i) **Write an account outlining the similarities and differences in the way that mitochondria and chloroplasts generate a proton gradient and generate ATP.**

Similarities

- An electron transport chain assembled in a membrane pumps protons across the membrane as electrons are passed through a series of carriers.
- Both pump protons across a membrane from a region of low H^+ concentration to a high H^+ concentration.
- Energy stored in H^+ gradient across a membrane.
- Hydrogen diffuses down the gradient to the phosphorylation of ADP.
- Both have two main processes that drive a final one; in mitochondria it is glycolysis and the krebs cycle and chloroplasts have PSI and PSII.

Differences

Mitochondria

- Food molecules are oxidised for respiration in mitochondria to chemical energy.
- Oxygen is absorbed and utilised in the process and carbon dioxide and water are formed.
- In the mitochondria, the inner membrane pumps protons from the mitochondrial matrix out to the inter membrane space, which is where hydrogen ions power the ATP synthase.
- ATP is made on the matrix side of the mitochondrial membrane.
- Exothermic process
- NADH and FADH2 is the electron acceptor which carries electrons

Chloroplast

- The thylakoid membrane of the chloroplast pumps protons from the stroma into the thylakoid space. The thylakoid membrane makes ATP as the hydrogen ions diffuse from the thylakoid space back to the stroma. So ATP forms in the stroma.
- Carbon dioxide and water are used while oxygen is formed.
- In the chloroplasts, photosystems capture light energy and use it to drive electrons to the top of the transport chain, turning light energy into chemical energy.
- Endothermic process
- NADPH carries electrons in photosynthesis