ASSIGNMENT 10

31 Marks Total

Part One: Electromagnetic Radiation

Part One of this assignment is worth 11 marks. The value of each question is noted in parentheses in the left margin. Note: The answer areas will expand to fit the length of your response.

1. Medical technologies related to imaging and cancer treatment use high-frequency EMR.

(1) a. Explain why high frequency EMR is harmful.

Answer:

(1) b. What precautions should medical personnel take when working with these types of technologies?

Answer:

2. A student measures the period of an electromagnetic wave as 3.64×10^{-15} s.

(1) a. What is the frequency of the wave?

Answer:

(1) b. What is the wavelength of the wave?

Answer:

(1) c. To which part of the electromagnetic spectrum does the wave belong?

Answer:

3. Two competing models explaining electromagnetic radiation are the wave model and the particle model. Complete the two statements below by filling in the missing word(s).

(1) a. Regarding the wave model, the greater the intensity, the larger the _____ of the wave.

Answer:

(1) b. Regarding the particle model, the greater the intensity, the larger the number of _____.

Answer:

(2) **4.** How does Young's experiment proved evidence that supports the wave model?

Answer:

(1) **5.** What has to occur for EMR to be produced?

Answer:

(1) **6.** What new concept did Maxwell introduce?

Answer:

STOP!

When you have completed all of the questions in Part One, save your work to your desktop. You will return to this assignment to complete Part Two after you have completed the remainder of the content in the next section.

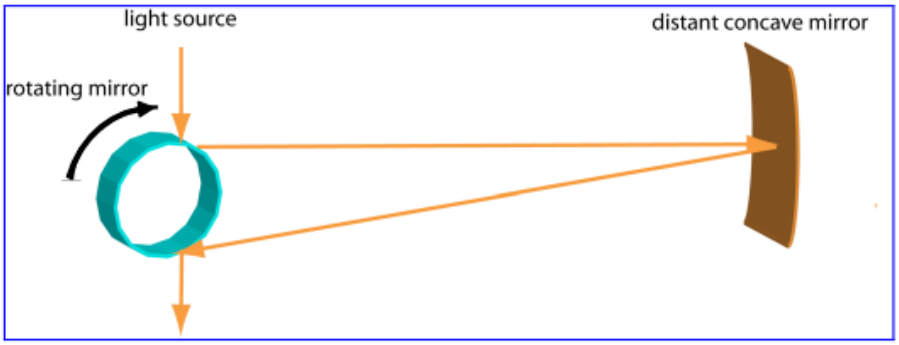
Part Two: The Speed of Light

Part Two of this assignment is worth 20 marks. The value of each question is noted in the left margin in parenthesis. Note: The answer areas will expand to fit the length of your response.

(3) **1.** If you know Earth's orbital diameter and can measure the difference in eclipse times for Jupiter's moon, Io, you can calculate the speed of light. If an eclipse of Io occurred 24 min later than expected and Earth's orbital diameter is 3.0×10^{11} m, what is the speed of light?

Answer:

(3) **2.** As shown below, a rotating mirror with 16 sides was used to measure the time it took light to travel 3.5 km to a concave mirror and back. At what frequency did the rotating mirror need to turn such that it made $1/16^{th}$ of a rotation in the time it took light to travel the 3.5 km and back again?



Answer:

(3) **3.** A rotating mirror with 8 sides rotates at 545 Hz in an experiment similar to that of Michelson. How far away should the distant concave mirror be placed to correctly measure the speed of light?

Answer:

(3) **4.** If the frequency of rotation of an 8-sided rotating mirror is 1.00×10^3 Hz and the distance between it and a fixed concave mirror is 17.5 km, calculate the speed of light.

Answer:

5. Microwaves, being a form of EMR, travel at the speed of light and are governed by the universal wave equation $v = f\lambda$. A group of students partially melted marshmallows in a microwave oven operating at a frequency of 2.50×10^9 Hz. The students found that the distance between adjacent melted spots equaled one half the wavelength of the microwaves. They recorded values of four adjacent melted spots as follows: 6.20 cm, 5.80 cm, 6.00 cm, and 5.60 cm.

(1) a. Calculate the average distance of separation for these four measurements.

Answer:

(1) b. Convert the average distance from centimeters to meters.

Answer:

(1) c. Determine the microwave wavelength.

Answer:

(2) d. Calculate the speed of light in meters per second using the microwave's frequency and wavelength.

Answer:

(2) e. Determine the percentage of error when your measured speed is compared to the currently accepted speed of 3.00×10^8 m/s.

$$\text{Percent Error} = \frac{\left|(\text{experimental value}) - (\text{accepted value})\right|}{(\text{accepted value})} \times 100\%$$

Answer:

(1) **6.** Why is the prefix “micro” used to describe microwaves?

Answer:

When you have completed all of the questions in this assignment, submit your work to your teacher.