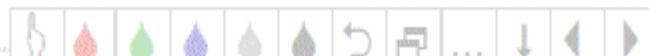


Announcements – Lecture XXIV – Tuesday, May 1<sup>st</sup>

1. Exam III:

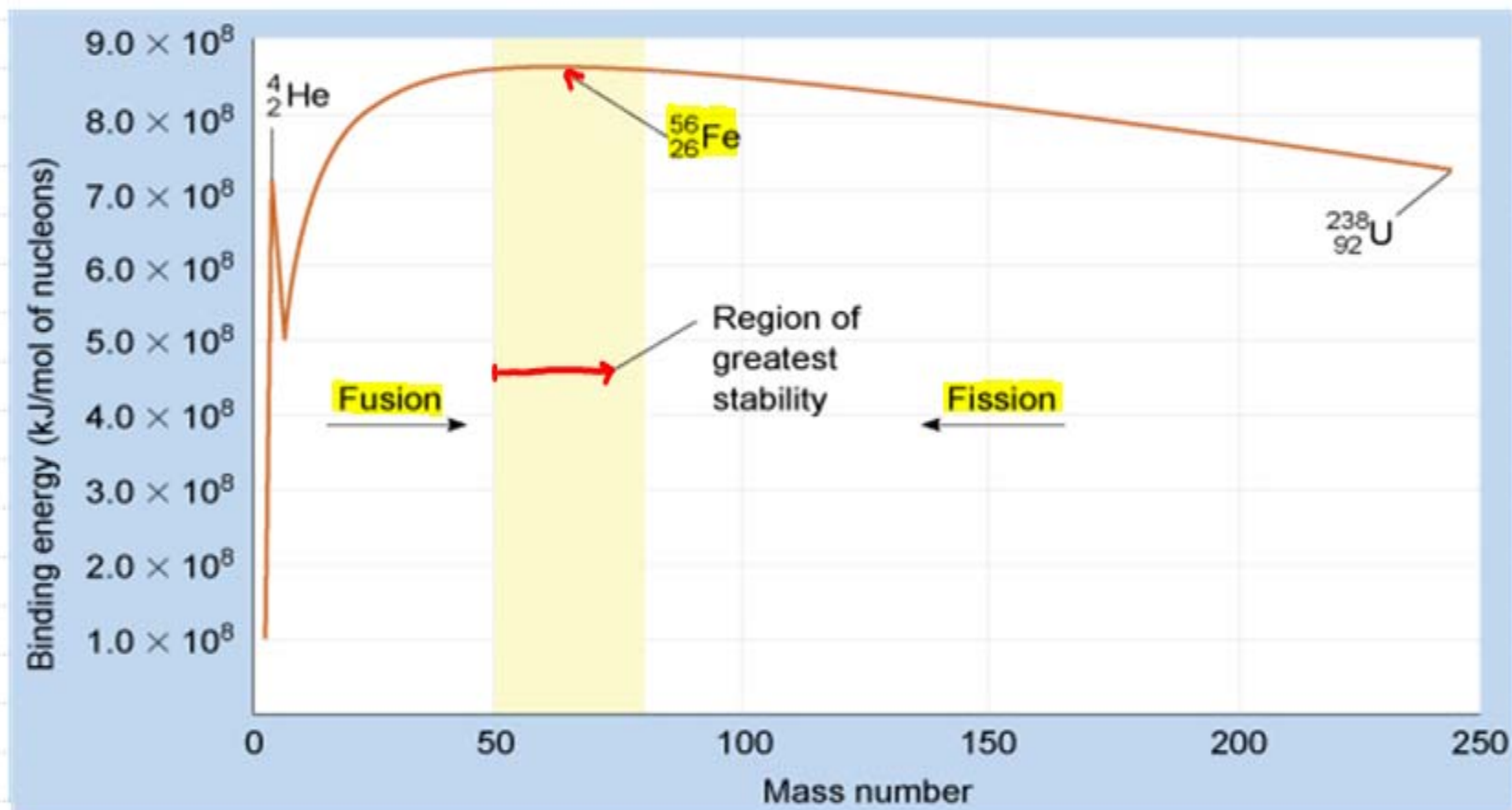
Thursday, May 3<sup>rd</sup>, 1:00-3:00pm, ISB 135

Time to Say  
Goodbye



## 24.2 Nuclear Stability

### Relative Binding Energy

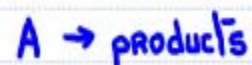


## 24.3 Kinetics of Radioactive Decay

### Rate of Decay

Radioactive Decay follows first order kinetics.

FIRST ORDER KINETICS RECALL:



Integrated rate law:

$$\ln \frac{[A]_t}{[A]_0} = -kt$$

Half life:

$$t_{1/2} = \frac{\ln 2}{k}$$

Radioactive Decay:

Substitute N - the number of nuclei - for A

$$\ln \frac{[N]_t}{[N]_0} = -kt$$

$$t_{1/2} = \frac{\ln 2}{k}$$

## 24.3 Kinetics of Radioactive Decay

### Rate of Decay

Radioactive radon-222, found in many homes, is a potential health hazard. The half-life of radon-222 is 3.82 days. How much time is required for the activity of a sample of radon-222 to fall to 19.5 percent of its original value?

  $\rightarrow 9$   
? days

$$t_{1/2} = \frac{\ln 2}{k}$$

$$3.82 = \frac{0.693}{k}$$

$$3.82k = 0.693$$

$$k = \frac{0.693}{3.82} = 0.1815$$

$$\ln \frac{[N]_t}{[N]_0} = -kt$$

$$[N]_t = 0.195 \quad [N]_0 = 1$$

$$\ln 0.195 = -0.1815t$$

$$-1.6348 = -0.1815t$$

$$t = \frac{-1.6348}{-0.1815} = 9 \text{ days}$$

## 24.3 Kinetics of Radioactive Decay

### Radioactive Dating

An artifact classified as seeds, found in a site at Newlands Cross, Ireland, is found to have a  $^{14}\text{C}$  radioactivity of  $9.71 \times 10^{-2}$  counts per second per gram of carbon. If living carbon-containing objects have an activity of  $0.255$  counts per second per gram of carbon, estimate the age of the artifact?

The half-life of  $^{14}\text{C}$  is **5730 years**

$$t_{1/2} = \frac{\ln 2}{k}$$
$$t_{1/2} = 5730 \text{ years}$$

$$t_{1/2} k = \ln 2$$
$$5730 k = 0.6931$$

$$k = \frac{0.6931}{5730} = 1.21 \times 10^{-4}$$

$$\ln \frac{[N]_t}{[N]_0} = -kt$$
$$[N]_t = 9.71 \times 10^{-2} \quad [N]_0 = 2.55 \times 10^{-1}$$

$$\ln \frac{9.71 \times 10^{-2}}{2.55 \times 10^{-1}} = -1.21 \times 10^{-4} t$$

$$\ln 0.381 = -1.21 \times 10^{-4} t$$
$$-0.965 = -1.21 \times 10^{-4} t$$

$$t = \frac{-0.965}{-1.21 \times 10^{-4}} = 7.98 \times 10^3 = 7980 \text{ years}$$



**24.5 Applications and Uses of Nuclear Chemistry**  
**Nuclear Medicine – Positron Emission Tomography**



## 24.5 Applications and Uses of Nuclear Chemistry

### Radioactivity in the Home



PROBLEM:



↳ adheres to lung tissue.



SOLUTION:

Seal all cracks.  
Ventilate the basement.