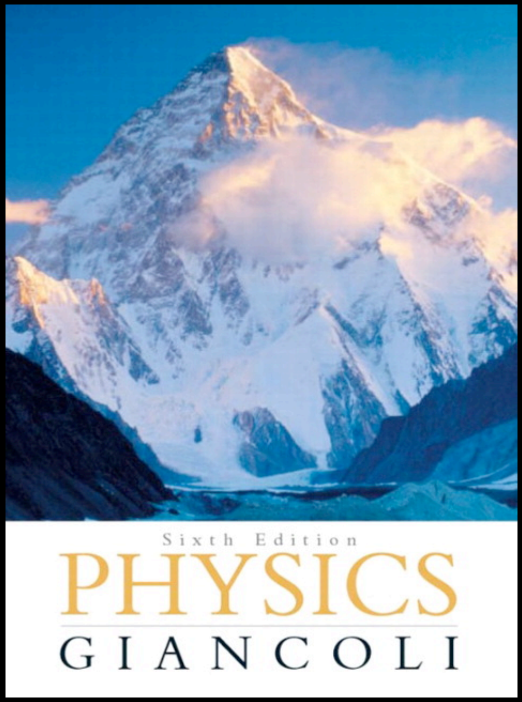

ConcepTest PowerPoints

Chapter 31

Physics: Principles with Applications, 6th edition

Giancoli

ConcepTest 31.1 Nuclear Reactions

What is the Q-value for radioactive decay reactions?

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2) $Q > 0$
3) $Q = 0$
4) sign of Q depends on the nucleus

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Radioactive decay happens ***spontaneously***, because the nucleus can reach a lower energy state. Thus, such reactions can only occur spontaneously if they ***release energy*** (***exothermic***), so the **Q-value is positive**.

Follow-up: Is radioactive decay an endothermic or exothermic reaction?

ConcepTest 31.2 Nuclear Reaction Products

What is the nucleus that results in the reaction given below?

$$n + {}^{16}_{8}O \rightarrow ? + {}^{2}_{1}H$$

1) ${}^{17}_{8}O$

2) ${}^{15}_{7}O$

3) ${}^{15}_{7}N$

4) ${}^{15}_{7}F$

$${}^{A}_{Z}X$$

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Add up the totals for nucleons (A) and protons (Z) separately, and see what you need to balance both sides:

Nucleons: $1 + 16 = x + 2 \Rightarrow x = 15$

Protons: $0 + 8 = y + 1 \Rightarrow y = 7$

The missing nucleus has $A = 15$ and $Z = 7$.

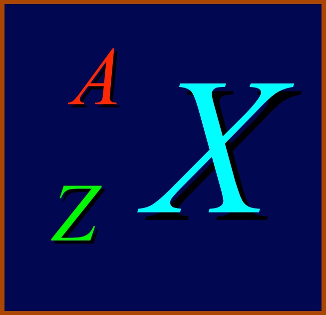
$${}^{A}_{Z}X$$

Follow-up: What would you get if you started with $p + {}^{16}O$ instead?

ConcepTest 31.3 Beta Decay Products

What element results when ^{14}C undergoes **beta decay**?

1) ^{15}C
2) ^{15}N
3) ^{14}C
4) ^{14}N
5) ^{15}O



ConcepTest 31.3 Beta Decay Products

What element results when ^{14}C undergoes beta decay?

1) ^{15}C
2) ^{15}N
3) ^{14}C
4) ^{14}N
5) ^{15}O

The reaction is: $^{14}_{6}C \rightarrow {}^{14}_{7}N + e^{-} + \text{neutrino}$

Essentially, a neutron turns into a proton (emitting a β^{-} particle), so the atomic number Z of the nucleus must increase by one unit, but without changing the atomic mass A.

$^{A}_{Z}X$

ConcepTest 31.4 Nuclear Fission

How does the **total mass** of the **fission fragments** compare to the mass of the **original nucleus** in a fission reaction?

