Unit 2 – Particles & Waves
Section 3 - Nuclear Reactions

2007 19. The classical experiment on the scattering of alpha particles from a thin gold foil suggested that

A positive charges were evenly distributed throughout the atom

B atomic nuclei were very small and positively charged

C neutrons existed in the nucleus

D alpha particles were helium nuclei

E alpha particles were hydrogen nuclei.

2008 19. Compared with a proton, an alpha particle has

A twice the mass and twice the charge

B twice the mass and the same charge

C four times the mass and twice the charge

D four times the mass and the same charge

E twice the mass and four times the charge.

2008 20. For the nuclear decay shown, which row of the table gives the correct values of x, y and z?

$$^{214}_{x}\text{Pb} \longrightarrow {}^{y}_{83}\text{Bi} + {}^{0}_{z}\text{e}$$

	x	y	z
A	85	214	2
B	84	214	1
C	83	210	4
D	82	214	–1
E	82	210	–1

2010 18. The following statement describes a fusion reaction.

$$^{2}_{1}\text{H} + {}^{2}_{1}\text{H} \longrightarrow {}^{3}_{2}\text{He} + {}^{1}_{0}\text{n} + \text{energy}$$

The total mass of the particles before the reaction is $6{\cdot}684 \times 10^{-27}$ kg.

The total mass of the particles after the reaction is $6{\cdot}680 \times 10^{-27}$ kg.

The energy released in this reaction is

A $6{\cdot}012 \times 10^{-10}$ J

B $6{\cdot}016 \times 10^{-10}$ J

C $1{\cdot}800 \times 10^{-13}$ J

D $3{\cdot}600 \times 10^{-13}$ J

E $1{\cdot}200 \times 10^{-21}$ J.

2011 19. The following statement represents a nuclear decay.

$$^{214}_{x}\text{Pb} \rightarrow {}^{y}_{83}\text{Bi} + {}^{o}_{z}\text{e}$$

Which row in the table shows the correct values of x, y and z for this decay?

	x	y	z
A	82	210	–1
B	82	214	–1
C	84	214	1
D	85	210	2
E	85	214	2

2012 18. Which of the following statements describes a spontaneous nuclear fission reaction?

A $^{235}_{92}\text{U} + {}^{1}_{0}\text{n} \rightarrow {}^{144}_{56}\text{Ba} + {}^{90}_{36}\text{Kr} + 2\,{}^{1}_{0}\text{n}$

B $^{7}_{3}\text{Li} + {}^{1}_{1}\text{H} \rightarrow {}^{4}_{2}\text{He} + {}^{4}_{2}\text{He}$

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

D $^{226}_{88}\text{Ra} \rightarrow {}^{222}_{86}\text{Rn} + {}^{4}_{2}\text{He}$

E $^{216}_{84}\text{Po} \rightarrow {}^{216}_{84}\text{Po} + \gamma$

2012 19. The statement below represents a nuclear reaction.

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

The total mass on the left hand side is $8{\cdot}347 \times 10^{-27}$ kg.

The total mass on the right hand side is $8{\cdot}316 \times 10^{-27}$ kg.

The energy released during one nuclear reaction of this type is

A $9{\cdot}30 \times 10^{-21}$ J

B $2{\cdot}79 \times 10^{-12}$ J

C $7{\cdot}51 \times 10^{-10}$ J

D $1{\cdot}50 \times 10^{-9}$ J

E $2{\cdot}79 \times 10^{15}$ J.

2013 19. A student makes the following statements about Rutherford's model of the atom.

I The nucleus has a relatively small diameter compared with that of the atom.

II Most of the mass of the atom is concentrated in the nucleus.

III The nucleus consists of positive and negative charges.

Which of these statements is/are correct?

A I only

B II only

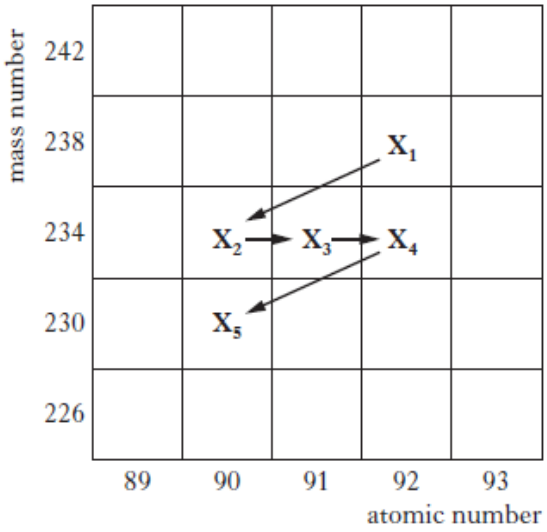
C III only

D I and II only

E I, II and III

2013 20. Part of a radioactive decay series is shown in the diagram.

