Year 12 Physics

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Contents

Chapter 1

Investigations

1.1 Investigation 1: Speed of Light Investigations

Summarise the historical and contemporary methods used to determine the speed of light and explain its current relationship to the measurement of time and distance.

1.2 Investigation 2: Spectral Analysis

Aim: To determine the emission spectra of various elements

Materials

- Spectroscope
- Spectral lamps with:
  - Hydrogen
  - Helium
  - Neon
  - Oxygen
  - Mercury
- Spectral lamp support
- Spectral lamp power supply

Risk Assessment

Hazard	**Precaution**
High voltage power pack	Turn off when not in use, do not touch contact points
Cuts from glass	Check spectral lamp before use, keep away from edge of table to prevent dropping
Burns from UV light	Don't observe directly, only view via spectrometer

Method

1. Prepare spectral support and power supply at 400V
2. Insert hydrogen spectral
3. Use spectrometer to observe emission spectrum and record wavelengths using chart on spectrometer
4. Repeat steps 2-3 with helium, neon, sulfur, and mercury
5. Record results

Results

Element	**Result**
Hydrogen	Bright pink
Helium	Red, orange, yellow
Neon	Red, orange
Oxygen	Pale blue white
Mercury	Blue-green

1.3 Investigation 3: Diffraction of Light

Summarise your qualitative analysis of light diffraction, including the experimental setup, observations, and what these phenomena demonstrate about the wave properties of light.

1.4 Investigation 4: Interference and Diffraction

Aim: To observe the diffraction and interference of light using diffraction gratings

Materials

- Laser pointer
- A diffraction grating set
- Meter ruler or tape measure

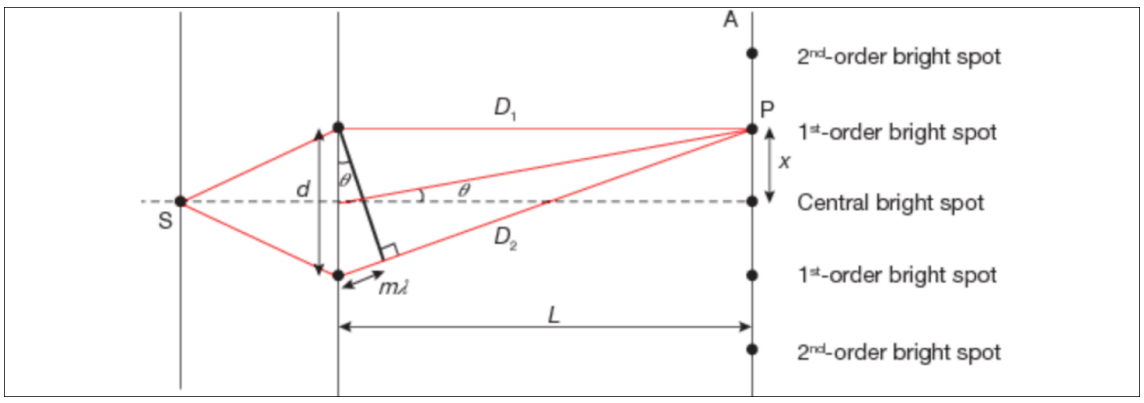
Risk Assessment

Hazard	**Precaution**
Retina burns	Do not directly look at laser light
Dropping equipment	Handle with caution, keep secure on table

Method

1. Use supports such as retort stands to set up the laser pointer so that it shines perpendicularly onto a screen, wall, or board at least one meter away.
2. Mount the diffraction grating directly in front of the laser pointer so that a regular row of dots appears on the screen.
3. Measure the values of x and L, and record these in your results table, along with the N value for your grating.
4. Repeat this procedure for each grating of different N value.
5. Analyse the data to determine the wavelength of the laser pointer.

Results



Slit separation d (m)	x (m)	L (m)	λ (m)	λ (nm)
100×10^{-6}	0.034	5.44	6.25×10^{-7}	625
200×10^{-6}	0.016	5.44	5.88×10^{-7}	588
300×10^{-6}	0.011	5.44	6.07×10^{-7}	607

Slit separation 1

$$\begin{aligned}
\text{At very small angles, } \sin\theta &= \tan\theta \\
d\sin\theta &= m\lambda \\
\sin\theta = \frac{m\lambda}{d} &= \frac{x}{L} \\
\lambda &= \frac{dx}{L} \\
&= \frac{100\times10^{-6}\times0.034}{5.44} \\
&= 6.25\times10^{-7} \\
\text{Actual } \lambda \text{ of Ne-He laser} &= 6.328\times10^{-7}
\end{aligned}$$

Slit separation 2

$$\begin{aligned}
d\sin\theta &= m\lambda \\
\sin\theta = \frac{m\lambda}{d} &= \frac{x}{L} \\
\lambda &= \frac{dx}{L} \\
&= \frac{200\times10^{-6}\times0.016}{5.44} \\
&= 5.88\times10^{-7} \\
\text{Actual } \lambda \text{ of Ne-He laser} &= 6.328\times10^{-7}
\end{aligned}$$

Slit separation 3

$$\begin{aligned}
d\sin\theta &= m\lambda \\
\sin\theta = \frac{m\lambda}{d} &= \frac{x}{L} \\
\lambda &= \frac{dx}{L} \\
&= \frac{300\times10^{-6}\times0.011}{5.44} \\
&= 6.07\times10^{-7} \\
\text{Actual } \lambda \text{ of Ne-He laser} &= 6.328\times10^{-7}
\end{aligned}$$

Chapter 2

Review Questions

2.1 Electromagnetic Spectrum

1. B
2. D
3. B
4. C
5. A
6. **Figure 8.11 shows the emission spectrum of sodium**
   (a) **Describe an experiment that could be used to examine the emission spectrum of an element.**
   The spectral lamp experiment can be used to observe the emission spectrum of an element. Running high voltage current through a spectral lamp containing a specific element will emit a bright spectrum that can be split into wavelengths by a prism or a spectrocope.
   (b) **Explain how emission spectra can be used to identify the elements in a sample?**
   A complete emission spectra can be analysed to find the lines in the black body spectrum and comparing that with the spectra of known elements.
   (c) **If sodium was present in the atmosphere of the Sun, how would it affect the emission spectra of the Sun?**
   If sodium is present, the Sun's emission spectrum will have lines at 589 nm to 590 nm.
7. **Outline one method that has been used to measure the speed of light**
   Leon Foucault measured the speed of light using a light