Astronomy II (ASTR1020) — Exam 3

Test No. 3D

23 October 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.*, 3D) 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
$M_{\rm moon}$	=	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

$D = \frac{\alpha\, d}{206265}$	$e = \frac{h}{2a} = \frac{a-b}{a}$	$E = mc^2$
$r_p = a(1-e)$	$r_a = a(1+e)$	$2a = r_p + r_a$
$v_t = 4.74\,\mu\, d\ \text{(km/s)}$	$\frac{v_r}{c} = \frac{\lambda - \lambda_\circ}{\lambda_\circ} = \frac{\Delta\lambda}{\lambda_\circ}$	$\nu = c/\lambda$
$P^2 = \left[\frac{4\pi^2}{G(m_1+m_2)}\right] a^3$	$F = G\left(\frac{m_1 m_2}{r^2}\right)$	$F = \sigma T^4$
$L = 4\pi R^2 F = 4\pi\sigma R^2 T^4$	$\frac{L}{L_\odot} = \left(\frac{R}{R_\odot}\right)^2 \left(\frac{T}{T_\odot}\right)^4$	$d = 1/p$
$\lambda_{\rm max} = \frac{0.0029\ \text{m K}}{T}$	$E = h\nu = \frac{hc}{\lambda}$	$P_{\rm yr}^2 = a_{\rm AU}^3$
$m_2 - m_1 = -2.5\log\left(\frac{f_2}{f_1}\right)$	$m - M = 5\log d - 5$	$F = ma$
$M_{\rm bol} - M_{\rm bol}(\odot) = -2.5\log\left(\frac{L}{L_\odot}\right)$	$M_1 + M_2 = \frac{a^3}{P^2}$	$v = \sqrt{v_r^2 + v_t^2}$
$t_{\rm MS} = \left(\frac{M_\odot}{M}\right)^3 \times 10^{10}\ \text{yr}$	$v_{\rm esc} = \sqrt{\frac{2GM}{R}}$	$v_r = H_\circ d$
$z = \frac{\Delta\lambda}{\lambda_\circ} = \frac{\sqrt{1+v_r/c}}{\sqrt{1-v_r/c}} - 1$	$z = \frac{\Delta\lambda}{\lambda_\circ} = \frac{v_r}{c}\quad (v_r \ll c)$	$\frac{L}{L_\odot} = \left(\frac{M}{M_\odot}\right)^4$
$T = \frac{1\ \text{(km/s/Mpc)}}{H_\circ} \times 10^{12}\ \text{yr}$	$q_\circ = \frac{8\pi G}{3}\frac{\rho}{H_\circ^2}$	

1. Which of the following is true about main sequence stars with $M > 2\ M_{\odot}$?

a) They have radiative cores and convective envelopes.

b) They have spectral types of G, K, or M.

c) They produce most of their energy via the CNO cycle.

d) They all have chromospheres and coronae.

e) They are stable due to electron degeneracy.

2. When the internal pressure of a layer of gas in a star is balanced by the weight of material on top of that layer, such a layer is said to be in

a) thermodynamic equilibrium   b) hydrostatic equilibrium   c) momentum equilibrium

d) radiative equilibrium   e) thermal equilibrium

3. Which of the following is true about main sequence stars with $0.4\ M_{\odot} < M < 2\ M_{\odot}$?

a) These stars do not have chromospheres and coronae.

b) They have spectral types of O, B, or A.

c) They produce most of their energy via the CNO cycle.

d) They have radiative cores and convective envelopes.

e) They are stable due to electron degeneracy.

4. The most massive stars have approximately $M =$

a) $50 M_{\odot}$ b) $0.08 M_{\odot}$ c) $1 M_{\odot}$ d) $0.4 M_{\odot}$ e) $1000 M_{\odot}$

5. In the *Cosmos* video we saw in class, what did the narrator say happens when you travel fast into space?

a) You travel backwards in time.

b) You travel fast into time.

c) You warp space and time.

d) You go into warp speed.

e) You go to Quark's bar on Deep Space 9.

6. How is a horizontal branch star similar to a red giant clump star?

a) Both are burning hydrogen in their cores.

b) Both are supported by degenerate electron pressure.

c) Both are of the same metalicity.

d) Both are collapsing down to the main sequence stage.

e) Both are burning helium in their cores.

7. As introduced in the *Cosmos* video we saw in class, which of the following is a googol?

a) ∞ b) 10^{10} c) 10^{100} d) 99^{-99} e) none of these

8. Stars that have $0.4M_\odot < M < 4M_\odot$ are/will

a) supernova.

b) completely convective.

c) go through a helium flash.

d) not massive enough to support nuclear fusion.

e) last 90% of their lifetime as a red giant.

9. The triple-alpha process is

a) responsible for production of carbon in the Universe.

b) how main sequence stars generate energy.

c) powered by the weak nuclear force.

d) the technique used to apply for Hubble Space Telescope observing time.

e) how astronomers determine the distances to stars.

