

Mark Scheme Topic Specific Questions : Waves : Stationary

Jan 2002 to Jan 2009

Section A: Objective test keys

Q4 Jan 2002

1-D; 2-C; 3-B; 4-C; 5-B; 6-D; 7-B; 8-A; 9-D; 10-C; 11-B; 12-B; 13-A; 14-D; 15-B.

Section A

Q4 Jun 2002

Key to Objective Test Questions

1-B; 2-B; 3-D; 4-C; 5-A; 6-C; 7-B; 8-B; 9-D; 10-A; 11-C; 12-C; 13-D; 14-A; 15-C.

1

- (a) interference or superposition ✓
reflection from metal plate ✓

Q1 Jun 2003

two waves of the same frequency/wavelength ✓
travelling in opposite directions (or forward/reflected waves) ✓
maxima where waves are in phase or interfere constructively ✓
minima where waves are out of phase/antiphase
or interfere destructively ✓
nodes and antinodes or stationary waves identified ✓

max(4)

- (b)(i) (distance between minima = $\frac{\lambda}{2}$)

$$\left(\frac{\lambda}{2} = \frac{144}{9} \text{ gives}\right) \lambda = 32.0 \text{ mm } \checkmark$$

- (b)(ii) $c = f\lambda$ and $c = 3 \times 10^8 \text{ (m s}^{-1}\text{)} \checkmark$

$$f = \frac{3 \times 10^8}{32 \times 10^{-3}} = 9.38 \times 10^9 \text{ Hz } \checkmark$$

(allow C.E. for value of λ from (i))

(3)

(7)

1

- (a) two waves that overlap/meet/superpose ✓
 same wavelength or frequency ✓
 equal and opposite velocities ✓
 same or similar amplitudes ✓

Q1 Jan 2004

max(2)

- (b)(i) 0.8(0) m ✓

(ii) (use of $f = \frac{c}{\lambda}$ gives) $f \left(= \frac{200}{0.8} \right) = 250 \text{ Hz}$ ✓

(allow C.E. for value of λ from (i))

(iii) (use of $T = \frac{1}{f}$ gives) $T \left(= \frac{1}{250} \right) = 4.0 \text{ ms}$ ✓

$3.0 \text{ ms} = \frac{3T}{4}$ [or $\frac{3}{4}$ of one cycle or vibration ✓



(to be drawn on the diagram)

(allow C.E. for value of T from (ii) if diagram still shows

a stationary wave)

(5)

(7)

Question 1	Q1 Jun 2005	
(a)	reference to resonance ✓ air set into vibration at frequency of loudspeaker ✓ resonance when driving frequency = natural frequency of air column ✓ more than one mode of vibration ✓ stationary wave (in air column) ✓ (or reference to nodes and antinodes) maximum amplitude vibration (or max energy transfer) at resonance ✓ [alternative answer to (a): first two marks as above, remaining four marks for wave reflected from surface (of water) ✓ interference/superposition (between transmitted and reflected waves) ✓ maximum intensity when path difference is $n\lambda$ ✓ maxima (or minima) observed when l changes by $\lambda/2$ ✓]	<p style="text-align: center;">Max 4</p>
(b) (i)	$\frac{\lambda}{2} = 523 - 168$ ✓ (= 355 mm) $\lambda = 710 \text{ mm}$ ✓ [if $\frac{\lambda}{4} = 168$, giving $\lambda = 670 \text{ mm}$, ✓ (1 max) (672 mm)]	<p style="text-align: center;">Much of this question is beyond year 12 work and relies on Y13 work some bits are not even covered in Y13</p> <p style="text-align: center;">4</p>
(ii)	$c (= f\lambda) = 480 \times 0.71$ ✓ $= 341 \text{ m s}^{-1}$ ✓ (allow C.E. for incorrect λ from (i)) [allow $480 \times 0.67 = 320 \text{ m s}^{-1}$ ✓ (1max) (322 m s ⁻¹)]	

Unit 4: PA04 Section A

Waves, Fields and Nuclear Energy

Q3 Jun 2004

Key to Objective Test Questions

1-C; 2-D; 3-A; 4-D; 5-D; 6-B; 7-A; 8-B; 9-B; 10-A; 11-B; 12-C; 13-D; 14-D; 15-B.

