Name:

CHAPTER 4: Energy from the nucleus review quiz

Multiple choice

1 The force that holds the nucleus together is called the strong nuclear force. It only acts over a distance of approximately:

A 10^{-5} m.

B 10^{-10} m.

C 10^{-15} m.

D 10^{-20} m.

2 Nuclear binding energy is:

A the energy needed to separate completely all the nucleons in a nuclide from each other.

B the force per nucleon needed to separate all the nucleons in a nuclide from each other.

C the energy per nucleon needed to separate one nucleon in a nuclide from all the other nucleons.

D the strong nuclear force needed to keep nucleons together.

3 Which of the following statements is correct?

A Fission is the process by which a nuclide absorbs a neutron and emits energy.

B Fusion is the process by which two heavy nuclides form a new nuclide.

C Fission is the process that causes a nuclide to split into two fragments.

D Fusion is the process by which two light nuclides emit energy.

4 On the stability curve of atomic number versus neutron number for nuclides:

A light and heavy elements have almost the same number of protons and neutrons.

B light elements have almost the same number of protons and neutrons but heavy elements have more neutrons than protons.

C positron emitters are found in the region below the stability line.

D alpha emitters are found in the region below the stability line.

5 Absorbed dose is defined as:

A the amount of energy absorbed by a body, in joule.

B the amount of energy that is carried from a source to a body, in watt.

C the amount of energy per kilogram that is incident on a body, in gray.

D the amount of energy per kilogram that is incident on a body, multiplied by the radiation weighting factor, in sievert.

6 In a fission or fusion event the mass defect is, approximately:

A the difference between the mass of the nuclides involved before and after the event.

B the difference between the energy of the nuclides involved before and after the event.

C the difference between the mass of the nucleons involved before and after the event.

D the difference between the energy of the nucleons involved before and after the event.

7 In a thermal nuclear power station:

A slow neutrons cause fission and are moderated by light elements.

B slow neutrons cause fusion and are controlled by neutron poisons.

C fast neutrons are produced by the moderator and removed by the control rods.

D fast neutrons cause fission and are moderated by neutron poisons in the moderator.

8 An experimental fusion reactor includes liquid lithium in its heat transfer system. This is because:

A fusion products transfer their kinetic energy to the lithium heat exchanger.
B fusion products transfer their kinetic energy to the lithium, which then flows to the heat exchanger.
C neutrons produced in the fusion reaction diffuse through the lithium to spread the heat out before it is transferred to the heat exchanger.
D neutrons produced in the fusion reaction react with the lithium to produce heat that is transferred to the heat exchanger.

9 A healthy young adult person is exposed to 1.0 Sv of radiation. The likely effects of this will be:

A nausea, followed by recovery with no long-term effects.
B nausea, vomiting and confusion followed by recovery, but with no long-term effects.
C nausea, vomiting and confusion followed by recovery, but with increased cancer risk some years later.
D nausea, vomiting, diarrhoea, anaemia and confusion, followed by relatively rapid death.

10 A fast neutron causes a uranium-238 nuclide to undergo fission. What is the most likely result?

A The nuclide splits in half; one neutron is released; neptunium is formed.
B The nuclide splits into two fragments; more than one neutron is released; plutonium is formed.
C The nuclide splits into two fragments; more than one neutron is released; energy is released.
D The nuclide splits into two fragments; more than one neutron is released; energy is released as gamma rays.

11 One possible daughter nuclide from the fission of 235U is $^{141}_{56}\text{Ba}$. This nuclide will later undergo decay to form $^{141}_{57}\text{La}$. What is the other product of this decay?

A An alpha particle
B A beta minus particle
C A gamma ray
D None of the above

12 A 100 kg person is irradiated with 240 mSv of slow neutrons $W_r = 3$. With what dose was the person irradiated?

A 80 mSv
B 80 Gy
C 8.0 J
D 0.80 Sv

13 What is the mass equivalence of $^{104}_{43}\text{Tc}$ in kilograms?

Particle	Proton	Neutron
Mass (u)	1.0078	1.0086
$1\ \text{u} = 1.660 \times 10^{-27}$ kg		

A 7.13×10^{-26} kg
B 1.01×10^{-25} kg
C 1.72×10^{-26} kg
D 1.74×10^{-25} kg

14 In a nuclear power plant, which of the following transformations best describes the energy transfer from nuclear to electricity?

A Nuclear $\rightarrow$ motion $\rightarrow$ heat $\rightarrow$ electrical

B Nuclear $\rightarrow$ heat $\rightarrow$ motion $\rightarrow$ electrical

C Nuclear $\rightarrow$ heat $\rightarrow$ motion $\rightarrow$ heat $\rightarrow$ electrical

D Nuclear $\rightarrow$ motion $\rightarrow$ heat $\rightarrow$ motion $\rightarrow$ electrical

15 In a thermal nuclear power station, a single neutron causes uranium-235 (mass = 235.044 u) to undergo fission. The fission fragments have masses of 130.896 u and 102.950 u respectively. Two neutrons are released. How much energy, in MeV, is released in this fission reaction?

Particle	Proton	Neutron
Mass (u)	1.0078	1.0086
1 u = 931.5 MeV		

A 109.9 MeV

B 176.4 MeV

C 200 MeV

D 1032 MeV

16 Boron is used in control rods, usually in metal alloys. The nuclear reaction that is the most important reason for its use is:

A ${}^{0}_{1}n + {}^{10}_{5}B \rightarrow {}^{10}_{6}C + \gamma$

B ${}^{10}_{5}B \rightarrow {}^{10}_{5}C + {}^{0}_{-1}e + \bar{\nu}$

C ${}^{1}_{0}n + {}^{10}_{5}B \rightarrow {}^{7}_{3}Li + {}^{4}_{2}He$

D ${}^{10}_{5}B \rightarrow {}^{10}_{4}Be + {}^{1}_{0}n + {}^{0}_{+1}e + \nu$

17 What is the mass defect in the following fusion reaction?

${}^{2}_{1}H + {}^{1}_{1}H \rightarrow {}^{3}_{2}He + \gamma$

Particle	Proton	Neutron	Deuterium	Helium-3	Helium-4	Electron/Positron
Mass (u)	1.0078	1.0086	2.0141	3.0160	4.00260	0.000549

A 2.0098 u

B 4.0323 u

C 0.058 u

D 0.0059 u

18 The operator of a nuclear power plant must take precautions to ensure the safety of workers and the public. These will likely include at least:

A low-level waste stored in shielded containers, with radiation levels at 100 mSv at the boundary.

B high-level waste diluted and cooled before release to the environment, with radiation levels at 10 Sv at the boundary.

C medium-level waste diluted and cooled before release to the environment, with 1 mSv at the boundary.

D high-level waste shielded and cooled, with 1 mSv at the boundary.

19 When ${}^{3}_{1}H$ (tritium) combines ${}^{2}_{1}H$ (deuterium) in a fusion reaction to produce helium according to the following reaction:

${}^{3}_{1}H + {}^{2}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n + \gamma$

If 17.6 MeV of energy is produced, what is the mass loss in the reaction?

A 1.95×10^{-10} kg

B 1.95×10^{-16} kg

C 3.1×10^{-29} kg

D 3.1×10^{-35} kg

20 In a 1500 MW nuclear reactor, what mass of nuclear fuel is used each second?

A 1.5×10^{-9} kg

B 1.67×10^{-8} kg

C 2.1×10^{-8} kg

D 3.4×10^{-8} kg

Check Your Work

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