

**QUESTIONSHEET 1**

(a) (i) B	1
(ii) D	1
(iii) C	1
(b) ${}_{90}^{234}\text{Th} + {}_2^4\text{He} / {}_2^4\alpha$	2
(c) (i) isotopes	1
(ii) different numbers of neutrons	1
	<b>TOTAL / 7</b>

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**QUESTIONSHEET 2**

(a) alpha radiation would not be able to pass through the cardboard	1
(b) gamma radiation would not be significantly reduced	1
(c) radiation detected drops	1
hopper stops/closes	1
signal goes to motor/conveyer belt/operator	1
next box moves under hopper	1

Note: A popular type of question. A variation of this is the monitoring of thickness of metal sheets as they are rolled out. (see question 6)

**TOTAL / 6**

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**QUESTIONSHEET 3**

- (a) negative particles/electrons 1  
 embedded in positively charged pudding 1
- (b) any five from  
 most alpha particles are not deflected/pass straight through  
 so, atom mostly empty space/core must be tiny  
 a few alpha particles deflect strongly  
 alpha particles are positively charged  
 like charges repel each other  
 so, positive charge at centre 5
- (c) large nucleus bombarded with neutrons 1  
 nucleus splits in two 1  
 more neutrons released 1  
 large amount of energy released 1

Note: If the neutrons released from the splitting of a nucleus bombard other nuclei, a chain reaction results. A controlled chain reaction occurs in a nuclear reactor.

**TOTAL / 11**

**QUESTIONSHEET 4**

- (a) time taken for half atoms present to decay 1
- (b)(i) 13 hours 1  
 (ii) 280 counts per min (+/ 5) 1
- (c)(i) 0.01 g 1
- Note: 39 hours is three half-lives. To find the answer, halve the mass three times.
- (ii) some has been metabolised/body has excreted some 1
- (d)(i) half-life too long so could damage body 1  
 some beta radiation absorbed by body tissue, so not all  
 could be detected from outside 1
- (ii)  ${}_{54}^{131}\text{Xe} + {}_{-1}^0\beta / {}_{-1}^0\text{e}$  2

**TOTAL / 9**

**QUESTIONSHEET 5**

(a) ½ marks for each of following. Total rounded up

	<u>protons</u>	<u>neutrons</u>
Rn	86	134
Na	11	13
P	15	17
Sr	38	52
C	6	8

5

(b)(i) C/carbon

1

(ii) P/phosphorus

1

1

**TOTAL / 7**

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**QUESTIONSHEET 6**

(a) Geiger-Muller/GM tube

1

(b) GM tube detects radiation

1

if sheet too thick, less radiation gets through

1

if sheet too thin, too much radiation gets through

1

pressure control adjusted

1

depending on amount of radiation detected

1

(c) alpha radiation would not pass through metal sheet

1

**TOTAL / 7**

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**QUESTIONSHEET 7**

- |  |        |
|--|--------|
| (a) (i) carbon-14/C-14/ $^{14}\text{C}$ / $^1_6\text{C}$                     | 1      |
| (ii) carbon present in all living materials/<br>those which were living      | 1      |
| (b) (i) present time/now/today   | 1      |
| (ii) 4200 years (+/- 200 years)  | 1      |
| (iii) 80 counts per minute (+/- 5 cpm)                                       | 1      |
| (iv) 5700 years (+/- 200 years)  | 1      |
| (c) organic matter would have decayed away<br>too little C-14 left in sample | 1<br>1 |

**TOTAL / 8**

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**QUESTIONSHEET 8**

- |   |        |
|---|--------|
| (a) (i) neutron   | 1      |
| (ii) show each uranium nucleus splitting into 2 smaller nuclei<br>and 2 further neutrons produced | 1      |
| (iii) chain reaction  | 1      |
| (iv) heat/heat energy   | 1      |
| (b) (i) heats/boils water<br>steam drives turbine to generate electricity                         | 1<br>1 |
| (ii) provides radiation shield/stops radiation escaping/<br>absorbs radiation from reactor        | 1      |
| (iii) to slow down chain reaction/absorb neutrons/<br>slow down nuclear fission                   | 1      |

**TOTAL / 8**

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**QUESTIONSHEET 9**

(a) nucleus	1
neutrons/protons	1
protons/neutrons (different from previous answer)	1
electrons	1
 (b) random	 1
emission	1
of radiation	1
from (atomic) nucleus	1

Note: The only atom that does not have neutrons in its nucleus is hydrogen.  
When an atom emits radiation it gives out alpha or beta particles or loses energy (gamma radiation). This is a random process – you can't predict exactly when it will happen.