Unit 4: PA04 Section A

Waves, Fields and Nuclear Energy

Q4 Jan 2005

Key to Objective Test Questions

1-B; 2-A; 3-D; 4-A; 5-C; 6-C; 7-D; 8-D; 9-C; 10-D; 11-C; 12-B; 13-B; 14-A; 15-C.

Section A

Q4 Jan 2006

This component is an objective test for which the following list indicates the correct answers used in marking the candidates' responses.

Keys to Objective Test Questions														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
C	C	B	C	A	D	B	B	A	D	C	A	D	B	D

PA04 Section A: Waves, Fields and Nuclear Energy

Q4 Jun 2006

Keys to Objective Test Questions														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B	C	A	C	A	D	B	C	D	D	B	C	D	B	B

Section A


Q5 Jan 2007

This component is an objective test for which the following list indicates the correct answers used in marking the candidates' responses.

Keys to Objective Test Questions														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	B	D	A	C	B	C	D	A	B	D	B	D	C	A

Question 1			
(a)	(i)	$\lambda = \left(\frac{ws}{D} \right) = \frac{2.0 \times 3.2}{16} = 0.40 \text{ m} \checkmark$	Q1 Jan 2007
	(ii)	$c (= f \lambda) = 850 \times 0.40 = 340 \text{ ms}^{-1} \checkmark$	
(b)	(i)	speakers act as coherent sources or have constant phase relation \checkmark light is emitted from sources in (incoherent) bursts \checkmark light sources are not coherent or phase relation not constant \checkmark	max 5
	(ii)	use of double slit \checkmark wavefronts are divided at slits \checkmark slits act as coherent sources \checkmark slit sources have the same frequency \checkmark slit sources have a constant phase relation \checkmark	
Total			7

Question 3			
(a)		at nodes displacement is always zero or a minimum \checkmark at antinodes the displacements have maximum amplitude \checkmark (not displacement is a maximum)	2
(b)		two waves of same frequency or wavelength (or dippers D and E vibrate at the same frequency) \checkmark waves travelling in opposite directions \checkmark waves travel at same speed \checkmark [or waves have equal and opposite velocities $\checkmark\checkmark$] waves meet or overlap or superpose or interfere \checkmark constructive or destructive superposition explained \checkmark (e.g. by reference to phase or antiphase of waves)	Q3 Jun 2007 max 4
(c)	(i)	$\lambda_1 (= 2 \times 12) = 24 \text{ mm} \checkmark$ $c = 24 \times 10^{-3} f$ and $c = 20 \times 10^{-3} (f + 2) \checkmark$ gives $f = 10 \text{ Hz} \checkmark$	4
	(ii)	$c (= 24 \times 10^{-3} \times 10) = 0.24 \text{ m s}^{-1} \checkmark$ (allow CE from (c) (i))	
Total			10

Question 1			
(a)	(i)	two progressive waves travelling in opposite directions ✓ e.g. forward wave and its reflection waves have same frequency or wavelength ✓ and same or similar amplitudes ✓	Q1 Jan 2008 max 2 3
	(ii)	length of string = $n \times (\lambda/2)$ ✓	
(b)	(i)	$\lambda \left(= \frac{c}{f} \right) = \frac{72}{30} = 2.4 \text{ m}$ ✓	
	(ii)	 [or accept top or bottom half of this sketch]	4
	(iii)	same amplitude and frequency ✓ phase difference of 180° or π rad ✓	
Total			7

Question 5			
(a)		(progressive waves travel from centre) to ends and reflect ✓ two (progressive) waves travel in opposite directions along the string ✓ waves have the same frequency (or wavelength) ✓ waves have the same (or similar) amplitude ✓ superposition (accept 'interference') ✓	Q5 Jan 2009 max 3
(b)	(i)	wavelength (= $2 \times PQ = 2 \times 1.20 \text{ m}$) = 2.4 m ✓ speed (= wavelength \times frequency = 2.4×150) = 360 m s^{-1} ✓ (answer only gets both marks)	
	(ii)	diagram to show three 'loops' ✓ and of equal length and good shape ✓ (or loop of one third length ✓)	4
Total			7