

**Department of Physics and Physical Oceanography**  
**Physics 2151**  
**Final Examination Winter 2007**

NAME \_\_\_\_\_ MUN NO. \_\_\_\_\_

**SECTION A: Circle the letter corresponding to the correct answer.**

- 1) A large star goes supernova and the remaining core is 2.8 solar masses. This indicates that the star will end its life as a:
  - a) white dwarf
  - b) neutron star
  - c) black hole
  - d) quasar
  
- 2) A star near the end of its life has a mass of 1.2 solar masses. The Chandrasekhar limit indicates that this star's life will end :
  - a) at the white dwarf stage
  - b) with a supernova eruption
  - c) as a neutron star
  - d) both b) and c) are correct
  
- 3) The central temperature of a G2V star is typically:
  - a) 100 K
  - b) 10 000 K
  - c) 10 million K
  - d) 10 billion K
  
- 4) Compared with stars of spectral class O, stars of spectral class G are:
  - a) cooler and evolve more slowly
  - b) hotter and evolve more slowly
  - c) cooler and evolve more quickly
  - d) hotter and evolve more quickly
  
- 5) A planetary nebula is:
  - a) a star with planets in orbit
  - b) a gas cloud surrounding a planet
  - c) an expanding gas shell around a giant star
  - d) the gas between the stars in a binary
  
- 6) The spectral type of a star is M3Ia. This indicates that the star is:
  - a) a white dwarf
  - b) a red giant
  - c) a neutron star
  - d) a main sequence star
  
- 7) A star with a high apparent magnitude and a low absolute magnitude:
  - a) a nearby star
  - b) a distant star
  - c) a star with a large proper motion
  - d) a star with a large angle of parallax
  
- 8) Globular clusters are:
  - a) found scattered throughout the arms of our galaxy
  - b) found at the core of the galaxy
  - c) found in a halo around the galaxy
  - d) actually small galaxies
  
- 9) Which of the following is most dense? :
  - a) a supergiant star
  - b) a main sequence star
  - c) a white dwarf
  - d) the sun

10) Younger stars have more heavy elements because:

- a) old stars destroy heavy elements as they age
- b) young stars burn their nuclear fuel faster
- c) heavy elements were made in previous generations of stars
- d) all of the above

11) The star Algol has an apparent magnitude of 2 and the star Minkar has an apparent magnitude of 3.

- a) Minkar will appear approximately 2.5 times brighter than Algol
- b) Algol will appear approximately 2.5 times brighter than Minkar
- d) Both stars are too dim to see on a dark, clear night
- e) Since Minkar and Algol are at different distances from earth it is hard to tell which will be brighter.

12) During star formation, a star stops collapsing when forces from the gas pressure and gravitational forces are balanced. What is this state of balance called?

- a) natural balance
- b) Newtonian balance
- c) hydrostatic equilibrium
- d) protostatic equilibrium

13) A planet (X) the size of the earth orbits a 20 solar mass black hole. Another earth size planet (Y) orbits a 20 solar mass B star. Which planet will feel the greatest gravitational attraction?

- a) Planet X
- b) Planet Y
- c) Both planets will feel the same gravitational pull
- d) There is no way to know because black holes "swallow" all information

14) Regulus has a color index (B-V) of - 0.09. Antares has a color index of 1.87

- a) Antares is a hot star, Regulus is cool
- b) Antares is a B7 star while Regulus is an M1 star
- c) Regulus is a B7 star while Antares is an M1 star
- d) Both a) and b) are correct

15) The mass - luminosity relation for main sequence stars states that:

- a) high mass is related to low luminosity
- b) High mass is related to high luminosity
- c) Luminosity is constant for all masses
- d) Luminosity is independent of mass

16) The transition from a main-sequence star to the giant or supergiant phase:

- a) takes about the same amount of time for all stars
- b) takes much longer for stars of greater mass
- c) takes a little longer for very low mass stars
- d) takes much longer for low mass stars than for high mass stars

17) A neutron star is about the size of:

- a) Toronto
- b) Earth
- c) Jupiter
- d) Europe

18) In a massive star, the heaviest element that can be produced in its core is:

- a) hydrogen
- b) neon
- c) silicon
- d) iron

19) All novae are thought to involve a:

- a) neutron star
- b) black hole
- c) supergiant
- d) white dwarf

20) Which one of the following is the coolest?

