

# 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 ✓  
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 ✓

Q1 Jun 2003

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  $\lambda$  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  $\lambda$  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;"><b>Max 4</b></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="color: red;"><b>Much of this question is beyond year 12 work and relies on Y13 work some bits are not even covered in Y13</b></p>
(b) (ii)	$c (= f\lambda) = 480 \times 0.71$ ✓ $= 341 \text{ m s}^{-1}$ ✓ (allow C.E. for incorrect $\lambda$ from (i)) [allow $480 \times 0.67 = 320 \text{ m s}^{-1}$ ✓ (1max) (322 m s <sup>-1</sup> )]	<p style="text-align: center;"><b>4</b></p>

# 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)	$\lambda = \left( \frac{ws}{D} \right) = \frac{2.0 \times 3.2}{16} = 0.40 \text{ m} \checkmark$	<b>Q1 Jan 2007</b>	<b>2</b>
	(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 $\checkmark$		<b>max 5</b>
	(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 $\checkmark$		
			<b>Total</b>	<b>7</b>

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)		<b>2</b>
(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)	<b>Q3 Jun 2007</b>	<b>max 4</b>
(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 $f = 10 \text{ Hz} \checkmark$		<b>4</b>
	(ii)	$c (= 24 \times 10^{-3} \times 10) = 0.24 \text{ m s}^{-1} \checkmark$ (allow CE from (c) (i))		
			<b>Total</b>	<b>10</b>

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

Question 5			
(a)		<p>(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) <b>amplitude</b> ✓ <b>Q5 Jan 2009</b>  superposition (accept 'interference') ✓</p> <p style="text-align: right;"><b>max 3</b></p>	
(b)	(i)	<p>wavelength (= <math>2 \times PQ = 2 \times 1.20 \text{ m}</math>) = 2.4 m ✓  speed (= wavelength <math>\times</math> frequency = <math>2.4 \times 150</math>) = <math>360 \text{ m s}^{-1}</math> ✓  (answer only gets both marks)</p>	
	(ii)	<p>diagram to show three 'loops' ✓ <b>and</b> of equal length and good shape ✓  (or loop of one third length ✓)</p> 	<b>4</b>
		<b>Total</b>	<b>7</b>