In stage 2, the experiment is repeated using violet light of twice the intensity. The frequency of the violet light is greater than the frequency of the red light.

c. Compare and contrast the two stages of the experiment in terms of

i. any reading observed on the ammeter display when the DC voltage source is 0 V. 2 marks

ii. any reading observed on the ammeter display when the DC voltage source is increased to 2.03 V. 3 marks

d. Explain the effect that doubling the intensity of light would have on the experimental results according to the wave model. Indicate whether the model's prediction agrees or disagrees with the observations. 3 marks

b. As long as the distance between the slit-plane and screen is small, the separation of the minima are determined by $\frac{\text{wavelength} \times \text{distance between slit-plane and screen}}{\text{slit separation}}$. 1 mark

Thus, the separation of the minima depends on the wavelength as it is the only variable.

Hence, separation $\propto$ wavelength, or $\frac{1}{\text{frequency}}$.

Thus, a higher frequency will cause the minima separation to decrease. 1 mark

Chen is correct and Melinda is incorrect. 1 mark

Note: To be awarded the final mark, responses must correctly assess both Chen and Melinda's statements.

Question 15 (13 marks)

a. Green light has a photon energy that is able to release electrons from the metal cathode. 1 mark

Thus the release of electrons from the shining of the green light is registered by the ammeter as a flow of current. 1 mark

Increasing the battery voltage to 2.03 V creates an electric field across the photocell that slows down ejected photoelectrons such that they do not reach the collector cathode to register as current in the circuit. 1 mark

b. $qV = hf - W$

$W = hf - qV$

$= (4.14 \times 10^{-15} \times 5.5 \times 10^{14}) - 2.03$ 1 mark

$= 0.25$ eV 1 mark

c. **i.** Photoelectrons will still be ejected because photons of violet light are more energetic than photons of green light, so there is a non-zero ammeter reading. 1 mark

Since there are more violet photons than green photons due to the greater intensity, there are more photoelectrons emitted. Thus, the ammeter reading is greater than that of the first experiment. 1 mark

ii. The emitted electrons will now have a greater maximum kinetic energy since $hf - W$ is now greater for the violet light than for the green light due to the greater photon energy for the same work function. 1 mark

Thus, a greater stopping voltage than 2.03 V would be required to reduce the current to zero. 1 mark

Hence, at $V = 2.03$ V, some electrons will still traverse the electric field in the vacuum tube, and thus the ammeter reading will be a non-zero but lesser reading. 1 mark

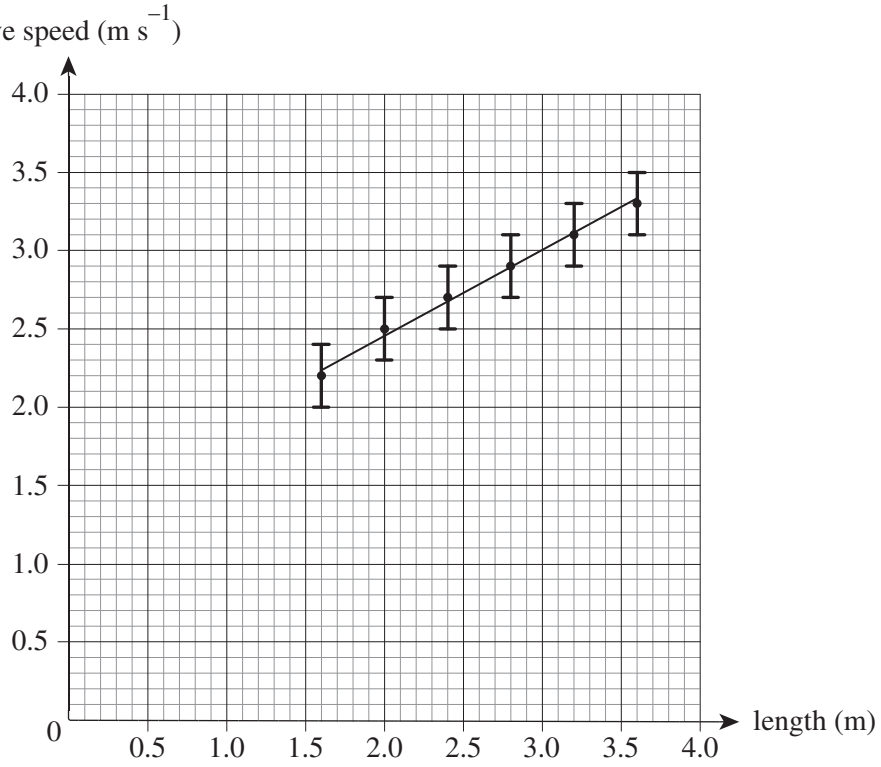
d. In the wave model, the doubling of intensity of light involves a doubling of energy provided to the electrons. 1 mark

The wave model predicts that doubling the intensity would cause an increase in the number of photoelectrons ejected and that they would eject with greater kinetic energy. Overall, the wave model fails to account for the observations. 1 mark

While the number of electrons did increase, their maximum kinetic energy remained the same. This is contrary to the results of the experiment. 1 mark

Question 18 (8 marks)

a.



5 marks

1 mark for correctly plotted points.
1 mark for vertical scale.
1 mark for horizontal scale.
1 mark for uncertainty bars.
1 mark for line of best fit.

b. The students' hypothesis is rejected since the wave speed is not a constant over the lengths of the spring. 1 mark

The relationship shows that wave speed increases with increasing spring length. 1 mark

The increase is linear to within the uncertainties. 1 mark

Note: To be awarded the final mark, responses must refer to the increase being within the uncertainties.