



GCSE MARKING SCHEME

SUMMER 2017

**GCSE (NEW)
SCIENCE (DOUBLE AWARD)
PHYSICS 1 - UNIT 3**

**3430U30/1
3430UC0/1**

INTRODUCTION

This marking scheme was used by WJEC for the 2017 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (except for the extended response question).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statement.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1 FT	(a)	(i)		1.6 [cm]		1		1		
		(ii)		0.5 [cm] ignore minus sign		1		1		
	(b)	(i)		5 Hz Accept any means of identifying the correct answer		1		1	1	
		(ii)		Selection of $v = f\lambda$ or by implication (1) Substitution: $v = 5 \times 1.6$ (1) ecf on f and λ $v = 8$ [cm/s] (1) Alternative: Selection of speed = $\frac{\text{distance}}{\text{time}}$ or by implication of any $\frac{\text{distance}}{2}$ (1) Substitution: $v = \frac{10 \times 1.6}{2}$ ecf (1) $v = 8$ [cm/s] (1) Answer of $v = 8$ [cm/s] not necessarily on the answer line award 3 marks	1 1	1		3	2	
	(c)			Wavefronts at 90° by eye at least 3 but all drawn with a ruler (1) Constant wavelength same as the incident wavelength for all gaps by eye (1) N.B. Wavefronts must be drawn on reflected ray to access any marks		2		2		
				Question 1 total	2	6	0	8	3	0

Question		Marking details		Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
2 FT	(a)		Microwaves / Infra-red / X-rays Accept IR, don't accept micro or X 3 correct = 2 marks, 1 or 2 correct = 1 mark	2			2		
	(b)		[In a transverse wave] the vibrations / oscillations (1) are at <u>90° / right angles / perpendicular to</u> [the direction of] energy [transfer] / <u>the wave</u> (1) don't accept to and fro, back and fore, side to side unless 90° clearly explained	2			2		
	(c)		2 nd and 3 rd boxes ticked (1 mark for each) i.e. All em waves travel at the same speed in a vacuum (1) All em waves are a form of radiation (1) Lose 1 mark for each extra tick		2		2		
	(d)		Gamma rays have a high[er] frequency or energy or short[er] wavelength (1) So are [more] ionising (1) N.B. I disagree must be included to be awarded 2 marks Alternative: Radio waves or they have a low[er] frequency or energy or long[er] wavelength (1) So don't ionise (1) N.B. I disagree must be included to be awarded 2 marks Don't accept reference to power			2	2		
			Question 2 total	4	2	2	8	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3 FT	(a)	(i)		Ammeter in series with correct symbol (1) Voltmeter in parallel with lamp with correct symbol (1)	2			2		2
		(ii)		Use the ammeter to measure current (or amps) (1) Use the voltmeter to measure voltage (or volts) (1) Adjust (or change) variable resistor and take values (1)	3			3		3
	(b)			All points correctly plotted $\pm < 1$ small square division (2) ignore (0,0) plot 5 points correctly plotted $\pm < 1$ small square division (1) ignore (0,0) plot 1-4 points correctly plotted $\pm < 1$ small square division (0) ignore (0,0) plot Smooth curve of best fit from (0 – 12 V) $\pm < 1$ small square division (1) Don't accept thick, double, wispy, wobbly or disjointed curves		3		3	3	3
	(c)	(i)		Reading taken from candidate's graph ± 0.02 shown anywhere - expect 0.62 [A] (1) Correct calculation expect $R = 4.84$ [Ω] (1) accept 4.8 or 5 [Ω] If no workings shown and no line on the graph and answer given between 4.69 and 5 [Ω] award 2 marks		2		2	2	2
		(ii)		[As voltage increases] current increases (1) by decreasing intervals / at a decreasing rate (1) Alternative: Gradient decreasing (1) and it is $\frac{1}{\text{resistance}}$ (1) Alternative: At least one further calculation of resistance using values from the graph or table (1) with comparison with answer to (c)(i) (1) Alternative: When the voltage doubles (1) the increase in current is <u>less than</u> double (1)			2	2		2
				Question 3 total	5	5	2	12	5	12

