Chapter 4 Fission and fusion

Chapter test answers Total marks 46

Question 1

B. The electrostatic repulsive force must be overcome for the particles to get close enough to fuse.

(1 mark)

Question 2

A. The strong nuclear force overcomes the repulsive electrostatic force inside the nucleus. (1 mark)

Question 3

a i 95 ii 146 iii 241 (3 marks)

b i 38 ii 52 iii 90 (3 marks)

Question 4

a  (2 marks)

b The combined mass of the products is less than the mass of the uranium-238. (1 mark)

Question 5

a There are 3 neutrons: . (1 mark)

The nucleon number (initially 236) has decreased by 3, but the proton number   
is unchanged at 92, so the right-hand side requires 3 neutrons. (1 mark)

b E = (170 × 106) × (1.6 × 10–19) = 2.72 × 10–11 J (1 mark)

c E = mc2 (consequential answer)

m =  = 3.02 × 10–28 kg (2 marks)

d E = (170 × 106) × (1.6 × 10–19) × (2.5 × 1024) (1 mark)

= 6.80 × 1013 J (1 mark)

Question 6

a i control rod (1 mark)  
 ii moderator or fuel rod (1 mark)  
 iii fuel rod or moderator (1 mark)  
 iv turbine (1 mark)

b A: Reactor core, where fission occurs. (2 marks)

B: Heat exchanger, where coolant from reactor cools by giving its heat to normal water, turning the water into steam. (2 marks)

C: Generator, where steam turns turbine and generates electricity. (2 marks)

Question 7

In any sample of uranium ore the concentration of the (1 mark)  
fissile isotope of uranium, uranium-235, is far too low. (1 mark)

Question 8

Coal-fired power stations produce carbon dioxide, a greenhouse gas. (1 mark)  
Nuclear power stations have radioactive waste products with very long half-lives, and bring  
the risk of an accident that may release radioactive material into the environment. (1 mark)

Question 9

a 1200 MW = 1200 × 106 W

E = Pt = 1200 × 106 × (24 × 60 × 60) = 1.04 × 1014 J (2 marks)

b Since E = mc2

m =  =  (2 marks)

c 25% of 1.037 × 1014 J = 2.59 × 1013 J (1 mark)

Question 10

a Balancing the mass numbers, one neutron has been released. (1 mark)

b The combined mass of the products is slightly less than that of the reactants. (2 marks)

c The difference in mass accounts for the energy released in the reaction according   
to *E* = *mc*2. (1 mark)

d 15 MeV = 15 × 106 × 1.6 × 10–19 = 2.4 × 10–12 J (2 marks)

Question 11

**a** The missing nuclide has an atomic number of 2 and a mass number of 4, so is . (2 marks)

**b** Energy =  (1 mark)