UNIT 6 - RADIOACTIVITY AND NUCLEAR CHEMISTRY

HONORS HOMEWORK 6.1B – HALF-LIVES AND USES OF RADIATION

(a)	A medical engineer is working on a radiotherapy treatment for thyroid cancer.	
	(i)	One treatment he is considering involves injecting some radioactive iodine into the patient's bloodstream. Explain briefly how this treatment is likely to work, what type of radiation the iodine should emit and whether the half-life should be long or short.
		- the iodine will migrate to the thyroid, where it will release radiation, killing the cancerous cells - the radiation should be alpha to maximize ionizing power - the half-life should be short so the body does not stay radioactive
	(ii)	Another treatment he is considering involves firing radiation at the tumor from outside the body. Explain briefly how this treatment is likely to work, what type of radiation he would need and whether the half-life should be long or short.
		- the radiation will reach the tumor and kill the cells - the radiation should be gamma to so it can pass through the body - the half-life should be long so you don't have to replace the machine regularly

(b)	A paper factory is developing a technique for using radioactive material to monitor the thickness of the paper being produced. Suggest how the technique might work. Indicate what type of radiation should be used and whether the radioactive material should have a long or short half-life.
	- fire radiation at the paper with a detector on the other side; the more radiation detected, the thinner the paper - the radiation should be beta as alpha can't pass through paper at all and gamma is not affected by paper - the half-life should be long so you don't have to replace the machine regularly

(c)	The half-life of carbon-14 is 5730 years.
	If a fossil is approximately 23,000 years old, approximately what percentage of its carbon-14 should still be present?
	n = 23,000/5730 = 4; 4 half-lives = 1/16 x 100% = 6.25%
	Bruno has discovered a skeleton which he thinks might be the remains of Jesus. He carbon-dates the skeleton and finds that 78.6% of its carbon-14 is present. Has Bruno discovered Jesus?
	$\log(\frac{N_i}{N}) = \log(\frac{100}{78.6}) = 0.105 = \frac{t\log 2}{t_{1/2}} = \frac{0.301\ t}{5730}$ $t = \frac{0.105 \times 5730}{0.301} = 1990$ years 2020 – 1990 = 30 AD so it could be Jesus (Jesus died in 33 AD)