universe was _____ than it is today.
A. About 2,400 times smaller
B. About 2,400 times larger
C. 7 times smaller
D. 49 times larger
E. 343 times larger

2. Precession, the gradual and periodic migration of the Earth's spin axis in a circular pattern over a period of 26,000 years, is directly responsible for the fact that:
A. The North Celestial pole coincides with Polaris today but coincided with Vega about 13,000 years ago
B. The shapes of the constellations appear different today than they did to astronomers 3,000 years ago
C. A person on Earth experiences summer and winter seasons in an annual cycle
D. Celestial objects rise in the east and set in the west in a daily cycle
E. All of the above

3. Declination on the celestial sphere corresponds to this on the Earth:
A. Latitude
B. Longitude
C. Altitude
D. Direction
E. Zenith

4. A photon carries an amount of energy proportional to its ____ and inversely proportional to its wavelength.
A. Frequency
B. Neutrons
C. Electrons
D. Ground state
E. Speed

5. The precession of the earth's spin axis takes about _____ to complete one full cycle.

A. 12,000 years
B. 2600 years
C. 1,300 years
D. 26,000 years
E. 260 years

6. The force of gravity is said to obey the "inverse square" law. If you triple the distance between two bodies, the force of gravity between them would become:

A. Nine times the original value
B. One third of the original value
C. One ninth of the original value
D. Same as the original value
E. None of the above

7. Which of the following statements is/are true for a light-emitting ruler that is moving toward you at 99% of the speed light? [Its twin (another otherwise identical ruler) is at rest relative to you.]

A. The photons emitted by the moving ruler will be redshifted from your perspective
B. You will measure the moving ruler to be shorter than its twin ruler at rest
C. You will measure drastically different speeds for the light emitted by the two rulers
D. All of the above
E. None of the above

8. Light is considered a(an):

A. Electromagnetic wave
B. Chemical wave
C. Nuclear wave
D. Kinetic wave
E. All of the above

9. Light emitted by an object moving toward you is said to be _____.

A. Blueshifted
B. Redshifted
C. Null shifted
D. Doppled
E. Dappled

10. While a star is on the main sequence it does not expand or contract as it enjoys a balance between _____ and _____.

A. Nuclear fusion reactions; nuclear fission reactions
B. Radiation pressure; nuclear fusion reactions
C. Radiation pressure; its own gravity
D. Temperature; luminosity

E. Electromagnetic pressure; its own gravity

11. A galaxy has a right ascension of 12 hours (180 degrees). During which season of the year will it be overhead at noon?

A. Northern hemisphere summer
B. Northern hemisphere winter
C. Northern hemisphere spring
D. Northern hemisphere fall

12. The Special Relativity formula $E=mc^2$ gives a quantitative description of the equivalence between _____ and _____.

A. Acceleration; a gravitational field
B. Energy; temperature
C. Radiation (photons); matter (particles)
D. Energy of fusion; the speed of light
E. Electromagnetism; the speed of light

13. The force that holds the nucleus of an atom together is called the _____.

A. Weak nuclear force
B. Strong nuclear force
C. Electromagnetic force
D. Gravity
E. None of the above

14. The Earth–Sun distance is known as a(an) _____.

A. Light year
B. Parsec
C. Astronomical unit
D. Kiloparsec
E. Light minute

15. _____ are relatively compact dead cores of stars like our sun.

A. White dwarfs
B. Neutron stars
C. Black holes
D. Supernovae
E. Planetary nebulae

16. Which of the following statements about supernovae is/are correct?

A. Our Sun will end its life in a supernova explosion
B. When a supernova explosion occurs, the outer layers of a star are ejected outwards at high speed
C. Supernovae help in cosmic chemical recycling by dispersing the elements produced in a massive star
D. There is a super-massive supernova at the center of each galaxy
E. Only B and C above

17. The typical place within a galaxy where new stars are formed is a _____.
A. Planetary nebula
B. HII region
C. Molecular cloud
D. Supernova
E. Hayashi track

18. The star Aldebaran is cooler and much more luminous than the Sun. Where do you expect to find Aldebaran in the Hertzsprung-Russell (H-R) diagram?
A. Center
B. Top right
C. Bottom right
D. Bottom left
E. Top left

19. According to the Big Bang model, energetic photons in the early Universe converted into _____ and vice versa.
A. Black holes
B. Hydrogen and helium atoms
C. Pairs of protons and neutrons
D. Pairs of matter and anti-matter particles
E. Pairs of protons and electrons