1) fission fragments have more mass
2) fission fragments have less mass
3) fission fragments have the same mass

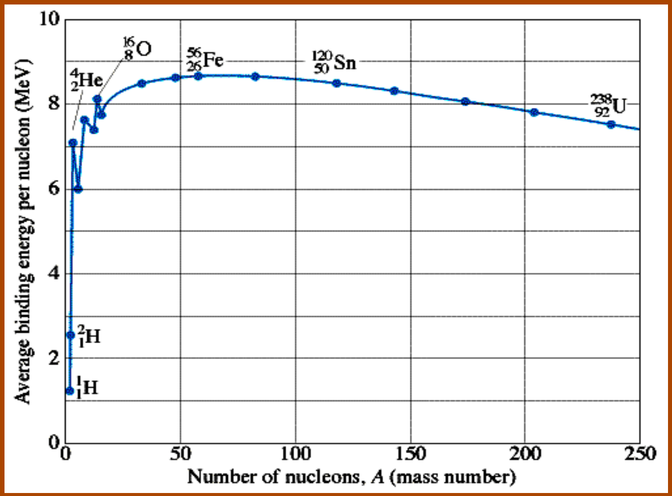
ConcepTest 31.4 Nuclear Fission

How does the total mass of the fission fragments compare to the mass of the original nucleus in a fission reaction?

1) fission fragments have more mass
2) fission fragments have less mass
3) fission fragments have the same mass

The fission reaction releases energy, so the total energy (or mass) of the fission fragments must be less than the energy (or mass) of the original nucleus.

Follow-up: Where are the fission fragments located relative to the original nucleus on the curve of binding energy per nucleon?



ConcepTest 31.5 Nuclear Fusion

How does the **binding energy per nucleon** of a fusion product compare to that of the pieces that combined to form it?

1) product has greater BE than the pieces

2) product has less BE than the pieces

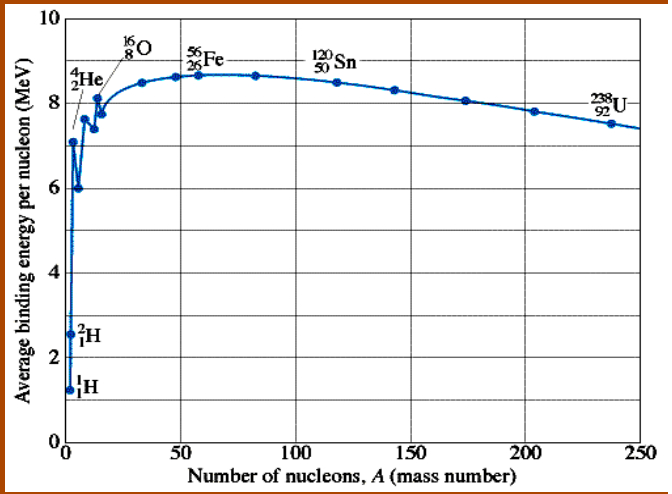
3) product has the same BE than the pieces

ConcepTest 31.5 Nuclear Fusion

How does the binding energy per nucleon of a fusion product compare to that of the pieces that combined to form it?

1) product has greater BE than the pieces
2) product has less BE than the pieces
3) product has the same BE than the pieces

The fusion reaction releases energy, so the product is more tightly bound (more stable) than the separate pieces that combined to form it. This means that the binding energy per nucleon is greater for the fusion product.



Follow-up: Which weighs more: the fusion product or the pieces?

ConcepTest 31.6 Radiation Shielding

Which type of radiation goes farther in matter before losing all of its energy ?

1) alpha radiation
2) beta radiation
3) gamma radiation
4) all about the same distance

