Year 12 Physics
HSC ER Questions 9.8.D – Artificial Transmutations

Module	9.8 – From Quanta to Quarks
Topic	9.8.D – Artificial Transmutations
Name	**Date**

2011

(b) (i) Explain how the reaction rate in a nuclear reactor can be increased or decreased. **4**

(ii) $^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{140}_{56}\mathrm{Ba} + {}^{92}_{36}\mathrm{Kr} + 4\,{}^{1}_{0}\mathrm{n}$ **2**

Explain why energy is released in this reaction.

2010

(e) (i) James Chadwick discovered the neutron in 1932. How did Chadwick apply conservation laws? **3**

(ii) Outline how the properties of neutrons make them useful in scattering experiments. **2**

(g) 'Important fundamental discoveries in physics often lead to applications which have a significant effect on society.' **7**

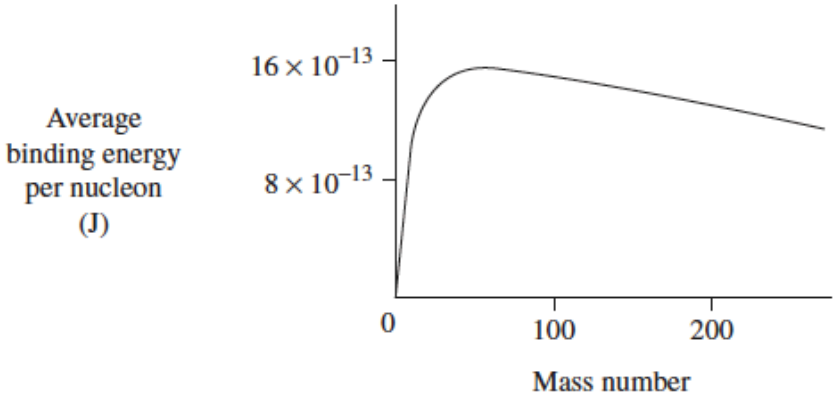
Evaluate this statement, with reference to the contributions of Rutherford, Einstein and Fermi to the development of the atomic bomb.

2009

(c) (i) Define *mass defect*. **1**

(ii) The energy required to separate all the nucleons within a nucleus is the binding energy. The average binding energy per nucleon is a measure of the stability of a nucleus. **2**

The graph shows how average binding energy per nucleon varies with mass number.



Use the graph to compare the stability of a nucleus of mass number 200 with a nucleus of mass number 50.

(d) In 1920, Rutherford suggested the existence of an undiscovered nuclear particle. Explain how Chadwick confirmed Rutherford's prediction using conservation laws. **3**

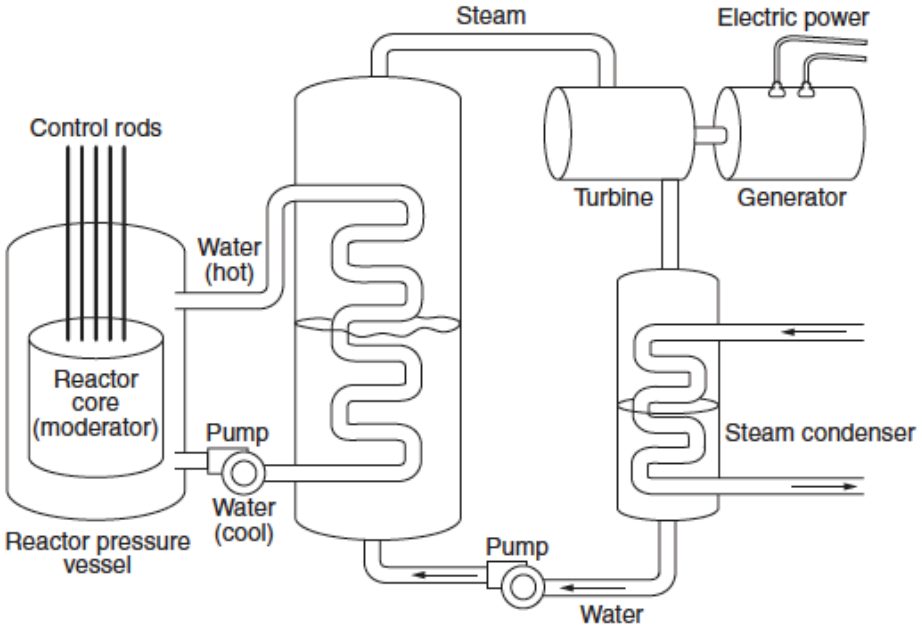
2008

(c) (i) An atom of Carbon-12 has 6 protons and 6 neutrons in its nucleus. The mass of a Carbon-12 atom is 12.000 atomic mass unit. Show that the mass defect of one Carbon-12 atom is 0.097 atomic mass unit. **3**

(ii) How much energy is this mass defect equivalent to? **1**

2007

The figure shows the basic features of a nuclear fission reactor.



(ii) Which part of a nuclear reactor regulates the rate of fission reaction taking place? Justify your answer. **2**

(iii) Neutron beams can be extracted from nuclear reactors. **3**

Describe how the neutrons can be used as a probe for investigating the properties of matter.

2006

(c) Australia has a large supply of uranium which may be used in fission reactors to create energy. The equation describes the relevant transmutation reaction: **7**

$$^{235}_{92}\text{U} + {}^{1}_{0}\text{n} \rightarrow {}^{141}_{56}\text{Ba} + {}^{92}_{36}\text{Kr} + 3{}^{1}_{0}\text{n}$$

Analyse how the process described in this equation has been developed into a technology which produces a sustained and controlled amount of energy.