

AS Physics 9702

Unit 7 · Waves

Worked answers

Try the separate worksheet first. These worked answers explain methods as well as results. Equivalent valid reasoning and sensible rounding may also be correct. Suggested marks are RevisionTown practice guidance, not Cambridge marking instructions.

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.

U7-Q1 · 6 marks

(a) A disturbance and energy travel along the rope; its particles oscillate about their equilibrium positions rather than travelling with each crest. (b) $\lambda = 0.60$ m. $T = 1/f = 1/5.0 = 0.20$ s. (c) Phase difference = $360^\circ \times 0.15/0.60 = 90^\circ$, or $\pi/2$ radians.

U7-Q2 · 6 marks

(a) Three periods occupy $9.0 \times 0.40 = 3.6$ ms, so $T = 1.2$ ms = 0.0012 s. $f = 1/T = 833$ Hz $\approx 8.3 \times 10^2$ Hz. (b) Peak-to-peak voltage = $5.0 \times 0.20 = 1.0$ V; amplitude is half, 0.50 V. (c) A similar absolute position-reading uncertainty is spread across a longer interval, reducing fractional uncertainty in the mean period.

U7-Q3 · 5 marks

(a) In one period T a crest travels λ , so $v = \lambda/T$. As $f = 1/T$, $v = f\lambda$. (b) $\lambda = 2.7/18 = 0.15$ m. (c) $\lambda = 1.8/18 = 0.10$ m. The source still sets the frequency; slower propagation makes successive crests closer together.

U7-Q4 · 6 marks

(a) Intensity is power per unit area perpendicular to propagation. $I = 0.036/0.012 = 3.0$ W m^{-2} . (b) $I_{\text{new}} = 3.0 \times 0.60^2 = 1.08$ W m^{-2} . (c) Intensity is proportional to amplitude squared, so the factor is 0.36 . New power = $1.08 \times 0.012 = 0.01296$ W ≈ 0.013 W.

U7-Q5 · 6 marks

(a) Longitudinal oscillations are parallel to propagation; transverse oscillations are perpendicular. (b) $\lambda = 0.34 - 0.10 = 0.24$ m. Adjacent compression-to-rarefaction spacing is $\lambda/2 = 0.12$ m. (c) The plotted vertical coordinate represents displacement along the propagation line, not literal vertical position. Compression occurs where neighbouring displacements bring particles closer together, not where every particle has its greatest displacement.

U7-Q6 · 7 marks

(a) Successive wavefronts are emitted from positions closer to the observer, so their spacing is reduced. With unchanged sound speed, more fronts arrive per second. (b) $f_o = 900 \times 340 / (340 - 25) = 971.4 \text{ Hz}$. (c) $f_o = 900 \times 340 / (340 + 25) = 838.4 \text{ Hz}$. (d) No; sound speed relative to the stationary air remains 340 m s^{-1} .

U7-Q7 · 8 marks

(a) In decreasing wavelength: radio, roughly above 10^{-1} m ; microwaves, 10^{-3} - 10^{-1} m ; infrared, 7×10^{-7} - 10^{-3} m ; visible, 4×10^{-7} - $7 \times 10^{-7} \text{ m}$; ultraviolet, about 10^{-8} - $4 \times 10^{-7} \text{ m}$; X-rays, about 10^{-13} - 10^{-8} m ; gamma rays, typically below 10^{-10} m . Accept sensible approximate boundary conventions, including X-ray/gamma overlap. Award one mark for correct ordering and three for reasonably complete ranges. (b) All are transverse; all travel at $c \approx 3.00 \times 10^8 \text{ m s}^{-1}$ in free space. (c) $f = c/\lambda = (3.00 \times 10^8)/(450 \times 10^{-9}) = 6.67 \times 10^{14} \text{ Hz}$. It is visible because 450 nm lies between 400 and 700 nm .

U7-Q8 · 6 marks

(a) Polarisation selects an oscillation direction in a plane perpendicular to propagation. Only transverse waves have this choice of direction; longitudinal waves oscillate along propagation. (b) $I = 48 \cos^2 35^\circ = 32.208 \text{ W m}^{-2} \approx 32 \text{ W m}^{-2}$. (c) $\cos^2 \theta = 12/48 = 0.25$; $\cos \theta = 0.5$ within the specified interval, so $\theta = 60^\circ$.

U7-Q9 · 5 marks

(a) The successive angles are 20° , $50^\circ - 20^\circ = 30^\circ$, and $90^\circ - 50^\circ = 40^\circ$. (b) $I = 120 \cos^2 20^\circ \cos^2 30^\circ \cos^2 40^\circ = 46.636 \text{ W m}^{-2} \approx 46.6 \text{ W m}^{-2}$. (c) Light reaching the final filter is polarised at 50° , not the original 0° , so its relative angle is 40° .

U7-Q10 · 6 marks

(a) Amplitude is 3.0 mm , not the 6.0 mm peak-to-peak distance. $\lambda = 0.50 - 0.10 = 0.40 \text{ m}$. $f = 12/0.60 = 20 \text{ Hz}$. (b) $v = f\lambda = 20 \times 0.40 = 8.0 \text{ m s}^{-1}$. (c) $I_2/I_1 = (2.0/3.0)^2 = 4/9 \approx 0.444$. A measurement at one fixed position gives a time period; wavelength requires spatial spacing or independent wave speed.

U7-Q11 · 2 marks

Correct option: C. The interval is period $T = 0.0040 \text{ s}$, so $f = 1/T = 250 \text{ Hz}$. A treats a time axis as a distance axis. B needs wavelength as well as frequency. D treats a horizontal time interval as the vertical displacement amplitude and gives it an inappropriate unit.

U7-Q12 · 2 marks

Correct option: C. For an approaching source, $f_o = f_s v / (v - 0.10v) = f_s / 0.90$, approximately $1.111f_s$. A predicts the wrong direction of change. B uses the simple factor associated with a different observer-motion model, not the required moving-source expression. D uses the denominator for recession.

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