Pearson

Mark Scheme (Results)

Summer 2026

Pearson Edexcel International Advanced Level In Physics
WPH14/01

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Mark scheme notes

Underlying principle
The mark scheme will clearly indicate the concept that is being rewarded, backed up by examples. **It is not a set of model answers.**

1. Mark scheme format

1.1 You will not see 'wtte' (words to that effect). Alternative correct wording should be credited in every answer unless the MS has specified specific words that must be present. Such words will be indicated by underlining e.g. 'resonance'

1.2 Bold lower case will be used for emphasis e.g. '**and**' when two pieces of information are needed for 1 mark.

1.3 Round brackets ( ) indicate words that are not essential e.g. "(hence) distance is increased".

1.4 Square brackets [ ] indicate advice to examiners or examples e.g. [Do not accept gravity] [ecf].

2. Unit error penalties

2.1 A separate mark is not usually given for a unit but a missing or incorrect unit will normally mean that the final calculation mark will not be awarded.

2.2 This does not apply in 'show that' questions or in any other question where the units to be used have been given, for example in a spreadsheet.

2.3 The mark will not be awarded for the same missing or incorrect unit only once within one clip in epen.

2.4 Occasionally, it may be decided not to insist on a unit e.g the candidate may be calculating the gradient of a graph, resulting in a unit that is not one that should be known and is complex.

2.5 The mark scheme will indicate if no unit error is to be applied by placing brackets around the unit.

3. Significant figures

3.1 Use of too many significant figures in the theory questions will not prevent a mark being awarded if the answer given rounds to the answer in the MS.

3.2 Too few significant figures will mean that the final mark cannot be awarded in 'show that' questions where one more significant figure than the value in the question is needed for the candidate to demonstrate the validity of the given answer.

3.3 The use of one significant figure might be inappropriate in the context of the question e.g. reading a value off a graph. If this is the case, there will be a clear indication in the MS.

3.4 The use of $g = 10\ m\ s^{-2}$ or $10\ N\ kg^{-1}$ instead of $9.81\ m\ s^{-2}$ or $9.81\ N\ kg^{-1}$ will be penalised by one mark (but not more than once per clip). Accept $9.8\ m\ s^{-2}$ or $9.8\ N\ kg^{-1}$

3.5 In questions assessing practical skills, a specific number of significant figures will be required e.g. determining a constant from the gradient of a graph or in uncertainty calculations. The MS will clearly identify the number of significant figures required.

4. Calculations

4.1 **use of** the formula means that the candidate demonstrates substitution of physically correct values, although there may be conversion errors e.g. power of 10 error.

4.2 If a 'show that' question is worth 2 marks, then both marks will be available for a reverse working. If the question is worth 3 marks then only 2 marks will be available.

