ASTR1050
Fall 2025

Equations

$$L \propto \frac{D^2}{P}$$
$$L = \sigma_{\rm SB} A T^4$$
$$F_* = \frac{L_*}{4\pi d^2}$$
$$m_2 - m_1 = -2.5 \log_{10} \frac{F_2}{F_1}$$
$$m_2 - m_1 = -5 \log_{10} \frac{d_1}{d_2}$$
$$\mu = m - M$$
$$\frac{L_*}{L_\odot} = \left[\frac{M_*}{M_\odot}\right]^{3.5}$$
$$g = \frac{GM}{R^2}$$
$$\lambda_p = \frac{2.898 \times 10^{-3} \text{ m K}}{T}$$
$$A_{\rm sphere} = 4\pi R^2$$
$$m = -2.5 \log_{10} \frac{F}{F_0}$$
$$\frac{F_2}{F_1} = 10^{\left(\frac{m_2 - m_1}{-2.5}\right)}$$
$$\frac{d_1}{d_2} = 10^{\left(\frac{m_2 - m_1}{-5}\right)}$$
$$\mu = 5 \log_{10} d \text{ (pc)} - 5$$
$$\tau_{\rm MS} = 10^{10} \left[\frac{M_*}{M_\odot}\right]^{-2.5} \text{ years}$$

Constants/Conversions

$1\ L_\odot = 3.828 \times 10^{26}$ W
$1\ M_\odot = 2 \times 10^{30}$ kg
$1\ R_\odot = 6.957 \times 10^{8}$ m
$T_\odot = 5780$ K
$\sigma_{\rm SB} = 5.67 \times 10^{-8}$ W m^{-2} K^{-4}
$G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}
1 AU $= 1.5 \times 10^{11}$ m
1 pc $= 3.09 \times 10^{16}$ m

SI prefixes

Name	Symbol	Base 10
Tera	T	10^{12}
Giga	G	10^{9}
Mega	M	10^{6}
Kilo	k	10^{3}
Centi	c	10^{-2}
Milli	m	10^{-3}
Micro	μ	10^{-6}
Nano	n	10^{-9}
Pico	p	10^{-12}
Femto	f	10^{-15}

Multiple Choice Section (20 %)

1. Which process makes a protostar give off light?

(a) Nuclear Fusion
(b) Nuclear Fission
(c) Gravitational contraction
(d) Internal mixing

2. A star forms from a cloud of gas and dust contracting by gravity. Which force keeps it from contracting without limit?

(a) The strong nuclear force
(b) Electric repulsion between hydrogen nuclei
(c) Pressure from the hot compacted gas
(d) Electron degeneracy pressure

3. Which one intrinsic property of a star determines its luminosity, size, and lifetime?

(a) Mass
(b) Location
(c) Composition
(d) Initial temperature

4. Which spectral type is the hottest?

(a) F
(b) A
(c) B
(d) O

5. For which stellar type is convection the method of heat transport in all layers?

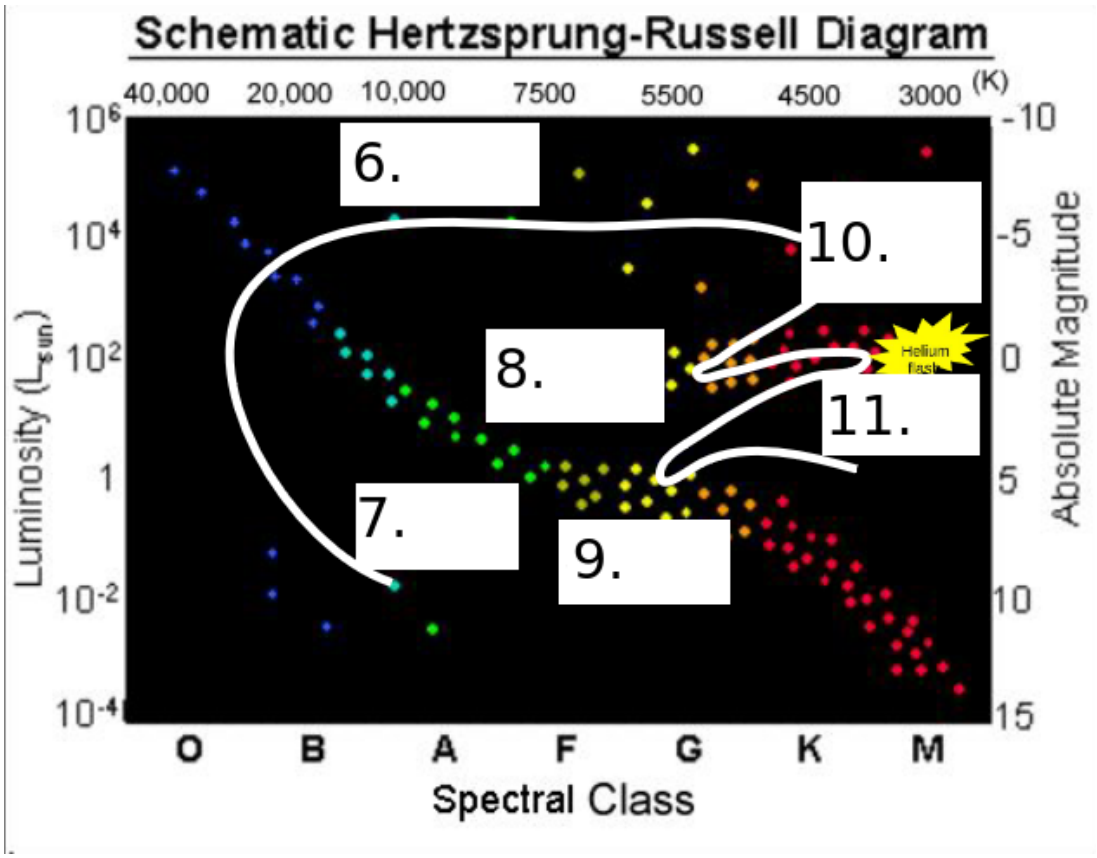
(a) Red dwarfs
(b) Low-to-intermediate mass
(c) High mass
(d) White dwarfs

