

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

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

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

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

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

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

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

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<b>2(c)</b>	krypton-91		<b>(1)</b>

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

Question Number	Answer	Acceptable answers	Mark
<b>2(e)</b>	<p>An explanation linking the following points</p> <ul style="list-style-type: none"> <li>• nuclei are positively charged (1)</li> <li>• need enough energy to overcome repulsion (1)</li> </ul>	<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>	<b>(2)</b>

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

Total marks for question 2 = 8



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

Question Number	Answer	Acceptable answers	Mark
<b>4(a)(ii)</b>	D      9 Be 4		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4(a)(iii)</b>	A explanation linking the following points <ul style="list-style-type: none"> <li>• Charge/electron transfer (1)</li> <li>• Correct transfer detail (1)</li> </ul>	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	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4(b)</b>	A description including any two of the following points <ul style="list-style-type: none"> <li>• Two (light) / (small) <u>nuclei</u> (1)</li> <li>• Fuse together (1)</li> <li>• To produce a large(r)/heavier nucleus/atom /particle (1)</li> </ul>	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)	<b>(2)</b>

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

<b>3</b>	<b>5 - 6</b>	<ul style="list-style-type: none"><li>• a detailed description that gives a linked statement about fission plus some detail about control or containment</li></ul> OR A detailed description that gives two pairs of linked statements about fission e.g Uranium nucleus absorbs a neutron and splits/fissions
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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.

- 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
<b>5(a)(i)</b>	B		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>5(a) (ii)</b>	(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	<b>(2)</b>

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

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