- a) M 5 V
- b) G 2 I
- c) O 5 V
- d) B 5 I

21) Which one of the following has the highest luminosity?

- a) M 5 V
- b) G 2 V
- c) O 5 V
- d) B 5 V

22) Cepheid variables are of interest because:

- a) they are all at the same distance from us
- b) their periods are related to their absolute magnitudes
- c) their masses vary from day to day
- d) they are the remains of stars that went supernova

23) Pulsars are known to be :

- a) pulsating white dwarfs
- b) pulsating neutron stars
- c) rotating neutron stars
- d) rotating white dwarfs.

24) Stars A and B are perfect blackbodies and both radiate energy at all wavelengths. The surface of Star A appears blue and is hotter than that of star B which appears red.

- a)  $\lambda_{\text{max}}$ , as defined in Wein's law, is greater for Star A than for star B
- b) At each wavelength, including the red part of the spectrum, Star A radiates more energy per square metre than Star B
- c) In a given time, Star A must radiate more total energy than Star B
- d) Star A must be approaching and Star B receding

25) Quasars have the following properties:

- a) they are strong radio emitters
- b) they have greatly red shifted spectral lines
- c) they are relatively close to the local group
- d) both a) and b) are correct.

26) The Tully-Fisher method for finding the distance to galaxies relates absolute magnitude to:

- a) redshift
- b) rotational velocity
- c) magnetic field
- d) angular size

27) Why are binary stars so important to astronomers ?

- a) because we can determine the centre of their masses
- b) because they are so rare they tell us something about the universe
- c) because it is by using binary stars that we can determine stellar masses
- d) because they give us opportunity to use Kepler's Laws

28) The microwave background temperature of the universe is approximately:

- a) 100 K
- b) 3 K
- c) 1.4 K
- d) 0 K

29) Our ability to detect distant stars in our galaxy is limited because of:

- a) absorption by dust in the galaxy
- b) the existence of 21 cm radiation in the galaxy
- c) the existence of many bright nebulae in the galaxy
- d) there is no limit in our ability to detect distant stars

30) The Hubble Law may be expressed by:

- a)  $v=H_0d$
- b)  $v=H_0/d$
- c)  $v=H_0d^2$
- d)  $v=H_0/d^2$

**Section B:** Answer any five of the following in the answer book provided. Remember your objective is to show that “you” understand the material. Please make sure you number your answers. (20 points).

- 1) Describe the structure of the Milky Way and outline Hubble’s classification of galaxies.
- 2) What are black holes, how do we detect them and what characteristics could we measure if we could get a probe near enough?
- 3) How do we determine the masses of stars?
- 4) How can we use the Hubble Constant to determine the age of the universe?
- 5) How can a star have a low temperature but a very high luminosity?
- 6) The space between stars contains clouds of cold gas that are transparent to light. Suppose you observe a distant star. How might the presence of a cloud between you and the star be detected?
- 7) Show by a diagram how two stars can have the same radial velocity and proper motion but different space velocities.
- 9) How can we determine a star’s radial velocity from analysis of its spectrum?
- 10) What is distance modulus and how do we determine absolute magnitudes? What is the value of the distance modulus in astronomy?

**SECTION C:** Write, in the answer book provided, an essay on one of the following topics. (Remember your objective is to show that “you” understand the material. Please make sure you number your answer). (10 points).

- 1) A month ago a nova was discovered in the constellation Scorpius. This Nova was first observed when it reached magnitude 9 star but in a couple of days it reached magnitude 3.8 star. Now the situation is back to where it was before the nova erupted. What is a NOVA ? Briefly trace the history of the star(s) from the protostar stage to the time when the nova occurred.
- 2) Newton considered gravity to be a force of attraction between two or more masses. But we now know that a large gravitational source will alter the path of a beam of light but light does not have mass. Write an essay on gravity outlining the part gravity plays in the life histories of stars and how our view of gravity has changed since Newton’s time.
- 3) What evidence do we have for the “Big Bang” and why do we spend so much time talking about forces when discussing the “Big Bang”? Briefly outline the history of the universe from  $10^{-43}$  seconds after the big bang to present and the possible outcomes assuming we have a true value for the critical density of the universe.