Short answer (30 %)

Below is an HR diagram with the evolutionary path of the Sun sketched. For questions 6–11, fill in the blanks in the HR diagram using the word bank below.

Word bank:

Planetary Nebula, Main sequence, Red giant branch, Asymptotic Giant Branch, Horizontal branch, White dwarf



6. _____

7. _____

8. _____

9. _____

10. _____

11. _____

Open ended (50 %)

12. Suppose you are observing a distant star.

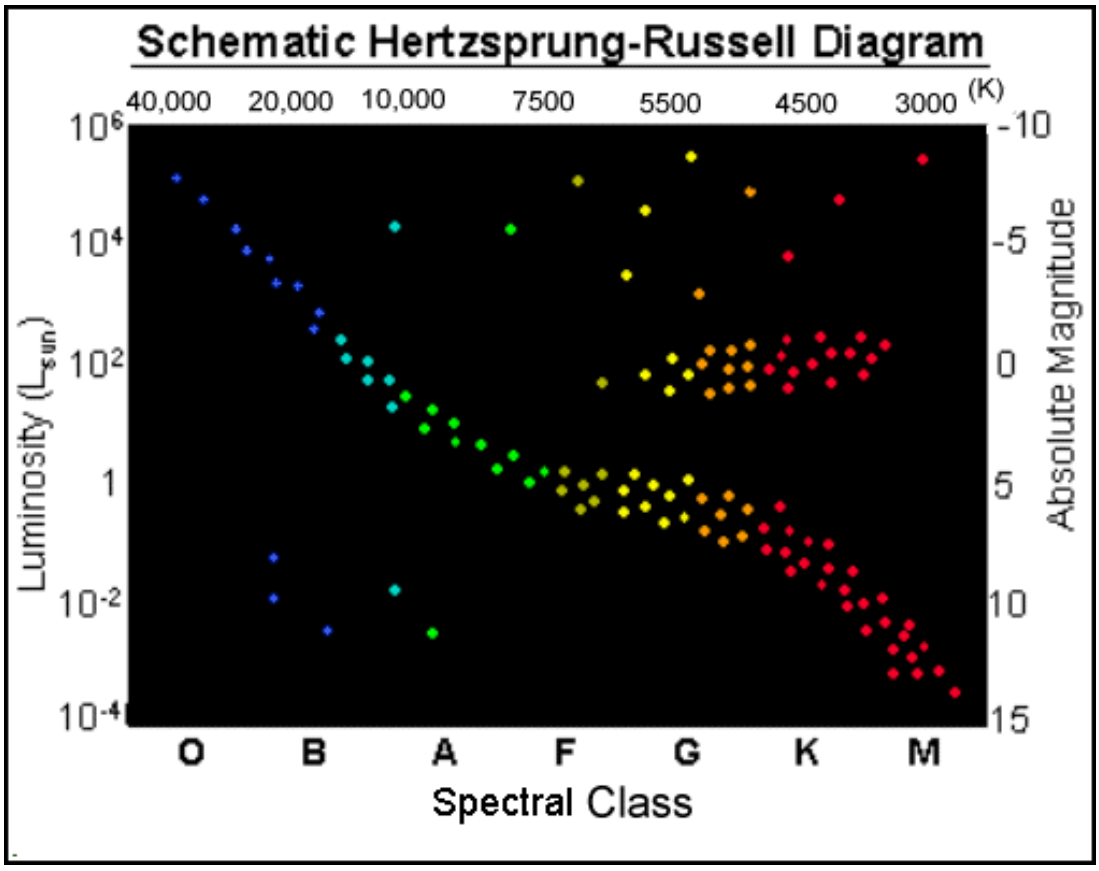
(a) **You measure the peak emission from this star to be** 828 **nm. What is this star's temperature in Kelvin?**

(b) **If this star has radius** $R_* = 27.3\ R_\odot$**, what is the luminosity of this star in solar luminosities** ($L_\odot$)**?**

(c) **Based on your answers from parts a) and b), which stage of evolution is this star undergoing?**

(d) **Spectroscopic analysis reveals this star's surface gravity to be** 0.629 **m s**$^{-2}$**. What is the star's mass in solar masses** ($M_\odot$)**?**

(e) **If this star is in the stage of evolution you identified in part c), what is the approximate lifetime of this star in years?**



Answer key

1. **C**
2. **C**
3. **A**
4. **D**
5. **A**
6. **Planetary Nebula**
7. **White dwarf**
8. **Horizontal branch**
9. **Main sequence**
10. **Asymptotic giant branch**
11. **Red giant branch**
12. **a.** $T_* = 3500$ K
    b. $L_* = 100\ L_\odot$
    c. Horizontal Branch
    d. $M_* = 1.70\ M_\odot$
    e. $\tau = 265$ million years