

Name:
Row Letter:

Test2 Version A
Formulae

$$E/m^2 = \sigma T^4 \quad L = 4\pi R^2 \sigma T^4 \quad L_{ap} = \frac{L}{d^2} = \frac{R^2 \sigma T^4}{d^2} \quad T = \frac{2.9 \times 10^6}{\lambda_{max}}$$

$$L_{MS} = M^{3.5} \quad t_{MS} = \frac{1 \times 10^{10}}{M^{2.5}} \text{ (in years)} \quad R_{Sch}(\text{km}) = 3M$$

$$\sigma = 5.67 \times 10^{-8} \text{ W/m}^2 \quad 1 \text{ pc} = 3.1 \times 10^{16} \text{ m} = 3.26 \text{ ly} \quad c = 3 \times 10^8 \text{ m/s}$$

Multiple Choice: *Choose the letter for the best answer.*

1) What stage of evolution is our Sun currently at?

- A) White dwarf.
- B) Red Giant.
- C) Protostar.
- D) Main Sequence.
- E) Horizontal Branch.

2) On Figure 2, HR diagram #4, what is the region labeled C?

- A) White dwarf.
- B) Red Giant Branch.
- C) Main Sequence.
- D) Supergiants
- E) Supernova.

3) What is the source of energy for a protostar?

- A) Fusion of H to He.
- B) Fusion of He to C.
- C) Gravity.
- D) Electron degeneracy pressure.
- E) Neutron degeneracy pressure.

4) Why do stars evolve?

- A) They dont. They are always the same.
- B) Because they change color with time.
- C) Because they change distance from us with time.
- D) They emit energy, and so use fuel which is a limited resource.
- E) Because their mass changes with time.

5) What produced all the nitrogen (#7 in the periodic table) in Earth's atmosphere?

- A) Supernovas
- B) Planetary nebulas
- C) The Universe (it was always around)
- D) Both A & B
- E) All of the above did.

6) In HR4 in Figure 2, what is the difference between stars near the letter D and stars near the letter E that *causes* them to be at those locations?

- A) Age.
- B) Mass.
- C) Temperature.
- D) Radius (size).
- E) None of the above.

7) In Figure 2, which of the HR diagrams shows the oldest set of stars?

- A) HR1
- B) HR2
- C) HR3
- D) There is no way to tell.
- E) They are all the same age.

8) If our Sun became a black hole, how large would its event horizon (Schwarzschild radius) be?

- A) 10 meters.
- B) 3km
- C) 30km
- D) The same size as it is now.
- E) There is no way to tell.

9) What is the surface temperature of a star with a peak in its continuous spectrum at 400 nm?

- A) 11,600 K
- B) 9730 K
- C) 7250 K
- D) 5140 K
- E) 3220 K

10) The most common type of exoplanets discovered so far....

- A) are Earth-like with orbits around 1AU.
- B) have masses between Earth's and Neptune's with short orbits.
- C) have large masses like Jupiter and have long orbits (like Jupiter's).
- D) have Earth-like masses but with distant orbits.
- E) have large masses like Jupiter and very short orbits (inside Mercury's).

11) Why does nuclear fusion only occur in the cores of stars?

- A) It is too hot on the surface.
- B) Only the cores are solid material.
- C) During the planetary nebula phase, the envelope is too large.
- D) Only the core is hot and dense enough.
- E) Fusion occurs everywhere in stars, not just in the core.

12) About what fraction of stars have planets?

- A) None of them do. Just us.
- B) 10%
- C) 50%
- D) 90%

13) A star with 34 times the mass of our Sun will end up as...

- A) a supernova explosion.
- B) a white dwarf.
- C) a neutron star.
- D) a black hole.
- E) There is no way to tell.

14) I see a red star and a blue star in a binary. The red star is brighter, what else do I know about these two stars?

- A) The red star is larger.
- B) The blue star is larger.
- C) The red star is closer.
- D) The red star is hotter.

Questions 15 - 17 are based on this statement: A gas cloud collapses to form 4 stars (so they all start the main sequence at the same time and are at the same distance). Star A is 0.08 solar masses, Star B is 1.2 solar masses, Star C is 2.6 solar masses, and Star D is 29 solar masses.

15) Which star is the brightest on the main sequence?

- A) Star A
- B) Star B
- C) Star C
- D) Star D
- E) They are all the same temperature.

16) Which star evolves the fastest?

- A) Star A
- B) Star B
- C) Star C
- D) Star D
- E) They all last the same amount of time.

17) Which stars will become white dwarfs?

- A) Star A only
- B) Stars A, B, and C
- C) All the stars will.
- D) None of them will. They will all explode.

Questions 18 through 20 have to do with Figure 1; the star cluster image.
Assume all the stars are in a cluster, so at the same distance.

18) Which star in the image is the brightest?

- A) Star A
- B) Star B
- C) Star C
- D) Star D
- E) Star E

19) Which star is the hottest?

- A) Star A
- B) Star B
- C) Star C
- D) Star D
- E) They are all the same temperature.

20) If Star C and Star D in the image are at the same distance and have the same apparent luminosity, what else do we know about these two stars?

- A) Star C is closer than Star D.
- B) Star C is larger than Star D.
- C) Star D is closer than Star C.
- D) Star D is larger than Star C.
- E) We don't know squat.

Here is a list of stages of stellar evolution for most stars:

A: Main Sequence B: Horizontal Branch C: White dwarf D: Red Giant Branch E: Protostar

Here is a list of energy sources:

I: Fusion of H into He II: Fusion of He into C III: Gravity IV: Electron Degeneracy Pressure
V: Neutron Degeneracy Pressure VI: Supernova

21) Put the steps of stellar evolution (just write the letters) in the correct order from beginning to end for regular (not high-mass) stars.

Next to each step put the roman numeral of its support mechanism (energy in most cases).

(Worth 10 points)

22) Put the HR diagrams 1-3 of Figure 2 in order from *youngest to oldest*. (Worth 5 points)

23) Put the labeled stars in Figure 1 in order from *hottest to coolest*. (Worth 5 points)