Question			Marking details			Marks Available					
						AO1	AO2	AO3	Total	Maths	Prac
4 FT	(a)	(i)	<p>3 correct = 2 marks 1 or 2 correct = 1 mark More than one line drawn from a method don't credit</p>			2			2		
		(ii)	<p>Coal efficiency = $\frac{8}{20} \times 100$ (1) = 40% and disagree or it is the same (1) For an answer of 0.4 so agree or it is less efficient award 1 mark only Efficiency >100% with any comment gets zero Alternative: $\frac{40}{100} \times 20$ [MJ] (1) = 8 [MJ] and disagree or it is the same (1) Alternative: Wasted from coal: $\frac{12}{20} \times 100 = 60\%$ (1) Wasted energy nuclear power station = 60% and disagree or it is the same (1)</p>					2	2	2	

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)	It is reliable [supply] / maintains supply in case of breakdown / responds to changing demand / has back-ups in case of demand or breakdown / it can import electricity from abroad if needed / works 24 hours a day Don't accept reference to efficiency	1			1		
		(ii)	A	1			1		
		(iii)	To increase voltage / step-up voltage / needs to be a high voltage / reduce current / needs to be a small current (1) Accept increase the volts or kV / decrease the amps Don't accept to increase the voltage and the current To reduce energy or heat loss / increase efficiency / reduce power losses [in lines] (1) Don't accept reference to increasing power or electricity or no energy loss	2			2		
			Question 4 total	6	0	2	8	2	0

Question		Marking details	Marks Available					
			AO1	AO2	AO3	Total	Maths	Prac
5 FT	(a)	<p>Indicative content: Energy will transfer from the warm house to the cold surroundings. The uPVC is a better insulator than the aluminium. This will reduce the heat loss via conduction. Also the white surface is a poor emitter of infra-red, so reduces losses by radiation. The reflective lining is a good reflector and poor emitter of heat radiation / infra-red and will reduce heat loss via radiation. The vacuum between the glass panes will prevent both conduction and convection losses as there are no particles and the reduced temperature on the outside of the glass reduces convection losses outside the house.</p> <p>5 – 6 marks Detailed description of how heat transfer is reduced by conduction, convection and radiation. <i>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.</i></p> <p>3 – 4 marks Detailed description of how heat transfer is reduced by 2 out of conduction, convection and radiation. Alternatively, a brief correct description of all 3 methods. <i>There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure.</i></p> <p>1-2 marks Detailed description of how heat transfer is reduced by 1 out of conduction, convection and radiation. Alternatively, a brief correct description of up to 2 of the methods. <i>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure.</i></p>	3	3		6		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				Note AO1 marks are for descriptions of heat transfer processes whereas the AO2 marks are for application of knowledge of how the features shown reduce transfer by those methods. 0 marks <i>No attempt made or no response worthy of credit.</i>						
	(b)	(i)		[Payback = $\frac{4\,000}{80}$] = 50 [years]		1		1	1	
		(ii)		<u>Cost of electricity / gas changes / cost of a unit changes</u> (1) the <u>number of</u> units used changes / <u>amount of</u> electricity or gas used changes (1) Award 1 mark only for this part of the question for answer of the heating <u>bill</u> may change Award 1 mark only for annual savings will change Don't accept costs will change / more or less heating will be used		2		2		
				Question 5 total	3	6	0	9	1	0

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
6 FT 1 HT	(a)	(i)	Unit conversion for power (i.e. 0.5) and time (i.e. 1.5) (1) Units used = $0.5 \times 1.5 = 0.75$ (1) N.B. 45 000 gets 1 mark Substitution into: cost = $0.75 \text{ ecf} \times 16$ or 0.16 (1) Cost = 12 [p] or £0.12 (1) Don't accept £0.12 p N.B. If multiplied by 0.16 4 th mark can only be awarded if answer given in p or unit changed on answer line Final answers of 720 000 or 12 000 or 720 award 3 marks To allow ecf for 3 rd and 4 th marks, an attempt to calculate the number of units must have been made If selected incorrect line from table with e.g. correct conversion award up to 3 marks	1	1 1 1		4	4	

