

AS Physics 9702

Unit 8 · Superposition

Original worksheet

Name: _____ Date: _____

Suggested marks: 69. Work through the questions over more than one study session if needed. Use additional paper for extended working and graph paper where requested.

Show equations, substitutions, units and reasoning. Use the constants specified in each question. The questions are original practice, not an official Cambridge examination or mark scheme.

Scope: Cambridge International AS Physics 9702, 2025–2027 learning outcomes. The published 2028–2030 AS scope has been checked separately and is substantively unchanged. Version: 11 October 2026.

U8-Q1 · 6 marks

Two equal waves travel in opposite directions along a string. At one point at one instant, their displacements are +4.0 mm and −1.5 mm. (a) State the superposition principle and find resultant displacement. [2] (b) Explain how equal counter-propagating waves form nodes and antinodes. [2] (c) Explain why a point having zero displacement in one photograph is not necessarily a node, and describe how a graphical construction can test for nodes. [2]

U8-Q2 · 6 marks

A string of vibrating length 0.90 m forms three equal loops between ideal fixed-end nodes at 120 Hz. (a) Describe how a vibration generator and reflection can produce the pattern. [2] (b) Calculate wavelength and wave speed. [2] (c) Find the distance from any node to its nearest antinode and state the phase relationship of adjacent loops. [2]

U8-Q3 · 6 marks

A microwave transmitter faces a metal reflector. A detector finds six consecutive minima, with distance 80.0 mm from the first to the sixth. Take $c = 3.00 \times 10^8 \text{ m s}^{-1}$. (a) Explain the minima. [2] (b) Calculate wavelength and frequency. [2] (c) Give two reasons for measuring across several minima and keeping detector orientation fixed. [2]

U8-Q4 · 6 marks

Plane water waves of wavelength 15 mm cross a barrier gap. (a) Define diffraction. [1] (b) Compare the patterns for gap widths 120 mm and 18 mm, explaining the role of the wavelength-to-gap ratio. [2] (c) Describe a fair ripple-tank comparison, including two controls and one observation. [3]

U8-Q5 · 8 marks

(a) Define coherence and explain why equal frequencies alone do not guarantee a stable pattern. [2] (b) Describe two-source interference demonstrations using water waves, sound and microwaves, stating how coherence is achieved in each. [3] (c) Give the path-difference conditions for constructive and destructive interference from in-phase sources, and state one reason minima may not be zero. [3]

U8-Q6 · 6 marks

A student proposes illuminating two slits using two unrelated lamps to produce stable light fringes. (a) Explain the main problem. [2] (b) Describe a better arrangement and state two conditions helping make the fringes observable. [3] (c) State one laser safety precaution if a laser is used. [1]

U8-Q7 · 7 marks

A double-slit pattern uses slit separation 0.30 mm and screen distance 1.80 m. The distance from the second to the tenth consecutive bright fringe on one side is 28.8 mm. (a) Find fringe spacing and wavelength. [3] (b) State two approximations needed for $\lambda = ax/D$. [2] (c) If uncertainties are 2.0% in a , 1.5% in measured fringe span and 0.5% in D , find maximum percentage uncertainty in λ and explain whether division by eight changes the percentage span uncertainty. [2]

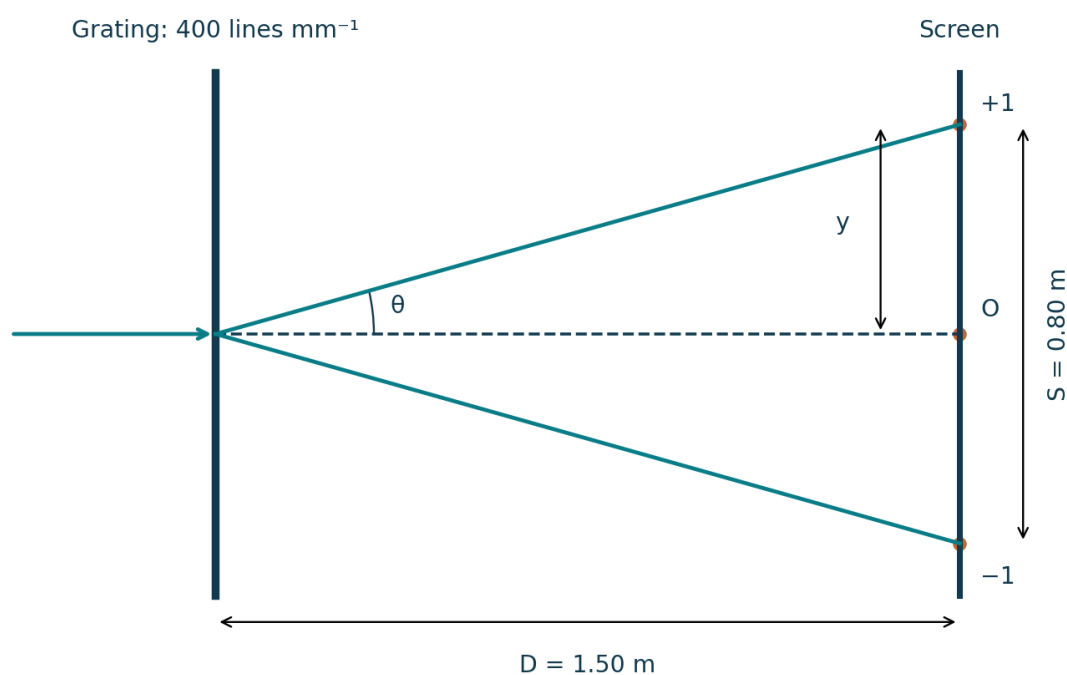
U8-Q8 · 6 marks

A grating has $600 \text{ lines mm}^{-1}$ and is illuminated normally by light of wavelength 520 nm . (a) Calculate grating spacing. [2] (b) Calculate the second-order angle to the normal. [2] (c) Determine the highest possible order and the number of principal maxima including the central one. [2]

U8-Q9 · 7 marks

A laser shines normally through a $400 \text{ lines mm}^{-1}$ grating onto a screen 1.50 m away. The two first-order spots are 0.80 m apart. (a) Describe the measurements needed to obtain wavelength and why both sides are useful. [2] (b) Calculate diffraction angle using the actual geometry, then wavelength. [3] (c) Give one alignment control and one way to check reliability. [2]

Figure for U8-Q9



U8-Q10 · 7 marks

A tube closed by water at one end and open at the other resonates at consecutive air-column lengths 0.170 m and 0.510 m with a fixed-frequency sound source. Neglect end corrections.

- (a) State the displacement boundary condition at each end and explain why resonance makes the sound louder. [3] (b) Calculate wavelength and frequency if sound speed is 340 m s^{-1} . [2] (c) Check whether the shorter length is consistent with the first closed-open resonance, and state the first-resonance length of an open-open tube at the same frequency. [2]
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U8-Q11 · 2 marks

Diagnostic multiple choice. In a stationary wave, consecutive nodes are 0.18 m apart. What are wavelength and nearest node-to-antinode distance? Choose one option and explain. [2]

- A. 0.18 m and 0.09 m
 - B. 0.36 m and 0.09 m
 - C. 0.36 m and 0.18 m
 - D. 0.72 m and 0.18 m
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U8-Q12 · 2 marks

Diagnostic multiple choice. A normally illuminated grating has spacing $1.50 \mu\text{m}$ and light wavelength 600 nm. How many principal maxima can exist in total, including the central maximum and both sides? Choose one option and justify it. [2]

- A. 2
 - B. 3
 - C. 5
 - D. 7
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