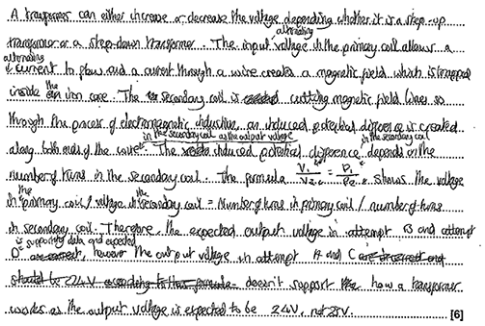
Mark scheme – Uses of Mangetism

Question			Answer/Indicative content	Marks	Guidance
1			A	1 (AO2.1)	
			Total	**1**	
2			C	1 (AO1.1)	
			Total	**1**	
3			B	1 (AO2.1)	
			Total	**1**	
4	a		Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Detailed explanation about how a transformer works. **AND** A quantitative link between coil and potential difference ratios to inform judgement that the data supports the expected output voltages. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Simple explanation of how a transformer works. **AND** A quantitative link between coil and potential difference ratios to inform judgement that the data supports the expected output voltages. **OR** Detailed explanation about how a transformer works. **AND** A qualitative link between coil and potential difference ratios to inform judgement that the data supports the expected output voltages.	6 (AO1.1x3) (AO3.1ax2) (AO3.2ax1)	**AO1.1 Demonstrates knowledge and understanding of scientific ideas to give an explanation of how a transformer works** For example: • Alternating current / ac / voltage / potential difference • (induces) (alternating) pd / current in secondary • Linking different numbers of coils to changing potential differences (or currents) • More secondary coils = bigger output potential difference • Alternating current in primary coil induces alternating magnetic field in the iron core • Alternating magnetic field in the iron core induces alternating potential difference in the secondary coil • An alternating current flows if the output is connected to a circuit • Ratio of potential differences depends on ratio of coils • Step up transformers increase potential difference and have more secondary coils ORA **AO3.1a Analyse information and ideas to interpret – quantitative** • Correct equation selected from data sheet • Data from table processed

			There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence. **Level 1 (1–2 marks)** Simple explanation of how a transformer works. **OR** A quantitative link between coil and potential difference ratios to inform judgement that the data supports the expected output voltages. **OR** A qualitative link between coil and potential difference ratios to inform judgement that the data supports the expected output voltages. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*		• For A and C expect secondary pd of 24 V • For B and D expect secondary pd of 6 V **AO3.1a Analyse information and ideas to interpret - qualitative** For example: • Double the number of secondary coils (compared to primary) and the output potential difference is doubled (compared to input) • Halve the number of secondary coils (compared to primary) and the output potential difference is halved (compared to input) • In transformer A the number of coils increases by 100% and the voltage increases by almost 100%/AW • In transformer B the number of coils decreases by 50% and the voltage decreases by 50%/AW • In transformer C the number of coils increases by 100% and the voltage increases by almost 100%/AW • In transformer D the number of coils decreases by 50% and the voltage decreases by 50%/AW **AO3.2a Analyses information and ideas to make judgements** • Data supports the expected output voltages • Energy losses in A and C • B and D are efficient **ALLOW** voltage for potential difference and vice versa **Examiner's Comments** This question gave candidates the opportunity to apply their knowledge and understanding of the operational of a transformer and to demonstrate that they are able to use the equation linking number of turns and potential difference given on the data sheet. The question is open ended so that candidates have the opportunity of demonstrating their knowledge as well as having the opportunity to structure their answers logically. The question required candidates to explain the operation of the transformer. Most

