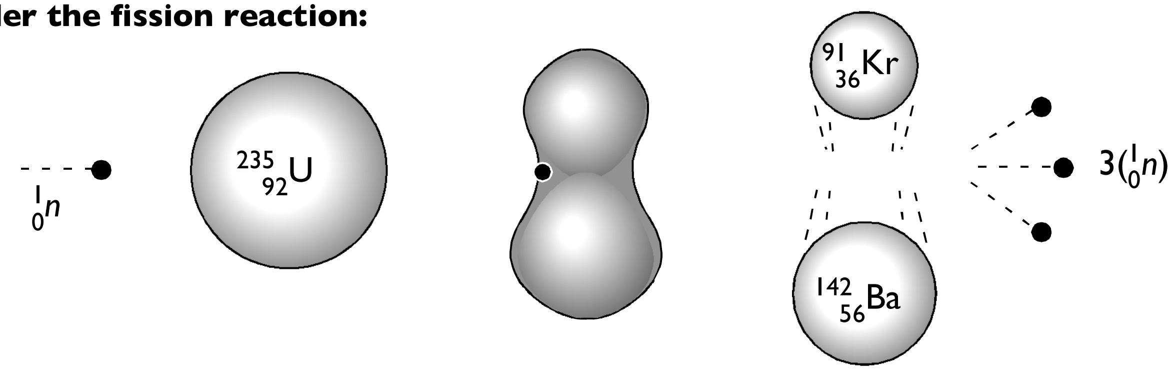
Name____ Period________ Date__________

CONCEPTUAL PHYSICS ALIVE! VIDEO QUESTION SET

Fission and Fusion

In this lecture, Paul Hewitt discusses the mechanics of nuclear fission and fusion. And he explains why each of the seemingly opposite processes is capable of releasing energy. Read the following questions before the presentation begins. Answer them while the presentation is in progress. [40 minutes]

Consider the fission reaction:



1. The neutron that triggers the reaction
A. is a low-speed neutron. **B. is a high-speed neutron.**
C. may be a low-speed or a high-speed neutron.

2. A fast-moving golf ball would be slowed down best if it
A. struck a solid wall and bounced back.
B. entered an arena of bowling balls.
C. entered an arena of Ping Pong balls.
D. were allowed to slow under its own inertia.

3. What is the energy output of each?

a. A drop of water over Niagara Falls: ___________________ eV

b. One molecule of high-octane gasoline: ___________________eV

c. One atom of uranium-235 undergoing fission: ___________________eV

4. Fill in the missing terms of the nuclear processes described in the lesson.

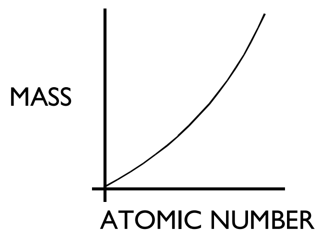
$$^{238}_{92}U + ^{1}_{0}n \rightarrow ^{239}_{92}U$$

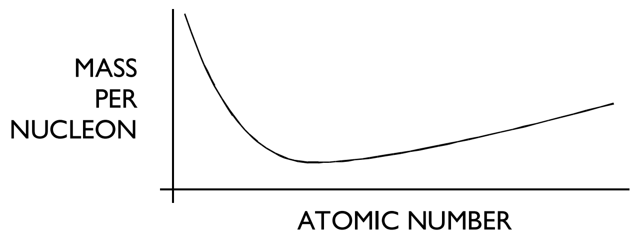
$$^{239}_{92}U \rightarrow ^{0}_{-1}e +$$

$$\rightarrow ^{0}_{-1}e +$$

5. Approximately how much U-235 was left in the US arsenal after the bomb was dropped that devastated Hiroshima?

Consider the graphs.





6. The mass of a nucleon (proton or neutron)
A. is universally constant. **B. depends on the nucleus it's in.**

7. Consider the particles before and after fission. Which set has more mass?
A. $^{1}_{0}n + ^{235}_{92}U$ **B.** $^{91}_{36}Kr + ^{142}_{56}Ba + 3(^{1}_{0}n)$ **C. same for both**

8. Energy released in nuclear fission can be used to boil water, turning it to steam. The steam can be used to spin a paddle wheel. The paddle wheel can be hooked to a ______________________________ which—when spinning—will produce ______________________________.

