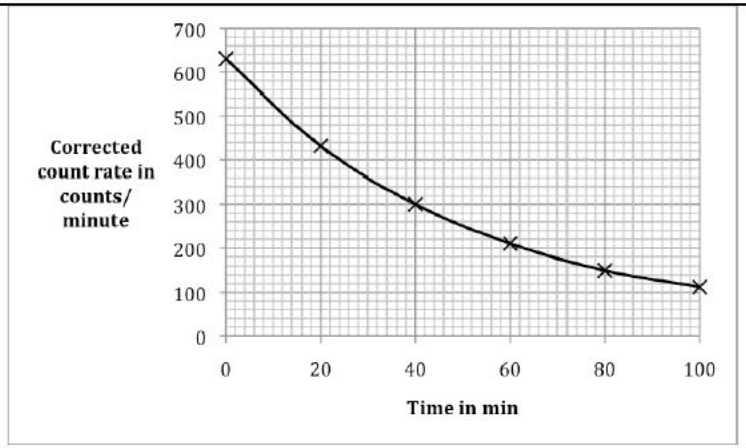
Question number			Answer	Notes	Marks
1	(a)	(i)	Any **two** sources: MP1. radiation from rocks/buildings/radon gas; MP2. cosmic radiation / radiation from the Sun / stars; MP3. radiation from medical sources; MP4. nuclear waste / accidents; MP5. some foods e.g. coffee, bananas;	 Ignore : cosmic microwave (background) radiation /cmbr allow named radioactive isotopes accept fire / smoke detector	2
		(ii)	Any three of MP1. Remove the radioactive source; MP2. Measure the (background) count rate; MP3. Repeat the measurement / measure for a long time; MP4. Background radiation is 30 (counts per minute); MP5. Subtract this value from (each) reading(s);	Accept standard abbreviations e.g. cpm Allow for 2 marks: measure the count rate without the source	3

<table>
<tr><th colspan="3">Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>1</td><td>(a)</td><td>(iii)</td><td>scale; at least half the paper
axes labelled including units;
Plotting to nearest sm sq;;
Best fit line to include at least 5 points;</td><td rowspan="2">-1 each plotting error, minimum 0 for plotting

<table><tr><th>Time in min</th><th>Corrected count rate in counts/minute</th></tr><tr><td>0</td><td>30</td></tr><tr><td>20</td><td>432</td></tr><tr><td>40</td><td>300</td></tr><tr><td>60</td><td>210</td></tr><tr><td>80</td><td>150</td></tr><tr><td>100</td><td>12</td></tr></table></td><td></td></tr>
<tr><td></td><td></td><td></td><td>
</td><td></td></tr>
<tr><td></td><td></td><td>(iv)</td><td>Evidence of correct graph use;
Correct value;</td><td>Allowed range is 35-42</td><td>2</td></tr>
</table>

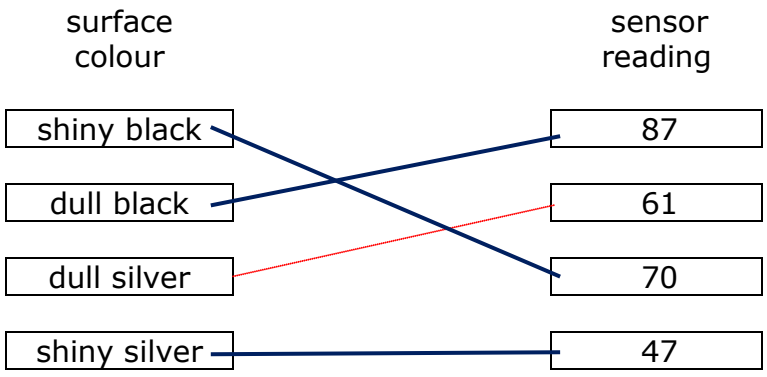
Question number			Answer	Notes	Marks
1	(b)		**correct statement about a neutron;** **e.** neutron changes neutron number decreases by 1 **correct statement about a proton/ atomic/number of positive charges in nucleus;** **e.** (neutron changes) into a proton proton number increases by 1 number of positive charges increases by 1	ignore : 'it becomes unstable' Accept answers in terms of quarks (down to up) or anti-neutrinos allow for 1 mark if no other mark gained: nucleus becomes another/new element it loses energy nucleus recoils reject: all implication that nucleus becomes ionised	2
	(c)	(i)	MP1. (they emit) ionising radiation; plus any one of - MP2. Cannot be seen; MP3. Can damage/harm cells; MP4. Can cause tumours / cancer;		2
		(ii)	Any three suitable, e.g. MP1. Reduce exposure time; MP2. Handle with tongs/use robotic handling/keep at distance /eq; MP3. Use shielding / work in fume cupboard /eq MP4. Wear film badge / monitor;	NB reduction of risks when WORKING with sources, not how to keep sources safe etc refs to gloves, mask etc are considered as shielding allow keep source in lead container when not in use	3