					candidates were able to select an appropriate equation from the data sheet and discuss the meaning of step-up and step-down transformers in terms of the turns ration and the p.d. ratio. Few candidates mentioned that transformers worked on a.c. or clearly explained the alternating magnetic field in the iron core of the transformer inducing an alternating p.d. across the secondary coil. For the highest marks, it was expected that clear calculations for each of the four transformers would be shown with a comment as to whether they supported the theoretical predictions. Many candidates did not show any working. There was also the opportunity to discuss energy losses in transformers particularly about transformer A and transformer C. **Exemplar 4**  A transformer can either increase or decrease the voltage depending whether it is a step-up transformer or a step-down transformer. The input voltage in the primary coil allows a alternating current to flow and a current through a wire creates a magnetic field which is trapped inside the an iron core. The the secondary coil is cutting magnetic field lines so through the process of electromagnetic induction, an induced potential difference is created along both ends of the coil. The induced potential difference in the secondary coil after output voltage depends on the number of turns in the secondary coil. The formula $\frac{V_p}{V_s} = \frac{n_p}{n_s}$ shows the voltage in primary coil / voltage in secondary coil = number of turns in primary coil / number of turns in secondary coil. Therefore, the expected output voltage in attempt A is and attempt C are correct, however the output voltage in attempt B and C are incorrect and should be 24V according to the formula. doesn't support the how a transformer works as the output voltage is expected to be 24V, not 2V. [6] This candidate has written a plan of how they intend to answer the question. The initial part of the plan explains how the transformer works. The candidate includes the alternating current, the alternating magnetic field in the iron core and the alternating p.d. induced across the secondary coil. The candidate then discusses step-up and step-down transformers. Before using the data, an equation is given with each of the symbols defined. Working is then shown for the four transformers with a reason why the step-up transformers do not agree with the predicted data. This candidate's response demonstrates a detailed explanation of how the transformer works and there is a quantitative line between the coils and potential difference

					ratios in relation to the expected output voltages. This is a Level 3 response. The response has a well-developed line of reasoning which is clear and logically structured and the information is relevant so this candidate is given six marks.  **AfL** Candidates should practice explaining physics concepts.
	b	i	**Incorrect word** (A) **resistance** (is induced across the ends of the wire) ✓ **Corrected sentence** (A) potential difference/voltage (is induced across the ends of the wire) ✓ **OR** **Incorrect word** (A microphone is similar to a) **motor** ✓ **Corrected sentence** (A microphone is similar to a) generator ✓	2 (AO2.1 x2)	**ALLOW** current is induced **ALLOW** dynamo **Examiner's Comments** A large number of candidates correctly identified that "resistance" was incorrect. Many realised that a potential difference is induced across the ends of the wire. The Examiners on this occasion also allowed a current is induced across the end of the wire. Other candidates identified "motor" as incorrect and substituted "generator" in the sentence A significant number of candidates stated that pressure was incorrect and re-wrote the sentence with longitudinal. A few candidates replaced "similar" with "not similar" which did not gain credit.
		ii	Loudspeaker/speaker/headphones ✓	1 (AO1.1)	**IGNORE** phone **Examiner's Comments** Most candidates stated speaker(s). It is

					important that candidates stated a relevant device as opposed to an appliance such as a phone.
			Total	**9**	
5			C ✓	1 (AO2.1)	**Examiner's Comments** About two thirds of candidates gave the correct answer C.
			Total	**1**	
6			A ✓	1 (AO2.1)	**Examiner's Comments** About 40% of the candidature gave the right answer A. The common incorrect response was usually 'D'.
			Total	**1**	
7			D ✓	1 (AO2.2)	**Examiner's Comments** This calculation was answered successfully by about three quarters of the candidates stating D.
			Total	**1**	
8	a	i	Fleming's left hand rule (1)	1	**ALLOW** left hand rule / motor rule
		ii	Reference to B, I, L are the largest in the table (1) Some calculation to show the use of F = BIL e.g. one mark point for four correct calculations: A: 0.125 N B: 0.225 N C: 0.225 N D: 1.250 N (1)	2	If no calculations are made pupils can only receive 1 mark
	b	i	Wind two coils of wire around an iron core / **AW** (1) Secondary coil has **twice** / **double** the number of primary turns / **ORA** (2) Connect primary coil to an a.c. supply (1)	4	**ALLOW** secondary coil has more turns than the primary coil / **ORA** (1)
		ii	High voltages can be produced / **AW** (1) Any 1 from: Insulate the secondary coil (1) Use very low voltages on the primary coil (1) Keep primary coil voltages low / **AW** (1)	2	**ALLOW** below 6 V
	c		Microphones convert pressure variations in sound waves (1) into variations in current / voltage in electrical circuits / **AW** (1)	2	

			Total	**11**	
9			A	1	
			Total	**1**	
10			C	1	
			Total	**1**	
11	a		Fewer coils in the secondary coil (1) Means it induces less potential difference in secondary coil (1) More current induced as power in constant (1)	3	
	b		$\frac{230}{27600} = \frac{12}{X}$ (1) **OR** $\frac{230 \times 12}{27600}$ / **AW** (1) 1 440 (turns) (1)	2	
	c	i	Simple use of P = V × I / idea of ratios using transformer equations (1) Current reduced by 16 times (1)	2	**ALLOW** current reduced (1)
		ii	Very large decrease in power loss (1) Power loss is related to the square of the current / **AW** (1)	2	
			Total	**9**	