Quiz E23.2

Nuclear physics(HL)

1. An alpha particle with kinetic energy *E* MeV is directed at a stationary nucleus of $^{62}_{28}\text{Ni}$. Which expression gives the distance of closest approach to the centre of the nucleus in meters?

A $\frac{9\times10^{9}\times56\times(1.6\times10^{-19})^{2}}{E}$

B $\frac{9\times10^{3}\times56\times(1.6\times10^{-19})^{2}}{E}$

C $\frac{9\times10^{9}\times56\times1.6\times10^{-19}}{E}$

D $\frac{9\times10^{3}\times56\times1.6\times10^{-19}}{E}$

2. What is the likely decay of an unstable nucleus with too many neutrons?

A Alpha decay
B Beta minus decay
C Beta plus decay
D Gamma decay

3. What provides evidence for the existence of the strong nuclear force?

A Deviations from Rutherford scattering
B The discrete nature of alpha and gamma energies in radioactive decay
C The existence of isotopes
D The shape of the binding energy curve

4. The nuclear radius of $^{6}_{4}\text{Be}$ is *R* and the density of the nucleus is ρ. What is the nuclear radius and nuclear density of $^{48}_{20}\text{Ca}$?

	Nuclear radius	Nuclear density
A	$2R$	$\frac{\rho}{2}$
B	$2R$	ρ
C	$8R$	$\frac{\rho}{2}$
D	$8R$	ρ

5. The binding energy per nucleon is roughly constant for large nuclei. What is this evidence for?

A The attractive nature of the strong nuclear force
B The existence of neutrons inside the nucleus
C The short range of the strong nuclear force
D The strong nuclear force acts on neutrons

6. Three statements are made for the strong nuclear force:

I It acts on protons
II It acts on neutrons
III It acts on electrons

Which statements are correct?

A I and II
B I and III
C II and III
D I, II and III

7. The half-life of radioactive element X is T and that of element Y is $2T$. A sample of nuclei X and a sample of nuclei Y have the same initial activity. What is the ratio $\frac{N_X}{N_Y}$ of nuclei that have not yet decayed after a time $2T$?

A 1 **B** $\frac{1}{2}$ **C** $\frac{1}{4}$ **D** $\frac{1}{8}$

8. A radioactive nucleus ${}^{A}_{Z}\mathrm{X}$ decays into the stable isotope ${}^{A-4}_{Z-2}\mathrm{Y}$ with a half life of T. A pure sample of ${}^{A}_{Z}\mathrm{X}$ is prepared. What is the ratio $\frac{\text{mass of } {}^{A-4}_{Z-2}\mathrm{Y}}{\text{mass of } {}^{A}_{Z}\mathrm{X}}$ after a time $2T$?

A 2 **B** 3 **C** $3\times\frac{A-4}{A}$ **D** $3\times\frac{A}{A-4}$

9. The decay constant of a radioactive nucleus is $\lambda = 1\,\mathrm{hr}^{-1}$. A sample of these nuclei is prepared. Which of the following expressions is **not** an estimate of the probability of decay of a nucleus in this sample in the course of 1 hour?

A $1-e^{-1}$ **B** e^{-1} **C** $1-(1-\frac{1}{60})^{60}$ **D** $1-(1-\frac{1}{3600})^{3600}$

10. In beta minus decay, the daughter nucleus gains very little energy. Which statement is correct about the rest of the energy released?

A Most of this energy is carried by the electron
B Most of this energy is carried by the antineutrino
C It is shared equally by the electron and the antineutrino
D It is shared by the electron and the antineutrino

Quiz E23.2 Answers	
1	D
2	B
3	A
4	B
5	C
6	A
7	C
8	C
9	B
10	D