

ASSIGNMENT 10

Due April 7 midnight

(18 questions 3 points each) for total of 54 points.

Students are encouraged to solve this assignment in the same fashion as any other paper assignment. However only the numerical values will need to be put in as the answers to each question.

The template for the assignment answers will be open by Wednesday April 5th on the class website on BBLearn.

1. The distance between eyepiece and objective lens in a certain compound microscope is 23.0 cm. The focal length of the eyepiece is 2.50 cm, and that of the objective is 0.400 cm. What is the overall magnification of the microscope?
2. The desired overall magnification of a compound microscope is 140 \times . The objective alone produces a lateral magnification of 12.0 \times . Determine the required focal length of the eyepiece.
3. A camera is being used with a correct exposure at $f/4$ and a shutter speed of (1/16) s. In order to photograph a rapidly moving subject, the shutter speed is changed to (1/128) s. Find the new f -number setting needed to maintain satisfactory exposure.
4. A nearsighted person cannot see objects clearly beyond 25.0 cm (her far point). If she has no astigmatism and contact lenses are prescribed for her, what power and type of lens are required to correct her vision?
5. The accommodation limits for Nearsighted Nick's eyes are 18.0 cm and 80.0 cm. When he wears his glasses, he can see faraway objects clearly. At what minimum distance is he able to see objects clearly?
6. How much time elapses before 90.0% of the radioactivity of a sample of $^{72}_{33}\text{As}$ disappears, as measured by its activity? The half-life of $^{72}_{33}\text{As}$ is 26 h.
7. Free neutrons have a characteristic half-life of 10.4 min. What fraction of a group of free neutrons with kinetic energy 0.040 0 eV will decay before traveling a distance of 10.0 km?

- 8 A ruby laser delivers a 10.0-ns pulse of 1.00 MW average power. If the photons have a wavelength of 694.3 nm, how many are contained in the pulse?
- 9(a) What value of n_i is associated with the 94.96-nm spectral line in the Lyman series of hydrogen?
- (b) Could this wavelength be associated with the Paschen series?
- (c) Balmer series?
- 10 X-rays having an energy of 300 keV undergo Compton scattering from a target. The scattered rays are detected at 37.0° relative to the incident rays. Find (a) the Compton shift at this angle, (b) the energy of the scattered x-ray, and (c) the energy of the recoiling electron.
- 11 Electrons are ejected from a metallic surface with speeds ranging up to 4.60×10^5 m/s when light with a wavelength of 625 nm is used. (a) What is the work function of the surface? (b) What is the cutoff frequency for this surface?
- 12 Calculate the de Broglie wavelength for an electron that has kinetic energy (a) 50.0 eV and (b) 50.0 keV.
- 13 A screen is placed 50.0 cm from a single slit, which is illuminated with 690-nm light. If the distance between the first and third minima in the diffraction pattern is 3.00 mm, what is the width of the slit?
14. Grote Reber was a pioneer in radio astronomy. He constructed a radio telescope with a 10.0-m-diameter receiving dish. What was the telescope's angular resolution for 2.00-m radio waves?
15. Light from an argon laser strikes a diffraction grating that has 5 310 grooves per centimeter. The central and first order principal maxima are separated by 0.488 m on a wall 1.72 m from the grating. Determine the wavelength of the laser light.

16. A thin film of oil ($n = 1.25$) is located on a smooth wet pavement. When viewed perpendicular to the pavement, the film reflects most strongly red light at 640 nm and reflects no blue light at 512 nm. How thick is the oil film?
17. A possible means for making an airplane invisible to radar is to coat the plane with an antireflective polymer. If radar waves have a wavelength of 3.00 cm and the index of refraction of the polymer is $n = 1.50$, how thick would you make the coating?
18. The final stage of the Sun as result of its stellar evolution will be _____.
The final stage of the star with the mass of 20 times larger than the Sun will be _____ or _____.
19. Based on current stage of knowledge in astrophysics and cosmology, the hydrogen and helium are produced in _____. Most of the elements lighter than Fe/Ni are produced as results of _____ inside the stars. Elements more massive than Fe/Ni are thought to be produced as result of _____.
20. All mesons are made of _____
All baryons are made of _____
The fundamental particles can be classified based on their spin into the families of
a) _____ with _____ spin (these particles obey Pauli principle).
b) _____ with _____ spin.