

What you need to know:

Wave Model:

Wave properties needed to explain:

- refraction
- diffraction
- interference

Particle Model:

Modern Physics: Particle properties needed to explain

- Photoelectric effect
- Compton effect

Dispersion:

Colour related to wavelength, λ . Refractive index, $n = c/v$, depends on λ

eg glass

$$n_{\text{red}} = 1.520$$

$$n_{\text{violet}} = 1.538$$

\Rightarrow red light refracted less \Rightarrow Dispersion

Dispersion

- Limits speed of optical fibre communications
- Chromatic aberration: position of focus depends on wavelength
- Colours from prisms
- Rainbows

Interference:

Interference patterns of double slits and diffraction gratings: (constructive: $d\sin\theta = m\lambda$),

Single slits and circular apertures: (Nodes $a\sin\theta = p\lambda$, $p = 1, 2, 3 \dots$)

Interferometers: Distance moved is $N\lambda/2$, N = number of fringes counted.

Diffraction crossover:

$$\Rightarrow D_c = \sqrt{2.44\lambda L}$$

For the Exam:

- You may be asked to find the fringe spacing for single or double slits or diffraction gratings.
- You may be asked to explain how a Michelson interferometer works.

Training:

Homework Problems and Problem Class Sheets.

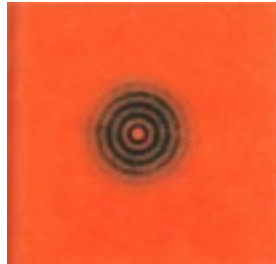
And then try an exam question:

What you need to know:

Question 10 (parts b and c)

[3 + 2 + 2 marks]

- (b) In the centre of the shadow of a disk or sphere there is a small bright spot, called the Poisson spot, as shown in the figure below. Briefly explain how this bright spot arises.



- (c) Two sources of light illuminate a double slit simultaneously. One has wavelength 580 nm and the second has an unknown wavelength. The $m = 5$ bright fringe of the unknown wavelength overlaps the $m = 4$ bright fringe of the light of 580 nm wavelength.
- (i) Find the unknown wavelength.
- (ii) For the 580 nm light, if the $m = 4$ bright fringes is 0.5 cm from the central maximum on a screen that is 2.0 m from the slits, what is the slit spacing?

Optics Formulae from exam paper:

$d \sin \theta = m \lambda$	$\Delta \theta = \frac{1.22}{D} \lambda$	$\frac{1}{f} = (n - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$
$n = \frac{c}{v}, \quad n_i \sin \theta_i = n_f \sin \theta_f$	$\frac{1}{f} = \frac{1}{s} + \frac{1}{s'}$	$m = -\frac{s'}{s}$
$f_{\#} = \frac{f}{D}$	$P = \frac{1}{f}$	$NA = n \sin \theta$

Answers to exam question:

(b) (i) 464 nm, (ii) 0.9 mm