

Nuclear fission and nuclear fusion

1. four lines correct

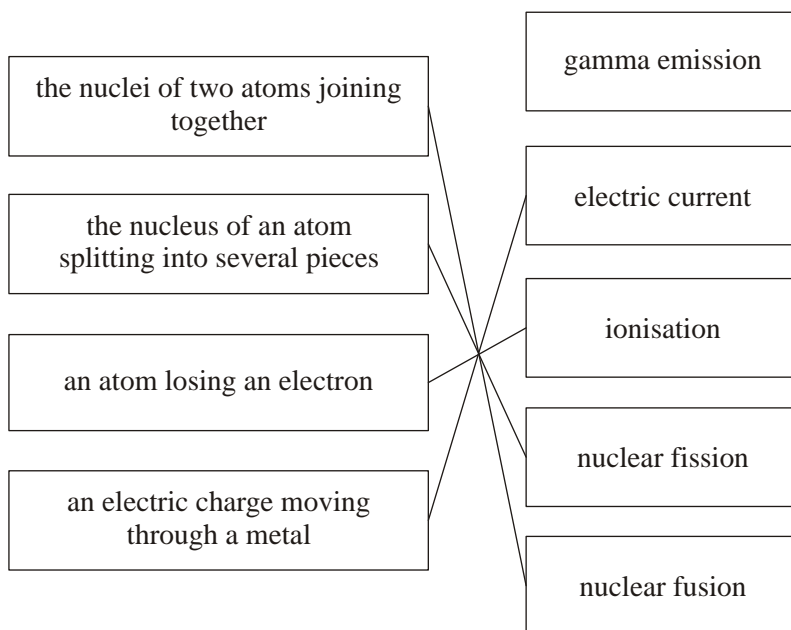
4

allow 1 mark for each correct line

if more than 1 line is drawn from a box in List A, mark each line incorrect

List A

List B



[4]

2. (a) (i) (nuclear) fission

1

*accept fission providing clearly **not** fusion*

(ii) (released) neutrons are absorbed by further (uranium) nuclei

1

*accept hit nuclei for absorbed / hit
do **not** accept atom for nuclei*

more neutrons are released (when new nuclei split)

1

*accept for **both** marks a correctly drawn diagram*

(iii) increases by 1

1

or goes up to 236

(b) any **two** from:

2

- (more) neutrons are absorbed

accept there are fewer neutrons

- (chain) reaction slows down / stops

accept keeping the (chain) reaction controlled

- less energy released

accept heat for energy

accept gases (from reactor) are not as hot

[6]

3.	(a)	(i)	(nuclear) fusion	1
			<i>allow minor misspellings but do not credit any response which could be fission</i>	
		(ii)	(in) stars	1
			<i>accept supernova / red giants / white dwarves do not allow the Sun</i>	
		(iii)	(by) supernova / explosion of star	1
			<i>do not credit just 'explosion(s)'</i>	
	(b)		the (available) evidence: supports this idea or does not contradict this idea or can be extrapolated to this idea	1
				[4]
4.	(a)		it use $E = mc^2$	4
			mass in kg i.e. $0.001 \times \frac{0.7}{100}$	<i>each gains 1 mark</i>
			but 000007	<i>gains 2 marks</i>
			2.1×10^3	<i>gains 3 marks</i>
			evidence of 0.000007	
			mass in kg (i.e. 0.0007 or 0.7/100000)	<i>each gains 1 mark</i>
			squaring the speed of light	<i>gains 3 marks</i>
			but 6.3×10^{11} (<i>credit alternative ways of stating this</i>)	
			units J/joule	<i>for 1 further mark</i>
			<i>(N.B credit kJ, MJ, GJ but check power of 10 for full credit)</i>	
	(b)	(i)	<i>idea that the bigger the mass the shorter the life</i>	2
			<i>gains 1 mark</i>	
			but idea that decrease in life is much more than proportional to increase in mass or more than proportional to mass²	
			<i>gains 2 marks</i>	
		(ii)	<i>ideas that:</i>	3
			greater mass means greater core temperature/pressure	
			greater core temperature/pressure means greater rate of fusion	
			increase in mass produces a proportionally much greater increase in the rate of fusion	
			<i>each for 1 mark</i>	
				[9]
5.	(a)		(a) supernova (explosion)	1
	(b)		solar system contains heavy elements / elements heavier than hydrogen <u>and</u> helium (1)	3
			these (heavy) elements are / were formed by (nuclear) <u>fusion</u> (1)	
			<i>accept minor misspellings for 'fusion'</i>	
			<i>but not anything which could also be 'fission'</i>	
			(at the very high temperature(s)) in a super nova / when stars explode (1)	
				[4]

6.	(a) any two from:	2	
	<ul style="list-style-type: none"> • nuclei / atoms of light elements fuse <i>accept hydrogen or helium for light elements</i> <i>accept join for fuse</i> <i>accept for 1 mark, by nuclear fusion</i> <i>answers about fission negates a mark</i> • each (fusion) reaction releases energy / heat / light • lots of reactions occur 		
	(b) presence of nuclei of the heaviest / heavy / heavier elements	1	
	<i>accept atom for nuclei</i>		
	(c) (i) (matter / mass) with such a high density / strong gravitational (field)	1	
	electromagnetic radiation / light is pulled in	1	
	<i>accept nothing can escape</i> <i>do not accept answers in terms of an empty void</i>		
	(ii) X-rays	1	
	<i>accept e-m radiation / e-m waves</i>		[6]
7.	Quality of written communication: One mark for using correct scientific sequence:	1	
	gravity → fusion → balance		
	any four from	4	
	<ul style="list-style-type: none"> • (dust and gas) pulled together by gravity • (star formed when) it is hot enough <i>accept (as mass is pulled together) it gets very hot</i> • <u>hydrogen</u> (and helium) nuclei <u>fuse</u> • (these nuclear fusion reactions) release the energy / heat / light (which is radiated by stars) • energy causes expansion • gravitational pull is balanced by the expansion (force) 		[5]