

Mark schemes

1	(a) (i)	(nuclear) fission is the splitting of a (large atomic) nucleus <i>do not accept particle/atom for nucleus</i>	1
		(nuclear) fusion is the joining of (two atomic) nuclei (to form a larger one) <i>do not accept particles/atoms for nuclei</i>	1
	(ii)	energy <i>accept heat/radiation/nuclear energy</i> <i>accept gamma (radiation)</i> <i>do not accept neutrons/neutrinos</i>	1
	(b) (i)	uranium (-235) <i>accept U (-235)</i> <i>ignore any numbers given with uranium</i> <i>accept thorium</i> <i>accept MOX (mixed oxide)</i> <i>do not accept hydrogen</i>	1
	(ii)	(same) number of protons <i>accept (same) atomic number</i> <i>accept (same) positive charge</i> <i>ignore reference to number of electrons</i>	1
2	(a) (i)	centre	1
	(ii)	protons and neutrons	2
	(iii)	different number of neutrons <i>gets 1 mark</i> heavier <i>gets 1 mark</i> 3 more neutrons or specified numbers <i>gets 2 marks</i>	2

[5]

- (b) atom hit by neutron;
splits into smaller nuclei;
further neutrons released;
neutrons released when one atom splits
cause further fission;
energy released.

any 4 for 1 mark each

4

[9]

3

- (a) (i) (two) nuclei (of light elements) join
accept hydrogen atoms for nuclei

1

forming a larger / heavier nucleus / 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

1

- (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

(ii) any **one** from:

- will give another source of energy
- unlimited fuel supplies / energy
accept unlimited hydrogen
- would not produce any radioactive waste
accept less radioactive waste
accept nuclear for radioactive
*do **not** accept toxic waste*
- want to show that it can be done
accept any sensible suggestion
*do **not** accept answers only in terms of fossil fuels or carbon dioxide*

1

[5]

4

(a)

Particle	Relative Mass	Relative charge
Proton	1	
Neutron		0

accept one, accept +1
*do **not** accept -1*

1

accept zero

*do **not** accept no charge/ nothing/neutral unless given with 0*

1

(b) equal numbers/amounts of protons and electrons

1

protons and electrons have equal but opposite charge

accept protons charge +1 and electron charge -1

accept (charge) on proton

cancel/balances (charge) on electron

accept positive (charges) cancel out the negative(charges)

neutrons have no charge is neutral

*do **not** accept total charge of protons, electrons (and neutrons) is 0 unless qualified*

1

- (c) (i) (3) fewer neutrons
accept lower/ smaller mass number
*do **not** accept different numbers of neutrons*
any mention of fewer/more protons/electrons negates mark
accept answers in terms of U-238 providing U-238 is specifically stated i.e. U-238 has (3) more neutrons 1
- (ii) neutron 1
- (iii) (nuclear) fission
accept fision
*do **not** accept any spelling that may be taken as fusion* 1

[7]

- 5** (a) uranium-235
accept any correct indication 1
- (b) splits / breaks (into two smaller parts)
nucleus is separated is insufficient
*do **not** accept atom splits – on its own* 1
- and (two / three) neutrons 1
- (c) steam
correct order only 1
- turbine 1
- generator 1

[6]

- 6** (a) inside the Sun 1
- (b) fusion 1
- (c) energy 1

[3]

- 7** (a) (i) nuclear reactor 1

star

1

(ii) nuclei are joined (not split)

accept converse in reference to nuclear fission

*do **not** accept atoms are joined*

1

(b) (i) any **four** from:

- neutron
- (neutron) absorbed by U (nucleus)
ignore atom
*do **not** accept reacts*
*do **not** accept added to*
- forms a larger nucleus
- (this larger nucleus is) unstable
- (larger nucleus) splits into two (smaller) nuclei / into Ba and Kr
- releasing three neutrons and energy
accept fast-moving for energy

4

(ii) 56 (Ba)

