REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

(a) Find the angular position in degrees of the second order maximum for green light of $\lambda = 510$ nm from a diffraction grating with 8500 lines/cm.

$$\sin \theta = \frac{m \lambda}{d} ; \quad m = 2 ; \quad d = \frac{1}{8500 \text{ lines/cm}}$$

$$\theta = \sin^{-1} \left( \frac{2 \times 510 \times 10^{-9} \text{ m}}{850000} \right) = 60.1^\circ$$

(b) The third minimum from the center in a single-slit diffraction pattern with red light of $\lambda = 640$ nm is found at 3.25 cm from the center on a screen 4.50 m from the slit. Calculate the width of the slit.

$$a \sin \theta_{dmax} = m \lambda ; \quad m = 3 ; \quad \sin \theta = \frac{y}{L} \Rightarrow a = \frac{3 \times 640 \times 10^{-9}}{(0.0325/4.5) \times 10^{-2}} = 266 \text{ m}$$

(c) Electrons are accelerated from rest through a potential difference of 5500 volts. Calculate their DeBroglie wavelength.

$$E = \frac{p^2}{2m} , \quad p = \frac{\hbar}{\lambda_{\text{deBroglie}}} \Rightarrow \lambda = \frac{\hbar}{p} = \frac{6.64 \times 10^{-34}}{\sqrt{2mE}} = \frac{6.64 \times 10^{-34}}{\sqrt{2 \times 9.11 \times 10^{-31} \times 1.6 \times 10^{-10} \times 5500}}$$

$$= 1.66 \times 10^{-11} \text{ m}$$

(d) Calculate the energy (in joules) of a photon of yellow light whose wavelength is 680 nm.

$$E = hf = \frac{hc}{\lambda} = \frac{6.64 \times 10^{-34} \times 3 \times 10^8}{680 \times 10^{-9}} = 2.93 \times 10^{-19} \text{ J}$$

(e) UV light of wavelength $\lambda = 350$ nm is incident on a metal surface. The maximum energy of photoelectrons is found to be $3.20 \times 10^{-19}$ J. Calculate the work function for this metal.

$$E_{\text{in}} = \frac{hc}{\lambda} = \phi + K_{\text{out}} \Rightarrow \phi = \frac{6.64 \times 10^{-34} \times 3 \times 10^8}{350 \times 10^{-9}} - 3.2 \times 10^{-19} \text{ J}$$

$$= 2.49 \times 10^{-19} \text{ J}$$

(f) Calculate the polarizing angle (Brewster angle) for light incident on diamond ($n = 2.42$) which is immersed in water ($n = 1.33$).

$$n_1 \sin \Theta_p = n_2 \cos \Theta_p \Rightarrow \tan \Theta_p = \frac{n_2}{n_1} = \frac{2.42}{1.33}$$

$$\Rightarrow \Theta_p = \tan^{-1} \left( \frac{2.42}{1.33} \right) = 61.2^\circ$$