Support Worksheet – Topic 6, Worksheet 3

1 **a** Explain why the wave theory of light cannot explain why electrons are emitted essentially without time delay in the photoelectric effect. [2]

b Explain how the photon theory explains the essentially instantaneous electron emission. [2]

2 **a** Explain why the wave theory of light cannot explain why the kinetic energy of the photoelectrons increases with increasing light frequency. [2]

b Explain how the photon theory explains the observation in **a**. [2]

3 State and explain the effect of increasing light intensity on

a the energy of the photoelectrons. [2]

b the number of the photoelectrons. [2]

4 State what is meant by the **work function** of a surface. [1]

5 Light of wavelength 4.4×10^{-7} m is incident on a metallic surface whose work function is 2.2 eV. Calculate the speed of the emitted electrons. [3]

6 **a** State what is meant by the **stopping voltage**. [1]

b In a photoelectric effect experiment the stopping voltage is plotted versus the incident light frequency. State what the slope of the straight line obtained in the graph represents. [1]

7 **a** State what is meant by the de Broglie hypothesis. [2]

b Describe an experiment to verify the de Broglie hypothesis. [3]

8 Calculate the de Broglie wavelength of an electron that has been accelerated from rest by a potential difference of 150 V. [2]

9 **a** An electron is confined to move on a straight line of length L. State the allowed de Broglie wavelengths for this electron. [1]

b Using your answer to **a** deduce that the kinetic energy of the electron is given by $E_K = \frac{n^2h^2}{8mL^2}$. [2]

10 **a** State the Heisenberg uncertainty principle for position and momentum. [1]

b Determine the uncertainty in the momentum of an electron that is confined within an atom of diameter 10^{-10} m. [2]