1

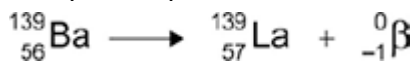
57 (La)

if proton number of Ba is incorrect allow 1 mark if that of La is 1 greater

1



accept e for β



scores **3** marks

1

[10]

8

(a) neutrons

1

(b) generate electricity

accept produce electricity

accept heat water

accept produce steam

turns turbines is insufficient

1

(c) (i) a neutron

1

(ii) two particles **X** released from the uranium-235

1

uranium-235 shown splitting into two fragments

or

each particle **X** shown colliding with a uranium-235 and producing 2 further particles

X

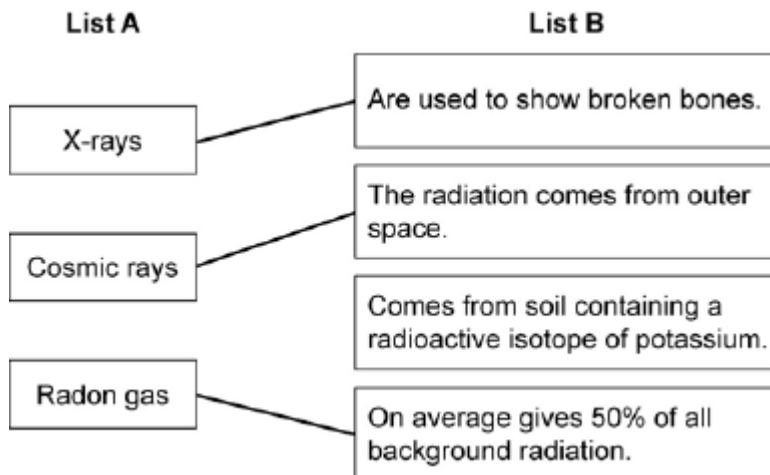
one uranium-235 shown splitting is sufficient, provided no contradiction shown

1

[5]

9

(a) 1 mark for each correct line



*if more than 1 line has been drawn from a box in **List A** then all those lines are marked incorrect*

3

(b) higher in village B

1

by 6 units

allow 1 mark for correctly obtaining a height difference of 180 (m) / 4 times higher – this refers to height not radiation levels

accept for 3 marks in village A it is 2 units (extra) and in village B it is 8 units (extra) allow 1 mark for a correct radiation calculation based on incorrect height readings

2

[6]

10

(a) Nucleus splitting into two fragments and releasing two or three neutrons

1

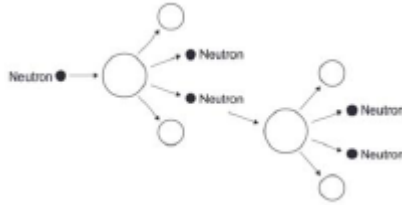
(at least one) fission neutron shown to be absorbed by additional large nucleus and causing fission

1

two or three additional neutrons released from fission reaction

1

This diagram would gain all **3** marks:



- (b) lowering the control rods increases the number of neutrons absorbed
accept converse description

1

(so) energy released decreases

1

allow changing the position of the control rods affects the number of neutrons absorbed for 1 mark

- (c) rate of increase between 240 and 276 (MW / min)

2

allow 1 mark for attempt to calculate gradient of line at 10 minutes

[7]

11

- (a) cell damage or cancer

accept kills / mutates cells

radiation poisoning is insufficient

ionising is insufficient

1

- (b) (i) any **one** from:

- use tongs to pick up source
- wear gloves
- use (lead) shielding
- minimise time (of exposure)
- maximise distance (between source and teacher).

accept any other sensible and practical suggestion

ignore reference to increasing / decreasing the number / thickness of lead sheets

1

- (ii) background

1

- (c) (i) curve drawn *from point 2, 160*

*do **not** accept straight lines drawn from dot to dot*

1

- (ii) (also) increases

less radiation passes through is insufficient

1

- (iii) 50

accept any value from 40 to 56 inclusive

1

(d) gamma

1

only gamma (radiation) can pass through lead

*accept alpha **and** beta cannot pass through lead
a general property of gamma radiation is insufficient*

1

[8]