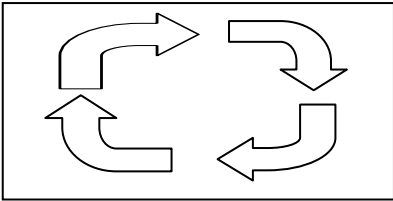


HIGHER TIER

Question		Marking details	Marks
1.	(a)	Can cause cancer / deform babies (1) because they ionise or damage or mutate or kill <u>cells</u> / ionising (1) The 2nd mark must be linked to the 1st mark.	2
	(b)	Abdomen [X –ray] (1) because it causes the <u>largest</u> received dose / <u>highest</u> dose or units / <u>most</u> days of radiation [given to the patient] (1) The 2nd mark must be linked to the 1st mark. Don't accept just a reference to 225	2
	(c) (i)	$\frac{140}{2}$ (1 - subs) = 70 (1)	2
	(ii)	210 days (1)(ecf) $3 \times$ answer to (i) $\times 43\,200 = 9\,072\,000$ [counts] (1) Award 1 mark for $[70 (\mathbf{ecf}) \times 43\,200] = 3\,024\,000$ Award 1 mark for $[3 \times 43\,200] = 129\,600$	2
Question total			[8]
2.	(a) (i)	Circulation of air from the radiator inside the room (1) arrows in clockwise direction (1) 	2
	(ii)	Air heated <u>all along floor</u> / air heated over <u>bigger area</u> (1) so rises at all points (everywhere) / more convection currents (1) The 2nd mark must be linked to the 1st mark. Don't accept heat rises or air in the room heats up faster	2
	(b) (i)	Plots (allow $\pm \frac{1}{2}$ small square division) (2) -1 for each error to a maximum of 2. No penalty for missing origin plot. Straight line (1) (ruler must be used) line must be extended back towards origin	3

Question	Marking details	Marks
	<p>(ii) Award 2 marks for: They're proportional OR As the area doubles the power doubles OR As the area increases the power increases at a constant rate OR Power = area × 150 Award 1 mark for: As the area increases so does the power OR Power \propto wire gird</p> <p>(iii) 1 800 [W]</p> <p>(c) Indicative content:</p> <p>Conduction and radiation will take place in all directions from the hot wire grid. The wire grid is at a higher temperature than the bottom surface of the concrete floor. This temperature difference causes energy to flow down through the floor. The foam insulation reduces heat transfer through the concrete by conduction. The silver foil reduces heat loss because it reflects radiant heat back up into the room.</p> <p>5 – 6 marks 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>3 – 4 marks 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>1 – 2 marks 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>0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.</p> <p style="text-align: right;">Question total</p>	<p>2</p> <p>1</p> <p>6</p> <p style="text-align: right;">[16]</p>

Question		Marking details	Marks
3.	(i)	Electricity is transmitted at high (increases the) voltages (1) to reduce the current (1). This reduces energy losses due to heat (1). Either the 2nd mark must be linked to the 1st mark or the 3rd mark must be linked to the 2nd mark. If reference to power increasing is made the maximum mark that can be awarded is 2. Don't accept any reference to stopping energy losses	3
	(ii)	$3950 \times \left(\frac{92}{100}\right)$ (1 - substitution) = 3 634 [MW] (1)	2
	(iii)	EITHER: $230 \times 80 = 18\,400$ [W] (1) Then pair of values with consistent units e.g $\frac{3634}{0.0184}$ or $\frac{3634000}{18.4}$ or $\frac{3634000000}{18400}$ (1) = 197 500 (1) (allow ecf from (ii) and on 18 400) OR: current = $\frac{3634000000(1)}{230(1)}, \frac{15800000}{80} = 197\,500$ (1) N.B. mark after 230 moves to after the 2 nd division Award 2 marks for an answer of 214 674 Question total	3 [8]
4.	(i)	<u>2.22 × 10⁶ years</u> Don't accept light years	1
	(ii)	<u>Atoms</u> of gas (1) absorb light (1) at certain wavelengths / frequencies / colours accept re-emitted in <u>all directions</u> (1) Either the 2nd mark must be linked to the 1st mark or the 3rd mark must be linked to the 2nd mark.	3
	(iii)	Red shift measurements show that <u>galaxies</u> are continuing to move apart / away (1) CMBR originated from waves / gamma rays (produced at the birth of the Universe) which have stretched (1) Don't accept reference to any other em wave which means the Universe (space) is expanding / does not look the same over time (1) Don't accept started from the same point Either the 3rd mark must be linked to the 1st mark or the 2nd mark. Question total	3 [7]

Question		Marking details	Marks
5.	(i)	Conversion of 1.5 GHz to 1.5×10^9 or 3×10^8 to 0.3 Gm/s (1) Substitution & manipulation (1) Answer = 0.2 [m] (1) Award 2 marks for answer of 2×10^8 [m] Any other answer of 2×10^n can be awarded a maximum of 2 marks if <u>clear workings shown</u> .	3
	(ii)	Conversion of 35 km to 35 000 m (1) Substitution & manipulation (1) Answer = 1.17×10^{-4} [s] (1) Accept 1.2×10^{-4} [s] Don't accept 1.16×10^{-4} [s] Award 2 marks for answer of 1.17×10^{-7} [s] Award 1 mark for answer of 1.16×10^{-7} [s] Any other answer of 1.17×10^{-n} can be awarded a maximum of 2 marks if <u>clear workings shown</u> .	3
Question total			[6]
6.	(a)	It provides <u>power (electricity)</u> to consumers / users (1) (accept 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) Don't accept reference to efficiency	2
	(b)	(i) $\text{Energy} = P \times t = \frac{5400(1)}{60(1)} \times 0.95 (1) = 85.5 \text{ [MWh]}$ Award 2 marks for an answer of 5 130 [MWh] Award 2 marks for an answer of 90	3
	(ii)	EITHER: 85.5 MWh (ecf) = 85 500 kWh (1) Cost = 85 500 × [£]0.05 (1) $= \text{[£]}4\,275(1) \frac{650000}{4275} = 152 \text{ [weeks]} (1)$ OR: 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)	4
		OR: (650 000 ÷ 0.05) (1) = 13 000 000 [kWh] (1) 13 000 000 ÷ 85 500(1-conversion) = 152 [weeks] (1)	
Accept an answer of 153 [weeks] if correct workings shown			

Question	Marking details	Marks
(c)	<p>Indicative content:</p> <p>The number of wind turbines required to meet the demand is $\frac{40000}{0.95} = 42\ 106$. 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>5 – 6 marks 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>3 – 4 marks 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>1 – 2 marks 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>0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.</p> <p style="text-align: right;">Question total</p>	<p style="text-align: center;">6</p> <p style="text-align: right;">[15]</p>
HIGHER TIER PAPER TOTAL		[60]