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
		(ii)	<p>Washing at 30° uses <u>33%</u> less energy or time or units than at 40° / washing at 30° uses <u>67%</u> of the energy or time or units compared with 40° (1) and <u>50%</u> less energy or time or units than at 50° (1) so the claim is not correct (1) N.B. If only one of the higher temperatures is considered then award a maximum of 2 marks if the conclusion is consistent with their answer Alternative: At 40° a 40% reduction in units used = <u>0.45</u> units [compared to 0.5 units at 30°](1) At 50° a 40% reduction in units used = <u>0.6</u> units [compared to 0.5 units at 30°] (1) So the claim is not correct (1) N.B. If only one of the higher temperatures is considered then award a maximum of 2 marks if the conclusion is consistent with their answer Alternative: At 40° a 40% reduction in time = <u>54</u> minutes [compared to 60 minutes at 30°](1) At 50° a 40% reduction in time = <u>72</u> minutes [compared to 60 minutes at 30°] (1) So the claim is not correct (1) N.B. If only one of the higher temperatures is considered then award a maximum of 2 marks if the conclusion is consistent with their answer</p>			3	3	3	

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
	(iii)		<p>Select one pair of statements from below:</p> <ul style="list-style-type: none"> - Reducing CO₂ [emissions] or greenhouse gases (1) so less [contribution to] global warming or greenhouse effect (1) - Reducing SO₂ [emissions] (1) so less [contribution to] acid rain (1) - Less use of fossil fuels (1) so less mining required / less transport [of fuel] / less CO₂ or SO₂ [emissions] / less [contribution to] global warming or greenhouse effect / so less [contribution to] acid rain (1) - Less output from power stations / less power stations needed (1) so less fossil fuels used / less CO₂ or SO₂ [emissions] / less mining required / less transport / less radioactive waste / less [contribution to] global warming or greenhouse effect / so less [contribution to] acid rain (1) <p>Don't accept less pollution / less gases / harm the environment / less energy / less electricity / no CO₂ or SO₂ [emissions]</p>		2		2		
(b)	(i)		Live or L	1			1		
	(ii)		<p>If a fault develops to make a <u>metal casing live</u> / <u>live</u> wire touches the <u>metal case</u> (1) it takes the <u>current</u> safely to ground / it prevents electric shock or protects the user / causes the fuse to blow or trips the mcb or rccb (1) Don't accept takes the electricity to ground or reference to electrified or take away excess current</p>	2			2		

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
	(c)		Power = 230×3 (1) Power = 690 [W] (1) So the fuse is not suitable since this is lower than the 2 400 W required (1) Alternative: Voltage = $\frac{2\,400}{3}$ (1) Voltage = 800 [V] (1) So the fuse is not suitable because the voltage is only 230 V (1) Alternative: Current = $\frac{2\,400}{230}$ (1) Current = 10[.4 A] (1) So fuse is not suitable as it is rated less than 10.4 A (1) N.B. Any of the answers shown above without workings award 2 marks and with correct conclusion award 3 marks N.B.2 If two different calculations of power / voltage / current are seen and not qualified award 1 mark only for correct conclusion N.B.3 Correct conclusion resulting from incorrect calculations award 1 mark			3	3	3	
			Question 6 FT Question 1 HT total	4	5	6	15	10	0

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
2 HT	(a)	(i)	$\frac{3.2}{2}$ or $\left(\frac{3.2}{8}\right) \times 4$ or $2.8 - 1.2$ (1) $X = 1.6$ [cm] (1)		2		2	2	
		(ii)	<p>Substitution into: $\text{speed} = \frac{\text{distance}}{\text{time}} = \frac{40}{5}$ (1) $= 8$ [cm/s] (1)</p> <p>N.B. Substitution into wave equation i.e. $f = \frac{v}{\lambda} = \frac{40}{5} = 8$ don't award the first 2 marks Manipulation and substitution of $v = f\lambda$ i.e. $f = \frac{8(\text{ecf})}{1.6(\text{ecf from part(i)})}$ (1) $= 5$ [Hz] (1)</p> <p>If no workings shown answer of 8 on answer line award no marks. If intermediate calculation shown with 8 on the answer line award the first 2 marks.</p> <p>Alternative: $= \frac{40}{1.6(\text{ecf})}$ (1) = 25 waves (1) [in 5 seconds] Frequency = $\frac{25}{5(\text{ecf})}$ (1) = 5 [Hz] (1)</p>	1	1		4	4	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)			Angle of reflection correct by eye at least 3 wavefronts (1) N.B. point of reflection must coincide with the point of incidence by eye Parallel wavefronts and constant wavelength same as the incident wavelength for all gaps by eye (1) N.B. 2 marks can only be awarded if lines have been drawn with a ruler Don't award any marks for refraction		2		2		
				Question 2 total	1	7	0	8	6	0

