Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable answers	Additional guidance	Mark
	An explanation that makes reference to the following points: • High viscosity oil will mean a large resistive force applied to the oscillations **(1)** • (When piston moves) a large amount of work will be done **(1)** • (Heavy damping so) energy of oscillation is quickly dissipated to the oil **(1)**	May refer to to $F = 6\pi\eta r v$ Mar refer to $\Delta W = F\Delta s$	3

Q2.

<table>
<tr><th>Question Number</th><th>Acceptable Answer</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 table shows how the marks should be awarded for indicative content and structure and lines of reasoning.

<table>
<tr><th>Number of indicative marking points seen in answer</th><th>Number of marks awarded for indicative marking points</th></tr>
<tr><td>6</td><td>4</td></tr>
<tr><td>5–4</td><td>3</td></tr>
<tr><td>3–2</td><td>2</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td></tr>
</table>

<table>
<tr><th></th><th>Number of marks awarded for structure of answer and sustained line of reasoning</th></tr>
<tr><td>Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout</td><td>2</td></tr>
<tr><td>Answer is partially structured with some linkages and lines of reasoning</td><td>1</td></tr>
<tr><td>Answer has no linkages between points and is unstructured</td><td>0</td></tr>
</table>
</td>
<td>
<table>
<tr><th>IC Points</th><th>IC Mark</th><th>Max linkage mark avail.</th><th>Max final mark</th></tr>
<tr><td>6</td><td>4</td><td>2</td><td>6</td></tr>
<tr><td>5</td><td>3</td><td>2</td><td>5</td></tr>
<tr><td>4</td><td>3</td><td>1</td><td>4</td></tr>
<tr><td>3</td><td>2</td><td>1</td><td>3</td></tr>
<tr><td>2</td><td>2</td><td>0</td><td>2</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>

IC1: accept references to flux cutting

Alternative indicative content for IC4 – IC5

4. The current is in the magnetic field produced by the magnet

5. The current experiences a magnetic force
</td>
<td>6</td>
</tr>
</table>

	Indicative content: 1. Removing the magnet from the ring changes the magnetic flux (linked with the ring) 2. This induces an e.m.f. (in the ring) 3. E.m.f. causes a current in the ring 4. Which produces a magnetic field 5. The magnetic fields interact/combine 6. This opposes the change, causing an attractive force to act		

Q3.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • (Magnetic levitation) reduces frictional forces (acting on the train as it moves) **(1)** • This reduces the work done against friction **Or** this makes it more efficient **Or** there is less time to reach maximum speed **Or** there is a higher maximum speed **(1)**	MP1: accept removes/no frictional forces MP2: accept there is less fuel used **Or** less energy is wasted	**2**

Q4.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to the following points: • $v_{max} = \omega A$ and ω constant (1) • If A doubles, then v_{max} doubles (1) • Hence max E_k will quadruple, since $E_k = \frac{1}{2}mv^2$ [dependent upon MP2] (1) OR • $\Delta E_{el} = \frac{1}{2}F\Delta x$ **and** $\Delta F = k\Delta x$ (1) • $\Delta E_{el} \propto (\Delta x)^2$ since k is constant (1) • Hence max E_k will quadruple, since max E_k = max ΔE_{el} (dependent upon MP2) (1)		3

Q5.

Question Number	Acceptable answers	Additional guidance	Mark
i	• Use of $\omega = 2\pi/T$ (1) • For at least 2 full cycles (1) • $\omega = 6.5 \times 10^{-6}$ (radian s^{-1}) (1)	For MP3, accept correctly rounded answers in range 6.5×10^{-6} radian s^{-1} to 6.6×10^{-6} radian s^{-1} Example of calculation $\omega = 5 \times 2\pi / (56 \times 24 \times 60 \times 60)$ s $= 6.49 \times 10^{-6}$ radian s^{-1}	3
ii	• Equates $F = Gm_1m_2/r^2$ and $F = m\omega^2r$ **Or** $F = Gm_1m_2/r^2$ and $F = mv^2/r$ with $v = 2\pi r/T$ (1) • Correct rearrangement and substitution (e.g. in $r^3 = Gm_1/\omega^2$) (1) • $r = 7.2 \times 10^9$ m (ecf from (b)(i)) (1)	Example of calculation $r^3 = 6.67 \times 10^{-11}$ N m^2 kg^{-2} $\times$ 0.12 $\times$ 1.99 $\times 10^{30}$ kg / $(6.5 \times 10^{-6}$ radian s$^{-1})^2$ $r = 7.2 \times 10^9$ m ($r = 7.6 \times 10^9$ m for 'show that' value)	3