# 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$^{-1}$) ✓

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

(allow C.E. for value of $\lambda$ from (i))

(3)

(7)

**1**

## Q1 Jan 2004

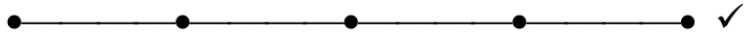
(a) two waves that overlap/meet/superpose ✓
same wavelength or frequency ✓
equal and opposite velocities ✓
same or similar amplitudes ✓

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 $\lambda$ 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)

| Question 1 | | Q1 Jun 2005 | |
|---|---|---|---|
| (a) | | reference to resonance ✓<br>air set into vibration at frequency of loudspeaker ✓<br>resonance when driving frequency = natural frequency of air column ✓<br>more than one mode of vibration ✓<br>stationary wave (in air column) ✓ (or reference to nodes and antinodes)<br>maximum amplitude vibration (or max energy transfer) at resonance ✓<br><br>[alternative answer to (a):<br>first two marks as above, remaining four marks for<br>wave reflected from surface (of water) ✓<br>interference/superposition (between transmitted and reflected waves) ✓<br>maximum intensity when path difference is $n\lambda$ ✓<br>maxima (or minima) observed when $l$ changes by $\lambda/2$ ✓] | **Max 4** |
| (b) | (i) | $\frac{\lambda}{2} = 523 - 168$ ✓ (= 355 mm)<br>$\lambda = 710$ mm ✓<br>[if $\frac{\lambda}{4} = 168$, giving $\lambda = 670$ mm, ✓ (1 max) (672 mm)] | **4** |
| | (ii) | $c(=f\lambda) = 480 \times 0.71$ ✓<br>$= 341$ m s$^{-1}$ ✓<br>(allow C.E. for incorrect $\lambda$ from (i))<br>[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 **C** 2 **C** 3 **B** 4 **C** 5 **A** 6 **D** 7 **B** 8 **B** 9 **A** 10 **D** 11 **C** 12 **A** 13 **D** 14 **B** 15 **D** | |

### PA04 Section A: Waves, Fields and Nuclear Energy

**Q4 Jun 2006**

| | **Keys to Objective Test Questions** | |
|---|---|---|
| | **1** B **2** C **3** A **4** C **5** A **6** D **7** B **8** C **9** D **10** D **11** B **12** C **13** D **14** B **15** 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** A **2** B **3** D **4** A **5** C **6** B **7** C **8** D **9** A **10** B **11** D **12** B **13** D **14** C **15** 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 ✓<br>light is emitted from sources in (incoherent) bursts ✓<br>light sources are not coherent or phase relation not constant ✓ | **max 5** |
| | (ii) | use of double slit ✓<br>wavefronts are divided at slits ✓<br>slits act as coherent sources ✓<br>slit sources have the same frequency ✓<br>slit sources have a constant phase relation ✓ | |
| | | **Total** | **7** |

| Question 3 | | | |
|---|---|---|---|
| (a) | | at nodes displacement is always zero or a minimum ✓<br>at antinodes the displacements have maximum amplitude ✓<br>(not displacement is a maximum) | **2** |
| (b) | | two waves of same frequency or wavelength<br>(or dippers D and E vibrate at the same frequency) ✓ **Q3 Jun 2007**<br>waves travelling in opposite directions ✓<br>waves travel at same speed ✓<br>[**or** waves have equal and opposite velocities ✓✓]<br>waves meet or overlap or superpose or interfere ✓<br>constructive or destructive superposition explained ✓<br>(e.g. by reference to phase or antiphase of waves) | **max 4** |
| (c) | (i) | $\lambda_1$ (= 2 × 12) = 24 mm ✓<br>$c = 24 \times 10^{-3} f$ 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 ✓<br>e.g. forward wave and its reflection **Q1 Jan 2008**<br>waves have same frequency or wavelength ✓<br>and same or similar amplitudes ✓<br>**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 ✓<br>[**or** accept top or bottom half of this sketch] | |
| | (iii) | same amplitude and frequency ✓<br>phase difference of 180° or π rad ✓ | |
| | | **Total** | **7** |

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