

Test2 Spring 2024 Version A  
Formulae

$$L_{ap} = \frac{R^2}{d^2} \sigma T^4 \quad T = \frac{2.9 \times 10^6}{\lambda_{max}} \quad R_{Sch} = 3M$$

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

Constants

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

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

- 1) What stage of evolution is our Sun currently at?  
D) Main Sequence.
  
- 2) About what fraction of stars have planets?  
D) Nearly all (90%)
  
- 3) On Figure 2, HR diagram #2, what is the region labeled A?  
D) Horizontal Branch.
  
- 4) What produced all the oxygen we breathe?  
A) Supernovas  
B) Planetary nebulas  
D) Both A & B
  
- 5) Which method has detected the most exoplanets?  
B) Transit
  
- 6) Stars are roughly made of  
A) Mostly H, then He, with a smidge of everything else.
  
- 7) What is the fate of our Sun?  
C) It will end up as a white dwarf.
  
- 8) Why do stars evolve?  
A) They have limited fuel, which makes them use other sources.

Questions 9 through 14 have to do with Figure 1; the color star cluster image.

- 9) Which star in the image is the brightest?  
A) Star A
  
- 10) Which star is the hottest?  
C) Star D

11) 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?

B) Star C is larger than Star D.

12) Stars A and C in the image have the same color. What else do I know?

C) Star A is larger than Star C.

13) If Star E is in a (not eclipsing) binary, what can I learn from that?

A) Mass.

14) Since the stars are in a cluster, I can assume that....

A) they are at the same distance.

B) they are the same age.

C) they formed from the same cloud of gas.

D) A, B, and C are all true.

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

A) White dwarf.

16) What is the temperature of a star if the peak of its spectrum is 550 nm?

B) 5300 K.

For Questions 17 - 20: A gas cloud collapses to form 4 stars (so they are at the same distance and begin the main sequence at the same time). Star A is 45 solar masses, Star B is 1.4 solar masses, Star C is 9 solar masses, and Star D is 0.5 solar masses.

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

A) Star A

18) Which star remains on the main sequence the longest?

D) Star D

19) How will star A end?

C) Black hole.

20) How will star B end?

A) White dwarf.

21) The most common type of exoplanets discovered are

B) Have masses between Earth's and Neptune's with short orbits.

22) What is the size of the Schwarzschild radius of a 15 solar mass black hole?

C) 45 km.

23) Put the lettered regions of HR diagram #2 in evolution order from first to last.  
D, A or B, C

24) Next to each step of stellar evolution put its energy source: fusion ( $H \rightarrow He$ ), fusion ( $He \rightarrow C$ ), gravity, electron degeneracy pressure, neutron degeneracy pressure.

Protostar- Gravity

Main sequence- Fusion (H to He).

Horizontal branch- Fusion (He to C)

Neutron star- Neutron degeneracy pressure.

25) Put stars B, C, D, and E in order from coolest to hottest.  
C, B, E, D