

Question 20**(16 marks)**

A light beam is directed toward a metal surface and electrons are ejected from it. The wavelength of the incident beam is varied between 238 nm (ultraviolet) and 464 nm (green). The maximum kinetic energy of the ejected photoelectrons is measured and recorded in the table below.

- (a) Complete the following table by calculating the missing energy of the incident photons for each wavelength. Show your working in the space below. (2 marks)

Wavelength of incident light (nm)	Energy of incident light (eV)	Maximum kinetic energy of photoelectrons (eV)
238		3.12
250	4.97	2.87
284	4.38	2.28
351		1.44
416	2.99	0.89
464	2.68	0.58

- (b) Plot the data from the table above on the grid provided, demonstrating the relationship between the energy of the incident photons on the horizontal axis and the maximum kinetic energy of photoelectrons on the vertical axis. Draw the line of best fit. (4 marks)
- (c) Using your graph, determine the work function of the metal. Express your answer in appropriate significant figures and include units. (4 marks)

- (d) Explain how the failure of red light to cause the emission of electrons demonstrates the particle nature of light. (3 marks)

- (e) In this photoelectric effect investigation, light is best described as a particle. There are other characteristics that demonstrate light to be a wave. State **one** such characteristic and describe how this demonstrates wave behaviour. (3 marks)
