Name: _____

Class: _____

Due Date: _____

E.5 Fusion and Stars

Understandings

- The stability of stars relies on an equilibrium between outward radiation pressure and inward gravitational forces.
- Fusion is a source of energy in stars.
- The conditions leading to fusion in stars in terms of density and temperature.
- The effect of stellar mass on the evolution of a star.
- The main regions of the Hertzsprung-Russell (HR) diagram and how to describe the main properties of stars in these regions.
- The use of stellar parallax as a method to determine the distance *d* to celestial bodies as given by $d(\text{parsec}) = \frac{1}{p(\text{arc}-\text{second})}$
- How to determine stellar radii

Equations

$$d(\text{parsec}) = \frac{1}{p(\text{arc}-\text{second})}$$

The solutions can be found on the YouTube channel Go Physics Go:

https://www.youtube.com/@gophysicsgo/playlists

Use your favorite sources to answer the following questions

1. C: Define *nuclear fusion.*

2. C: Give two examples of *nuclear fusion*:

3. C: Define *celestial.*

4. C: Define *star*.

5. C: Define *thermal gas pressure*.

6. C: Define *radiation pressure.*

7. C: Define *gravitational pressure*.

8. C: Define *stellar equilibrium*.

9. C: Define *main sequence star*.

10. C: Define *Sun*.

11. C: Describe the *proton-proton cycle*.

12. C: Define *apparent brightness b.* Units?

13. C: Define *luminosity L.* Units?

14. C: Define a *perfect black body*.

15. C: Describe *Wien's displacement law*.

16.C: Describe the *absorption spectrum*.

17.C: Describe *main sequence stars*.

18.C: Describe the *Hertzsprung-Russell diagram*.

19.C: Describe the *instability strip*.

20.C: Define a *red giant*.

21.C: Define a *red supergiant*.

22.C: Define a *dwarf star*.

23.C: Define *electron degeneracy pressure*.

24.C: Define a *white dwarf*.

25.C: Describe what happens after a *supernova*.

26.C: Describe the term *evolutionary path*.

27.C: Describe the equation $L \propto M^{3.5}$.

28.C: Define *astronomical unit*.

29.C: Define *light year*.

30.C: Define *stellar parallax* (or *parallax method*).

31.C: Define *parallax angle*.

32.C: Define *arc second*.

33.C: Define *parsec*.

34.C: Describe the equation $d(\text{parsec}) = \frac{1}{p(\text{arc}-\text{secon })}$.

35.E: An example of a fusion reaction is when deuterium and tritium combine to create helium, a neutron, and energy. Determine the

a. energy released (in MeV) from this reaction with the data given, and

Binding energy of deuterium: 2.22452 MeV
Binding energy of tritium: 8.48179 MeV
Binding energy of helium: 28.2957 MeV
Binding energy of a neutron: 0 MeV

b. the change in mass (in u) from this reaction.

36.E: The temperature of a main sequence star is approximately 2.50×10^4 K.

a. Determine the peak wavelength of this main sequence star.

b. Determine an approximate value of the luminosity of this main sequence star.

c. Determine an approximate value for its radius.

37.E: The surface temperature of a main sequence star is approximately 1.00×10^4 K.

a. Use the Hertzsprung-Russell diagram to estimate the luminosity of the star.

b. The apparent brightness of this main sequence star is approximately $1.60 \times 10^{-9} \frac{\text{W}}{\text{m}^2}$. Determine the approximate distance between this main sequence star and Earth.

38.E: The parallax angle to a star is 0.320 arc-seconds. Determine the distance, in meters, to the star.

39.E: The parallax angle for Betelgeuse is approximately 5.95×10^{-3} arc $-$ seconds. Determine the distance of Betelgeuse from Earth in

a. parsecs,

b. meters,

c. light years, and

d. astronomical units.