4.3 The mark scheme will show a correctly worked answer for illustration only.

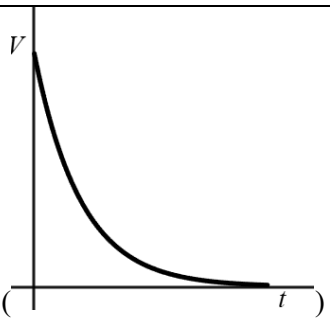
5. Quality of Written Expression

5.1 Questions that asses the ability to show a coherent and logically structured answer are marked with an asterisk.

5.2 Marks are awarded for indicative content and for how the answer is structured.

5.3 Linkage between ideas, and fully-sustained reasoning is expected.

Question Number	Answer	Mark
1	**The only correct answer is B** ($^{24}_{10}$Ne contains $24 - 10 = 14$ neutrons) A is not correct because it contains $20 - 10 = 10$ neutrons C is not correct because it contains $24 - 12 = 12$ neutrons D is not correct because it contains $25 - 12 = 13$ neutrons	**1**
2	**The only correct answer is A** ($2.3 \times \frac{360}{2\pi}$) B is not correct because it does not equal $2.3 \times \frac{360}{2\pi}$ C is not correct because it does not equal $2.3 \times \frac{360}{2\pi}$ D is not correct because it does not equal $2.3 \times \frac{360}{2\pi}$	**1**
3	**The only correct answer is B** (GeV s^{-1}) A is not correct because these are units of momentum (mass × velocity) C is not correct because these are units of a moment (force × distance) D is not correct because these are units of intensity (power per unit area)	**1**
4	**The only correct answer is A** (linear momentum conserved, kinetic energy conserved) B is not correct because kinetic energy must be conserved for elastic collisions C is not correct because linear momentum must always be conserved D is not correct because linear momentum must always be conserved and kinetic energy must be conserved for elastic collisions	**1**
5	**The only correct answer is C** ($\text{d}\bar{\text{u}}$) A is not correct because mesons are a quark antiquark pair B is not correct because mesons are a quark antiquark pair D is not correct because mesons are a quark antiquark pair	**1**
6	**The only correct answer is C** (X negative and Y positive) A is not correct because the field lines show the direction of the force on a positive charge B is not correct because the field lines show the direction of the force on a positive charge D is not correct because the field lines show the direction of the force on a positive charge	**1**

7	 **The only correct answer is D** ( ) A is not correct because the potential difference across the resistor is increasing B is not correct because the potential difference across the resistor is increasing C is not correct because the potential difference across the resistor is increasing	**1**
8	**The only correct answer is A** $(80 \times (9 - 0))$ B is not correct because the Earth's gravitational field strength should not be a factor C is not correct because the time should not be a factor D is not correct because the time should not be divided by	**1**
9	**The only correct answer is A** (electron) B is not correct because the neutral pion will not be deflected at all, as it has no charge C is not correct because the neutron will not be deflected at all, as it has no charge D is not correct because the proton is heavier than the electron with the same charge, so will be deflected less (into a larger radius circle)	**1**
10	**The only correct answer is D** $(\frac{F}{4})$ A is not correct because the charge centres are further apart so the force should be weaker B is not correct because the charge centres are further apart so the force should be weaker C is not correct because the distance between charge centres has doubled but the force depends on distance squared	**1**

Question Number	Answer		Additional Guidance	Mark
11(a)	(Region/area) where a charged particle experiences a force	**(1)**		**1**
11(b)	Use of $E = \frac{Q}{4\pi\varepsilon_0 r^2}$ $E = 620\ \text{N C}^{-1}$	**(1)** **(1)**	Accept Use of $E = \frac{kQ}{r^2}$ Allow Vm^{-1} <u>Example calculation</u> $E = \frac{1.4 \times 10^{-8}\ \text{C}}{4\pi \times 8.85 \times 10^{-12}\ \text{F m}^{-1} \times (0.45\ \text{m})^2}$ $= 622\ \text{N C}^{-1}$	**2**
	Total for question 11			**3**

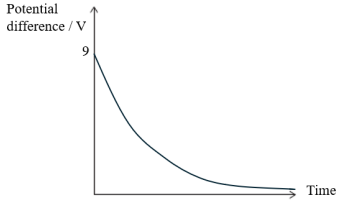
Question Number	Answer		Additional Guidance	Mark
12	Use of $p = mv$	**(1)**	Example calculation $\rightarrow 5.20 \times 10^4\ \text{kg} \times 2.00 \cos 30.0°\ \text{m s}^{-1} + 4.50 \times 10^5\ \text{kg} \times 1.70\ \text{m s}^{-1} = 8.551 \times 10^5\ \text{kg m s}^{-1} = (4.50 \times 10^5\ \text{kg} + 5.20 \times 10^4\ \text{kg})\ v \cos\theta$ $\uparrow 5.20 \times 10^4\ \text{kg} \times 2.00 \sin 30.0°\ \text{m s}^{-1} = 5.200 \times 10^4\ \text{kg m s}^{-1} = (4.50 \times 10^5\ \text{kg} + 5.20 \times 10^4\ \text{kg})\ v \sin\theta$ $v \sin\theta = \frac{5.200 \times 10^4 \text{kgms}^{-1}}{4.50 \times 10^5\ \text{kg} + 5.20 \times 10^4\ \text{kg}} = 0.1036\ \text{ms}^{-1}$ $v\ cos\theta = \frac{8.551 \times 10^5\ \text{kg m s}^{-1}}{4.50 \times 10^5\ \text{kg} + 5.20 \times 10^4\ \text{kg}} = 1.703\text{ms}^{-1}$ $tan\theta = \frac{0.1036\ \text{ms}^{-1}}{1.703\text{ms}^{-1}} = 0.06082.\ \theta = 3.48°$ $v = \frac{0.1036\ \text{ms}^{-1}}{\sin(3.48°)} = 1.706\text{m s}^{-1}$	**6**
	Use of conservation of momentum	**(1)**		
	Resolves momentum into components	**(1)**		
	Use of trigonometry to calculate θ	**(1)**		
	$v = 1.71\ \text{m s}^{-1}$	**(1)**		
	$\theta = 3.48°$	**(1)**		
	Total for question 12			**6**

