(a) i) A Wilson cloud chamber can be used to distinguish between alpha particles and beta particles. As alpha particles enter the supersaturated vapour, a path will appear which will be short and thick, since alpha particles have a strong ionising ability and low penetration.
As beta particles enter, the paths will be long + thin as beta particles are more penetrating and ionise less, so use up their energy more slowly than alpha does.

ii) $^{218}_{84}Po \longrightarrow {}^{214}_{82}Pb + {}^{4}_{2}He$

$\Delta m = m(\text{reactants}) - m(\text{products})$

$m(\text{reactants}) = 218.00897u$

$m(\text{products}) = 213.99981 + 4.00260$

$= 218.00241u$

$\Delta m = 218.00897 - 218.00241$

$= 0.00656\,u$

$E = \Delta m c^2$

$= (0.00656 \times 1.661 \times 10^{-27}) \times (3 \times 10^8)^2$

$= 9.807 \times 10^{-13}\,J.$

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

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

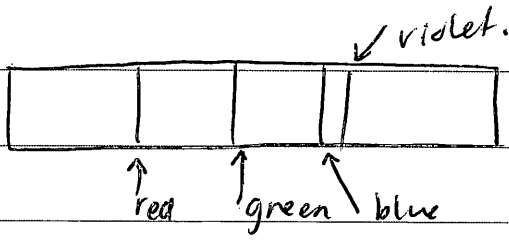
$$v = \frac{h}{\lambda m}$$

$$= \frac{6.626 \times 10^{-34}}{0.2 \times 10^{-9} \times 9.109 \times 10^{-31}}$$

$$= 3.637 \times 10^{6} ms^{-1}.$$

ii) Neutrons are neutral particles so have no charge and can therefore enter an atom without being deflected by electron clouds as X-rays would. Neutrons also possess a magnetic moment which makes it useful when studying the structure of magnetic materials. Neutrons also have wave properties so can be deflected off nuclei and produce an interference pattern to be studied.

(c) Previously to the Bohr model, Rutherford proposed that as electrons orbited the nucleus with acceleration they should emit emr. ~~However the did not explain~~ So this suggested that the emission spectrum should be continuous. However, ~~with~~ the development of the spectroscope, showed otherwise, producing a line spectrum when directed at a hydrogen discharge tube



With this experimental evidence Bohr sought to explain line spectra. In his 2nd postulate, he proposed that electrons could transition from states with the emission of energy that was quantised, $E = hf$, and therefore would produce a line spectrum.

Therefore the development of the spectroscope was crucial in ~~finding~~ providing experimental data from which the Bohr model could be developed.

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. ☐

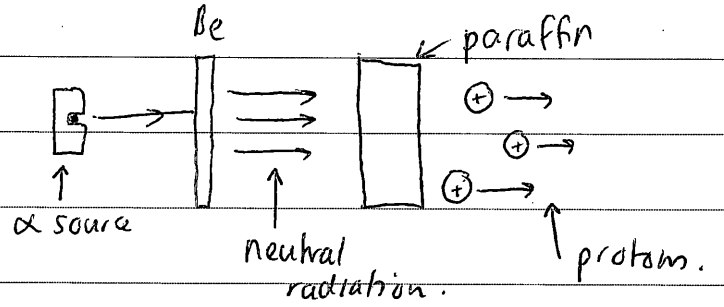
(d) i) The electron were scattered as they deflected off the crystal, producing an interference pattern. This showed that electrons had a wavelength and therefore wave properties and that light could exhibit wave properties.

ii) This experimental evidence was significant to the development of the Rutherford-Bohr model as it supported de Broglie's proposal. de Broglie proposed that since ~~light~~ waves could exhibit particle properties then light could have wave properties. He proposed that the orbit of an electron was comprised of an integral number of wavelengths $n\lambda = 2\pi r$, which would be standing waves in which energy is conserved. This thus explained Bohr's 1st postulate regarding the stability of electron orbits.

(e) ~~The structure of the atomic nucleus is constantly being refined.~~

The structure of the atomic nucleus and the particles and forces which exist within, is constantly being refined with the advancement of knowledge.

Rutherford was the first to propose that a neutral particle existed within the nucleus. Bothe + Becker, the Joliots and Chadwick all worked from each others knowledge to prove this proposal experimentally.



Chadwick used the Laws of conservation of energy and momentum of the emitted proton to determine that the neutral radiation was actually a neutral particle with similar mass to a proton, the neutron.

This finding of an additional subatomic particle prompted research into studying the structure of the atom.

~~Research into the existence of more subatomic particles arose with the development of particle colliders.~~

These collisions revealed hundreds of extra unknown subatomic particles within the nucleus as well as the forces that existed.

Beta Energy emitted by beta particles had been found to be of varying values. Fermi proposed the existence of an additional subatomic particle, the neutrino, to explain this which would carry away momentum and energy shared between the electron. This was an impetus to research the forces involved within the nucleus. Scientists theorised that there must be a strong force that binds nucleons together, overcoming the repulsive electrostatic force. This was called the strong nuclear force.

These discoveries into the nature of the nucleus prompted further ~~investi~~ research with the development of particle collider. In these collisions ~~of~~ hundreds of unknown subatomic particles were discovered. They found that all ~~matter~~ particles was made up of either matter or ~~for~~ bosons. The matter included leptons, electrons + neutrinos, and quarks; of which protons and neutrons belonged to.

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. ☑

Start here.

Bosons were found to be force carrying particles, such as gluons, strong nuclear, weakons, weak nuclear, photons, emr, and gravity.

The discovery of the neutron, neutrino and quarks had a significant impact on our structure of the atom, and is still constantly being changed with advances in knowledge. The discovery of quarks additionally provided an insight into conditions that could have been present after the Big Bang, thus providing us with more knowledge about the origins of the universe. Therefore these advancements in knowledge have benefited society and scientific research positively as they act as the impetus for further research and experiments in that area.