1. A double slit illuminated with light of wavelength 588 nm forms a diffraction pattern on a screen 11 cm away. The slit separation is \( d = 2464 \text{ nm} \). What is the distance \( \Delta x \) between orders \( m = 6 \) and \( m = 4? \)  
\[ \text{Ans: } 5.25 \times 10^7 \text{ nm} \]  
Formula: \( dsin\theta_m = m\lambda \) and \( tan\theta_m = \frac{y_m}{L} \), \( \Delta x = y_{m2} - y_{m1} \)

2. Two sources of light illuminate a double slit simultaneously. One has wavelength 570 nm and the second has an unknown wavelength. The \( m = 5 \) bright fringe of the unknown wavelength overlaps the \( m = 4 \) bright fringe of the light of 570 nm wavelength. What is the unknown wavelength?  
\[ \text{Ans: } 456 \text{ nm} \]  
Formula: \( dsin\theta_m = m\lambda \), and \( m_1\lambda_1 = m_2\lambda_2 \)

3. A grating with 316 lines/mm is illuminated with light of wavelength 531 nm. What is the angular separation between the two lines formed in order \( m = 2? \)  
\[ \text{Ans 39.2}^\circ \]  
Formula: \( dsin\theta_m = m\lambda \) and \( tan\theta_m = \frac{y_m}{L} \)

4. Light from a He-Ne laser of wavelength 633 nm passes through a circular aperture. It is observed on a screen 4.0 m behind the aperture. The width of the central maximum is 5.4 cm. What is the diameter of the hole?  
\[ \text{Ans: 110} \mu\text{m} \]  
Formula: \( asin\theta_p = 1.22 \lambda \)

5. A fish appears to be 7.00 m below the surface of a pond when viewed almost directly above by a fisherman. What is the actual depth of the fish? (\( n_{\text{water}} = 1.33 \))  
\[ \text{Ans: 9.31 m} \]

6. The speed of light in a material is 0.48 c. What is the critical angle of a light ray at the interface between the material and a vacuum?  
\[ \text{Ans: 29 deg} \]

7. A helium-neon laser emits light at 632.8 nm. If the laser emits 1.88 \times 10^{17} \text{ photons/second}, what is its power output in mW?  
\[ \text{Ans: 59.1 mW} \]

8. You want to confine an electron in a box so that its minimum energy is 2.6 \times 10^{-18} \text{ J}. What is the length of the box?  
\[ \text{Ans: 0.15 nm} \]

9. A metal sphere is insulated electrically and is given a charge. If 24 electrons are added to the sphere in giving a charge, how many Coulombs are added to the sphere?  
\[ Q = N*e \]

10. The charge in the bottom right corner of the figure is \( Q = -10 \text{ nC} \). What is the magnitude of the force on \( Q \)?  
\[ \text{Ans: } 4.3 \times 10^{-3} \]

11. In the figure below the charge in the middle is \( Q = -3.7 \text{ nC} \). For what charge \( q_1 \) will charge \( q_2 \) be in static equilibrium?  
\[ \text{Ans: 15 nC} \]

12. What is the strength of an electric field that a 0.010 C negative charge experiences 0.90 mm from a 0.20 C positive charge? (The value of \( K \) is \( 9.0 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2 \)).  
\[ \text{Ans: } 2.2 \times 10^{15} \text{ N/C} \]