Question Number	Answer		Additional Guidance	Mark
13(a)	baryon number: $(+1) + (-1) = 0 + 0 + 0$, (so conserved) charge: $(+1) + (-1) = (-1) + (+1) + 0$, (so conserved)	**(1)** **(1)**	. 	**2**
13(b)(i)	Antilepton **Or** Lepton number = -1 Neutral **Or** charge = 0 Therefore, it is an antineutrino	**(1)** **(1)** **(1)**	 Accept electron antineutrino or muon antineutrino Accept symbol	**3**
13(b)(ii)	Muons are travelling just below the speed of light So there is a increase in lifetime, and the muons will travel further (before they decay) **Or** So there is a increase in lifetime, and the muons will decay at a slower rate .	**(1)** **(1)**	 Do not accept takes longer to decay Accept time elapsed in muon's frame is smaller, so fewer have decayed	**2**
	Total for question 13			**7**

Question Number	Answer		Additional Guidance	Mark
14(a)	out of the page	**(1)**		**1**
14(b)(i)	Equates centripetal and magnetic forces: $\frac{mv^2}{r} = BQv\sin\theta$ with $\sin\theta = 1$ Identify the momentum as $p = mv$ and suitable algebra to obtain required equation	**(1)** **(1)**	Accept $\frac{mv^2}{r} = BQv$	**2**
14(b)(ii)	Use of $p = mv$ Use of $r = \frac{p}{BQ}$ $\frac{m}{Q} = 2.43 \times 10^{-7}$ (kg C^{-1})	**(1)** **(1)** **(1)**	<u>Example calculation</u> $\frac{m}{Q} = \frac{rB}{v}$ $= \frac{1.52\text{ m} \times 40 \times 10^{-3}\text{ T}}{2.5 \times 10^{5}\text{ m s}^{-1}}$ $= 2.43 \times 10^{-7}$ kg C^{-1}	**3**

