Astronomy II (ASTR1020) — Exam 1
Test No. 1D

11 September 2001

The answers of this multiple choice exam are to be indicated on the **Scantron** with a **No. 2 pencil**. Don't forget to write your name and the **Test No.** (*e.g.*, 1D) on the **Scantron** sheet. You may keep these test questions. There are 32 questions on this exam and you will be graded out of 30 points. As such, 2 of the questions can be considered as extra credit.

Useful Constants

G	$=$	6.673×10^{-11} m^3/s^2/kg	g	$=$	9.80 m/s^2
c	$=$	3.00×10^5 km/s	h	$=$	6.626×10^{-34} J s
k	$=$	1.38×10^{-23} J/K	$H_\circ$	$=$	50 km/sec/Mpc
M_{moon}	$=$	7.35×10^{22} kg	$M_\odot$	$=$	1.99×10^{30} kg
$M_\oplus$	$=$	5.98×10^{24} kg	$R_\oplus$	$=$	6.38×10^6 m
$R_\odot$	$=$	6.96×10^8 m	$T_\odot$	$=$	5800 K
1 AU	$=$	1.50×10^{11} m	$L_\odot$	$=$	3.90×10^{26} W
e	$=$	1.60×10^{-19} C	σ	$=$	5.67×10^{-8} W/m^2/K^4
m_e	$=$	9.11×10^{31} kg	m_p	$=$	1.67×10^{-27} kg
1 ly	$=$	9.46×10^{15} m	1 pc	$=$	3.09×10^{16} m
1 km	$=$	10^3 m	1 hr	$=$	3600 s
1 mi	$=$	5280 ft	1 mi	$=$	1.609 km
1 day	$=$	24 hrs	1 yr	$=$	365.24 days
1 Å	$=$	10^{-10} m	1 nm	$=$	10^{-9} m
10^3	$=$	one thousand	10^6	$=$	one million
10^9	$=$	one billion	10^{12}	$=$	one trillion

Useful Equations

$$D = \frac{\alpha \, d}{206265}$$

$$e = \frac{h}{2a} = \frac{a-b}{a}$$

$$E = mc^2$$

$$r_p = a(1-e)$$

$$r_a = a(1+e)$$

$$2a = r_p + r_a$$

$$v_t = 4.74 \, \mu \, d \; (\text{km/s})$$

$$\frac{v_r}{c} = \frac{\lambda - \lambda_\circ}{\lambda_\circ} = \frac{\Delta\lambda}{\lambda_\circ}$$

$$\nu = c/\lambda$$

$$P^2 = \left[\frac{4\pi^2}{G(m_1 + m_2)} \right] a^3$$

$$F = G\left(\frac{m_1 m_2}{r^2} \right)$$

$$F = \sigma \, T^4$$

$$L = 4\pi R^2 F = 4\pi \sigma R^2 T^4$$

$$\frac{L}{L_\odot} = \left(\frac{R}{R_\odot} \right)^2 \left(\frac{T}{T_\odot} \right)^4$$

$$d = 1/p$$

$$\lambda_{\max} = \frac{0.0029 \text{ m K}}{T}$$

$$E = h\nu = \frac{hc}{\lambda}$$

$$P_{\text{yr}}^2 = a_{\text{AU}}^3$$

$$m_2 - m_1 = -2.5 \log\left(\frac{f_2}{f_1} \right)$$

$$m - M = 5 \log d - 5$$

$$F = ma$$

$$M_{\text{bol}} - M_{\text{bol}}(\odot) = -2.5 \log\left(\frac{L}{L_\odot} \right)$$

$$M_1 + M_2 = \frac{a^3}{P^2}$$

$$v = \sqrt{v_r^2 + v_t^2}$$

$$t_{\text{MS}} = \left(\frac{M_\odot}{M} \right)^3 \times 10^{10} \text{ yr}$$

$$v_{\text{esc}} = \sqrt{\frac{2GM}{R}}$$

$$v_r = H_\circ d$$

$$z = \frac{\Delta\lambda}{\lambda_\circ} = \frac{\sqrt{1 + v_r/c}}{\sqrt{1 - v_r/c}} - 1$$

$$z = \frac{\Delta\lambda}{\lambda_\circ} = \frac{v_r}{c} \;\; (v_r \ll c)$$

$$\frac{L}{L_\odot} = \left(\frac{M}{M_\odot} \right)^4$$

$$T = \frac{1 \; (\text{km/s/Mpc})}{H_\circ} \times 10^{12} \text{ yr}$$

$$q_\circ = \frac{8\pi G}{3} \frac{\rho}{H_\circ^2}$$

1. Energy flow via mass motion of hot blobs of gas in an object is known as

a) convection   b) radiation transport   c) conduction

d) advection   e) Bob

2. Electromagnetic radiation with the highest energy is

a) X-rays   b) infrared light   c) microwaves

d) radio waves   e) gamma rays

3. Which of the following unit systems is considered archaic by science?

a) Australian system   b) SI system   c) cgs system

d) English system   e) none of these

4. Which of the following best describes a photon's journey inside the Sun?

  a) Travels in a straight line at the speed of 2.997925×10^5 km/s.
  b) Travels in a curved path following the Sun's magnetic field.
  c) Travels in a zig-zag (random walk) type of path.
  d) Photons do <u>not</u> exist inside the Sun.
  e) Photons do not move inside the Sun once they are created.

