Name of the Student:_____
Max. Marks : 17 Marks **Time : 17 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable answers		Additional guidance	Mark
	• Determine period, T • Use of $T = 2\pi\sqrt{(l/g)}$ • Subtracts radius of mass • Length of wire = 10.3 (m)	(1) (1) (1) (1)	Example of calculation T = 52.2 s / 8 = 6.53 s 6.53 s = $2\pi\sqrt{(l/9.81\ \text{N kg}^{-1})}$ Length of pendulum to centre of mass = 10.6 m Length of wire = 10.6 m − 0.3 m = 10.3 m	4

Q2.

Question Number	Acceptable Answer		Additional Guidance	Mark
	• No of divisions read from oscilloscope trace • Use of time base setting • Use of $f = 1/T$ • Use of $v = f\lambda$ • v = 340 m s^{-1}	(1) (1) (1) (1) (1)	MP1: Must be for a recognised part of wave Example of calculation $T = 3 \times 0.20 \times 10^{-3}$ s = 6.0×10^{-4} s $f = \frac{1}{6.0 \times 10^{-4}\ \text{s}}$ = 1.67×10^{3} Hz $v = 1.67 \times 10^{3}\ \text{s}^{-1} \times 0.205$ m = 342 m s^{-1}	5

Q3.

<table>
<tr><th>Question Number</th><th>Acceptable Answers</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td>*</td><td>This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning.

Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.

The following table shows how the marks should be awarded for indicative content.
<table>
<tr><th>Number of indicative marking points seen in answer</th><th>Number of marks awarded for indicative marking points</th><th>Max linkage mark available</th></tr>
<tr><td>6</td><td>4</td><td>2</td></tr>
<tr><td>5</td><td>3</td><td>2</td></tr>
<tr><td>4</td><td>3</td><td>1</td></tr>
<tr><td>3</td><td>2</td><td>1</td></tr>
<tr><td>2</td><td>2</td><td>0</td></tr>
<tr><td>1</td><td>1</td><td>0</td></tr>
<tr><td>0</td><td>0</td><td>0</td></tr>
</table></td><td>Guidance on how the mark scheme should be applied: The mark for indicative content should be added to the mark for lines of reasoning. For example, an answer with five indicative marking points which is partially structured with some linkages and lines of reasoning scores 4 marks (3 marks for indicative content and 1 mark for partial structure and some linkages and lines of reasoning). If there are no linkages between points, the same five indicative marking points would yield an overall score of 3 marks (3 marks for indicative content and no marks for linkages).</td><td>3</td></tr>
</table>

The following table shows how the marks should be awarded for structure and lines of reasoning.

	Number of marks awarded for structure of answer and sustained line of reasoning
Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout	2
Answer is partially structured with some linkages and lines of reasoning	1
Answer has no linkages between points and is unstructured	0

Indicative content

- The pendulums have the same length, so they have the same time period/frequency
- The first pendulum causes forced oscillations of the second pendulum
- The driving frequency equals the natural frequency
- Resonance occurs, so there is maximum transfer of energy so the amplitude increases until all energy is transferred
- The second pendulum then acts as a driver for the first pendulum
  Or the process repeats with energy transfer from B to A
- When the lengths differ the driving frequency is not the natural frequency of the second pendulum so little energy transfer occurs

Q4.

Question Number	Acceptable Answer	Additional Guidance	Mark
	Any **TWO** from: • Should have used (a fiducial mark as) a reference point **(1)** • Should have timed from the equilibrium position of the bob **Or** Shouldn't time from the maximum displaced position of the bob **(1)** • Only timed one oscillation **Or** should have times more than one oscillation **(1)** • Should have allowed the pendulum to swing to and fro a few times before starting to time (as the first swing may be different from the others) **(1)**	Accept centre/vertical/undisplaced position for equilibrium position	**2**