

Test2 Spring 2024 Version B
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

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

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

- 1) What stage of evolution is our Sun currently at?
D) Main Sequence.

- 2) The most common type of exoplanets discovered are
B) Have masses between Earth's and Neptune's with short orbits.

- 3) What is the size of the Schwarzschild radius of a 15 solar mass black hole?
C) 45 km.

For Questions 4 - 7: 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.

- 4) Which star is the brightest on the main sequence?
A) Star A

- 5) Which star remains on the main sequence the longest?
D) Star D

- 6) How will star A end?
C) Black hole.

- 7) How will star B end?
A) White dwarf.

- 8) On Figure 2, HR diagram #2, what is the region labeled C?
A) White dwarf.

- 9) What is the temperature of a star if the peak of its spectrum is 550 nm?
B) 5300 K.

Questions 10 through 15 have to do with Figure 1; the color star cluster image.

- 10) Which star in the image is the brightest?
A) Star A
- 11) Which star is the hottest?
C) Star D
- 12) 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.
- 13) Stars A and C in the image have the same color. What else do I know?
C) Star A is larger than Star C.
- 14) If Star E is in a (not eclipsing) binary, what can I learn from that?
A) Mass.
- 15) 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.
- 16) What is the fate of our Sun?
C) It will end up as a white dwarf.
- 17) Why do stars evolve?
A) They have limited fuel, which makes them use other sources.
- 18) Which method has detected the most exoplanets?
B) Transit
- 19) Stars are roughly made of
A) Mostly H, then He, with a smidge of everything else.
- 20) On Figure 2, HR diagram #2, what is the region labeled A?
D) Horizontal Branch.
- 21) What produced all the oxygen we breathe?
A) Supernovas
B) Planetary nebulas
D) Both A & B
- 22) About what fraction of stars have planets?
D) Nearly all (90%)

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

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 ($H \rightarrow He$).

Horizontal branch- fusion ($He \rightarrow C$).

Neutron star- neutron degeneracy pressure.

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