Shedding Light on Nuclear Radiation Episode 5: Half-Life and Activity Name: _____

Part A:

1. Iodine-131 decays at a faster/slower (circle the correct answer) rate than cobalt-60 does.

Part B:

2. Cobalt-60 has a half-life of 5.27 years. If you started with a sample of 100.0 g at the beginning, then after…

a. 1 half-life has elapsed (_____ years), your sample would contain _____ g of Co-60 and _____ g of Ni-60.
b. 2 half-lives have elapsed (_____ years), your sample would contain _____ g of Co-60 and _____ g of Ni-60.
c. 3 half-lives have elapsed (_____ years), your sample would contain _____ g of Co-60 and _____ g of Ni-60.

The answers to the rest of the questions in Part B cannot be found in the video.

3. Yttrium-90 is an isotope of yttrium. It is a beta emitter used to treat some forms of cancer. Its half-life is 60 hours and it decays into zirconium-90 (which is stable). Fill in the table below.

Decay of a 100-gram sample of (beta-emitting) Yttrium-90 ($t_{½}$ = 60 hours)

Number of half-lives	Time in Hours	Time in Days	Amount of Yttrium-90 in Sample (g)	Fraction of original amount that has not decayed yet.	Amount of Zirconium-90 in Sample (g)
0	0	0	100	1	0
1	60			1/2	
2					
3					
4					
5					
6					

4. Sodium-24, which is used to locate blood clots in the human circulatory system, has a half-life of 15.0 hours. A sample of sodium-24 with an initial mass of 20.0 g was stored for 45.0 hours. How many grams of sodium-24 is left in the sample after 45.0 hours? HINT: you may want to (a) draw a little table or (b) calculate how many half-lives and then keep halving the original amount that many times or (c) add the amounts remaining to the graphic.

0 → 1 half-life → 2 half-lives → 3 half-lives

5. Sodium-24 decays into magnesium-24 via beta-minus emission. Using your answer above, calculate how many grams of Mg-24 will have been produced in the decay process (after 45 hours).

6. An isotope of technetium has a half-life of 6 hours. If it is given to a patient as part of a medical procedure, what fraction of the radioisotope remains in the body after one day?

7. The half-life of plutonium-239 is 24,300 years. If a nuclear bomb released 50 g of this isotope, how many years would pass before the amount is reduced to 12.5 g?

8. If 100 grams of Au-198 decays to 25 grams in 5.4 days, what is the half-life of Au-198?

9. If you have 35g of caesium-137, which has a half-life of 30 years, how much would you have had 30 years ago?

10. A particular isotope of technetium has a half-life of 6.0 hours. A 5-gram sample is needed in a Darwin hospital but it takes 18 hours to get the sample from the nuclear reactor in Sydney where it is made to the hospital in Darwin. How many grams need to be produced to satisfy the order?

11. Cobalt-60 has a half-life of 5.3 years. If I have 0.25g now, how much was there when I originally bought the sample 10.6 years ago?

Part C:

12. What is the activity of 1 gram of U-235? _____becquerels.
13. Calculate the activity of a 0.5-gram sample of U-235.

14. Calculate the activity of a 0.1-gram sample of U-235.

15. Complete the table below.

Decay of 1 g of cobalt-60 ($T_{1/2}$ = 5.27 years)			
Number of half-lives	**Time (years)**	**Amount of Co-60 (g)**	**Activity (Bq)**
0	0	1	
1			
2			
3			
4			

16. The activity of a tiny sample of a certain radioisotope decreases from 4000 Bq to 1000 Bq in 12 days. Calculate the half-life of the radioisotope.

17. The activity of a sample of cobalt-60 halves every half-life, but the activity of a sample of U-235 doesn't halve every half-life. Why not?

_____

_____

_____

_____

18. Use the prefixes k, M, G, T, P, and E to simplify the values below.

(a) 3,000 Bq = 3 _____ (b) 450,000 Bq = 450 _____ (c) 500,000,000 Bq = 500 _____

(d) 39 x 10^{12} Bq = _____ (e) 580 x 10^{15} Bq = _____

(f) 2,500 Bq = _____ (g) 8,300 Bq = _____ (h) 17 billion Bq = _____