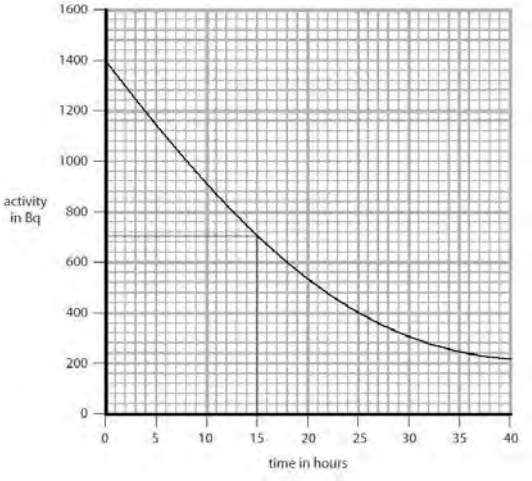
Question number	Answer	Notes	Marks
4 a	(Atoms / nuclei with the) same number of protons; Different numbers of neutrons;	ALLOW relevant correct alternatives e.g. • atomic number, proton number • nucleon number, atomic mass ignore comments about electrons	1 1
b i	Electron;	ignore comments about properties of electrons e.g. speed ALLOW • e^- or e^+ • positron	1
ii	any suitable detector e.g. Geiger(-Muller) tube/detector/counter; photographic film; zinc sulfide; gold leaf electroscope;	ALLOW • phonetic/incorrect spelling	1
iii	beta penetrates paper; beta absorbed/stopped by lead +/or aluminium ;	IGNORE • all details of experimental setup • beta goes through aluminium/eq DO NOT ALLOW • bounced back for absorbed • contradictions in answers e.g. re aluminium	1 1 1

	MP1. line goes through 0,1400 and (first half-life plotted at) 15, 700; MP2. line goes through/second half-life plotted at 30, 350; MP3. a correctly **curved line** between 15 and 30 hours AND the line extends beyond 35 hours; i.e.  	ALLOW for MP2 an ecf from incorrect first half-life to 'correct' second half-life e.g. 800---400 IGNORE • a *slight* upcurve at 35 to 40 hours • Bar charts • **Since this is a sketch then allow tolerance of + / - 1 square on the points**	1 1 1

Question number	Answer	Notes	Marks
d i	any FOUR from: MP1. there is a known proportion / composition / activity when rocks formed; MP2. measure/determine the proportion of uranium or the activity now; MP3. compare activity now to original activity/eq; MP4. (hence) determine the time / number of half-lives elapsed; MP5. (hence) calculate age from reference to half-life;	allow as a numerical example ignore work out the proportion when rocks were formed ALLOW • Bq for activity • radioactivity for activity • amount for proportion IGNORE • measure half-life of uranium • they know its activity ALLOW colloquial expressions such as 'see how long it took to decay this much'	1 1 1 1

ii	MP1. idea that it/half-life is **too** short OR idea that decay occurs **too** quickly/rapidly; PLUS MP2. (hence) **U / isotope** would (all) have decayed (long ago) OR **U activity** would be too small (to distinguish from background / to measure);	comparative of some sort needed for MP1 allow not enough time care that you do not award both alternatives for MP2 IGNORE granite decays it decays	1 1

(Total for Question 4 = 15 marks)