physicsUK
Smarter practice. Stronger understanding

WORKSHEETS
ATTEMPT | CHECK | CORRECT | IMPROVE

AQA AS Interference, Diffraction and Diffraction Gratings worksheet

35–40 minutes independent practice + 15–20 minutes review | 37 marks

Specification points covered

• 3.3.2.1(a) Path difference and coherence. • 3.3.2.1(b) Laser interference and diffraction. • 3.3.2.1(c) Young double slit and coherent sources. • 3.3.2.1(d) Use w = λD/s. • 3.3.2.1(e) White-light interference pattern. • 3.3.2.1(f) Laser safety. • 3.3.2.1(g) Laser operation is not required. • 3.3.2.1(h) Sound and electromagnetic interference.	• 3.3.2.1(i) Changing understanding of electromagnetic waves. • 3.3.2.2(a) Single-slit patterns in monochromatic and white light. • 3.3.2.2(b) Central maximum, wavelength and slit width. • 3.3.2.2(c) Intensity–angle graph is not required. • 3.3.2.2(d) Plane transmission grating at normal incidence. • 3.3.2.2(e) Derive and use d sin θ = nλ. • 3.3.2.2(f) Applications of diffraction gratings. • 3.3.2.2(g) Spectrometer use is not tested.

Autonomous inspection robot optical alignment

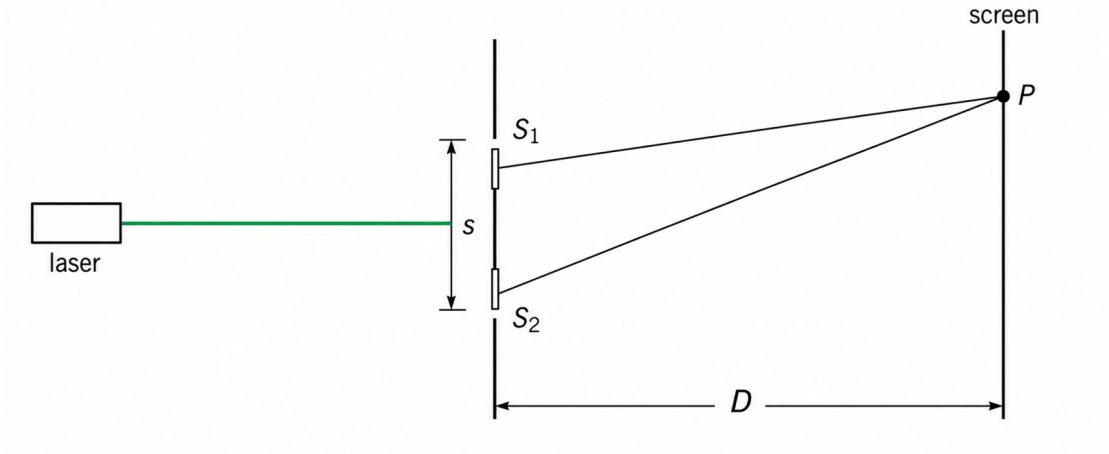
A robot uses interference to align a camera, diffraction to test apertures and a grating to identify an unknown laser.
Base every prediction on path difference, wavelength or aperture geometry, and make uncertainty-reduction steps measurable.

1. Establishing coherence

1. The robot uses one laser and a double slit to align its camera. Define coherent sources and path difference. **[2 marks]**

2. Double-slit geometry

2. The diagram shows light from slits S_1 and S_2 reaching P. Explain the condition for P to be at the centre of a bright fringe and state the path-difference condition for any bright fringe. **[2 marks]**



3. The laser wavelength is 532 nm, the slit separation is 0.300 mm and the screen is 2.40 m away. Calculate the fringe spacing. **[2 marks]**

3. Reading and changing fringes

4. To reduce percentage uncertainty, a technician measures across 11 consecutive bright fringes and obtains 42.6 mm from the first to the eleventh centre. Calculate the wavelength indicated by this measurement. [3 marks]

5. Predict the separate effect on fringe spacing of (a) doubling screen distance, (b) halving slit separation and (c) replacing the laser with a shorter-wavelength laser. [3 marks]

6. At a nominal dark fringe the waves arrive in antiphase, but the intensities from the two slits are unequal. Explain why the intensity does not fall to zero. [2 marks]

7. The laser is replaced by white light. Describe the central fringe and the coloured fringes observed away from the centre. [3 marks]

4. Diffraction in other settings

8. State two precautions that reduce risk when aligning the laser and screen. [2 marks]

9. Two loudspeakers emit coherent 400 Hz sound. At the robot's microphone their path difference is 0.425 m. The sound speed is 340 m s^{-1}. Determine whether the interference is constructive or destructive and justify your answer. [3 marks]

10. A single adjustable slit is placed in front of the laser. Describe the monochromatic diffraction pattern and explain how narrowing the slit changes it. Then state one difference for white light. [3 marks]

5. Diffraction grating

11. A grating has 600 lines per millimetre. Calculate the grating spacing and the first-order angle for 532 nm light at normal incidence. [3 marks]

12. Calculate the highest possible order for the grating in Question 11 and explain one advantage of a diffraction grating over a double slit for measuring wavelength. [3 marks]

13. Design a grating experiment to measure an unknown laser wavelength. Include apparatus and alignment, measurements, use of several orders or repeats, calculation, uncertainty reduction and safety. [6 marks]

Review and improve

□ I translate path difference into constructive or destructive interference.
□ I predict pattern changes from wavelength and aperture geometry.
□ I improve wavelength measurements using symmetry, several spacings or several orders.