10. Pulsating stars fall on what strip on the H-R Diagram?

a) main sequence   b) sub dwarf   c) Chandrasekhar

d) instability   e) Eddington

11. When the UV photons from a collapsed core lights up the *detached* shell of a star's outer envelope, the shell is called a(n)

a) supernova remnant   b) reflection nebula   c) H II region

d) planetary nebula   e) none of these

12. Which of the following energy mechanisms does the Sun currently derive its energy?

a) coal burning   b) photoelectric effect   c) fusion with CNO cycle

d) fission of uranium   e) fusion with proton-proton chain

13. What opacity source causes the kappa effect to function in Miras?

a) Balmer lines   b) hydrogen ionization   c) Lyman lines

d) Rayleigh scattering   e) electron scattering

14. In the *Cosmos* video that we saw in class, what was the name of the astronomer that narrated the episode?

a) Carl Sagan
b) Chandrasekhar
c) Arthur Eddington
d) Albert Einstein
e) Issac Asimov

15. Objects that have $M < 0.01\ M_\odot$ are called

a) brown dwarfs
b) planets
c) black dwarfs
d) main sequence stars
e) white dwarfs

16. Which of the following is true about main sequence stars with $M < 0.4\ M_\odot$?

a) They produce most of their energy via the proton-proton chain.
b) They have spectral types of A, F, or G.
c) They have radiative cores and convective envelopes.
d) These stars do <u>not</u> have chromospheres and coronae.
e) They are stable due to electron degeneracy.

17. What happens to stars that ignite carbon in a degenerate core?

a) They become completely disrupted through a supernova explosion.
b) They collapse to a carbon-rich white dwarf.
c) They go through a helium flash.
d) They get drunk at the local bar and follow a random walk back to their home like a photon trying to escape the interior of a star.
e) They collapse to a black hole.

18. Main sequence stars with $4M_\odot < M < 8M_\odot$ will

a) helium flash and finally end up as a white dwarf.

b) supernova via an Fe-core bounce.

c) never become red giant stars.

d) collapse directly into a black hole.

e) supernova via carbon detonation in a degenerate core.

19. Stars that have $M > 8M_\odot$ are/will

a) go through a helium flash.

b) supernova via an iron-core bounce.

c) be completely convective their entire lives.

d) supernova via carbon detonation.

e) not massive enough to support nuclear fusion.

20. When the energy that flows into a layer of gas in a star is balanced by the flow of energy out of that layer, such a layer is said to be in

a) dynamic equilibrium b) hydrostatic equilibrium c) momentum equilibrium

d) radiative equilibrium e) thermal equilibrium

21. Massive stars end their thermonuclear lives by blowing themselves up. Astronomers call these explosions

a) supernova b) nova c) gamma ray bursters

d) big bangs e) none of these

22. In the *Cosmos* video we saw in class, what would happen to the forward field-of-view in your spaceship as you traveled close to the speed of light?

a) You no longer can see directly in front of you.

b) It completely turns red.

c) It completely turns black.

d) It completely turns blue.

e) It get smaller and smaller as you go faster and faster.

23. How are the stellar winds of an O main sequence star and an M giant star similar?

a) They are driven by conductive transport.

b) They are driven by radiation pressure.

c) They are driven by convection transport.

d) They are thermally driven from the star's hot corona.

e) They are driven by a Honda Accord.

24. Which of the following <u>best</u> describes a red giant clump star?

a) hydrogen core burner   b) hydrogen shell burner   c) helium core burner

d) helium shell burner   e) collapsing protostar

25. During He-shell burning, stars can pulsate. These types of stars are called what type of variables?

a) Cepheids   b) RR Lyrae   c) Miras

d) eclipsing   e) none of these

26. The Russell-Vogt theorem states that

a) almost all properties of a stars are determined by its mass and composition.

b) white dwarfs must be much smaller than main sequence stars.

c) almost all properties of a stars are determined by its magnetic field and rotation rate.

d) 90% of all stars lie on the main sequence.

e) stars shine due to thermonuclear reactions.

27. What is an alpha (α) particle?

a) an electron b) a photon c) a neutron

d) a proton e) a helium nucleus

28. Which of the following best describes a red giant branch star?

a) helium shell burner b) hydrogen core burner c) helium core burner

d) hydrogen shell burner e) collapsing protostar

29. We know the age of star clusters by

a) the main sequence turn-off.

b) asking them.

c) counting tree rings.

d) radioactive dating.

e) the number of stars in the cluster.

30. Why are Cepheids used as a distance indicator to external galaxies?

a) They are bright and follow a period-luminosity law.
b) They are bright hence it is easy to use trigonometric parallax.
c) They are found in clusters which allows us to use the moving cluster method.
d) Their pulsation period is directly related to their distance.
e) All Cepheids are the same brightness hence their apparent brightness tells us their distance.

31. What drives the strong stellar winds seen in M-type giant stars?

a) Radiation pressure on dust.
b) Momentum coupling of gas with acoustic (sound) waves.
c) Radiation pressure on atomic lines.
d) Radiation pressure on electrons.
e) Momentum coupling of ionized gas with magnetic Alfvén waves.

32. Why do main sequence stars stay fairly stable in both size and luminosity?

a) Degenerate electron pressure is balanced by degenerate neutron pressure.
b) They are in both thermal and hydrostatic equilibrium.
c) They are continuously creating new matter as they lose mass through stellar winds.
d) The interior of a star is a vacuum and hence cannot change.
e) Non-local thermodynamic processes dominate their interiors.