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
3 HT	(a)		<p>Correct symbols for lamp and cell and variable resistor shown correctly in a series circuit (1)</p> <p>Accept variable power supply instead of cell and variable resistor</p> <p>If more than 1 cell shown they must be connected correctly in terms of polarity and no line passing through the cell</p> <p>Correct symbol for voltmeter and connected in parallel with their symbol for a lamp only (1)</p> <p>Correct symbol for ammeter and connected in series (1)</p>	3			3		3
	(b)	(i)	<p>Scale on x-axis of 1 V/cm and on y-axis of 0.1 A/cm (1)</p> <p>Accept scale on y-axis of 0.125 A/cm</p> <p>All points correctly plotted $\pm <1$ small square division – ignore (0,0) plot (1)</p> <p>Less than 5 points correctly plotted $\pm <1$ small square division – ignore (0,0) plot (0)</p> <p>Smooth curve between 0 – 12 V with $\pm <1$ small square division (1)</p>		3		3	3	3

Question			Marking details	Marks Available																	
				AO1	AO2	AO3	Total	Maths	Prac												
		(ii)	<p>Any one calculation of resistance e.g. $R = \frac{2}{0.4} = 5 \text{ } [\Omega] \text{ (1)}$</p> <p>Another calculation of resistance e.g. $R = \frac{12}{1.1} = 10.91 \text{ } [\Omega] \text{ (1)}$</p> <p><u>so disagree</u> – conclusion must be consistent with results and based on at least 2 calculated values of resistance (1)</p> <p>For information:</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Voltage (V)</th> <th>Resistance (Ω)</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>5[.00]</td> </tr> <tr> <td>4</td> <td>5.26</td> </tr> <tr> <td>6</td> <td>6.38</td> </tr> <tr> <td>10</td> <td>9.26</td> </tr> <tr> <td>12</td> <td>10.91</td> </tr> </tbody> </table> <p>Ignore incorrect rounding of resistance values</p> <p>Use of $R = \frac{P}{I^2}$ to obtain correct values award the marks</p>	Voltage (V)	Resistance (Ω)	2	5[.00]	4	5.26	6	6.38	10	9.26	12	10.91			3	3	3	3
Voltage (V)	Resistance (Ω)																				
2	5[.00]																				
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6	6.38																				
10	9.26																				
12	10.91																				
			Question 3 total	3	3	3	9	6	9												

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
4 HT	(a)	(i)	<p>Aluminium is a better or good conductor (1) The metal spacer conducts heat from the inner <u>pane</u> to the outer <u>pane</u> or from one <u>pane</u> to the <u>other</u> (1) <u>Increased vibrations</u> pass on energy from one particle to another (1) Also <u>free (or delocalised) electrons</u> transfer energy [from high T to low T] (1) Alternative: uPVC is <u>a worse or poor conductor</u> or a good insulator (1) The non-metal spacer conducts heat poorly from the inner <u>pane</u> to the outer <u>pane</u> or from one <u>pane</u> to the <u>other</u> (1) <u>Increased vibrations</u> pass on energy from one particle to another [less effectively] (1) <u>No free (or delocalised) electrons</u> to transfer energy [from high T to low T] (1)</p>	1					
				1	1	1	4		
		(ii)	<p>Heat from the house <u>conducts</u> through the <u>ceiling</u> into the attic or heat <u>conducts</u> through the <u>roof tiles</u> (1) <u>Air</u> is heated it becomes <u>less dense and rises</u> (1) Creating a convection [current] in the <u>roof space</u> / <u>outside air</u> becomes heated by the roof tiles causing a convection current (1)</p>						
	(b)		<p>Energy needed to maintain the temperature / heating is used to replace energy lost / energy in = energy out (1) If you lose less heat your heating doesn't need to be on for as long (1) So less fuel is burned / less use of fossil fuels / less mining required / less transport of fuels / fewer power stations / less CO₂ or SO₂ [emissions] / less [contribution to] global warming or greenhouse effect / so less [contribution to] acid rain (1) Don't accept reference to pollution</p>	3					
			Question 4 total	8	2	0	10	0	0

