2021A7PS0173U DRASHTI

BITS Pilani Dubai Campus

PHY F215 Introduction to Astronomy and Astrophysics

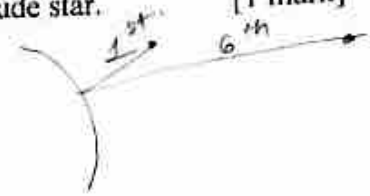
Midterm examination, Maximum marks: 30 marks

Date: 01.11.2023 Time: 90 minutes

1. A 1st magnitude star is ____ times as bright as a 6th magnitude star. [1 mark]

A. 2.5
B. 100
C. 1/6
D. 5
E. 6

↓ mag ↑ bright.



2. These Main Sequence stars all have the same parallax. Which one would appear brightest to us? [1 mark]

A. G2
B. B5
C. K3
D. A1
E. F8

O B A F G K M

3. If a star has a parallax of ____ arcseconds, then its distance is ____. [2 mark]

A. 0.2; 20 parsecs
B. 0.04; 25 lightyears
C. 0.1; 10 lightyears
D. 0.25; 4 parsecs
E. 0.5; 0.5 parsecs

4. Which of these is a Supergiant star? [1 mark]

A. M5 III
B. F3 I
C. K8 V
D. O9 II
E. G7 IV

5. Of these, which is the hottest star? [1 mark]

A. M5 III
B. F3 I
C. K8 V
D. O6 II
E. G7 IV

6. After about 5 billion years the Sun is expected to swell to 200 times its present size. If its temperature becomes half of what it is today, find the change in its absolute magnitude. [3 marks]

t = 5 billion T = T/2 A = 200 0.495

7. The brightest star in the sky has luminosity L = 26 times the sun and the radius is R = 1.7 times the sun.

A) Estimate its surface temperature. (Given T_sun = 6000 K) [1 mark]

B) Calculate the wavelength (in nm) at which the black body curve would peak for the star spectrum. [1 mark]

C) Calculate the absolute magnitude of the star. (Given M_sun = +4.83.) [2 marks]

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8. An astronomer observed a Cepheid star with period of 34 days, comparing to previously measured Cepheids, its absolute magnitude is -5.65. If its apparent magnitude was +23.0, calculate the distance of the star. [2 marks]

9. Sirius is actually a binary system, consisting of a luminous main sequence star (Sirius A) and a hot but dim white dwarf (Sirius B), orbiting their center of mass. The orbital period of the Sirius system is P = 50 years. The average separation of Sirius A and Sirius B, taken over their entire orbit, is a = 20 AU.

a) Calculate the total mass of the Sirius system [2 marks]

b) Observation of the Sirius system has revealed that $a_1 / a_2 = 0.45$, where a_1 is the distance of Sirius A (the luminous main sequence star) from the center of mass. Find its individual masses of Sirius A and Sirius B. [2 marks]

$\log L = (4\pi R^2 \sigma) \log(T^4)$

10. Write a brief description about HR diagram. Explain (with equation) how you will construct constant radius lines in this diagram. [4 marks]

HR diagram = luminosity vs. temp diagram.

11. For a gas of neutral hydrogen atoms, at what temperature will equal numbers of atoms have electrons in the ground state (n = 1) and in the first excited state (n = 2)? [4 marks]

E =

12. p-p chain: $2e^- + 4^1H \rightarrow {}^4He + 2\nu_e + 6\gamma$ (26.7 MeV)

The power output of the Sun is 4×10^{26} W.

If 90% of this energy is supplied by the proton-proton chain, how many protons are consumed per second? [3 marks]

$\log_{10}(d) = 6.73$

$10^{\log_{10}(d)}$

$10^{6.73}$

$\log_{10} d^{(1/6.73)} = \log_{10} 10$

$d =$