

Question number	Answer	Notes	Marks
5 (a)	- 268.8 (°C);	Minus sign is essential Allow - 269(°C) - 268.95 (°C)	1
(b) (i)	Any two of - MP1 idea that molecules move faster; MP2 idea that molecules become further apart; MP3 idea that molecules move more freely;	Must be comparative statements relating to boiling Allow increased KE increased vibration Allow (for "freely") idea that forces between molecules have been overcome Ignore ideas of bonding	2
(ii)	Straight line with positive slope; Aimed at origin;	Allow line passing through origin, stopping short or dropping to θ axis at "4.2 K"	2
(c)	Any four of - MP1 Appropriate instrument to measure temperature; MP2 Appropriate instrument to measure volume or length or tube diameter; MP3 Means of varying temperature; MP4 consideration of diameter and volume; MP5 Idea of obtaining a range of values; MP6 Idea of repetition or averaging of readings; MP7 Draw a graph to display results; MP8 Mention of kelvin temperature;	Points may be shown as labelled additions to the diagram e.g. ruler e.g. water bath / heater Allow treatment of anomalies	4

Total 9 marks

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7 (a) (i)	90		1
(ii)	time; either for amount of (radioactive) isotope to halve; or for (radio)activity to halve;	Allow for amount - (number of un-decayed) nuclei/atoms/molecules (un-decayed) mass of isotope	2
(iii)	Any two of – MP1 Idea that (beta) radiation causes a stated hazard; MP2 Idea that strontium-90 has a long half-life; MP3 Idea that <u>all</u> beta emission will be absorbed by the body;	e.g. causes cancer, kills cells, mutates DNA, ionises tissue Accept lasts a long time Accept answers in terms of range	2
(b) (i)	90 and 0; -1; <div style="display: flex; align-items: center; justify-content: center;"> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">90</div> <div style="margin-right: 10px;">Sr</div> <div style="margin-right: 10px;">→</div> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">90</div> <div style="margin-right: 10px;">Y</div> <div style="margin-right: 10px;">+</div> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">0</div> <div style="margin-right: 10px;">β^-</div> </div> <div style="display: flex; align-items: center; justify-content: center; margin-top: 5px;"> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">38</div> <div style="margin-right: 10px;"></div> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">39</div> <div style="margin-right: 10px;"></div> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">-1</div> </div>	Must have both Minus is essential	2
(ii)	Any two ideas from – MP1 They are isotopes of different elements; MP2 Strontium-90 (nucleus/atom) has the same number of protons as other strontium (nuclei/atoms); MP3 Yttrium-90 (nucleus/atom) has the same number of protons as other yttrium (nuclei/atoms);	Allow use of proton number data (38) Allow use of proton number data (39)	2

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8 (a) (i)	Any one of- MP1 Speed / velocity (in a vacuum); MP2 Transverse (wave); MP3 Electromagnetic (wave); MP4 A general wave property;	e.g. reflection, refraction, diffraction, transfer energy	1
(ii)	Any two of- Frequency; Wavelength; Energy;	Any wavelength or frequency relationship if stated must be correct	2
(b) (i)	There are more than two values; Reference to shape/slope/ramp(s);	Accept peaks not all same height not just 1 and 0 Accept RA Ignore "analogue"	2
(ii)	MP1 More than one gap measured / averaging seen; MP2 Value of 1.15 or 1.35 (s);	Allow 2 marks for bald answers of: 1.15 or 1.35 (s) Allow 1 mark (MP1) for bald answers of: 1.2, 1.25, 1.4, 1.55 (s)	2
(iii)	Calculation of frequency (from $f = 1/T$); Unit to match value; e.g. $f = 1/1.15 = 0.87$ Hz	Allow e.c.f from time value given in (b)(ii) $1/1.35 = 0.74$	2

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