

Question Number	Answer	Acceptable answers	Mark
1(a)(i)	<input checked="" type="checkbox"/> A electron		(1)

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	<p>suggestion to include two of</p> <ul style="list-style-type: none"> the ionisation is different (1) correct difference in ionisation (1) the <u>masses</u> are different (1) alpha is bigger than beta (1) alpha hits more (air) particles (1) alpha loses its energy in shorter distance (1) 	<p>alpha more ionising (than beta) scores 2 marks</p> <p>RA (heavier for bigger)</p> <p>RA</p> <p>RA</p> <p>IGNORE references to penetration</p>	(2)

Question Number	Answer	Acceptable answers	Mark
1(b)	<input checked="" type="checkbox"/> A gamma radiation		(1)

Question Number	Answer	Acceptable answers	Mark
1(c)(i)	<p>A description linking the following:</p> <ul style="list-style-type: none"> neutron decays / changes / becomes (1) (neutron) into proton (1) (plus an) electron (1) 	<p>quark changes</p> <p>(quark changes) from down to up / d to u</p> <p>e^- (do not accept β^-)</p> <p>accept n and p for neutron and proton</p> <p>$n > p + e^-$ scores 3 marks</p> <p>IGNORE references to atomic and mass numbers; unstable nuclei; too many neutrons; gamma emitted</p>	(3)

Question Number	Answer	Acceptable answers	Mark
1(c)(ii)	<p>An explanation linking three of the following:</p> <ul style="list-style-type: none"> • mass number doesn't change (1) • (because) same number of nucleons / quarks (1) • atomic number goes up by one (1) • (because) there is an extra proton (1) 	<p>emitted electron mass is negligible</p> <p>proton and neutron have same mass</p> <p>a neutron has (decayed in)to a proton</p>	(3)

Question Number	Answer	Acceptable answers	Mark
2(a)	<p>A description including the following points</p> <ul style="list-style-type: none"> • steam {drives/turns} turbine (1) • (which){drives/turns/powers} generator (1) 	<p>transfers ke to electrical energy rotates a magnet in coils or coils in magnet accept dynamo for generator</p>	(2)

Question Number	Answer	Acceptable answers	Mark
2(b)	<p>A description including the following points</p> <ul style="list-style-type: none"> • neutron {hits / splits / is absorbed by} uranium (nucleus) (1) • producing more neutrons (1) • at least one neutron can {hit / split / be absorbed by} other uranium (nuclei) (1) 	<p>full marks may be scored on a labelled diagram</p> <p>fired at other U (nuclei) or "process repeats"</p>	(3)

Question Number	Answer	Acceptable answers	Mark
2(c)	krypton-91		(1)

Question Number	Answer	Acceptable answers	Mark
2(d)	<p>An explanation linking the following points</p> <ul style="list-style-type: none"> • removes electrons (1) • from atoms (1) 	<p>collides with atoms</p> <p>ignore references to β decay process (nucleus losing an electron)</p>	(2)

Question Number	Answer	Acceptable answers	Mark
2(e)	<p>An explanation linking the following points</p> <ul style="list-style-type: none"> • nuclei are positively charged (1) • need enough energy to overcome repulsion (1) 	<p>ignore references to high temp and pressure</p> <p>accept same charge accept protons for nuclei accept atoms</p> <p>and will repel each other</p>	(2)

Question Number	Answer	Acceptable answers	Mark
3(a)(i)	A 92		(1)
Question Number	Answer	Acceptable answers	Mark
3(a)(ii)	neutron(s) (1)	allow phonetic spelling nutron, newtron, nueutron	(1)
Question Number	Answer	Acceptable answers	Mark
3(b)	An explanation linking any two of the following points <ul style="list-style-type: none"> • a neutron(s)(1) • hits nucleus/nuclei (1) • uranium/nucleus splits (1) • (producing) neutrons /daughter nuclei/ energy / Kr and Ba (1) 	collides/is absorbed breaks/divides accept chain reaction for 1 mark if no other mark awarded accept a correctly labelled diagram	(2)
Question Number	Answer	Acceptable answers	Mark
3(c)	An explanation linking two of the following points <ul style="list-style-type: none"> • absorb (1) • neutrons (1) • (influences) chain reaction / rate of reaction (1) 	Accept reverse arguments collects/removes/takes away slows down/changes	(2)
Question Number	Answer	Acceptable answers	Mark
3(d)	An explanation linking any two of the following points <ul style="list-style-type: none"> • heats/boils water (1) • to produce steam (1) • to run/turn/spin turbines (1) • to turn/power generators (1) 	labelled diagram that indicates process (not just parts). heats boiler turns a coil in a magnet	(2)