Question		Marking details		Marks Available																					
				AO1	AO2	AO3	Total	Maths	Prac																
5 HT	(a)		<table border="1"> <thead> <tr> <th>Wavelength (m)</th> <th>Frequency (Hz)</th> </tr> </thead> <tbody> <tr> <td>$> 1 \times 10^{-1}$</td> <td>$< 3 \times 10^9$</td> </tr> <tr> <td>$1 \times 10^{-3} - 1 \times 10^{-1}$</td> <td>$3 \times 10^9 - 3 \times 10^{11}$</td> </tr> <tr> <td>$7.5 \times 10^{-7} - 1 \times 10^{-3}$</td> <td>$3 \times 10^{11} - 4 \times 10^{14}$</td> </tr> <tr> <td>$4 \times 10^{-7} - 7.5 \times 10^{-7}$</td> <td>$4 \times 10^{14} - 7.5 \times 10^{14}$</td> </tr> <tr> <td>$1 \times 10^{-8} - 4 \times 10^{-7}$</td> <td>$7.5 \times 10^{14} - 3 \times 10^{16}$</td> </tr> <tr> <td>$1 \times 10^{-11} - 1 \times 10^{-8}$</td> <td>$3 \times 10^{16} - 3 \times 10^{19}$</td> </tr> <tr> <td>$< 1 \times 10^{-11}$</td> <td>$> 3 \times 10^{19}$</td> </tr> </tbody> </table> <p>(1) each correct to maximum of 3 marks</p>	Wavelength (m)	Frequency (Hz)	$> 1 \times 10^{-1}$	$< 3 \times 10^9$	$1 \times 10^{-3} - 1 \times 10^{-1}$	$3 \times 10^9 - 3 \times 10^{11}$	$7.5 \times 10^{-7} - 1 \times 10^{-3}$	$3 \times 10^{11} - 4 \times 10^{14}$	$4 \times 10^{-7} - 7.5 \times 10^{-7}$	$4 \times 10^{14} - 7.5 \times 10^{14}$	$1 \times 10^{-8} - 4 \times 10^{-7}$	$7.5 \times 10^{14} - 3 \times 10^{16}$	$1 \times 10^{-11} - 1 \times 10^{-8}$	$3 \times 10^{16} - 3 \times 10^{19}$	$< 1 \times 10^{-11}$	$> 3 \times 10^{19}$		3		3	3	
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	(b)		<table border="1"> <thead> <tr> <th>Region</th> <th>Energy (J)</th> </tr> </thead> <tbody> <tr> <td>Radio</td> <td>$< 2 \times 10^{-24}$</td> </tr> <tr> <td>Microwave</td> <td>2×10^{-24} to 2×10^{-22}</td> </tr> <tr> <td>Visible</td> <td>3×10^{-19} to 5×10^{-19}</td> </tr> <tr> <td>X-ray</td> <td>2×10^{-17} to 2×10^{-14}</td> </tr> <tr> <td>Gamma ray</td> <td>$> 2 \times 10^{-14}$</td> </tr> </tbody> </table> <p>Mark is for correct values for radio and gamma rays</p>	Region	Energy (J)	Radio	$< 2 \times 10^{-24}$	Microwave	2×10^{-24} to 2×10^{-22}	Visible	3×10^{-19} to 5×10^{-19}	X-ray	2×10^{-17} to 2×10^{-14}	Gamma ray	$> 2 \times 10^{-14}$			1	1	1					
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			Question 5 total	0	3	1	4	4	0																

Question		Marking details	Marks Available					
			AO1	AO2	AO3	Total	Maths	Prac
6 HT	(a)	<p>Indicative content: The National Grid consists of a network of power stations, transformers/sub-stations and power lines all joined together supplying electricity to consumers. Supply and demand is monitored. At times of power station failure electricity can be transferred from one part of the Grid to another. At times of peak demand, reserve generation can increase supply or electricity can be imported from abroad. Transformers are used to step-up the voltage before transmission along power lines. This reduces current and power loss as heat in the cables.</p> <p>5-6 marks Full description of the 3 aspects i.e. the National Grid and how it achieves reliability and greater efficiency. <i>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</i></p> <p>3 -4 marks Full description of 2 out of the 3 aspects i.e. the National Grid and how it achieves reliability and greater efficiency or brief description of all 3 aspects. <i>There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</i></p> <p>1-2 marks Full description of 1 out of the 3 aspects i.e. the National Grid or how it achieves reliability or greater efficiency or limited description of up to 2 aspects. <i>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate used limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</i></p> <p>0 marks <i>No attempt made or no response worthy of credit.</i></p>	6			6		

