10 In a nuclear reactor, a chain reaction is produced and controlled.

(a) (i) Uranium-235 is the isotope used in many nuclear reactors.

Explain how the fission of uranium-235 can lead to a chain reaction.

(4)

(ii) Nuclei of beryllium-9 do not absorb neutrons.

Instead, nuclei of beryllium-9 absorb alpha particles and emit neutrons.

Give a reason why a chain reaction can result from the emission of neutrons by uranium nuclei but not by beryllium nuclei.

(1)

(b) Explain what happen inside a nuclear reactor if neutron speeds are not controlled.

(3)

(c) Describe how the energy released in the chain reaction in a nuclear reactor is used to drive a turbine in a nuclear power station.

(3)

(Total for Question 10 = 11 marks)

Question number	Answer	Additional guidance	Mark
10(a)(i)	An explanation that combines identification – knowledge (1 mark) and reasoning/justification – knowledge (3 marks): • causes 2 or 3 neutrons to be released (1) • (and) one or more of these (released) neutrons are absorbed by other (U) nuclei (1) • which cause further fission of U nuclei (1) • and release further neutrons that can be absorbed, causing a chain reaction (1)	ignore U nucleus 'splits up'/eq	**(4)**

Question number	Answer	Mark
10(a)(ii)	Idea that to get a chain reaction the particle that impacts the nucleus must be the same as the one released (1)	**(1)**

Question number	Answer	Additional guidance	Mark
10(b)	An explanation that combines identification – knowledge (1 mark) and reasoning/justification – knowledge (2 marks): • reaction will slow down (1) • because there are fewer fissions (1) • because fission more likely with slow neutrons (1)	allow reactor shuts down/eq fission requires slow neutrons thermal neutrons for slow neutrons	**(3)**

Question number	Answer	Mark
10(c)	An answer that combines the following points of understanding to provide a logical description: • the reactor is surrounded by a coolant (1) • the thermal energy release from the chain reaction heats the coolant (1) • the hot coolant is used to generate steam which is used to drive the turbine (1)	**(3)**