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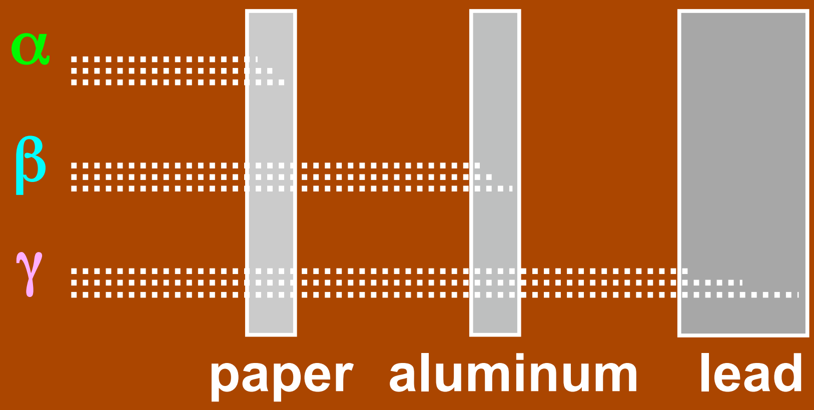
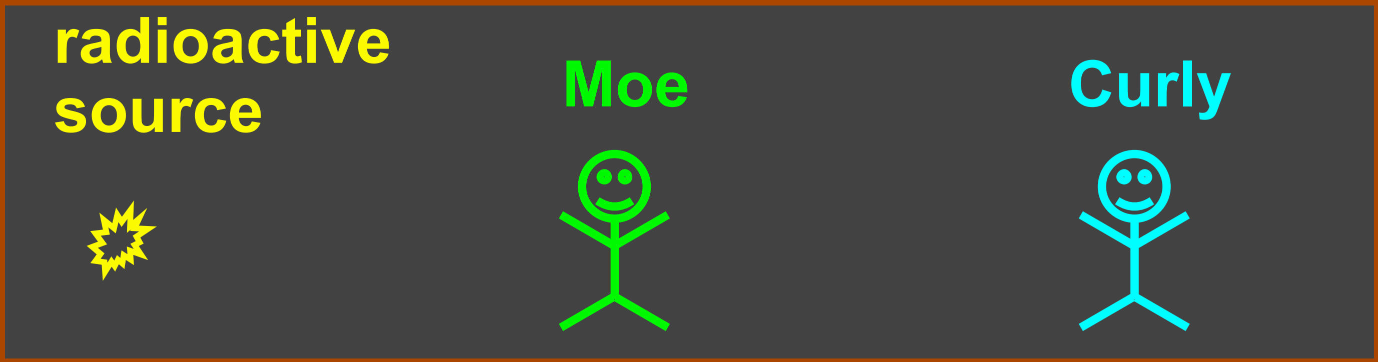
Alpha particles have such a large charge, they ionize many atoms in a short distance, and so lose their energy rapidly and stop. Gamma rays travel great distances before ionizing an atom.



ConcepTest 31.7a Radiation Exposure I

Curly is twice as far from a small radioactive source as Moe. Compared to Curly's position, the intensity of the radiation (and therefore exposure) at Moe's position is about:

1) one-quarter
2) one-half
3) the same
4) double
5) quadruple



ConcepTest 31.7a Radiation Exposure I

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1) one-quarter
2) one-half
3) the same
4) double
5) quadruple

A small source can be treated as a point source and so it obeys the inverse square law of intensity. Twice as close means 4 times the intensity (and therefore exposure).

ConcepTest 31.7b Radiation Exposure II

Curly is working **5 m** from a highly radioactive source and must reduce his exposure by **at least a factor of 10**. Assuming that an **inverse square law ($1/r^2$)** applies in this case, to what distance should he move?

1) 7.5 m
2) 10 m
3) 15 m
4) 20 m
5) 50 m

ConcepTest 31.7b Radiation Exposure II

Curly is working 5 m from a highly radioactive source and must reduce his exposure by at least a factor of 10. Assuming that an inverse square law ($1/r^2$) applies in this case, to what distance should he move?

1) 7.5 m
2) 10 m
3) 15 m
4) 20 m
5) 50 m

A small source can be treated like a point source and so it obeys the inverse square law of intensity. Moving to 15 m (3 times farther) only reduces the exposure by 9 times. He has to move farther away (20 m) in order to get a factor of 16 reduction, which meets the "safety limit" of 10 times.

ConcepTest 31.8 Radiation Damage

Radiation can damage matter such as metals or biological tissue by:

1) heating up the material
2) causing cancer in the metal
3) producing fission reactions in the material
4) removing electrons from the atoms
5) producing fusion reactions in the material

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Radiation can ionize the atoms in matter, which means knocking out electrons. Metals become brittle and cell processes can be disrupted.

Follow-up: What type of radiation will tend to do the most damage?