Total 19 marks

Question number	Answer	Notes	Marks
2 (a) i)	C - 14		1
(ii)	B - 8		1
(iii)	A - 6		1
(b)	A - An electron		1
(c)	A - 1.5 g		1
(d)	Atoms/nuclei with same number of protons / same atomic number / same element; Different numbers of neutrons / different mass number / different atomic mass;	ALLOW 'different mass' for second mark if it's clear they are comparing atoms within the same element rather than different elements IGNORE references to electrons if possible, but if candidates makes an incorrect reference to electrons then list principle applies for that mark (e.g 'same number of protons but different number of neutrons and electrons' = 1)	1 1
		Total	**7**

Question number	Answer	Notes	Marks
3 (a)	(nuclear) fission;	DO NOT ALLOW fusion	1
(b)	Nucleus splits; Releasing neutrons; Which (hit / are absorbed by) different (uranium) nuclei;	PENALISE ONCE if 'atom' used for 'nucleus'	3
(c)	Kinetic (energy of particles) Of (fission) products / (daughter) nuclei / neutrons	DO NOT ALLOW 'movement' for kinetic	1 1
(d) (i)	Slow down neutrons;	DO NOT ALLOW 'movement' for kinetic	1
(ii)	Kinetic/heat/thermal; Kinetic; Kinetic/electrical; Electrical;	ALLOW 'electric' for 'electrical'	4
		Total	**11**

Question number	Answer	Notes	Marks
4 (a) (i)	rocks / radon (gas) / space / cosmic / Sun / medical sources / from carbon atoms in living things	REJECT named radiation e.g. gamma	1
(ii)	Any three from Remove source / with no source present; measure background / count; repeat / find mean / average value; subtract (background value) from experimental values (with source);	ACCEPT take readings (of background) / read background	Max 3
(b) (i)	GRAPH S A P P L	Orientation unimportant Quantity and unit on both axes Single smooth curve	5
(ii)	value consistent with graph (should be 0.9 – 1.4 minutes)		1
(c)	(gamma) can be detected outside the body /can pass through; half life related to use – long enough to get around the body (for use as tracer); half life related to patient safety - falls to low levels soon after use;	Ignore ionising ability Reject "cause less damage" without reference to activity or time	3

Question number	Answer	Notes	Marks
5 (a) (i)	 any one correct; all 3 correct;;		2
(ii)	(different surfaces) emit heat at different rates/eq;	allow emit different amounts of heat / radiation	1

Question number	Answer	Notes	Marks
5 (b) (i)	P = ρ x g x h ;	do not accept: • gravity for g • 10 for g • d for density accept: • word equations and rearrangements • for h allow height depth height difference	1
(ii)	sub into eqn for P; evaluation; unit; e.g. (P=) 1260x10x0.25 3150 Pa	no POT error as 'g' used allow 9.8(1) for g 1260x9.8x0.25 3090 allow • N/m^2 • matching unit e.g. 3.15 kPa	3

(iii)	any THREE from: MP1. black absorbs IR/heat; MP2. black heats up more than shiny; MP3. gas particles on black side move faster/get hotter/have more KE/move apart; MP4. pressure on left/black side increases;	Allow RA where appropriate allow gas expands allow force(/area) for pressure ignore: ideas of collisions	3
(iv)	difference in liquid height is less; more difficult/harder to move ;	height goes down less /decrease in h is less allow: argument in terms force /pressure	2

(v)	MP1 it will give a bigger temperature (range)/eq; AND DOP a suitable comment e.g. MP2 a larger difference in water level; MP3 a larger difference in air volume; MP4 a larger difference in (kinetic) energy of air/gas molecules/particles; MP5 idea of upper limit to range;	Allow the girl is right amount of water for water level amount of air for air volume speed of molecules /particles water would reach the bulb if the second statement is chosen, no marks	2

(Total for Question 5 = 14 marks)