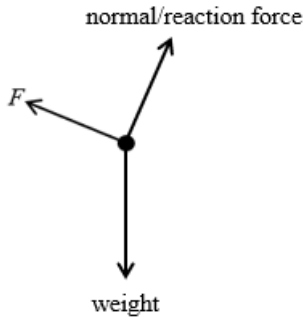
14(b)(iii)	Uses 1.67×10^{-27} kg	**(1)**		
	Uses $\frac{m}{Q}$ (ecf from ii)	**(1)**		
	Mass of ion $= 3.89 \times 10^{-26}$ kg $\approx 3.84 \times 10^{-26}$ kg, so suggestion correct **Or** No of nucleons = $23.3 \approx 23$ so suggestion correct **Or** mass to charge ratio = $\frac{m}{Q} = 2.40 \times 10^{-7}$ (kg C^{-1}) $\approx 2.43 \times 10^{-7}$ (kg C^{-1}) so suggestion is correct **Or** charge = 1.58×10^{-19} C $\approx 1.60 \times 10^{-19}$ C so suggestion correct **Or** radius = 1.50 m $\approx$1.52 m so suggestion correct	**(1)**	Example calculation $m_{Na} = 23 \times 1.67 \times 10^{-27}$kg $= 3.84 \times 10^{-26}$ kg $\left(\frac{m}{Q}\right) \times e = 2.43 \times 10^{-7}$kg $C^{-1} \times 1.6 \times 10^{-19}$ C $= 3.89 \times 10^{-26}$ kg [show that gives 3.84×10^{-26} kg] $m_{Na} \approx \left(\frac{m}{Q}\right) \times e$ They are correct 3.89×10^{-26} kg $\approx 3.84 \times 10^{-26}$ kg	**3**
	Total for question 14			**9**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr>
<td>*15</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>IC points</th><th>IC mark</th><th>Max linkage mark</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>
Indicative content
IC1 Most alpha particles will pass through the foil undeflected
IC2 Most of an atom is empty space.
IC3 Some alpha particles will be detected at angles up to 90°
IC4 There is a concentration of charge (in the nucleus)
IC5 Very few alpha particles are detected at angles greater than 90°
IC6 Most of the mass is in a small region (nucleus).</td>
<td>The following table shows how the marks should be awarded
<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>
for structure and lines of reasoning.</td>
<td>6</td>
</tr>
<tr><td></td><td>Total for question 15</td><td></td><td>6</td></tr>
</table>

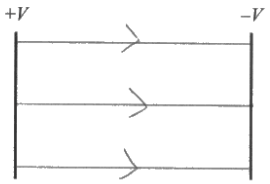
Question Number	Answer		Additional Guidance	Mark
16(a)	The time taken (for the capacitor) to discharge to $(\frac{1}{e})$ of its initial charge/p.d./current	**(1)**	Allow time taken (for the capacitor) to charge to $(1-\frac{1}{e})$ of its maximum charge/p.d.	**1**
16(b)	Axes labelled Exponential decrease starting from 9V	**(1)** **(1)**	<u>Example graph</u>  	**2**
16(c)	Use of $V = V_0 e^{-t/RC}$ $t = 21$ (s) **Or** 1.8 (V) **Or** 14 (MΩ) Time = $21.3(s) < 25(s)$ so it will not produce the correct time delay **Or** Potential difference = 1.8 (V) <2.3 (V) so it will not produce the correct time delay **Or** Resistance = 14 ((MΩ)>12 (MΩ) so it will not produce the correct time delay **Or** Correct conclusion with their calculated values	**(1)** **(1)** **(1)**	Allow $lnV = \ln V_0 - \frac{t}{RC}$ <u>Example calculation</u> $t = -12 \times 10^6\ \Omega \times 1.30 \times 10^{-6}\ \text{F} \times \ln\left(\frac{2.3\ \text{V}}{9.0\ \text{V}}\right) = 21.3\ \text{s}$ $21.3\text{s} < 25\text{s}$ ∴ it will not produce the correct time delay	**3**
	Total for question 16			**6**

Question Number	Answer		Additional Guidance	Mark
17(a)	Use of $E = hf$	**(1)**		
	Use of $\Delta E = c^2 \Delta m$	**(1)**		
	Uses factor of 2	**(1)**		
	$E = 3.01 \times 10^{-10}$(J) **Or** $m = 3.4 \times 10^{-27}$(kg) **Or** $f = 4.53 \times 10^{23}$(Hz)	**(1)**	Example calculation 4.6×10^{23} Hz $\times$ 6.63×10^{-34} J s= 3.05×10^{-10} J Mass of 2 protons = $2 \times 1.67 \times 10^{-27}$ kg = 3.34×10^{-27} kg Energy of 2 protons = 3.34×10^{-27} kg $\times$ $(3.00 \times 10^8$ m $s^{-1})^2 = 3.01 \times 10^{-10}$ J	
	E=3.05×10^{-10} J > 3.01×10^{-10} J so the energy is sufficient **Or** m= 3.39×10^{-27} kg > 3.34×10^{-27} kg so the energy is sufficient **Or** f= 4.53×10^{23}(Hz) < 4.6×10^{23}(Hz) so the energy is sufficient **Or** Compare of their calculated value with consistent conclusion	**(1)**	3.05×10^{-10} J > 3.01×10^{-10} J ∴ the energy is sufficient	**5**