Total marks for question 2 = 8

Question Number	Answer	Acceptable answers	Mark
4(a)(i)	Neutron(s)	Accept phonetic spellings eg newtron(s) or neutron(s) Reject newtons	(1)

Question Number	Answer	Acceptable answers	Mark
4(a)(ii)	D $\begin{matrix} 9 \\ \text{Be} \\ 4 \end{matrix}$		(1)

Question Number	Answer	Acceptable answers	Mark
4(a)(iii)	A explanation linking the following points <ul style="list-style-type: none"> • Charge/electron transfer (1) • Correct transfer detail (1) 	Gains/loses charge Gains an electron = 1mark Loses (an) electron(s) gains both marks Award 1 mark for gaining a proton as idea of gains charge	(2)

Question Number	Answer	Acceptable answers	Mark
4(b)	A description including any two of the following points <ul style="list-style-type: none"> • Two (light) / (small) <u>nuclei</u> (1) • Fuse together (1) • To produce a large(r)/heavier nucleus/atom /particle (1) 	Ignore references to releasing energy as this is in the Q. two hydrogen (and or helium) <u>nuclei</u> / two protons join /combine/merge/come / forced together helium/lithium (nucleus/atom/particle)	(2)

Question Number	Indicative Content	Mark
QWC *)	<p>A description including some of the following points</p> <ul style="list-style-type: none"> • Nucleus absorbs a neutron • Nucleus becomes unstable • nucleus fissions/ splits • (2 or) more neutrons released • daughter products • chain reaction • use of moderator • to control kinetic energy of neutrons/slow down neutrons • increases chance of further/more (fission) reactions • use of control rods • control rods absorb neutrons • reducing number of neutrons available for fission/to control (fission) reaction • containment of radioactive materials • little/no radiation enters environment <p>Ignore references to the release of energy as this is given in Q</p> <p>Marks can be scored by a suitably labelled diagram</p>	(6)
Level	0	No rewardable content
1	1 - 2	<ul style="list-style-type: none"> • a limited description that contains one or two points and possibly has a number of inaccuracies e.g. Uranium atom splitscontrol rods are used (to moderate the reaction) <p>OR</p> <p>Uranium atom absorbs a neutronthere is a chain reaction</p> <p>OR</p> <p>(In the nuclear reactor)chain reaction starts</p> <ul style="list-style-type: none"> • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	<ul style="list-style-type: none"> • a simple description that links two points e.g. A uranium nucleus absorbs a neutron and splits. <p>OR</p> <p>A uranium atom splits and releases more neutrons.</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none">• a detailed description that gives a linked statement about fission plus some detail about control or containment OR A detailed description that gives two pairs of linked statements about fission e.g Uranium nucleus absorbs a neutron and splits/fissions
		AND 2 or more neutrons are released and are slowed by a moderator/ produce a chain reaction. OR Control rods absorb (some) neutrons to control the reaction.
		<ul style="list-style-type: none">• 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
5(a)(i)	B		(1)

Question Number	Answer	Acceptable answers	Mark
5(a)(ii)	(equivalent to a) helium nucleus	Two protons and two neutrons for 2 marks helium/mass of 4 for 1 mark charge of +2 for 1 mark correct statement of any property for 1 mark	(2)

Question Number	Answer	Acceptable answers	Mark
5(b)	A description to include any four of the following <ul style="list-style-type: none"> • neutron • is captured by a U-235 nucleus • nucleus (is) unstable • nucleus splits • into 2 daughter nuclei (of similar size) • (2 or more) neutrons are released • energy is released 	<ul style="list-style-type: none"> • collides with /absorbed by (U-235) nucleus • metastable • named isotopes 	(4)

Question Number	Answer	Acceptable answers	Mark
5(c)	An explanation linking <ul style="list-style-type: none"> • moderator slows down (absorbs energy from) neutrons • more likely to be captured /cause fission (if it collides with a U-235 nuclei) 	Reverse argument	(2)