Astronomy II (ASTR1020) — Exam 4

Test No. 4D

13 November 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.*, 4D) 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

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

1. Which of the following is <u>not</u> true about open star clusters?

a) contains 10^5 to 10^6 stars

b) contain Pop I stars

c) often near stellar nurseries

d) entirely found in galactic disk

e) all of these are true

2. What is the maximum mass of a neutron star?

a) $3.0M_\odot$ b) $10M_\odot$ c) $1.4M_\odot$ d) $50M_\odot$ e) $0.4M_\odot$

3. The science that describes the physics of electrons and other subatomic particles is called

a) general relativity b) special relativity c) classical mechanics

d) quantum mechanics e) electronics

4. Rapidly spinning neutron stars with intense magnetic field are called

a) pulsars b) drunks c) white dwarfs d) X-ray bursters e) black holes

5. White dwarfs are stable due to the weight of the star being balanced by

a) radiation pressure from the intense light within the white dwarf.

b) degenerate neutron pressure.

c) internal gas pressure resulting from thermonuclear reactions.

d) degenerate electron pressure.

e) fast spin of the star.

6. A black hole is an object that has collapsed down to a

a) neutron star b) singularity c) white dwarf

d) quark star e) Herbig-Haro object

7. Supernovae with no hydrogen Balmer lines seen in their spectra results from what process?

a) Gradual mass transfer onto a white dwarf.

b) The iron-core bounce of a massive star.

c) A run away He-flash.

d) Gradual mass transfer onto a neutron star.

e) Rapid mass transfer onto a white dwarf.

8. What is the dominant energy transport mechanism inside a white dwarf?

a) magnetic waves b) radiation transport c) conduction

d) acoustic waves e) convection

9. The metal poor stars seen in the Galaxy are called what type stars?

a) Population II b) Population III c) Population I

d) Population IV e) Population V

10. There is substantial observational evidence that *what* exists at the center of the Milky Way?

a) a stellar black hole b) a large magnetar c) a supermassive black hole

d) the Borg e) a large pulsar

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12. Small open clusters containing about 10 stars are called

a) globulars b) spiral arms c) associations

d) H II regions e) black holes

13. Currently the Sun is in which spiral arm?

a) Orion b) Cygnus c) Sagittarius d) Pegasus e) Perseus

14. Supernovae that are produced the iron-core bounce of a massive star are called

a) Type II supernova b) nova c) Type III supernova

d) X-ray bursters e) Type I supernova

15. How was the Sun's location in the Galaxy determined?

a) Distribution of galactic star clusters in the Galaxy.

b) Period-luminosity relation of Mira variables.

c) Distribution of globular star clusters in the Galaxy.

d) Period-luminosity relation of Cepheid variables.

e) Through the spiral density wave theory.

16. Supernovae that are produced by rapid mass transfer onto a white dwarf by a binary companion are called

a) Type I supernova b) nova c) Type III supernova

d) X-ray bursters e) Type II supernova

17. Self-sustaining star formation means that

a) supernova explosions cause new stars to form, then they evolve and supernova causing further star formation, and so on.

b) stars can form all by themselves without help from spiral density waves or supernovae.

c) stars always produce planetary systems that can support life.

d) stars produce their energy through thermonuclear reactions.

e) none of the above

18. Which of the following describe the Pauli Exclusion Principle?

a) Singularities have infinite density.

b) No two electrons can share the same quantum state at the same time in the same location.

c) Particles with the same charge will repel each other.

d) Particles with the opposite charge will repel each other.

e) Like Rudolf, let's exclude Pauli from our reindeer games.

19. The *gradual* transfer of mass from a normal star onto a white dwarf will cause a

a) Type I supernova b) gamma ray burster c) Type II supernova

d) wormhole e) nova

20. The rotation curve of the Milky Way stays rather flat instead of falling off in a Keplerian fashion in the outer regions of the Galaxy. On the other hand, light that is emitted from matter in the Galaxy falls off rather sharply in the outer regions. This indicates that there is a lot of *what* in the halo of the Galaxy?

a) dark matter b) photons c) O and B stars

d) shock waves e) supernovae

21. Which of the following is <u>not</u> a spiral tracer?

a) H II regions b) OB associations c) neutral hydrogen gas

d) white dwarfs e) all of these are tracers

22. The radius of the event horizon around a black hole is named after

a) Galileo b) Schwartzschild c) Newton d) Chandrasekhar e) Einstein

23. What is the brightest absolute magnitude of a nova?

a) -17 b) -19 c) -26 d) -13 e) -5

24. The <u>best</u> *stellar* black hole candidate yet observed is

a) Cyg X-1 b) LMC X-3 c) SS 433 d) SMC X-1 e) V404 Cyg

25. Which one of the following items below is <u>not</u> necessarily a characteristic of an observable black hole candidate?

a) The unseen companion in a binary star system must have a mass greater than $3M_{\odot}$.

b) The black hole must have an accretion disk around it.

c) There must be a rapidly fluctuating X-ray signal from a binary star system.

d) The candidate must be close enough for a trigonometric parallax to be obtained.

e) It must be an unseen companion in a binary star system.

26. Of the following sample, which would be considered the *youngest* stellar type?

a) Population I stars b) Population II stars c) Population III stars

d) Disk Population stars e) all have the same age

27. What is Geminga?

a) The name of the white dwarf in orbit about Sirius.

b) The name of the robot in the movie *The Day the Earth Stood Still*.

c) A pulsar with a high proper motion.

d) The nearest *stellar* black hole candidate.

e) The brightest star in the constellation of Gemini.

28. Approximately how many stars are there in the Milky Way Galaxy?

a) four thousand b) four c) 400 hundred trillion

d) four million e) four hundred billion

29. The *gradual* transfer of mass from a normal star onto a neutron star will cause a(n)

a) X-ray burster b) nova c) Type II supernova

d) Type I supernova e) wormhole

30. Which of the following describes a black dwarf?

a) Another name for a mini-black hole.

b) An old white dwarf star that has cooled off.

c) A massive collapse star whose escape velocity exceeds the speed of light.

d) A rapidly spinning neutron star with an intense magnetic field.

e) One of Snow White's dwarfs.

31. Which of the following is <u>not</u> true about globular star clusters?

a) contains 10^5 to 10^6 stars

b) contain Pop II stars

c) spherical in shape

d) entirely found in galactic disk

e) all are true

32. Which of the following is <u>not</u> true of the galactic halo?

a) It is composed of Population I stars.

b) There is almost no ISM there.

c) Stellar orbits are highly elliptical.

d) Its shape is spherical.

e) Globular clusters are found there.