20. The full moon is at the highest point in the sky at:
A. Sunset
B. Sunrise
C. Midnight
D. Noon
E. 3:00AM

21. Which of the following objects is experiencing the Earth's gravitational force?
A. A boat floating in water
B. An airplane taking-off
C. A skydiver falling under the force of gravity
D. All of the above
E. Only B and C above

22. The speed of light we measure from a stationary source is 300,000 km/s. You are watching a spaceship moving away from you at 1,000 km/s. The light reaching you from the spacecraft will be measured by you to be moving at a speed of _____.
A. 301,000 km/s
B. 299,000 km/s
C. 1,000 km/s
D. 300,000 km/s
E. 3,000,000 km/s

23. The Earth spins about its own axis and revolves around the Sun in the same sense. The length of a sidereal day is 23 hours and 56 minutes. If the Earth's spin rate were to double, the length of the sidereal day would be:
A. 23 hours and 58 minutes
B. 11 hours and 56 minutes
C. 24 hours and 4 minutes
D. 12 hours and 4 minutes
E. 11 hours and 58 minutes

24. The Earth spins about its own axis and revolves around the Sun in the same sense. The length of a sidereal day is 4 minutes shorter than the length of a solar day. If the sense of Earth's spin were to be reversed relative to its revolution around the Sun (while keeping its spin rate the same), the length of the sidereal day would be:
A. 4 minutes longer than the solar day
B. 2 minutes longer than the solar day
C. 2 minutes shorter than the solar day
D. 4 minutes shorter than the solar day
E. Half the length of the solar day

25. One half of the Moon's surface is never visible from the Earth even though the Moon orbits around the Earth once every 27 days. This implies that the time taken by the Moon to spin once about its own axis is:
A. Infinitely long
B. 27 days
C. 54 days
D. 1 day
E. 13.5 days

26. If the _____ of the Universe were _____ and there were no anti-gravity or dark energy, then the Universe would ultimately _____.
A. Temperature of the afterglow radiation; larger than the Sun's temperature; recollapse in a "Big Crunch"
B. Density; larger than the critical density; expand forever
C. Dark matter content; larger than its visible mass content; expand forever
D. Density; larger than the critical density; recollapse in a "Big Crunch"
E. Baryon asymmetry; absent; be made of anti-protons alone

27. We observe a planet in the Solar System going through nearly all possible phases: new, crescent, quarter (semi-circle), gibbous, and nearly full. What conclusion(s) can be drawn about the planet?
A. The planet's orbital period is less than 1 year
B. The planet's distance from the Sun is less than 1 A.U. (the Earth-Sun distance)
C. The planet is spinning on its own axis as it orbits the Sun
D. Only A and B above
E. All of the above

28. A/An _____ spectrum has bright lines on dark background and is caused by the transition of electrons within atoms from _____ to _____energy states.
A. Absorption-line; lower; higher
B. Emission-line; higher; lower
C. Continuous; ground; ionized
D. None of the above

29. An active galactic nuclei or quasar is characterized by the following feature(s):
A. Variation in brightness on time-scales of hours to weeks
B. Ten to 1000 times as many stars as a normal galaxy
C. Broad emission lines in their spectra
D. All of the above
E. Only A and C above

30. Hawking radiation relates to:
A. Evaporation of black holes
B. "False vacuum", which in turn relates to the Uncertainty Principle in quantum mechanics
C. Matter and anti-matter particles
D. Pair creation and pair annihilation near the event horizon
E. All of the above

31. One of the major astronomical discoveries of this decade is the finding that the overall rate of expansion of the Universe has been _____ over the last billion years.
A. Speeding up
B. Changing randomly
C. Constant
D. Slowing down

32. _____ galaxies have smaller bulges and more loosely wound arms compared to _____ galaxies.
A. Sa; Sb
B. E0; S0
C. Sa; E4
D. Sd; Sc

33. Which of the following are predictions of the theory of Inflation?
A. The early Universe expanded very rapidly (faster than the speed of light) over a tiny period of time
B. Parts of our observable Universe that are outside each other's horizons today were within each other's horizons before Inflation and were therefore able to mix thoroughly and reach the same temperature
C. The cosmic microwave background radiation (CMBR) should be more or less uniform over the whole sky, with tiny fluctuations within it at the level of 1 part in 100,000
D. All of the above
E. Only A and C above