ANSWERS AS20: Radioactivity

1 **(a)** β-emission is the emission of fast-moving electrons from an unstable nucleus.
(b) Proton number = 28, nucleon number = 60.
(c) From 100%→50%→25%→12.5%, so it needs 3 ½-lives which is 3x5.3 = 15.9 yrs.

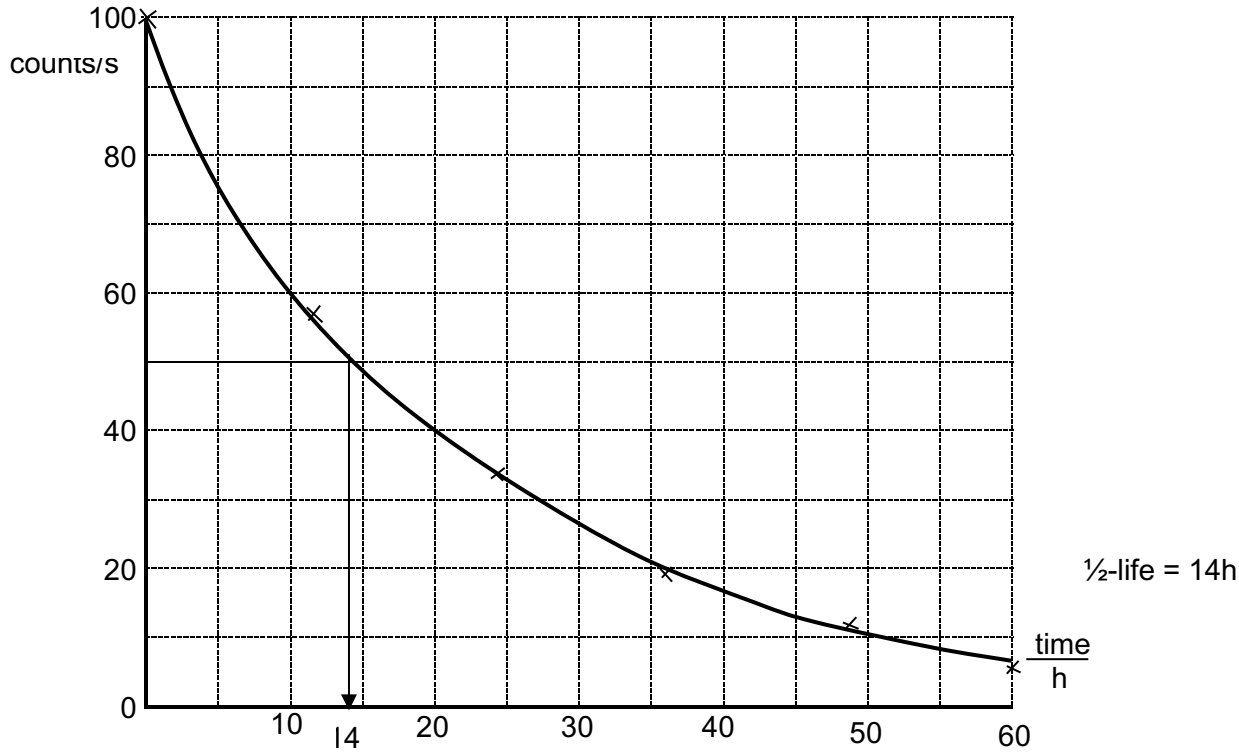
2 The isotope does not emit α-particles although there is a drop in count-rate from 860 to 850, this most probably due to the random property of emission or minimal absorption in the card.
The isotope emits β-particles which are absorbed by the aluminium causing a drop in count-rate from 850 to 25 which is the background count rate.
There is no γ-rays since the count-rate is not affected by the lead / the count rate is already at the background count rate.

3

Element	nucleon number	Proton number	neutron number	Radioactive decay
Radium	228	88	140	$^{228}_{88}Ra \longrightarrow {}^{4}_{2}He + {}^{224}_{86}Rn$ + γ-rays
Radon	224	86	138	$^{224}_{86}Rn \longrightarrow {}^{4}_{2}He + {}^{220}_{84}Po$
Polonium	220	84	136	$^{220}_{84}Po \longrightarrow {}^{4}_{2}He + {}^{216}_{82}Pb$
Lead	216	82	134	$^{216}_{82}Pb \longrightarrow {}^{0}_{-1}e + {}^{216}_{83}Bi$ + γ-rays
Bismuth	216	83	133	

4 **(a)** 53 is the proton number and 135 is the nucleon number /mass number (total number of protons and neutrons).
(b) **(i)** As nuclear decay is a random process
(ii) (1880+1960+1940+1820+1080)/5 = 1916 = 1920 (3 s.f.)
(iii) 21 h = 3 half-lives
final average count rate = 1916 x ½ x ½ x ½ = 240 counts/min (3 s.f.

5



6 **(a)** **(i)** Approximately 1.3 minutes.

(ii) 16.5 millions

(b) 1 minute.

(c) After 8 minutes, sample A almost stop decaying as the graph shows the number of radioactive atoms in the sample goes to '0' at t=8 minutes. There are about 7 millions of radioactive atoms in sample B.