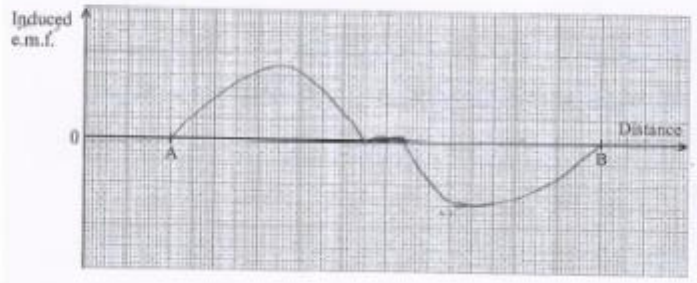
Name of the Student:_____
Max. Marks : 22 Marks **Time : 22 Minutes**

Mark Schemes

Q1.

Question Number	Answer		Mark
*(a)	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate) **Max 6 from**		
	Reference to changing/cutting of field/flux	(1)	
	Induced e.m.f. proportional to rate of change/cutting of flux (linkage) (accept equation)	(1)	
	Initial increase in e.m.f. as the magnet gets closer to the coil	(1)	
	Identifies region of negative gradient with magnet going through the coil	(1)	
	Indication that magnet's speed increases as it falls	(1)	
	Negative (max) value › positive (max) value (this mark is dependent on awarding marking point 5)	(1)	
	Time for second pulse shorter (this mark is dependent on awarding marking point 5)	(1)	
	The areas of the two parts of the graph will be the same (since $N\varphi$ constant)	(1)	
			6

(b)	Two sequential pulses (if **not** two sequential pulses, scores zero) Pulses same height (+/- 3 mm squares) and width (by eye) Pulses in opposite directions Region of zero e.m.f. in the middle Example (peaks could be in opposite directions)  	**(1)** **(1)** **(1)** **(1)**	**4**

Q2.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• Electric field vertically downwards (from top plate to bottom plate) **(1)** • Magnetic field into paper **(1)**		**2**

Question Number	Acceptable Answer	Additional Guidance	Mark
(ii)	• Use of $E = \frac{V}{d}$ **(1)** • Use of $F_E = EQ$ **(1)** • Use of $F_M = BQv$ **(1)** • Show that these forces are equal (if v is 2.2×10^5 m s^{-1}) and hence state that B is suitable **(1)**	Do not award MP4 if incorrect ion charge used Example of calculation: $E = \frac{V}{d} = \frac{135\,\text{V}}{2.5\times10^{-2}\,\text{m}} = 5400\,\text{V m}^{-1}$ $F = EQ = 5400\,\text{V m}^{-1} \times 1.6\times10^{-19}\,\text{C} = 8.6\times10^{-16}\,\text{N}$ $F = BQv = 24.5\times10^{-3}\,\text{T} \times 1.6\times10^{-19}\,\text{C} \times 2.2\times10^{5}\,\text{m s}^{-1}$ $= 8.6\times10^{-16}\,\text{N}$	**4**

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.

Indicative content:
• (Maximum/Initial) current is equal to battery emf divided by R
Or current as switch closed
Or current as complete circuit
Or current due to battery
• Coil rotates
• (movement of) coil "cuts/changes" (magnetic) flux (linkage) / field
• Which induces an emf (according to Faraday's law)
• Opposes original emf/current according to Lenz's law
Or current reduced as effect opposes change
• The faster the coil rotates the larger this (back) emf/effect the smaller the current</td><td><table><tr><th>IC points</th><th>IC mark</th><th>Max linkage mark available</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>
ic3 needs a link to coil moving
ic4 depends on ic3</td><td>6</td></tr>
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