**TOTAL / 8**

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**QUESTIONSHEET 10**

(a) 2 protons + 2 neutrons	1
beta negative	2
electromagnetic radiation    speed of light    zero	3
 (b) a neutron in the nucleus	 1
becomes a proton + electron	1
the electron is emitted	1

Note: It is a common mistake to think that since a beta particle is an electron, it must be an orbital electron.

**TOTAL / 9**

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**QUESTIONSHEET 11**

- |  |   |
|--|---|
| (a) film detects amount of radiation to which worker exposed | 1 |
| (b) (i) Geiger-Muller/GM tube                                | 1 |
| (ii) atom gains/loses  | 1 |
| electrons  | 1 |
| and becomes negatively/positively charged                    | 1 |

Note: Radiation ionises atoms/molecules in materials through which it passes. This can happen in living cells and damage them. There are annual limits on the amount of radiation to which a worker in the industry should be exposed.

**TOTAL / 5**

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**QUESTIONSHEET 12**

- |   |        |
|---|--------|
| (a) radioactive emission is a random process/not constant<br>therefore count rates vary | 1<br>1 |
| (b) $\frac{87 + 92 + 81 + 84 + 80}{5}$  | 1      |
| = 84.8 counts per sec   | 1      |
| (The units are not essential as they are given in the table)                            |        |
| (c) (i) background radiation  | 1      |
| (ii) lower  | 1      |

Note: To measure the true activity of a source, the background radiation should be measured and subtracted from the average count rate for the source.

**TOTAL / 6**

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**QUESTIONSHEET 13**

- |   |   |
|---|---|
| (a) radiotherapy                                      | 1 |
| (b) gamma   | 1 |
| (c) a single (strong) beam would damage healthy cells | 1 |
| a single weak beam would not kill cancerous cells     | 1 |
| three weak beams combine together                     | 1 |
| to kill cancerous cells/leave healthy cells undamaged | 1 |

Note: Alpha and beta radiation would not be suitable as they would be absorbed before reaching the tumour and so damage healthy tissue.

**TOTAL / 6**

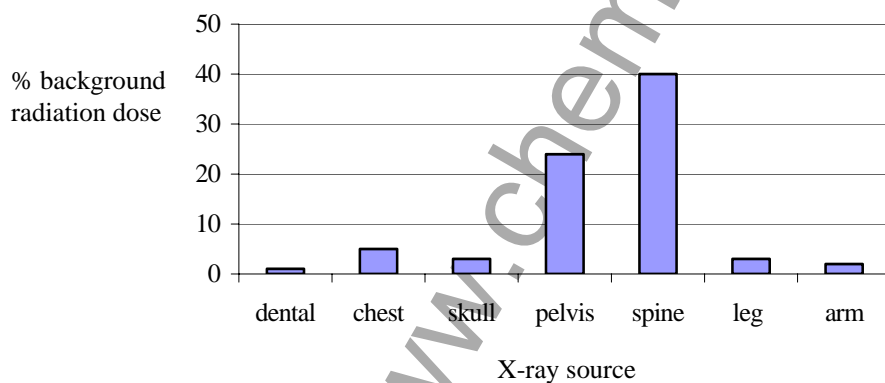
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**QUESTIONSHEET 14**

(a) (i) 15 counts per min/cpm	1
(ii) cosmic rays/building materials/industrial pollution/ bomb tests/smoke alarms	1
(b) 436 counts per minute/cpm	1
(c) beta/ $\beta$ radiation	1
(d) (i) half-life	1
(ii) half-life is longer than length of experiment/ half the atoms could not decay once during experiment	2
(e) use tongs/keep source away from body/ do not try to open container/keep in lead-lined container/ replace in locked cupboard when finished	2
<b>TOTAL / 9</b>	

**QUESTIONSHEET 15**

(a) (i)



deduct one mark for each incorrect bar to maximum of 4

(ii) 5	1
(iii) any <b>two</b> from damage genes deformed babies cancer burns tissues	2
(b) <b>two</b> from protective clothing remote control equipment wear film badge to monitor dose	2