9. If you split a light nucleus such as magnesium,
A. energy will be released. **B. nucleon mass will increase.**
C. Both of these will occur. **D. None of these will occur.**

10. Helium has
A. less mass than hydrogen. **B. less mass per nucleon than hydrogen.**
C. both of these. **D. neither of these.**

11. If 200 MeV is released when a uranium nucleus undergoes fission, how much energy is needed to fuse the fission by-products back together?

12. What could you do to release energy from iron nuclei?
A. split them (fission) **B. join them (fusion)** **C. both** **D. neither**

13. How much matter is converted to energy each second by the Sun?

14. What makes fusion-based power production difficult on Earth?
A. neutrons are hard to come by
B. the nuclear strong force is hard to overcome
C. hydrogen nuclei electrostatically repel
D. fusion cannot occur at temperatures lower than that of stars

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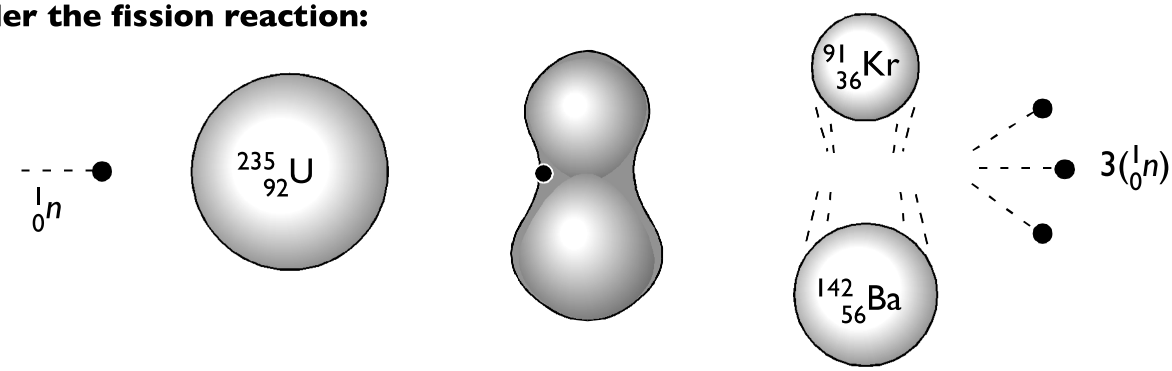

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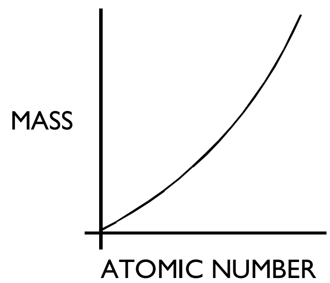
$$^{239}_{92}U \rightarrow ^{0}_{-1}e +$$

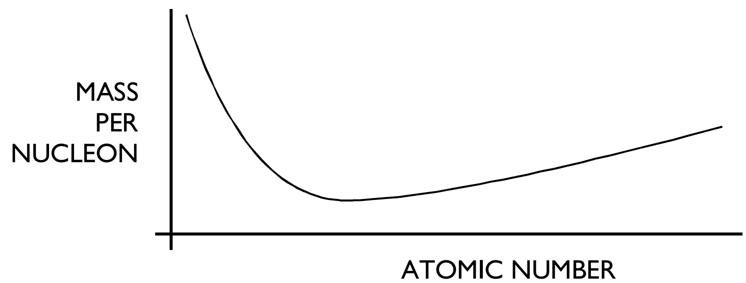
$$+ ^{0}_{-1}e \rightarrow$$

5. The bomb that devastated Hiroshima was made with _?_; the bomb that devastated Nagasaki was made with _?_.

A. uranium; uranium **B. uranium; neptunium**
C. neptunium; plutonium **D. uranium; plutonium**
E. neptunium; uranium **F. plutonium; plutonium**

Consider the graphs.





6. The mass of a nucleon (proton or neutron)
A. is universally constant. **B. depends on the nucleus it's in.**

7. What becomes of the mass missing after a fission reaction?

8. The by-products of nuclear fission are
A. neutron-rich. **B. radioactive.** **C. both of these** **D. none of these**

9. The name of the game in any means of power production is to have

10. Helium has
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14. If a nuclear power plant were to undergo catastrophic failure, it would
A. explode in a nuclear chain reaction.
B. undergo a series of chemical explosions.
C. overheat, sending radioactive material into the environment.
D. create a quantum singularity, creating a black hole.