5. The closest point from the Sun in a planetary orbit is called

a) aphelion   b) eccentricity   c) semimajor axis

d) semiminor axis   e) perihelion

6. The total energy flux emitted over the entire surface of an object is called the *what* of the object?

a) spectrum   b) temperature   c) magnitude

d) intensity   e) luminosity

7. Of the following reaction chains, which is not part of the CNO cycle?

a) $^{13}C + {}^{1}H \longrightarrow {}^{14}N + \gamma$

b) $^{12}C + {}^{1}H \longrightarrow {}^{13}N + \gamma$

c) $^{14}N + {}^{1}H \longrightarrow {}^{15}O + \gamma$

d) $^{15}O + {}^{1}H \longrightarrow {}^{12}C + {}^{4}He$

e) $^{15}N + {}^{1}H \longrightarrow {}^{12}C + {}^{4}He$

8. If the **mass** of the Moon is 7.35×10^{22} kg, what is the Moon's **weight**

a) 7.35×10^{22} kg   b) 7.35×10^{22} N   c) -7.35×10^{22} kg

d) 0   e) none of these

9. Approximately how long does it take a photon to leave the interior of the Sun once it is created?

a) 1 million years   b) 4.5 billion years   c) 1.5 seconds

d) 8.5 minutes   e) 4.3 years

10. If we know a star's temperature and luminosity, which of the following can we determine from this information?

a) mass   b) size   c) distance   d) age   e) composition

11. Main sequence stars are burning hydrogen into helium through thermonuclear reactions in their cores. In the low-mass main sequence stars, the dominant reaction process is

a) HCO chain   b) proton-proton chain   c) HCN cycle

d) hydrogen cycle   e) CNO cycle

12. For the number 20.060, which of the digits are considered significant?

  a) The zero preceding the decimal point.

  b) The last zero following the "6."

  c) The number "20.06".

  d) The "20" preceding the decimal point.

  e) The zero preceding the "6."

13. The top of the solar convection zone can be seen in the photosphere as

a) neutrinos   b) granules   c) faculae   d) sunspots   e) flares

14. A blackbody spectrum is represented by what type of curve?

a) Bohr curve   b) elliptical curve   c) parabolic curve

d) Planck curve   e) hyperbolic curve

15. Determining the internal structure of the Sun through photospheric sound waves is called

a) geology   b) seismology   c) topology

d) wavology   e) helioseismology

16. Which is following is true about the Sun's radiative zone?

   a) Nuclear reactions take place in the inner region of this zone.

   b) Energy is transported by the flow of photons.

   c) It is the hottest region of the Sun.

   d) It is the densest region of the Sun.

   e) All of the above are valid statements of the Sun's radiation zone.

17. Both the energy flux and the wavelength of maximum flux emission are dependent on a blackbody's:

a) intensity   b) temperature   c) magnitude

d) spectrum   e) luminosity

18. The language of science is

a) German   b) English   c) French   d) Greek   e) mathematics

19. What is the name of the science that describes the interaction between light and matter?

a) quantum mechanics   b) thermodynamics   c) relativity

d) classical mechanics   e) statistical mechanics

20. The theory of relativity is a theory because

   a) it has been validated through repeated experiments.

   b) its equations are known by all scientists.

   c) its model was the simplest.

   d) force is equal to mass times acceleration.

   e) Einstein said so.

21. The relative *flatness* of an ellipse is measured by a quantity called

a) ellipticity   b) semimajor axis   c) eccentricity

d) semiminor axis   e) temperature

22. Why is astrology called a pseudoscience?

  a) Newton said it was.

  b) It doesn't take the Earth's precession into account when formulating horoscopes.

  c) Even though it uses the language of science, it doesn't follow the scientific method.

  d) It is not a pseudoscience, it actually <u>is</u> a science.

  e) It doesn't use the equation $F = ma$.

23. Approximately how long does it take a photon to pass Earth's orbit once it is emitted from the solar photosphere?

a) 4.3 years   b) 1.5 seconds   c) 1 million years

d) 4.5 billion years   e) 8.5 minutes

24. Which of the following did Issac Newton <u>not</u> invent?

a) laws of motion   b) calculus   c) pendulum clock

d) reflecting telescope   e) law of gravity

25. Approximately how old is the solar system?

a) 6000 years   b) 1 million years   c) 5 million years

d) 5 billion years   e) none of these

26. An object in thermal equilibrium emits what type of spectrum?

a) absorption line   b) emission line   c) absolute

d) blackbody   e) bolometric

27. Which of the following best describes a photon?

a) It is a particle that make up nucleons (*i.e.*, protons and neutrons).

b) It orbits about the nucleus of atoms.

c) It transmits audio signals through a vacuum.

d) It behaves both like both a wave and a particle.

e) It can travel at any velocity <u>less</u> than c in a vacuum.

28. If an object is at 0 K in temperature, which of the following is true?

a) It emits most of its light at visual wavelengths.

b) It emits most of its light at X-ray wavelengths.

c) The atoms that compose the object are not moving.

d) The atoms that compose the object are ionized.

e) None of the above.

29. Which one of these best describes Kepler's 2nd law of planetary motion?

a) $P_{yr}^2 = a_{AU}^3$

b) $a_{AU}^2 = P_{yr}^3$

c) A planet's velocity will increase as it moves closer to the Sun.

d) All planets orbit the Sun in elliptical paths.

e) None of these

30. The stream of charged particles emitted by the Sun is called the

a) photon flow b) solar wind c) solar corona

d) photon plasma e) solar flow

31. A small unit of length equal to 10^{-10} meter is called the

a) parsec b) Ångstrom c) astronomical unit

d) light year e) eccentricity

32. Which of the following best describes Newton's 2nd Law?

a) $F = ma$

b) $P_{yr}^3 = a_{AU}^2$

c) A body will stay in uniform motion unless acted upon by an external force.

d) Whenever one body exerts a force on a second body, the second body exerts an equal and opposite force on the first body.

e) $F = Gm_1m_2/r^2$