Nuclear Physics - 2018

1. 9702/11/M/J/18/No.38

Which elementary particle is a lepton?

A proton

B neutron

C electron

D quark

2. 9702/11/M/J/18/No.39

How many down quarks are in a nucleus of hydrogen-3, ${}^{3}_{1}H$?

A 2 B 3 C 4 D 5

${}^{3}_{1}H$ – 1 proton – uud

2 neutrons – udd + udd

3. 9702/11/M/J/18/No.40

What is the correct equation for β^+ decay?

A neutron → proton + electron + electron antineutrino

B neutron → proton + electron + electron neutrino

C proton → neutron + positron + electron antineutrino

D proton → neutron + positron + electron neutrino

${}^{1}_{1}p \rightarrow {}^{1}_{0}n + {}^{1}_{+1}e + \nu$

proton, neutron, positron, electron neutrino

4. 9702/12/M/J/18/No.38

In the α-particle scattering experiment, a beam of α-particles is aimed at a thin gold foil. Most of the α-particles go straight through or are deflected by a small angle. A very small proportion are deflected through more than 90°, effectively rebounding towards the source of the α-particles.

Which conclusion about the structure of atoms **cannot** be drawn from this experiment alone?

A Most of the atom is empty space.

B Most of the mass of an atom is concentrated in the nucleus.

C The nucleus contains both protons and neutrons.

D The nucleus is charged.

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5. 9702/12/M/J/18/No.39

Radon-211, $^{211}_{86}Rn$, francium-210, $^{210}_{87}Fr$, and radium-212, $^{212}_{88}Ra$, are three nuclides.

How many neutrons does each nuclide have in its nucleus?

	radon-211	francium-210	radium-212
A	86	87	88
B	125	123	124
C	211	210	212
D	297	297	300

Rn, $n = 211 - 86 = 125$

Fr, $n = 210 - 87 = 123$

Ra, $n = 212 - 88 = 124$.

6. 9702/12/M/J/18/No.40

A neutron is composed of one up (u) quark and two down (d) quarks. When the neutron decays to a proton, there is β-emission.

What is the change in the quark structure of the neutron due to the β-emission?

(The symbol for a neutrino is ν_e and for an antineutrino is $\overline{\nu_e}$.)

A $d \rightarrow u + \beta^- + \nu_e$

B $d \rightarrow u + \beta^- + \overline{\nu_e}$

C $u \rightarrow d + \beta^+ + \nu_e$

D $u \rightarrow d + \beta^+ + \overline{\nu_e}$

$^1_0n \rightarrow {}^1_1p + {}^0_{-1}e + \bar{\nu}$

$udd \rightarrow uud$.

$d \rightarrow u + {}^0_{-1}e + \bar{\nu}_e$

$d \rightarrow u + \beta^- + \bar{\nu}_e$

7. 9702/13/M/J/18/No.39

A nucleus of magnesium-23 undergoes β^+ decay, as represented by the nuclear equation shown.

$$^{23}_{12}Mg \rightarrow X + \beta^+ + \nu_e$$

What is nucleus X?

A $^{22}_{11}Na$ B $^{22}_{13}Al$ C $^{23}_{11}Na$ D $^{23}_{13}Al$

8. 9702/13/M/J/18/No.40

Which list contains only leptons?

A electron, neutrino, positron

B electron, neutrino, proton

C electron, proton, neutron

D neutrino, neutron, positron

Two sub-atomic particles types

hadrons – protons, neutrons, pi$^+$, phi

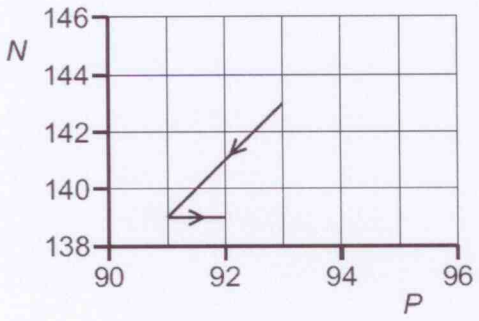
Leptons – electrons, neutrino, positron

9. 9702/12/F/M /18/No.39

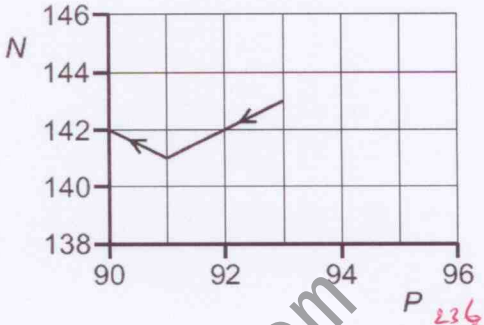
A nucleus of neptunium-236 contains 93 protons and 143 neutrons. This nucleus decays with the emission of an α-particle. The nucleus formed then emits a β^- particle.

Which diagram shows the changes in the number *P* of protons and the number *N* of neutrons in these nuclei?

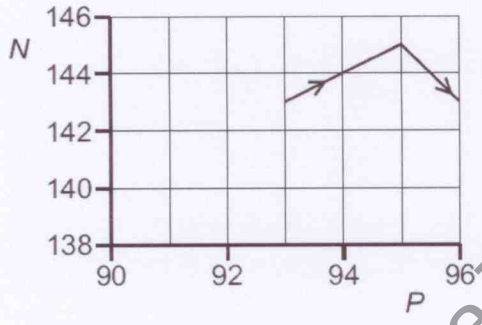
A



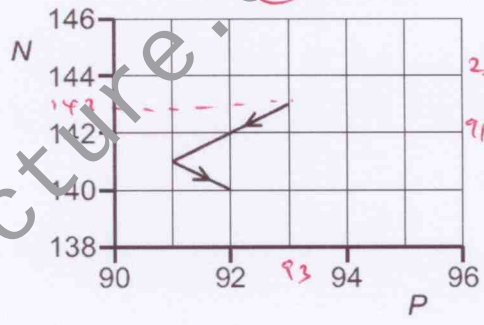
B



C



D ✓



$^{236}_{93}Np \rightarrow ^{232}_{91}X + {}^{4}_{2}\alpha$

236 − 93 = 143, 232 − 91 = 141

$^{232}_{91}X \rightarrow ^{232}_{92}Y + {}^{0}_{-1}\beta$

$^{1}_{0}n \rightarrow {}^{1}_{1}p + {}^{0}_{-1}e + \bar{\nu}$

- neutron is changed to proton.
- n decrease by 1
- p increases by 1.

10. 9702/12/F/M /18/No.40

An isolated neutron decays to produce a proton, a β^- particle and an antineutrino.

Which row gives the quark composition of the neutron and the proton and the type of force that gives rise to this reaction?

	quark composition		type of force
	neutron	proton	
A ✓	down, down, up	down, up, up	strong interaction
B	down, down, up	down, up, up	weak interaction
C	down, up, up	down, down, up	strong interaction
D	down, up, up	down, down, up	weak interaction

$^{1}_{0}n \rightarrow {}^{1}_{1}p + \beta^- + \bar{\nu}$

udd → uud.

d → u.

- β decay is due to weak interaction force.