Option C.3 Nuclear fusion and fission

Understandings:

Nuclear fusion

- Light nuclei can undergo fusion reactions as this increases the binding energy per nucleon.
- Fusion reactions are a promising energy source as the fuel is inexpensive and abundant, and no radioactive waste is produced.
- Absorption spectra are used to analyse the composition of stars.

Nuclear fission

- Heavy nuclei can undergo fission reactions as this increases the binding energy per nucleon.
- ^{235}U undergoes a fission chain reaction:
  $^{235}_{92}U + ^{1}_{0}n \rightarrow ^{236}_{92}U \rightarrow$ X + Y + neutrons.
- The critical mass is the mass of fuel needed for the reaction to be self-sustaining.
- ^{239}Pu, used as a fuel in “breeder reactors”, is produced from ^{238}U by neutron capture.
- Radioactive waste may contain isotopes with long and short half-lives.
- Half-life is the time it takes for half the number of atoms to decay.

Applications and skills:

Nuclear fusion

- Construction of nuclear equations for fusion reactions.
- Explanation of fusion reactions in terms of binding energy per nucleon.
- Explanation of the atomic absorption spectra of hydrogen and helium, including the relationships between the lines and electron transitions.

Nuclear fission

- Deduction of nuclear equations for fission reactions.
- Explanation of fission reactions in terms of binding energy per nucleon.
- Discussion of the storage and disposal of nuclear waste.
- Solution of radioactive decay problems involving integral numbers of half-lives.