Answer key — Two-source interference

A

λ = 1.5 cm. Eight gaps span 12.0 cm. Accept 1.4–1.6 cm.

B

Point	XP / cm	YP / cm	Diff / cm	In λ	Result
P0	12.00	12.00	0.00	0	strong
Q1	12.00	12.75	0.75	0.5	still
P1	10.50	12.00	1.50	1	strong
Q2	10.50	12.75	2.25	1.5	still
P2	9.00	12.00	3.00	2	strong
Q1'	12.75	12.00	0.75	0.5	still
P1'	13.50	12.00	1.50	1	strong
P2'	15.00	12.00	3.00	2	strong

Ruler tolerance ±0.1 cm on each length, so ±0.2 cm on a difference. The half-λ points sit on a crest arc from one source, midway between two crest arcs from the other.

C

1. P0 (0), P1 and P1' (λ), P2 and P2' (2λ).
2. Q1 and Q1' (0.5λ), Q2 (1.5λ).
3. Reinforce: path difference = $n\lambda$. Cancel: path difference = $(n + ½)\lambda$.
4. Every point on that line is equidistant from X and Y, so the path difference is zero all along it.
5. A curve, one branch of a hyperbola. Close to the sources the constant difference of two distances is a strongly curved locus; only far out, where the two paths are nearly parallel, does it approach a straight line.

D

1. They spread out.
2. $d \sin\theta = \lambda$ gives $\sin\theta = \lambda/d$. With d = 6.0 cm, $\sin\theta = 0.25$, $\theta = 14.5°$. With d = 3.0 cm, $\sin\theta = 0.50$, $\theta = 30.0°$. At a fixed distance from the sources the first strong point is roughly twice as far off-centre.
3. Halving the separation roughly doubles the spacing: spacing $\propto 1/d$.