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Question 30) From Quanta to Quarks.

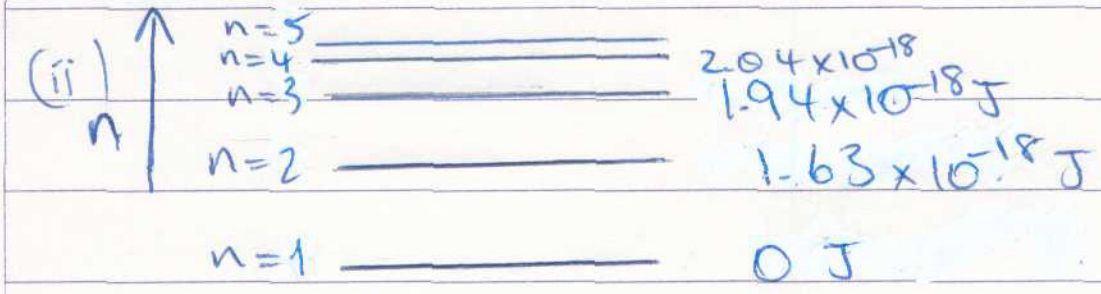
(a) ~~(i) Nucleons is the collecti~~

(i) Protons and neutrons are collectively called nucleons.

(ii) Neutron is a neutral particle.
Proton is a positively charged particle.

(b) (i) $2.04 \times 10^{-18} - 1.94 \times 10^{-18}$
$= 1.00 \times 10^{-19}$ J.

(ii)



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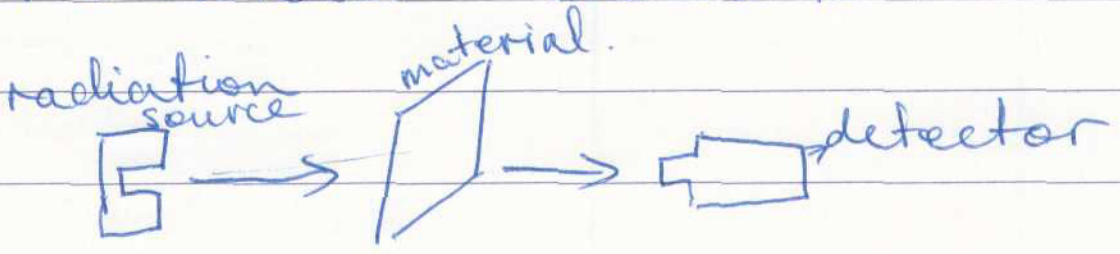
(c) * Get sources of alpha, beta and gamma radiation.
* Gather different materials to be tested.
eg. thin aluminium foil, thin Pb foil, piece of paper and several centimetres of concrete.
* Place the material in between the radiation source and a detector.



* The detector will show the amount of radiation.
* From the results, it was found out that alpha is the least penetrating not even penetrating paper. Gamma is the most penetrating, stopped by several centimetres of concrete. Beta is in between in terms of penetrating power.

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(d) The Manhattan Project is the codename given to the development of atomic bombs during Word War II.

~~Advantages:~~

* After the atomic bomb was developed, the Americans dropped it on two Japanese cities destroying both of them. An atomic bomb is an example of an uncontrolled chain reaction. The ~~re~~ Unlike a controlled chain reaction there is a build up of neutrons which cause more ~~fission~~ and more fission with $^{235}_{92}U$ atoms and release energy and heat indefinitely. This is what happened when the bomb was dropped on the two cities of Japan. Many people died of the heat produced

Advantages:

- The dropping of the ~~world~~ bomb caused Japan to surrender which ended the war.

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- With the end of the war, lives of many people were saved.
- Countries are now aware of the destroying powers of their weapons and so are more cautious.
- With this awareness, possible wars could be prevented in the future.

Disadvantages:

- Many people we killed in the two cities of Japan with the dropping of the bomb.
- Radiation caused by the bomb caused cancers in people even ~~the~~ ~~after~~ many years after the bomb was dropped.
- Another world war might mean the end of the world as these weapons are capable of destroying the world.

There are both advantages and disadvantages of the Manhattan Project. As a result of the project USA emerged as the most powerful country in the world.

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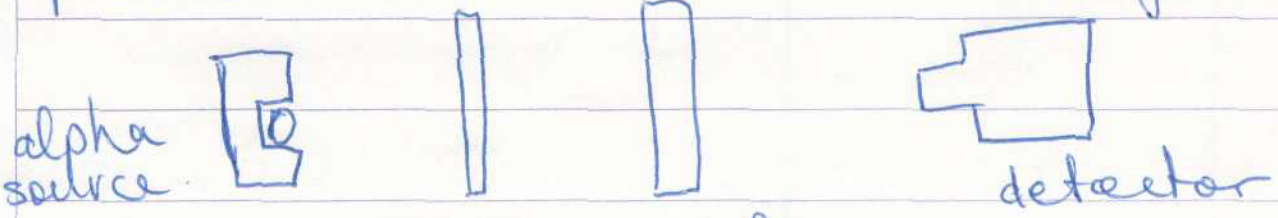
(e) Chadwick was responsible for discovering the neutrons. When α particles were fired at Beryllium, a penetrating particle was emitted. This penetrating particle was the neutron but it was hard to detect as it was neutral. To detect it, the particle must cause ionisation, To detect it, the neutrons were directed towards a proton rich parrafin. Using the laws of conservation of momentum and energy, Chadwick proved that the penetrating particle was a neutron. As a result of elastic collisions protons were emitted which were easy to detect.



The discovery of the neutron, led to the

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discovery that the nucleus of an atom was ~~made of~~ consisted of neutrons and protons which later led to many other discoveries about the structure of the atom. With these discoveries technology improved and standard of living improved.

Fermi bombarded as many of the known elements as possible with neutrons. In most cases a new element was produced ~~from~~ some being radioactive. Han and Strassman repeated Fermi's experiment with $^{238}_{92}U$ atoms. Other than the new elements being formed, they found the atom $^{141}_{56}Ba$. This they believed was caused by the splitting of another atom $^{235}_{92}U$. They had discovered nuclear fission but were

* $^{235}_{92}U$ was present in the $^{238}_{92}U$ in little amounts

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reticent to conclude

Later, Fermi using graphite as his moderater initiated the first self sustaining fission reaction. The nuclear age had began! ~~With this, ex experiment~~

~~As result of fermi's work with nuclear fission~~

As a result of Fermi's work, it was discovered that some isotopes go through fission and some don't. Fission is the splitting of the atom. The energy released in the splitting went to the mass defect or added to binding energy. His work was another support for mass defect.

The neutrons discovered by Chadwick were later used in neutron scattering to analyse the internal structure of bulk matter.