The symbols $\mathbf{X_1}$ to $\mathbf{X_5}$ represent nuclides in this series.



A student makes the following statements about the decay series.

I Nuclides $\mathbf{X_2}$ and $\mathbf{X_3}$ contain the same number of protons.

II Nuclide $\mathbf{X_1}$ decays into nuclide $\mathbf{X_2}$ by emitting an alpha particle.

III Nuclide $\mathbf{X_3}$ decays into nuclide $\mathbf{X_4}$ by emitting a beta particle.

Which of these statements is/are correct?

A I only

B II only

C III only

D II and III only

E I, II and III

2014 Revised 10. An isotope of uranium decays into an isotope of protactinium in two stages as shown.

$$^{238}_{92}\mathrm{U} \xrightarrow[\text{stage 1}]{} {}^{234}_{90}\mathrm{Th} \xrightarrow[\text{stage 2}]{} {}^{234}_{91}\mathrm{Pa}$$

Which row in the table identifies the radiations which must be emitted at each stage?

	stage 1	*stage 2*
A	alpha	gamma
B	beta	gamma
C	gamma	beta
D	beta	alpha
E	alpha	beta

2014 Revised 11. The following statement represents a fission reaction.

$$^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{139}_{57}\mathrm{La} + {}^{95}_{42}\mathrm{Mo} + 2\,{}^{1}_{0}\mathrm{n} + 7\,{}^{0}_{-1}e$$

The total mass of the particles before the reaction is $391{\cdot}848 \times 10^{-27}$ kg.

The total mass of the particles after the reaction is $391{\cdot}478 \times 10^{-27}$ kg.

The energy released in this reaction is

A $3{\cdot}53 \times 10^{-8}$ J

B $3{\cdot}52 \times 10^{-8}$ J

C $3{\cdot}33 \times 10^{-11}$ J

D $1{\cdot}67 \times 10^{-11}$ J

E $1{\cdot}11 \times 10^{-19}$ J.

2015 12. The following statement describes a fusion reaction.

$$^{2}_{1}\mathrm{H} + {}^{2}_{1}\mathrm{H} \rightarrow {}^{3}_{2}\mathrm{He} + {}^{1}_{0}\mathrm{n} + \text{energy}$$

The total mass of the particles before the reaction is $6{\cdot}684 \times 10^{-27}$ kg.

The total mass of the particles after the reaction is $6{\cdot}680 \times 10^{-27}$ kg.

The energy released in the reaction is

A $6{\cdot}012 \times 10^{-10}$ J

B $6{\cdot}016 \times 10^{-10}$ J

C $1{\cdot}800 \times 10^{-13}$ J

D $3{\cdot}600 \times 10^{-13}$ J

E $1{\cdot}200 \times 10^{-21}$ J.

2016 10. The last two changes in a radioactive decay series are shown below.

A Bismuth nucleus emits a beta particle and its product, a Polonium nucleus, emits an alpha particle.

$$^{P}_{Q}\mathrm{Bi} \xrightarrow[\text{decay}]{\beta} {}^{R}_{S}\mathrm{Po} \xrightarrow[\text{decay}]{\alpha} {}^{208}_{82}\mathrm{Pb}$$

Which numbers are represented by P, Q, R and S?

	P	*Q*	*R*	*S*
A	210	83	208	81
B	210	83	210	84
C	211	85	207	86
D	212	83	212	84
E	212	85	212	84

2017 8. The following statement represents a nuclear reaction.

$$^{256}_{103}\mathrm{Lr} \rightarrow \mathrm{Z} + {}^{4}_{2}\mathrm{He}$$

Nucleus Z is

A $^{252}_{101}\mathrm{Md}$

B $^{252}_{101}\mathrm{No}$

C $^{256}_{101}\mathrm{Md}$

D $^{260}_{105}\mathrm{Db}$

E $^{252}_{103}\mathrm{Lr}$.

2018 11. A nuclear fission reaction is represented by the following statement.

$$^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{141}_{56}Ba + X + 3\,{}^{1}_{0}n$$

The nucleus represented by X is

A $^{96}_{40}Zr$

B $^{92}_{36}Kr$

C $^{97}_{40}Zr$

D $^{93}_{36}Kr$

E $^{94}_{40}Zr$.

2019 14. A nucleus represented by $^{223}_{87}Fr$ decays by beta emission.

The symbol representing the nucleus formed as a result of this decay is

A $^{224}_{87}Fr$

B $^{222}_{87}Fr$

C $^{223}_{88}Ra$

D $^{223}_{86}Rn$

E $^{224}_{88}Ra$.