

CENTRIPETAL FORCE Unit 14 Dr. John P. Cise , Professor of Physics , Austin Community College,

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Preliminary Information: Uranium **235 has 92 protons and 143 neutrons. Uranium 238 has 92 protons and 146 neutrons.**

Iran is separating U-235 from U-238. Rare in nature, U-235 easily splits in two to produce bursts of atomic energy. It also has three fewer neutrons than its cousin, making it slightly lighter and thus a candidate for centrifuge separation. First, engineers turn the natural mix of uranium (0.7 and 99.3 percent, respectively) into a gas. **Then, the centrifuge throws the heavier U-238 atoms toward the wall, letting the rare U-235 ones accumulate near the center.** The results get scooped up continually. Rows of centrifuges repeat the process to slowly raise the rare isotope's concentration. It seems easy. But the **centrifuges spin at about the speed of sound**, must work day and night for months or years on end and can easily lose their balance, tearing themselves apart.

Proton mass = 1.6726×10^{-27} kg , mass of Neutron = 1.6749×10^{-27} kg.

Question:(a) At 0.15 meters from center of centrifuge find the centripetal force on Uranium 235 ? As mentioned above the centrifuge speed is the speed of sound(331 m/s). (b) Same as (a), but Uranium 238?

Answer: (a)U235... 2.8733×10^{-19} Newtons (b) U238..... 2.91×10^{-19} Newtons



Speeding Up Enrichment

Iran released a set of 48 images showing President Mahmoud Ahmadinejad touring the Natanz uranium enrichment facility on April 8.

Above, Mr. Ahmadinejad walks between cascades of P-1 centrifuges, which are Pakistani-designed.

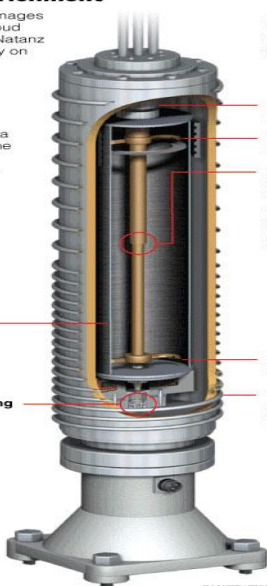
A NEW GENERATION OF CENTRIFUGE

Surprisingly, the photos also show components of a new machine, known as the IR-2, for Iranian second generation, about half the size of the P-1 but faster and more powerful.



Carbon fiber rotor is lighter than previous steel and aluminium rotors, and able to spin up to twice as fast.

Low-friction bottom bearing is the most secret and critical component of the centrifuge. The bearing supports the full weight of the rotor. Spiral grooves on the head aid the flow of lubricant.



Magnetic bearing holds the inner rotor in place.

Upper scoop collects the lighter Uranium 235 gas.

Uranium hexafluoride gas is fed into the rotor. Gas molecules that contain an atom of Uranium 238 are slightly heavier, and will move toward the outside of the spinning centrifuge.



Uranium 235
92 Protons,
143 Neutrons

Uranium 238
92 Protons,
146 Neutrons

Lower scoop collects the heavier Uranium 238 gas.

Water-filled pipes help control the temperature of the inner chambers.

ILLUSTRATION BY MIKA GRÖNDAHL/THE NEW YORK TIMES