17(b)	Converts MeV to J **(1)** Uses factor of 2 **(1)** Use of $E_k = \frac{1}{2}mv^2$ **Or** Use of $E_k = \frac{p^2}{2m}$ **and** $p = mv$ **(1)** Speed of proton $= 5.2 \times 10^7$ m s^{-1} **(1)**	<u>Example calculation</u> Excess energy = 28×10^6 eV $\times 1.60 \times 10^{-19}$ C $= 4.48 \times 10^{-12}$ J Excess energy of proton $= \frac{4.48 \times 10^{-12}\text{ J}}{2} = 2.24 \times 10^{-12}$ J $v = \sqrt{\frac{2 \times 2.24 \times 10^{-12}\text{ J}}{1.67 \times 10^{-27}\text{ kg}}}$ $= 5.18 \times 10^7$ m s^{-1}	**4**
	Total for question 17		**9**

Question Number	Answer		Additional Guidance	Mark
18(a)	Arrow labelled weight acting vertically downwards Arrow labelled normal reaction acting up and to the right, roughly drawn perpendicular to the inclined plane	**(1)** **(1)**	Allow *m*g or *W* instead of weight Allow *N* or *R* instead of reaction/normal force <u>Example drawing</u>  	**2**
18(b)(i)	Use of $F = \frac{mv^2}{R}$ Centripetal force $= 1.7 \times 10^5$ N	**(1)** **(1)**	<u>Example calculation</u> $F = \frac{2.6 \times 10^4 \text{ kg} \times (19 \text{ m s}^{-1})^2}{55 \text{ m}} = 1.71 \times 10^5 \text{ N}$	**2**

18(b)(ii)	Use of $W = mg$	**(1)**	Allow use of $\tan\theta = v^2/rg$ with a correct answer scores 4 marks. [using this equation but with an incorrect answer scores 2 marks]	**4**
	Resolves vertically	**(1)**		
	Use of $F = \frac{mv^2}{r}$	**(1)**		
	$v = 15\ \text{m s}^{-1}$	**(1)**		
			Example calculation Weight of lorry $= 2.6 \times 10^4\ \text{kg} \times 9.81\ \text{m s}^{-2} = 2.55 \times 10^5\ \text{N}$ Normal reaction on lorry $= \frac{2.55\times10^5\ \text{N}}{\cos 22°} = 2.75 \times 10^5\ \text{N}$ $F_{horizontal} = 2.75 \times 10^5\ \text{N} \times \sin 22° = 1.03 \times 10^5\ \text{N}$ $v = \sqrt{\frac{1.03 \times 10^5\ \text{N} \times 55\ \text{m}}{2.6 \times 10^4\ \text{kg}}} = 14.8\ \text{m s}^{-1}$	
	Total for question 18			**8**

