A-level Physics taster session

This is a practical task based on a PAG performed in Year 12.

AIM: Use different coloured LEDs to find the speed of light.

MEASUREMENTS: the minimum potential difference (p.d.) for particular LEDs to **just** emit light.

THEORY

A Light Emitting Diode (LED) comprises of a p-type (positive) and n-type (negative) semiconductor. The junction between these materials is known as the p-n junction. Electrons in the n-type semiconductor receive energy from the cell and are able to jump into a "hole" (a gap where an electron could be) in the p-type semiconductor. The hole exists at a lower energy level, therefore, the electron must lose energy in this process.

The minimum energy given by an electron moving across the p-n junction is given by eV, where e is the charge on an electron, and V is the p.d. through which the electron moves.

The energy the electron gives out is in the form of light. The energy of a photon of light is given by hc / λ where h is Planck's constant, λ is the wavelength of the light from the LED, and c is the speed of light.

Since the energy is conserved, we can see that;

$$eV = hc / \lambda$$

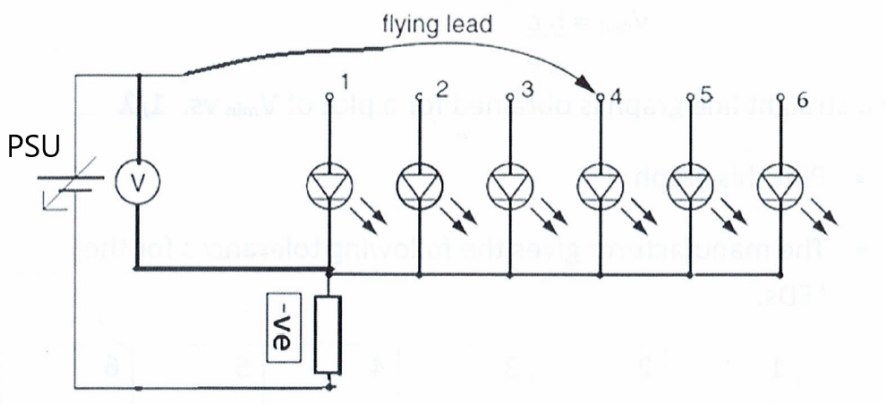
This means plotting a graph of V against $1/\lambda$ will produce a straight line, with the gradient, m, being;

$$m = hc / e$$

Q1. Rearrange this expression to make *c* the subject of the equation

METHOD

1. Set up the circuit as shown below.



2. Slowly increase the p.d. on the power supply as your lab partner looks through the blackout tube onto the LED. Stop increasing the p.d. when you partner says they can see the LED **just** start to emit light.

3. Swap roles with your partner and take a repeat reading for the same LED.

4. Record the minimum p.d. for the LEDs in the results table. Also record the colour of the light emitted.

5. Your teacher will collate the data and plot the graph for you. Record the gradient of the graph below your results table.

RESULTS

LED number	LED colour	minimum p.d. to light (V)		
		Repeat 1	Repeat 2	Average
1 (closest to resistor)				
2				
3				
4				
5				
6 (furthest from resistor)				

ANALYSIS

Gradient of p.d. against 1/λ graph = _____ Vm

Q2. From your answer to Q1, and the data below, calculate the speed of light from the practical.

e = 1.6 x 10^{-19} C

h = 6.63 x 10^{-34} Js

speed of light, c = _____ m/s

The actual speed of light is 3.0 x 10^{8} m/s.

Q3. Use the equation below to work out your percentage difference. An accurate value has a percentage difference close to zero.

$$\text{percentage difference} = \frac{\text{your value} - \text{true value}}{\text{true value}} \times 100\%$$

percentage difference = _____ %