InkPhysics

QUESTION WORKBOOK

Diffraction gratings

Waves · Year 12

AQA 3.3.2.2 · CIE 8.4.1, 8.4.2 · OCR A 5.5.2(g), 5.5.2(h)

18 questions · 58 marks

PRINT EDITION

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SECTION A · Warm-up

A1 State the diffraction grating equation and define each term in it. [2]

A2 A diffraction grating has 300 lines per millimetre. Calculate the grating spacing d in metres. [2]

A3 Explain why a diffraction grating produces sharper, brighter maxima than a double slit. [2]

A4 State what is meant by the zero-order maximum produced by a diffraction grating, and give the path difference between light from adjacent slits at this maximum. [2]

A5 Explain why, for a given grating and wavelength, only a limited number of orders of maxima can be produced. [2]

SECTION B · Standard

B1 Light of wavelength 600 nm is shone normally at a grating with 500 lines per millimetre. Calculate the angle of the first-order maximum. [4]

B2 Light of wavelength 600 nm is incident normally on a grating with 500 lines per millimetre. Calculate the angle of the second-order maximum. [3]

B3 A grating with 600 lines per millimetre gives a first-order maximum at 21°. Calculate the wavelength of the light. [3]

B4 Light of wavelength 500 nm gives a first-order maximum at 15° with a certain grating. Calculate the grating spacing and hence the number of lines per millimetre. [3]

B5 Blue light of wavelength 486 nm from a hydrogen discharge lamp is incident normally on a grating with 420 lines per millimetre. Show that the grating spacing is about 2.4×10^{-6} m. Go on to calculate the angle of the third-order maximum. [4]

B6 A laser of wavelength 633 nm shines normally through a grating with 250 lines per millimetre. The maxima form spots on a screen 1.5 m beyond the grating and parallel to it. Calculate the distance on the screen between the two first-order spots. [4]

B7 To reduce the uncertainty in an angle measurement, a student measures the angle between the two first-order maxima on either side of the centre and obtains 40.0°. The grating has 600 lines per millimetre. Calculate the wavelength of the light.

[3]

SECTION C · Stretch

C1 A grating has a spacing of 2.0×10^{-6} m and is used with 600 nm light. Calculate the highest order of maximum that can be seen, and the angle at which it appears.

[4]

C2 White light (400 nm to 700 nm) passes normally through a grating of spacing 2.0×10^{-6} m. Calculate the angular width of the first-order spectrum (the angle between the 400 nm and 700 nm maxima). [4]

C3 Give two practical uses of diffraction gratings. [2]

C4 White light with wavelengths from 400 nm to 700 nm passes normally through a grating with 400 lines per millimetre. Deduce whether the second-order and third-order spectra overlap. [4]

C5 A teacher wants to show a class at least three orders of maxima on each side of the centre, using light of wavelength 589 nm from a sodium lamp. Two gratings are available: grating X with 300 lines per millimetre and grating Y with 800 lines per millimetre. Deduce which grating the teacher should use. [4]

C6 White light with wavelengths from 400 nm to 700 nm is incident normally on a diffraction grating with 500 lines per millimetre. Describe and explain the appearance of the pattern produced, up to and including the second order, and show that the second-order spectrum is complete. [6]