(a) i) when a radioisotope is brought near a wilson cloud chamber, the particles cause the air in the chamber resulting in ~~condensation~~ condensation, leaving trails. Alpha decay can be distinguished as Alpha particles leave short thick trails, while for beta decay, beta particles leave long relatively straight ~~trail~~ trails.

ii) mass defect = mass of product − mass of resultant

$= 218.00897u - (213.99981u - 4.00260u)$

$= 8.01176\ u$

$= 8.01176 \times 1.661 \times 10^{-27}$

$= 1.33 \times 10^{-26}\ kg$

$\therefore E = mc^2$

$= 1.33 \times 10^{-26} \times (3 \times 10^8)^2$

$= 1.19 \times 10^{-9}\ J$

(b) i) $\lambda = 0.2 \times 10^{-9}$ m

$m = 1.675 \times 10^{-27}$

$h = 6.626 \times 10^{-34}$

$\lambda = \frac{h}{mv}$

$v = \frac{h}{m\lambda}$

$= \frac{6.626 \times 10^{-34}}{1.675 \times 10^{-27} \times 0.2 \times 10^{-9}}$

$= 1977.9 \text{ ms}^{-1}$

ii) neutrons are useful in determining structure of neutrons ~~ee~~ due to ~~their~~ its properties. Neutrons ~~are~~ have no charge, hence they ~~do not~~ are not influenced by the forces, in the nuclei. The only deflection which can occur is a collisions with other particles. Also, compared to an electron, neutrons have a greater mass, allowing neutrons to further penetrate a crystal structure than say electrons. These properties allow for a clear imaging of crystal structures as having no charge means it can explore the structure unimpeded by forces and greater mass allowing it to travel further into a structure of a material.

(c) when a high voltage is passed through a glass tube containing low pressure hydrogen gas, is viewed through a spectroscope, ~~the speed~~ the discrete spectral lines are visible. * ~~Bohrs model of the atom states~~ proposed that when an electron moves from one energy level to a lower energy level it emits light energy which is quantised according to $E=hf$, which is equal to the difference between the two states.

the spectroscope was important because it gave Bohr evidence for the quantised light energy which is emitted when electrons move to lower states, which was the discrete spectral lines in the hydrogen atom. If energy wasn't quantised, so all energy values are possible, there would be an infinite number of spectral lines. However, having only discrete amount of spectral lines suggest that only light energy at specific amount ~~specific magnitude~~ ($E=hf$) can be emitted.

* Bohrs postulates are
- electron orbits exist in stationary states.
- the movement of electron to different states can accompanied by the emission of EMR
- angular momentum is quantised.

~~This postulate of the bohr model of the atom~~ explained that

If you require more space to answer parts (a), (b) and (c) of the question, you may ask for an extra writing booklet.

If you have used an extra writing booklet for parts (a), (b) and (c) of the question, tick here. ☐

(d) i) ~~when they fired~~ they concluded that particles had a wave nature as debroglie proposed. This is due to the interference pattern, which was similar to x-rays, when the electrons were sent back to the detectors, and ~~they~~ their calculated wavelength for electrons was similar to that of debroglie

ii) Rutherford's model couldn't explain why ~~an orbit~~ electrons are in their orbits as accelerating electron orbiting at the nucleus emitting EMR ~~doesnt~~ spiral into the nucleus. Bohrs refinement of this model suggested that electron orbits are in stationary states which doesn't emit any EMR and he used ~~along~~ that the angular momentum is quantised as ~~stable~~ a condition for these stationary states. they couldn't be explained why it exist in stationary states until de'broglie ~~s~~ proposed, ~~it had a wavelength~~ electrons have a wave particle and explained why they were stable through constructive interference which is a wave property. the significance of this experiment is confirming the wave nature of particles ie electrons to validate de Broglies proposal, therefore further refine ~~the~~ Bohrs model of ~~the~~ atom.

(e) The impact of the knowledge of the particles: quarks and leptons, and the forces bosons have been significant in developing and increase our understanding of the standard model of ~~matter, and the matter~~ the matters atomic structure and which make up the components within the nucleus universe. The advance knowledge of particles, ~~increase~~ include both quarks and leptons. ~~Quarks~~ Quarks are ~~the~~ building blocks of hadrons. ~~they consist of~~ there are six quarks: up, down, top, strange, charm and bottom. Hadrons are ~~group~~ all when quarks are joined together to form mesons (consisting of 2 quarks) and baryons (consisting of 3 quarks): protons (uud) and ~~anoth~~ neutrons (ddu) are the only particles ~~that have bee~~ known particles that exist in the universe along with electrons. Hadrons obey pauli's exclusion principle; which explains why electrons are positioned in such a way etc. This allows us to further understand atoms at a quantum level. Leptons are single ~~elemen~~ elementary particles that ~~exist by~~ themselves, and are not affected by strong nuclear force. Electrons are ~~the~~ only leptons which are known to exist. They are able to explain why electrons are not affected by forces of ~~the~~ within the nucleus allowing us to further understand its orbital properties.

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Finally the advance knowledge about forces, ~~shows~~ has impact our understanding about the forces within the nucleon ~~nuclear~~. Forces are Bosons ~~particle can~~ consisting of gluons – strong nuclear forces, & gravitons – gravitational force and photons – electrical force. Each force have provided the scientific community with their role within the nucleus, SNF is attractive over short distance of (10^{-15} m) and repulsive over shorter ~~shorther~~ distances than this. It is also the strongest force in the universe. The other two forces are present: photon providing electrostatic force of repulsion while gravitational force from gravitons are negligible.

These advances in knowledge about particles: leptons and quarks and forces: Bosons, ~~atoms~~ ~~forces~~ ~~are~~ is significant in allowing scientist to further develop theories and to validate existing ones, in order to better understand the atomic nucleus.

If you require more space to answer parts (d) and (e) of the question, you may ask for an extra writing booklet.

If you have used an extra writing booklet for parts (d) and (e) of the question, tick here. ☐