

**WJEC Physics GCSE**  
**Topic 1.2: Generating electricity**  
**Mark Schemes for Questions by topic**

1.

Question			Marking details	Marks	
1.	(a)	(i)	Any 2 x (1) from: <ul style="list-style-type: none"><li>• produces a lot of energy <u>for a small mass</u> of fuel or is a concentrated energy source (accept amount for mass)</li><li>• it is reliable or it can generate all of the time</li><li>• produces no pollutant <u>gases</u> / doesn't contribute to global warming (accept named gas or greenhouse gases) (do not accept no pollution)</li><li>• produces only a small volume of (solid) waste (accept amount for volume)</li><li>• less dependence on fossil fuels / conserves fossil fuels</li><li>• provides energy security</li></ul>	2	
		(ii)	Any (1) from: <ul style="list-style-type: none"><li>• [radioactive waste] may <u>leak</u> [into the ground / environment] (don't accept radiation leaking)</li><li>• geological changes (accept earthquakes etc.)</li><li>• radioactive material may get into the food chain</li><li>• [over time if location not correctly recorded] it may be excavated</li></ul> Do not accept answers in terms of property prices or damages the environment or cost or terrorism.	1	
	(b)	Does not add to / cause global warming or greenhouse effect (1)  because carbon dioxide released during burning = carbon dioxide used during growing / overall add no carbon dioxide to the environment (1) (Accept they are carbon neutral <u>or</u> they <u>just</u> release CO <sub>2</sub> <u>back</u> into the air) <b>Either mark can be awarded on its own but only award 2 marks if they are linked.</b>	2		
	(c)	(i)	Grass (1) <u>lowest</u> crop yield (accept <u>only</u> 5 tonnes .... (1) <u>lowest</u> energy content (accept <u>only</u> 16 ..... ) (1)	3	
		(ii)	(I)	$\frac{50000}{10} = 5000[\text{km}^2]$ Mark for the answer	1
			(II)	$50\,000 \times 20 = 1\,000\,000$ [units] Mark for the answer	1
		(iii)	Less land / space used (1) so less destruction of habitats / so more land available for food production (1) (Don't credit references to CO <sub>2</sub> or SO <sub>2</sub> .) <b>Either mark can be awarded on its own but only award 2 marks if they are linked.</b>	2	
		Question total			

2.

Question			Marking details	Mark
4.	(a)		<p>Indicative content:</p> <p>Cost of generating electricity using nuclear energy is cheaper than wind. To generate the same power output requires 1 800 turbines for every nuclear power station which would cost £5 400 million compared with £4 000 million. Also during the lifetime of a nuclear power station, wind turbines would need to be replaced 3 times. There is no waste produced by wind but with nuclear power there is radioactive waste to dispose of which adds cost and has an impact on the environment due to radiation hazards. Onshore wind power would produce less of a greenhouse effect than nuclear but offshore wind would produce more.</p>	6

Question			Marking details	Mark
			<p><b>5 – 6 marks</b> The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p><b>3 – 4 marks</b> The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p><b>1 – 2 marks</b> The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p><b>0 marks</b> The candidate does not make any attempt or give a relevant answer worthy of credit.</p>	
	(b)	(i)	plots (1) x2 smooth curve or best fit straight line (1)	3
		(ii)	As rotor diameter increases so does the maximum power output (1) but the increase is non-uniform / at an increasing rate / non-linear / not proportional (1)	2
	(c)		<p>use of 3 MW (1), subs into equation (1),</p> <p>rearrange to give <math>\frac{3}{0.6}</math> ans = 5 [MW] (1)</p>	3
Question total				[14]

3.

Question			Marking details	Marks
6.	(a)		It provides <u>power (electricity)</u> to consumers / users (1) ( <b>accept</b> 2 named consumers e.g. schools, hospitals, factories, houses) and maintains a reliable supply / is capable of responding to fluctuating demand / caters for a power station breakdown (1) <b>Don't accept</b> reference to efficiency	2
	(b)	(i)	Energy = $P \times t = \frac{5400(1)}{60(1)} \times 0.95$ (1) = 85.5 [MWh] <b>Award 2 marks</b> for an answer of 5 130 [MWh] <b>Award 2 marks</b> for an answer of 90	3
		(ii)	<b>EITHER:</b> 85.5 MWh (ecf) = 85 500 kWh (1) Cost = 85 500 × [£]0.05 (1) = [£]4 275(1) $\frac{650000}{4275} = 152$ [weeks] (1) <b>OR:</b> 85.5 MWh (ecf) = 85 500 kWh (1) Cost = 85 500 × 5 [p] = 427 500 [p] (1) 65 000 000 (1) ÷ 427 500 = 152 [weeks] (1) <b>OR:</b> (650 000 ÷ 0.05) (1) = 13 000 000 [kWh] (1) 13 000 000 ÷ 85 500(1-conversion) = 152 [weeks] (1) <b>Accept</b> an answer of 153 [weeks] if correct workings shown	4