Question Number	Answer		Additional Guidance	Mark
19(a)	At least 3 parallel equally spaced horizontal lines touching both plates Arrow towards negative plate	**(1)** **(1)**	Ignore edge effect (curved lines curved at the plate ends). <u>Example of a diagram</u>  	**2**
19(b)(i)	Use of $E = \frac{V}{d}$ $E = 4.2 \times 10^4$ (V m^{-1})	**(1)** **(1)**	<u>Example calculation</u> $E = \frac{220\text{ V} - (-30\text{ V})}{6.0 \times 10^{-3}\text{ m}}$ $= 4.17 \times 10^4\text{ V m}^{-1}$	**2**
19(b)(ii)	Use of $E = \frac{F}{Q}$ (ecf (b) (i)) Use of $F = ma$ Use of $s = ut + \frac{1}{2}at^2$ with $a = 0$ Use of $s = ut + \frac{1}{2}at^2$ with $u = 0$ $s = 1.7 \times 10^{-3}$ m [Show that value gives 1.6×10^{-3} m]	**(1)** **(1)** **(1)** **(1)** **(1)**	<u>Example calculation</u> $F = 4.17 \times 10^4\text{ V m}^{-1} \times 5.0 \times 10^{-12}\text{ C}$ $= 2.08 \times 10^{-7}\text{ N}$ horizontal acceleration, $a = \frac{2.08 \times 10^{-7}\text{ N}}{2.9 \times 10^{-11}\text{ kg}} = 7.18 \times 10^3\text{ m s}^{-2}$ time to pass through plates, $t = \frac{3.0 \times 10^{-2}\text{ m}}{44\text{ m s}^{-1}} = 6.82 \times 10^{-4}\text{ s}$ horizontal deflection, $s = \frac{1}{2} \times 7.18 \times 10^3\text{ m s}^{-2} \times (6.82 \times 10^{-4}\text{ s})^2$ $s = 1.67 \times 10^{-3}$ m	**5**

19(b)(iii)	**EITHER** No electric force **Or** No longer in the electric field **(1)** No resultant/horizontal force acts **(1)** **Or** No (horizontal) acceleration **Or** Constant (horizontal) velocity (So) oil droplet moves in a straight line (tangentially to its motion at point B) **(1)** **OR** No electric force **Or** No longer in the electric field **(1)** Only weight acts **Or** No horizontal force acts **Or** No horizontal acceleration **Or** Constant horizontal velocity **(1)** (So) the oil droplet moves in a different curved path **Or** (So) straight line in horizontal direction (and curved path in vertical direction.) **(1)**	Alternative 1 assumes negligible gravitational force Alternative 2 assumes there is a gravitational force	**3**
	Total for question 19		**12**

Question Number	Answer		Additional Guidance	Mark
20(a)	(as the coil rotates) there is a changing flux (linkage) in the coil	**(1)**	Accept the coil/conductor cuts lines of magnetic flux	**2**
	this induces an e.m.f. (so there is a current)	**(1)**		
20(b)(i)	Time period read from graph	**(1)**		**3**
	Use of $\omega = \frac{2\pi}{T}$	**(1)**		
	$\omega = 540$ rad s^{-1} [allow answers in range 528 rad s^{-1} to 542 rad s^{-1}]	**(1)**	Allow s^{-1} Example calculation $T \approx 11.6 \times 10^{-3}$ s from graph $\omega = \frac{2\pi \text{ rad}}{11.7 \times 10^{-3} \text{ s}}$ $= 537$ rad s^{-1}	

20(b)(ii)	Tangent drawn at position where magnetic flux density is zero **(1)** Gradient of tangent calculated **(1)** Use of $\phi = BA$ **(1)** Use of $\varepsilon = (-)\frac{d(N\phi)}{dt}$ **(1)** Use of $R = \frac{V}{I}$ **(1)** $I = 3.5 \times 10^{-2}$ A [accept range 3.1×10^{-2} A to 3.9×10^{-2} A] **(1)**	<u>Example calculation</u> gradient = $\frac{(40-(-40))\times 10^{-3}\ \text{T}}{4.1\times 10^{-3}\ \text{s}} = 19.5\ \text{T s}^{-1}$ $\varepsilon = 250 \times 19.5\ \text{T s}^{-1} \times 2.56 \times 10^{-4}\ \text{m}^2$ $\varepsilon = 1.25\ \text{V}$ $I = \frac{1.25\ \text{V}}{35\ \Omega} = 3.5 \times 10^{-2}\ \text{A}$	**6**
20(c)	(Doubling the frequency of rotation) doubles the e.m.f. **Or** (Doubling the frequency of rotation) doubles the current **(1)** Reference to relevant electrical power equation **(1)** Power quadruples so suggestion is incorrect **(1)**		**3**
	Total for question 20		**14**