

# Wave Basics

## Mark scheme

Level	A Level
Subject	Physics
Exam Board	OCR
Topic	Electrons , waves and photons
Sub-Topic	Wave Basics
Booklet	Mark Scheme 4

**Time Allowed:** 53 minutes

**Score:** / 44

**Percentage:** /100

**Grade Boundaries:**

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

Question		Expected Answers	M	Additional Guidance
<b>1</b>				
	<b>a</b>	oscillation/vibration of <u>particles/medium</u> in direction of travel of the wave example: sound wave, etc. oscillation/vibration of <u>particles/medium</u> (in the plane) at right angles to direction of travel of the wave example: surface water waves, string, electromagnetic, etc	B1 B1  B1 B1	<b>allow</b> direction of energy transfer of the wave <b>not</b> direction of wave motion  <b>allow</b> direction of energy transfer of the wave <b>allow</b> RE mark for weaker descriptions with same omissions as in longitudinal wave
	<b>b</b>	the incident wave is reflected at the end of the pipe <u>reflected</u> wave <u>interferes/superposes</u> with the incident wave to produce (a resultant wave with) nodes and/or antinodes	B1 B1 B1	<b>QWC mark</b> <b>accept</b> resultant wave with no energy transfer
	<b>c</b>	<b>i</b> at 0 oscillation with max amplitude along tube at 0.2 m (oscillation along tube with) smaller amplitude at 0.6 m no motion/node	B1 B1	<b>not</b> displacement (penalise only once)  all 4 correct for 2 marks; 2 correct for 1 mark
		<b>ii</b> oscillation at 3 times the frequency of c(i) at 0 (oscillation with) max amplitude (along tube)/antinode at 0.2 m no motion/node at 0.4 m motion as at 0 (but in antiphase/opposite direction)	B1 B1	3 correct for 2 marks; 2 correct for 1 mark
	<b>d</b>	<b>i</b> $\lambda/2$ sketch with zero at 0.3 m	M1 A1	<b>accept</b> 1 or 2 lines, solid or dotted
		<b>ii</b> $2f_0$	B1	<b>no ecf from d(i)</b>
		<b>Total question 6</b>	<b>14</b>	

Question		Expected Answers	M	Additional Guidance
<b>2</b>				
	<b>a</b>	<b>i</b>	light emitted from (excited isolated) atoms produces a line spectrum a series of (sharp/bright/coloured) lines against a dark background	B1 B1 <b>max 2 marks</b> from 3 marking points
		<b>ii</b>	in an absorption spectrum a series of <u>dark</u> lines (appears against a bright background/within a continuous spectrum)	B1 <b>accept</b> black
	<b>b</b>	<b>i</b>	$\epsilon = hc/\lambda$ $= 6.63 \times 10^{-34} \times 3.00 \times 10^8 / 436 \times 10^{-9}$ $= 4.56 \times 10^{-19} \text{ (J)}$	C1 C1 A1 <b>apply</b> SF error if all numbers not to 3+ figures 4.54 if use 6.6
		<b>ii</b>	$3.64 \times 10^{-19} \text{ (J)}$	A1 <b>allow</b> mark if repeated error from <b>b(i)</b>
	<b>c</b>	<b>i</b>	correct vertical lines; correct labels arrow(s) downwards	B1 B1 B1 <b>1 mark</b> for 1 vertical line + correct label
		<b>ii</b>	$- 8.86 + 4.56 = - 4.3 \times 10^{-19} \text{ (J)}$ $- 7.94 + 3.64 = - 4.3 \times 10^{-19} \text{ (J)}$	B1 B1 <b>ecf b(i)</b> <b>do</b> calculation for one line only correctly scores 2 marks; give answer as $4.3 \times 10^{-19}$ <b>or</b> -4.3 scores 1 mark <b>do</b> calculation for both lines and give answer as $4.3 \times 10^{-19}$ <b>or</b> -4.3 scores both marks
<p><b>N.B.</b> Before marking 7d check pages 18, 19 and 20 for additional answers by scrolling down. Extra answers <b>MUST</b> be annotated to show that they have been seen and credited back in the relevant question when appropriate.</p> <p>✓ = 1 extra mark  x = incorrect; scores 0  NBOD = no added value or no further action needed; scores 0  CON = if reference is made to the additional answer in the main text and this answer contradicts the other then deduct the original mark; = if NO reference is made to the additional answer in the main text and this answer contradicts the other then do NOT change the original mark</p>				
	<b>d</b>		$(d \sin \theta = \lambda)$ $3.3 \times 10^{-6} \sin \theta = 546 \times 10^{-9}$ $\sin \theta = 0.165$ $\theta = 9.5^\circ$	C1 C1 A1
<b>Total question 7</b>			<b>15</b>	

Question			Expected Answers	Marks	Additional Guidance
3	(a)	(i)	diffraction or refraction or superposition or interference	B2	<b>accept</b> any two from the four listed <b>accept</b> sound is a longitudinal wave or e-m waves are transverse
		(ii)	only transverse waves can be polarised	B1	
		(iii)	place transmitter and receiver facing each other  rotate either transmitter or receiver through 90° about axis joining aerials <b>or</b> use two polarising filters and rotate from parallel to crossed  observe signal fall to zero/minimum from initial high value on meter monitoring output of receiver explanation of observations/link between observations and polarisation	B1  B1  B1 B1	
(b)	(i)	1	0.3 (mm)	B1	tolerance $\pm 0.02$ mm ie 0.28 – 0.32 (mm)
		2	T = 4.0 ms F = 1/T = 250 (Hz)	C1 A1	<b>allow</b> 0.25 Hz or any other POT error for 1 mark
		(ii)	realisation that intensity is proportional to (amplitude) <sup>2</sup> giving amplitude increase by $\sqrt{2}$ , ie 4(.2) mm sine wave of same frequency with any increased amplitude	B1 B1 B1	
		(iii)	microphone (to transfer mechanical motion to electrical signal/voltage) oscilloscope to display oscillation/wave for measurement (of period)/AW	B1 B1	<b>accept</b> computer/datalogger/frequency meter with qualification as for oscilloscope
<b>Total question 4</b>				<b>15</b>	