Question		Marking details	Marks
	(c)	<p><b>Indicative content:</b></p> <p>The number of wind turbines required to meet the demand is <math>\frac{40000}{0.95} = 42\,106</math>. This compares with 16 nuclear power stations. The area of land or sea required for this number of turbines would be extremely large. Is there sufficient area available? Wind turbines can only operate between certain wind speeds. They will not produce a consistent power supply. However, wind turbines do not use any fuel so will not produce any waste. Running wind turbines will not produce greenhouse gases so will not contribute to global warming or acid rain. Some people consider wind turbines to be a source of visual and noise pollution.</p> <p><b>5 – 6 marks</b> The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p><b>3 – 4 marks</b> The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p><b>1 – 2 marks</b> The candidate makes some relevant points, such as those in the indicative content, showing limited</p>	6
		<p>reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p><b>0 marks</b> The candidate does not make any attempt or give a relevant answer worthy of credit.</p>	
Question total			[15]



Question	Marking details	Marks
3.	<p>(i) Electricity is transmitted at high (increases the) voltages (1) to reduce the current (1). This reduces energy losses due to heat (1). <b>Either the 2<sup>nd</sup> mark must be linked to the 1<sup>st</sup> mark or the 3<sup>rd</sup> mark must be linked to the 2<sup>nd</sup> mark.</b> If reference to power increasing is made the maximum mark that can be awarded is 2. <b>Don't accept</b> any reference to stopping energy losses</p> <p>(ii) <math>3950 \times \left( \frac{92}{100} \right)</math> (1 - substitution) = 3 634 [MW] (1)</p> <p>(iii) <b>EITHER:</b> <math>230 \times 80 = 18\,400</math> [W] (1)</p> <p>Then pair of values with consistent units e.g. <math>\frac{3634}{0.0184}</math> or <math>\frac{3634000}{18.4}</math> or <math>\frac{3634000000}{18400}</math> (1) = 197 500 (1) (allow ecf from (ii) and on 18 400)</p> <p><b>OR:</b> current = <math>\frac{3634000000(1)}{230(1)}</math>, <math>\frac{15800000}{80} = 197\,500</math> (1) N.B. mark after 230 moves to after the 2<sup>nd</sup> division</p> <p><b>Award 2 marks</b> for an answer of 214 674</p>	<p>3</p> <p>2</p> <p>3</p>
<b>Question total</b>		<b>[8]</b>

Question Number		Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	(a)	i	2	1000 [J] in rotating turbine (1) 300 [J] heats the air (1) <b>ecf on 1<sup>st</sup> answer - 700</b>			Negative answer
			ii	1	700 [J]			
			iii	2	Subs: $\frac{700}{2000}$ (1) <b>no ecf from (ii)</b> Ans = 35 (1)	0.35 (1)		
			iv	1	65 <b>ecf</b> Accept 65 even if answer to (iii) is incorrect	0.65		
		(b)		2	[Burning gas adds to] - greenhouse emissions / global warming [effect] / release of CO <sub>2</sub> (1) Limited resource / non-renewable / finite source (1)		Reference to cost Not very efficient Gas is a fossil fuel Reference to pollution	Acid rain
		Total		8				

## 6.

Question Number									
FT	HT	Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept	
1		(a)		2	320 [MJ] (1) 150 [MJ] (1)				
		(b)	(i)	1	chemical [energy]				
			(ii)	1	electrical [energy]	electricity			
		(c)	(i)	1	coal	C			
			(ii)	2	Wasted as heat (thermal) energy (1) Since turbines, pipes etc become hot / water cools (1) <b>Alternative:</b> Wasted as sound energy (1) Because of the noise [released by the machines] (1) <b>The 2<sup>nd</sup> mark can only be awarded if it is linked to the 1<sup>st</sup> mark.</b>	Cooling towers/chimney/ Transformers / friction in moving parts Steam	Other types of named energies References to CO <sub>2</sub>	Friction only Smoke	
		(d)		2	$\text{efficiency} = \frac{\text{useful power transfer}}{\text{total power input}} \times 100$ $\text{efficiency} = \frac{170}{500} \times 100$ Selection of 170 anywhere (1) Efficiency = 34 (1)	Answer alone gains both marks $\frac{500}{170} = 34$ gets 1 mark only Answer only of 0.34 gets 1 mark		170 on the answer line	
		(e)		3	<b>Oil:</b> causes [increased] greenhouse effect / global warming / climate change (1) <b>Nuclear:</b> must be stored safely for a long time / problems linked to storage or leaks (1) <b>Coal:</b> causes acid rain (1)		Global warming when referring to problems with SO <sub>2</sub>	Leaves nuclear waste / ozone layer / harmful to humans or wildlife	