4 The activation potential difference (p.d.) is the minimum p.d for photons to be emitted from a light emitting diode (LED). A student measured the activation p.d. for different LEDs.

The relationship between activation p.d. and wavelength is given by the equation

$$eV_a = \frac{hc}{\lambda} + W$$

where

V_a is the activation p.d.
λ is the wavelength of the photons emitted by the LED
W is a constant representing the work done by an electron passing through an LED.

(a) Explain why a graph of V_a against $1/\lambda$ should give a straight line.

(3)

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(b) The student recorded his values of activation p.d. and the manufacturer's corresponding values of wavelength.

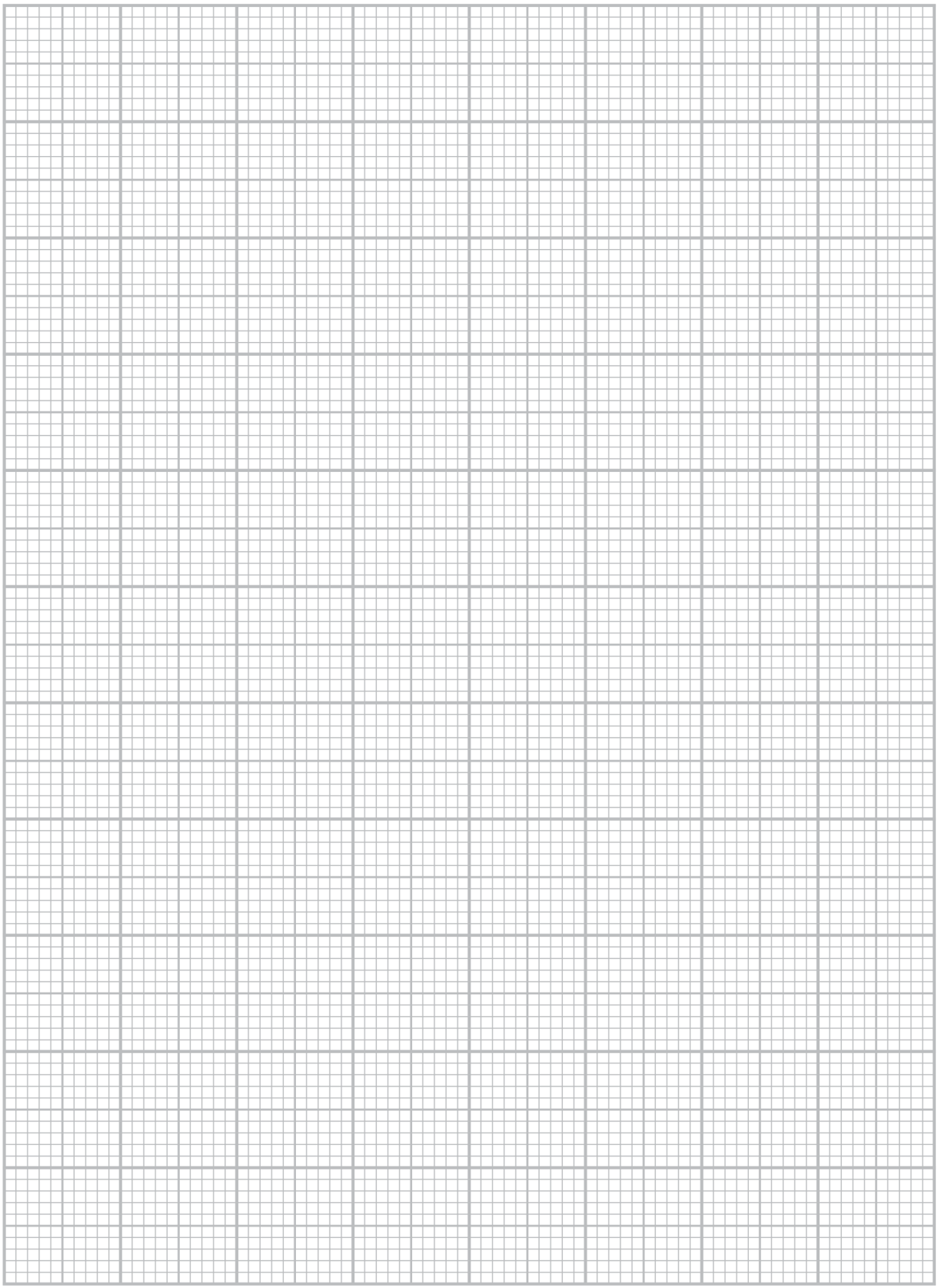
$\lambda / 10^{-7}$ m	V_a / V	
6.60	1.82	
6.12	1.97	
5.92	2.02	
5.85	2.07	
5.30	2.31	
4.70	2.58	

(i) Complete the table with the corresponding values of $1/\lambda$.

(2)

(ii) Plot a graph of V_a on the y-axis against $1/\lambda$ on the x-axis.

(5)



(iii) Determine the value of the Planck constant given by the student's data.

(3)

Planck constant = ...

(iv) The student states that the value for the Planck constant obtained from the graph is accurate.

Evaluate the student's statement.

(2)

(c) Each LED in the investigation emits a narrow range of wavelengths.

The wavelength value stated by the manufacturer is the wavelength of light that is emitted with maximum intensity when the LED is at normal brightness.

The wavelength emitted at the activation p.d. is not equal to the manufacturer's value.

Discuss whether this affects the accuracy of the value of the Planck constant obtained.

(4)

(Total for Question 4 = 19 marks)