Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Why do sunspots appear dark in pictures of the Sun?   1) _____
   A) They are holes in the solar surface through which we can see to deeper, darker layers of the
     Sun.
   B) They are too cold to emit any visible light.
   C) They emit light in other wavelengths that we can't see.
   D) They are tiny black holes, absorbing all light that hits them.
   E) They actually are fairly bright but appear dark against the even brighter background of the
     surrounding Sun.

2) Studies of sunquakes, or *helioseismology*, have revealed that   2) _____
   A) "sunquakes" are caused by similar processes that create earthquakes on Earth.
   B) the Sun generates energy by nuclear fusion.
   C) our mathematical models of the solar interior are fairly accurate.
   D) the Sun vibrates only on the surface.
   E) neutrinos from the solar core reach the solar surface easily.

3) What observations characterize *solar maximum*?   3) _____
   A) The Sun emits light of longer average wavelength.
   B) The Sun becomes much brighter.
   C) The Sun rotates faster at the equator.
   D) We see many sunspots on the surface of the Sun.
   E) all of the above

4) Which of the following statements about the sunspot cycle is *not* true?   4) _____
   A) The number of solar flares peaks about every 11 years.
   B) The rate of nuclear fusion in the Sun peaks about every 11 years.
   C) With each subsequent peak in the number of sunspots, the magnetic polarity of the Sun is the
     reverse of the previous peak.
   D) The cycle is truly a cycle of magnetic activity, and variations in the number of sunspots are
     only one manifestation of the cycle.
   E) The number of sunspots peaks approximately every 11 years.

5) When does a star become a main–sequence star?   5) _____
   A) when the protostar assembles from a molecular cloud
   B) when a star becomes luminous enough to emit thermal radiation
   C) when the rate of hydrogen fusion within the star's core is high enough to maintain
     gravitational equilibrium
   D) the instant when hydrogen fusion first begins in the star's core
   E) when hydrogen fusion is occurring throughout a star's interior

6) What happens to the rotation of a molecular cloud as it collapses to form a star? 6) _____
    A) The rotation dissipates and any residual is left in small overall rotation of the star.
    B) The rotation rate remains the same and results in stellar rotation.
    C) The rotation rate increases and results in fast rotation of the star.
    D) The rotation rate increases and results in a disk of material around a protostar.
    E) The rotation increases the speed of collapse and produces more massive stars.

7) What is the likely reason that we cannot find any examples of the first generation stars? 7) _____
    A) The first generation stars are too faint to be visible now.
    B) The first generation stars formed with only H and He and therefore have no spectral features.
    C) The first generation stars formed such a long time ago that the light from them has not yet
       had time to reach us.
    D) The first generation stars were all very massive and exploded as supernova.
    E) We do not know how the first generation stars were formed.

8) What property of a molecular cloud does not counteract gravitational contraction? 8) _____
    A) magnetic fields   B) turbulent motions
    C) fragmentation   D) thermal pressure

9) The thermal pressure of a gas depends on 9) _____
    A) composition.
    B) density only.
    C) gravity.
    D) temperature only.
    E) density and temperature.

10) What happens to the visible radiation produced by new stars within a molecular cloud? 10) _____
    A) It is reflected back onto the protostar, heating it up further.
    B) It escapes the cloud completely.
    C) It shoots out in bright jets.
    D) It is absorbed by dust grains and heats up the cloud.
    E) The blue light is absorbed and the red light transmitted.

11) Which of the following statements about an open cluster is *true*? 11) _____
    A) All stars in the cluster will evolve similarly.
    B) All stars in the cluster are approximately the same color.
    C) All stars in the cluster are approximately the same age.
    D) All stars in the cluster have approximately the same mass.
    E) There is an approximately equal number of all types of stars in the cluster.

12) In a pulsating variable star, which characteristic of the star changes dramatically with time? 12) _____
    A) rotation rate
    B) core temperature
    C) energy–generation process
    D) mass
    E) luminosity

13) Which of the following luminosity classes refers to stars on the main sequence? 13) _____
    A) I   B) II   C) III   D) IV   E) V

14) On the main sequence, stars obtain their energy

14) _____

    A) from chemical reactions.
    B) from nuclear fission.
    C) by converting helium to carbon, nitrogen, and oxygen.
    D) from gravitational contraction.
    E) by converting hydrogen to helium.

15) Which of the following best describes the axes of a Hertzsprung–Russell (H–R) diagram?

15) _____

    A) mass on the horizontal axis and luminosity on the vertical axis
    B) surface temperature on the horizontal axis and radius on the vertical axis
    C) mass on the horizontal axis and stellar age on the vertical axis
    D) interior temperature on the horizontal axis and mass on the vertical axis
    E) surface temperature on the horizontal axis and luminosity on the vertical axis

16) Which of the following terms is given to a pair of stars that appear to change positions in the sky, indicating that they are orbiting one another?

16) _____

    A) visual binary
    B) eclipsing binary
    C) double star
    D) spectroscopic binary
    E) none of the above

17) The spectral sequence sorts stars according to

17) _____

    A) mass.
    B) radius.
    C) core temperature.
    D) surface temperature.
    E) luminosity.

18) The most distant stars we can measure stellar parallax for are approximately

18) _____

    A) 10,000 parsecs away.
    B) halfway across the Milky Way Galaxy.
    C) in the Andromeda Galaxy.
    D) 100 parsecs away.
    E) 5 parsecs away.

19) A star's *luminosity* is the

19) _____

    A) total amount of light that the star will radiate over its entire lifetime.
    B) total amount of light that the star radiates each second.
    C) apparent brightness of the star in our sky.
    D) lifetime of the star.
    E) surface temperature of the star.

20) Since all stars begin their lives with the same basic composition, what characteristic most determines how they will differ?

20) _____

    A) luminosity they are formed with
    B) color they are formed with
    C) time they are formed
    D) location where they are formed
    E) mass they are formed with

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

21) Describe two general ways we learn about the Sun's interior.

21) _____

22) List at least two ways the sunspot cycle affects us on Earth.

22) _____

23) Briefly describe the phenomena of the sunspot cycle.

23) _____

24) Briefly explain why sunspots are cooler than surrounding regions of the Sun and why they look dark in photos.

24) _____

25) How do scientists estimate stellar luminosities?

25) _____

26) Two stars, Tom and Jerry, have the same spectral type. Tom is luminosity class V and Jerry is luminosity class I. Which star is bigger? Which star is more luminous? Which star has a hotter surface temperature? Explain your answers.

26) _____

27) Briefly describe how a star forms.

27) _____

28) Since scientists can't follow the stellar formation process of a single star from start to finish, how do they study solar life cycles?

28) _____

29) Describe the four distinct stages in the life track of a solar–mass protostar on the H–R diagram and explain why the track is the shape it is.

29) _____

30) Explain how gas in a protostellar disk spirals onto the central star.

30) _____

31) Why does a cloud collapse rapidly at first, and then slow down as the it gets denser?

31) _____

32) Explain why stars form only in molecular clouds, the coldest, densest parts of the interstellar medium.

32) _____