Question Number	Answer	Acceptable answers	Mark
1(a)(i)	D		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	ampere(s), amp(s), A		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)(i)	A description linking magnet (1) (in/near) coil (1) (magnet/coil) spins/moves/turns (1)	 IGNORE handle turns	 **(3)**

Question Number	Answer	Acceptable answers	Mark
1(b)(ii)	Any one from the following: Increase strength of magnet (1) Increase number of coils/turns of wire (1) Increase speed of rotation (1)	 add another magnet / move magnets closer turn handle/magnet/coil faster IGNORE bigger magnet/coil/ generator / longer wire	**(1)**

Question Number		Indicative Content	Mark
QWC	*)	A comparison including some of the following points Non- renewable sources • coal, oil, gas and nuclear • coal, oil, gas are fossil fuels • fossil fuels will run out • fossil fuels burn and produce CO_2 • fossil fuels burn to produce atmospheric pollution • CO_2 contributes to global warming • are a more expensive source • Nuclear power stations do not produce CO_2 • Nuclear power produces radioactive waste • Radioactive waste is dangerous and difficult to store safely Renewable resources • Wind, waves, solar, biofuels, geothermal and hydroelectric • are a free/cheaper source • The energy source is unreliable • No (net) CO_2 produced • No atmospheric pollution (except biofuels) • Waves and hydroelectric cause environmental changes • Wind farms and solar panels give visual pollution • Wind farms can be built off shore Comparison • Fossil fuel power stations are cheaper to build than wind farms for the same power output • Coal, oil, gas and nuclear fuel will run out, wind, waves and sun will always be available • Fossil fuel power stations produce CO_2 which may increase global warming, renewable energy generators (wind farms) do not • Renewable energy generators have a free/cheaper source of fuel • fossil fuels have to be taken out of the ground • Nuclear power stations produce radioactive waste, which is dangerous, none of the other energy generators do this. • Wind, waves and sun are unreliable sources of energy but fossil and nuclear fuels are always available	**(6)**

Level	0	No rewardable content
1	1 - 2	• a limited statement about either renewable or non-renewable e.g. Coal is non-renewable **OR** renewable energy will not run out **OR** oil will run out • the answer communicates ideas using simple language and uses limited scientific terminology. • spelling, punctuation and grammar are used with limited accuracy.
2	3 - 4	• a simple comparison including 2 statements covering renewable and non-renewable e.g. Coal is non-renewable and solar power is renewable **OR** renewable energy sources will not run out and non-renewable sources do not pollute the atmosphere **OR** oil will run out, solar will not • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately. • spelling, punctuation and grammar are used with some accuracy.
3	5 -6	• a detailed comparison including at least 3 statements with a direct comparison between a renewable and a non-renewable source, at least one named e.g. Renewables will not run out but non-renewables like coal will. **OR** Coal is non-renewable. When it is burnt carbon dioxide is produced. Wind farms do not produce any carbon dioxide. **OR** Carbon dioxide is produced when coal is used. Wind farms do not produce any carbon dioxide. Wind farms are noisy. **OR** Oil will run out, solar will not. Oil causes air pollution • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately. • spelling, punctuation and grammar are used with few errors.

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	proton(s) (1)	NOT photon	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a)(ii)	electron(s) (1)		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(b)(i)	evidence of halving activity eg line on graph at 80 (Bq) or two lines at, say, 100 and 50. (1) 8 (days) gains both marks (2)	accept halving in answer space e.g. 160 -> 80 or 80 -> 40 or 160 ÷ 2 = 80 NOT 160 ÷ 40 or 131 ÷ {2 or 4} or 40 ÷ 2 (unless clearly an activity)	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(b)(ii)	idea of two half-lives (1) but, 16 (days) gains both marks (2)	halving of 800 twice, e.g. 400 AND 200 seen Allow ECF from graph eg allow half-life from graph x 2 for both marks	**(2)**

Question Number		Indicative Content	Mark
QWC	***2( )**	A discussion including some of the following points Advantages - (currently) large resources of **fuel**/ **fuel** (reserves) will last a long time - (Produces) large amount of (electrical) energy/electricity - Does not produce (much/any) carbon dioxide - Does not produce (much/any) sulphur dioxide - Does not add to global warming/climate change - Good safety record (under normal operating conditions) - Only small amount of fuel needed to produce large amount of energy/electricity - Reliable supply/provides continuous supply of electricity (for a long time) - Reduces dependence on foreign supplies of energy - Conserves fossil fuel supplies - (Spent) fuel can be processed (to produce fuel for other reactors) - Provides employment/jobs Disadvantages - Produces nuclear/radioactive {waste/materials} - nuclear/radioactive waste/materials can cause mutations in DNA/cells/people/animals - Non- renewable (energy source) - Difficulties in transporting nuclear/radioactive waste/material - ifficulty in (safely) storing/disposing nuclear waste/material - Nuclear accidents (can) pollute large areas - Nuclear accidents pollute for a long time - Accept named example of accidents eg Fukishima, Chernobyl, 3-mile island - Mining and processing fuel both produce large amounts of carbon dioxide - Expensive to build and/or decommission (nuclear power stations) - Reference to target for terrorist attacks - Produces material which can be used to develop nuclear weapons/by terrorists - Negative public perception OWTTE ignore references such as unsightly, large area needed, noisy as true for most large buildings. Ignore cost of generation or restating stem ie generates electricity or supplies electricity to homes etc.	**(6)**

Level		No rewardable content
1	**1 - 2**	• A limited discussion giving one fact e.g. they give people jobs (in that area) OR they can have accidents like in Japan (after the tsunami). • the answer communicates ideas using simple language and uses limited scientific terminology. • spelling, punctuation and grammar are used with limited accuracy
2	**3 - 4**	• A simple discussion that states one advantage and one disadvantage OR states more than one advantage OR states more than one disadvantage**.** e.g. they are a reliable energy source and do not produce any carbon dioxide. OR they do not cause any global warming as they do not produce sulphur dioxide. OR they produce radioactive waste and many people don't want them built. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	**5 - 6**	• A detailed discussion of either advantages or disadvantages AND at least a mention of the other one. e.g. They produce large amounts of electricity and don't produce carbon dioxide but they produce radioactive materials (in the fuel rods). OR They are a reliable source of energy but they can damage large areas if there is an accident and the fuel is non-renewable. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

(Total for Question 5 =12 marks)

Question Number	Answer	Acceptable answers	Mark
3(a)(i)	An explanation linking • 60 % of {total/electrical/input/output} energy (is used/transferred) (1) • into/is kinetic/useful energy (1) If no other marks scored accept: 60% (of the energy produced by the motor) is useful/40% is wasted for 1 mark	**Accept reverse argument ie** 40 % of {total/electrical/input/output} energy (is/transferred) into/lost as/thermal (heat)/waste energy	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(a)(ii)	☒ **B** energy		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(a)(iii)	substitution 20 x 15 (1) evaluation 300 (J) (1) If no other mark scored award 1 mark for correct transposition ie E= P x t Ignore any unit given by candidate	Power of 10 error maximum of 1 mark eg 300 000 (J) gains 1 mark Give full marks for correct answer, no working	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(a)(iv)	substitution 18 ÷ 24 (x 100) (1) evaluation 0.75 or 75% (1) Ignore any unit given by candidate	Power of 10 error maximum of 1 mark give full marks for correct answer, no working	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(b	tion of energy		**(1)**