**TOTAL / 9**

**QUESTIONSHEET 16**

(a) (i)	alpha arrow as far as paper, but not beyond	1
	beta arrow as far as aluminium, but not beyond	1
	gamma arrow as far as lead (allow small amount beyond)	1
(ii)	alpha & beta beams deflected/moved/bent	
	gamma beam not affected	1
(iii)	alpha & beta are beams/streams/currents of charged particles	1
	these are affected by magnetic fields	1
(b) (i)	concrete/lead lined concrete	1
(ii)	distance/stays as far away as possible/use remote control	1
		<b>TOTAL / 8</b>

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**QUESTIONSHEET 17**

(a) Two from		
	can damage (living) cells/cause mutation	
	can cause cancer	
	can burn flesh	
	can kill cells	2
(b) alpha/ $\alpha$		1
	less likely to reach living cells	1
(c) equipment exposed to radioactive source		1
	radioactivity kills bacteria/micro-organisms	1

Note: Beta and gamma radiation can reach internal tissues and be absorbed.

**TOTAL / 6**

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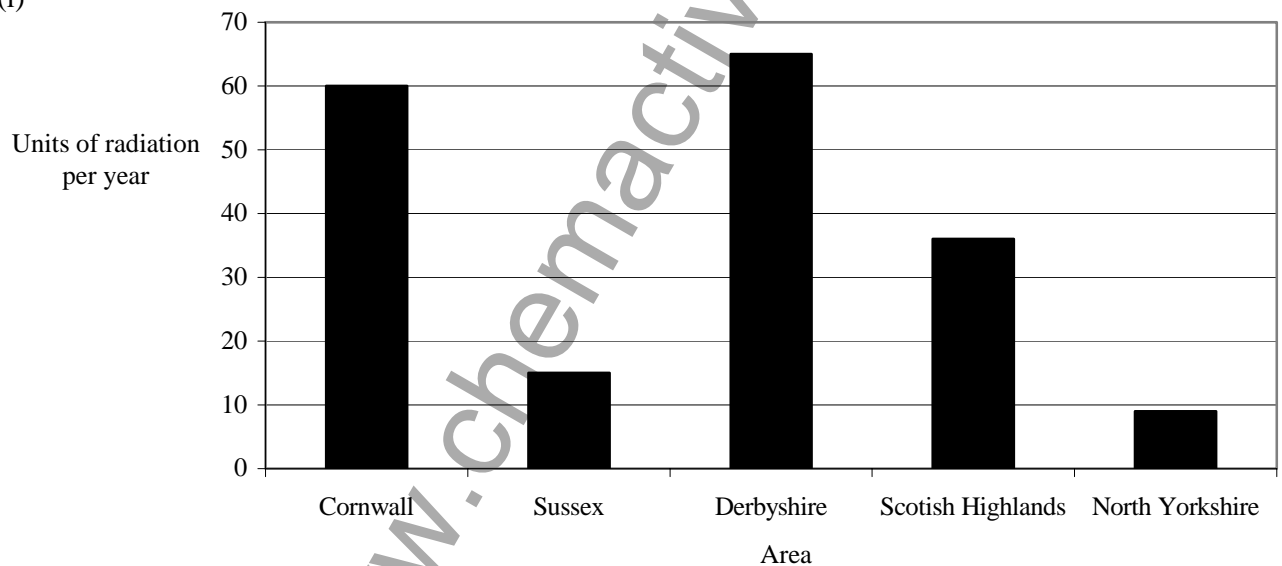


## QUESTIONSHEET 18

(a) uranium/plutonium	1
(b)(i) A – blown to UK	1
B – settles on grass	1
C – cows produce milk	1
(ii) kill/damage plants/ kill/damage animals/ damage water supplies	2
(iii) radiation level remains high for thousands of years	1
<b>TOTAL / 7</b>	

## QUESTIONSHEET 19

(a) (i)



deduct one mark for each incorrect bar to maximum of 3 3

(ii) North Yorkshire 1

(iii) products of radioactive materials in rocks/  
given out when radioactive materials in rocks decay 1

(b) 60 / 6 1  
= 10 1

**TOTAL / 7**

**QUESTIONSHEET 20**

- (a) any two from  
ground/air/building materials/food space 2
- (b)(i) Two from  
dangerous waste produced  
wind & wave energy should be developed  
Waste needs to be stored for thousands of years  
radiation may leak out 2
- (ii) Two from  
fossil fuels are running out – alternative needed  
radiation little compared to background  
chances of accidents very small  
very little fuel needed to produce much energy 2
- (c) Two from  
X-rays  
treatment of cancers  
tracing passage of blood or urine through organs  
sterilising instruments 2

**TOTAL / 8**

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