Nuclear Stability

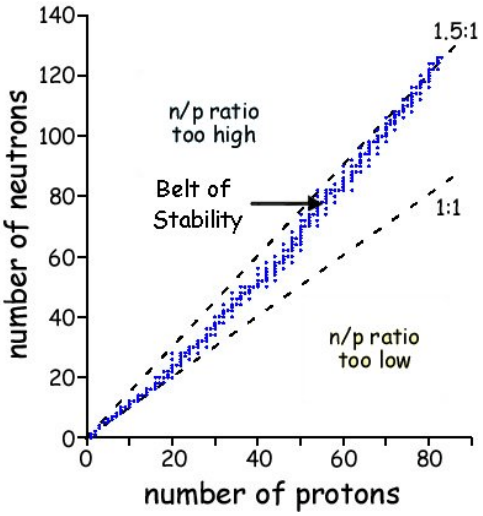
Aim

- to explain why substances are radioactive

Notes

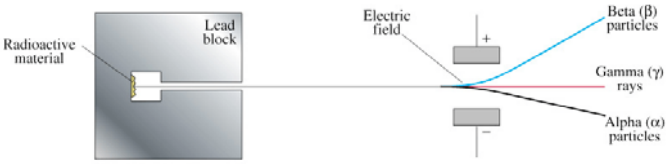
Instability

- ★ Protons repel each other
  - ☆ the higher the atomic number is, the greater the repulsion among protons is, making the nucleus unstable
    - ★ atoms with atomic numbers above 82 have no stable isotopes
  - ☆ neutrons help to stabilize the nucleus
    - ★ hydrogen is the only element that does not have neutrons
    - ★ as the number of protons increases, the number of neutrons needed to keep the nucleus stable increases
    - ★ the ratio of neutrons to protons in stable nuclei is between 1:1 and 1.5:1, the higher ratio being associated with larger nuclei that have larger repulsive forces
      - ★ stable atoms have a ratio of neutrons to protons that falls in the belt of stability.



Radioactivity

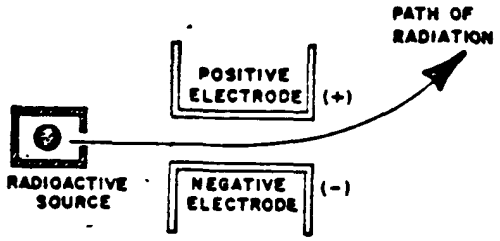
- ★ Unstable nuclei break apart or decay
  - ☆ decaying nuclei release high speed particles and energy called radioactive emissions
  - ☆ radioactive emissions separate in an electric field into three main types
    - ★ alpha particle – helium nucleus
    - ★ beta particle – electron
    - ★ gamma ray – energy
  - ☆ other important emissions – positrons



COMMON RADIOACTIVE EMISSIONS				
Particle	**Mass**	**Charge**	**Symbol**	**Penetrating Power**
Alpha	4 amu	2+	${}^{4}_{2}He$ or α	low
Beta	0 amu	1–	${}^{0}_{-1}e$ or β^-	moderate
Positron	0 amu	1+	${}^{0}_{+1}e$ or β^+	moderate
Gamma	0 amu	0	γ	high

Answer the questions below by circling the number of the correct response

1. A radioactive source emits radiation which is deflected as shown in the diagram below.



This radiation could be

(1) $^{0}_{-1}e$ (3) $^{1}_{1}\mathrm{H}$

(2) $^{4}_{2}\mathrm{He}$ (4) $^{1}_{0}\mathrm{n}$

2. Which product of nuclear decay has mass but no charge?
   (1) alpha particles (3) gamma rays
   (2) neutrons (4) beta positrons