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 **Q1 Jun 2003**

(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 ✓ $_{max}(4)$

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

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

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

$f = \frac{3\times10^8}{32\times10^{-3}} = 9.38 \times 10^9$ Hz ✓

(allow C.E. for value of λ from (i))

(3)

(7)

1

Q1 Jan 2004

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

max (2)

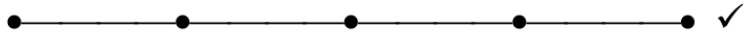
(b)(i) 0.8(0) m ✓

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

(allow C.E. for value of λ from (i))

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

3.0 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)

Q1 Jun 2005

Question 1			
(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 $\lambda/2$ ✓]	**Max 4**
(b)	(i)	$\frac{\lambda}{2} = 523 - 168$ ✓ (= 355 mm) $\lambda = 710$ mm ✓ [if $\frac{\lambda}{4} = 168$, giving $\lambda = 670$ mm, ✓ (1 max) (672 mm)]	**4**
	(ii)	$c(=f\lambda) = 480 \times 0.71$ ✓ $= 341$ m s^{-1} ✓ (allow C.E. for incorrect λ from (i)) [allow $480 \times 0.67 = 320$ m s^{-1} ✓ (1max) (322 m s^{-1})]	

Much of this question is beyond year 12 work and relies on Y13 work some bits are not even covered in Y13

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)	$\lambda = \left(\frac{ws}{D}\right) = \frac{2.0 \times 3.2}{16} = 0.40\,\text{m}$ ✓ **Q1 Jan 2007**	**2**
	(ii)	$c\ (= f\lambda) = 850 \times 0.40 = 340\,\text{ms}^{-1}$ ✓	
(b)	(i)	speakers act as coherent sources or have constant phase relation ✓ light is emitted from sources in (incoherent) bursts ✓ light sources are not coherent or phase relation not constant ✓	**max 5**
	(ii)	use of double slit ✓ wavefronts are divided at slits ✓ slits act as coherent sources ✓ slit sources have the same frequency ✓ slit sources have a constant phase relation ✓	
		Total	**7**

Question 3			
(a)		at nodes displacement is always zero or a minimum ✓ at antinodes the displacements have maximum amplitude ✓ (not displacement is a maximum)	**2**
(b)		two waves of same frequency or wavelength (or dippers D and E vibrate at the same frequency) ✓ **Q3 Jun 2007** waves travelling in opposite directions ✓ waves travel at same speed ✓ [**or** waves have equal and opposite velocities ✓✓] waves meet or overlap or superpose or interfere ✓ constructive or destructive superposition explained ✓ (e.g. by reference to phase or antiphase of waves)	**max 4**
(c)	(i)	λ_1 (= 2 × 12) = 24 mm ✓ $c = 24 \times 10^{-3} f$ and $c = 20 \times 10^{-3}(f + 2)$ ✓ gives f = 10 Hz ✓	**4**
	(ii)	$c\ (= 24 \times 10^{-3} \times 10\ ) = 0.24\,\text{m s}^{-1}$ ✓ (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 **Q1 Jan 2008** waves have same frequency or wavelength ✓ and same or similar amplitudes ✓ **max 2**	**3**
(ii)	length of string = $n \times (\lambda/2)$ ✓	
(b) (i)	$\lambda\left(=\frac{c}{f}\right)=\frac{72}{30}$ = 2.4 m ✓	**4**
(ii)	P  Q ✓ [**or** accept top or bottom half of this sketch]	
(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** ✓ **Q5 Jan 2009** superposition (accept 'interference') ✓	**max 3**
(b) (i)	wavelength (= 2 × PQ = 2 × 1.20 m) = 2.4 m ✓ speed (= wavelength × frequency = 2.4 × 150) = 360 m s^{-1} ✓ (answer only gets both marks)	**4**
(ii)	diagram to show three 'loops' ✓ **and** of equal length and good shape ✓ (or loop of one third length ✓) 	
	Total	**7**