Question		Marking details	Marks Available					
			AO1	AO2	AO3	Total	Maths	Prac
(b)	(i)	<p>63 - 1.42 = 61.58 or 63 000 - 1 420 = 61 580 (1)</p> <p>Substitution: $\frac{61.58 \text{ ecf}}{63} \times 100$ or $\frac{61\,580 \text{ ecf}}{63\,000} \times 100$ (1)</p> <p>% efficiency = 97.7[5] (1)</p> <p>Alternative (example of a wasted energy route):</p> <p>$\frac{1.42}{63} = 0.0225$ (1)</p> <p>0.0225 ecf $\times 100 = 2.25\%$ (1)</p> <p>so % efficiency = 100 - 2.25 = 97.7[5] (1)</p> <p>Alternative (max demand off the winter curve):</p> <p>55 000 - 1 420 = 53 580 (1)</p> <p>$\frac{53\,580 \text{ ecf}}{55\,000} \times 100$ (1)</p> <p>So % efficiency = 97.4 (1)</p> <p>Alternative (max demand off the summer curve):</p> <p>(43 000 \pm 1 000) - 1 420 = 41 580 (1)</p> <p>$\frac{41\,580 \text{ ecf}}{43\,000} \times 100$ (1)</p> <p>So % efficiency = 96.7 (1)</p> <p>Alternative (calculating input energy)</p> <p>Useful energy = 63 000 [MW]</p> <p>Input energy = 63 000 + 1 420 = 64 420 [MW] (1)</p> <p>$\frac{63\,000}{64\,420 \text{ ecf}} \times 100$ (1)</p> <p>So % efficiency = 97.8 (1)</p> <p>N.B.1 If in any of the above methods 1 420 has not been subtracted then award no marks</p>	1	1		3	3	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				<p>N.B.2 $63\,000 - 1\,420 = 61\,580$ (1) $\frac{61\,580}{79\,900}$ no further credit to be given and for $\frac{63\,000}{79\,900}$ no credit to be given</p> <p>N.B.3 Attempt at subtracting 1 420 MW from 63 GW or 79.9 GW where the conversion is incorrect award 1 mark only provided the outcome is positive</p> <p>N.B.4 Ignore rounding errors on the % value</p> <p>Accept - If output capacity used $79\,900 - 1\,420 = 78\,480$ (1) $\frac{78\,480}{79\,900} \times 100 = 98.2\%$ (1) so award a maximum of 2 marks</p>						
		(ii)		<p>Substitution: $\frac{360\text{ TWh}}{8\,766\text{ h}}$ (1)</p> <p>Conversion i.e. $\frac{360\,000}{8\,766}$ (1) $= 41[.1]$ [GW] (1)</p>	1					
		(iii)		<p>Ticks in boxes 1 and 3 (for 1 mark each) i.e. At maximum demand there is spare capacity of 16.9 GW (1) The difference in minimum demand between summer and winter is approximately 10 000 MW (1) Lose 1 mark for each extra tick</p>			2	2		
				Question 6 total	8	4	2	14	6	0

Summary of marks allocated

FOUNDATION TIER

Question	Marks Available					
	AO1	AO2	AO3	Total	Maths	Prac
1	2	6	0	8	3	0
2	4	2	2	8	0	0
3	5	5	2	12	5	12
4	6	0	2	8	2	0
5	3	6	0	9	1	0
6	4	5	6	15	10	0
Total	24	24	12	60	21	12

HIGHER TIER

Question	Marks Available					
	AO1	AO2	AO3	Total	Maths	Prac
1	4	5	6	15	10	0
2	1	7	0	8	6	0
3	3	3	3	9	6	9
4	8	2	0	10	0	0
5	0	3	1	4	4	0
6	8	4	2	14	6	0
Total	24	24	12	60	32	9