# **Nuclear Fission and Nuclear Fusion Mark Schemes**

#### **QUESTION 1**

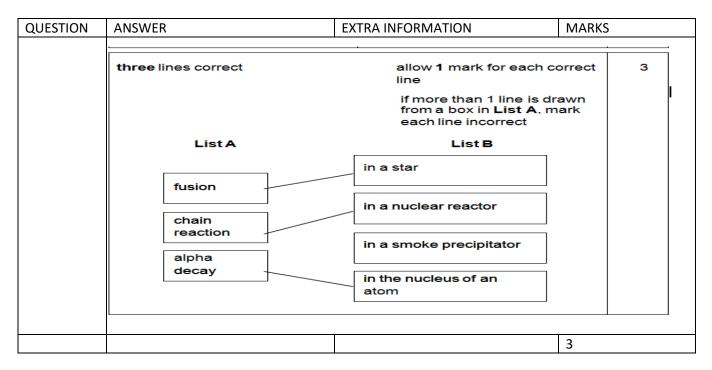
QUESTION	ANSWER	EXTRA INFORMATION	MARKS
a)i)	(nuclear) fission	accept fission providing clearly not fusion	1
a)ii)	(released) neutrons are absorbed by further (uranium) nuclei	accept hit nuclei for absorbed / hit do not accept atom for nuclei	1
	more neutrons are released (when new nuclei split)	accept for both marks a correctly drawn diagram	1
a)iii)	increases by 1 or goes up to 236		1
b)	any two from:  (more) neutrons are absorbed (chain) reaction slows down / stops  less energy released	accept there are fewer neutrons accept keeping the (chain) reaction controlled accept heat for energy accept gases (from reactor) are not as hot	2
Total marks			6

QUESTION	ANSWER	EXTRA INFORMATION	MARKS
a)i)	(two) nuclei (of light elements) join	accept hydrogen atoms for	1
	forming a larger / heavier nucleus /	nuclei	1
	one		
		accept comparative term	
		equivalent	
		to larger	
		accept forms a helium (nucleus	
		/	
		atom) this mark only scores if	

		fusion is in terms of hydrogen atoms	
a)ii)	stars	accept a named star e.g. the Sun accept nebula mention of planets negates answer	1
b)i)	any one from:  (currently) only experimental reaction does not last long enough use more energy than they produce	allow difficult to control do not allow inefficient on its own	1
b)ii)	any one from:    will give another source of energy   unlimited fuel supplies / energy   would not produce any radioactive waste   want to show that it can be done	accept unlimited hydrogen accept less radioactive waste accept nuclear for radioactive do not accept toxic waste accept any sensible suggestion	1
c)i)	any one from:  repeating did not produce the same results / data experiments were not / may not be reproducible data / experiments were not valid	accept could not be repeated accept has not been repeated do not accept answers in terms of scientists being biased	1
c)ii)	any one from: cannot trust journalists newspaper journalist may not have a science background newspaper may publish what people want to read newspaper may simplify ideas people believe / trust the scientists	bias is insufficient on its own  accept any sensible suggestion, these are examples they do not constitute a full list	1

	writing the journal people have heard of the scientists writing in the journal	
	2 scientists writing in the journal are famous	
	<ul><li>journal only publishes</li><li>the work of</li><li>respected / famous</li></ul>	
	scientists  2 data is checked by other scientists	
	before published in the journal	
Total marks		

QUESTION	ANSWER	EXTRA INFORMATION	MARKS
	four lines correct	allow 1 mark for each correct line if more than 1 line is drawn from a box in List A, mark each line incorrect	4
	List A	List B	
	the nuclei of two atoms joining together	gamma emission	
	the nucleus of an atom splitting into several pieces	electric current	
	an atom losing an electron	ionisation	
	an electric charge moving	nuclear fission	
	through a metal	nuclear fusion	
Total marks			4



## **QUESTION 5**

QUESTION	ANSWER	EXTRA INFORMATION	MARKS
a)	uranium-235	accept any correct indication	
b)	splits / breaks (into two smaller parts) and (two / three) neutrons	nucleus is separated is insufficient do not accept atom splits – on its	1
		own	
c)	steam	correct order only	1
	turbine		1
	generator		1
Total marks			6

QUESTION	ANSWER	EXTRA INFORMATION	MARKS
a)	(same) number of protons	same atomic number is insufficient	1
b)i)	nuclei split	do not accept atom for nuclei / nucleus	1

b)i)i)	(nuclear) reactor		1
c)	beta any one from: • atomic / proton number increases (by 1) • number of neutrons decreases / changes by 1 • mass number does not change • a neutron becomes a proton	accept atomic / proton number changes by 1 (total) number of protons and neutrons does not change	1 1
d)	(average) time taken for number of nuclei to halve or (average) time taken for countrate / activity to halve		1
e)i)	6.2 (days)	Accept 6.2 to 6.3 inclusive allow 1 mark for correctly calculating number remaining as 20 000 or allow 1 mark for number of 80 000 plus correct use of the graph (gives an answer of 0.8 days)	2
e)ii)	radiation causes ionisation that may then harm / kill healthy cells	allow radiation can be ionising accept specific examples of harm, eg alter DNA / cause cancer	1 1
e)iii)	benefit (of diagnosis / treatment) greater than risk (of radiation)	accept may be the only procedure available	1
Total marks			11

QUESTION	ANSWER	EXTRA INFORMATION	MARKS
a)i)	splitting of a(n atomic) nucleus	do not accept splitting an atom	1
a)ii)	neutrons		1
b)i	nuclei have the same charge or nuclei are positive	accept protons have the same charge	1

b)ii)	(main sequence) star	accept Sun or any correctly named star	1
		accept red (super) giant	
c)i)	any two from:  •easy to obtain / extract  •available in (very) large amounts  •releases more energy (per kg)  •produces little/no radioactive waste	do not accept figures only naturally occurring is insufficient seawater is renewable is insufficient less cost is insufficient	2
c)ii)	any one from:  • makes another source of energy available  •increases supply of electricity  • able to meet global demand  •less environmental damage  • reduces amount of other fuels used	accept any sensible suggestion  accept a specific example  accept a specific example	1
d)	12	allow 1 mark for obtaining 3 half-lives	2
Total marks			9

QUESTION	ANSWER	EXTRA INFORMATION	MARKS
a)	inside the Sun		1
b)	fusion		1
c)	energy		1
Total marks			3