PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

Radioactivity - CSIR NET Physics PYQs

Nuclear and Particle Physics . All PYQs (2015-2025) with answer key

14 questions . Answer key included

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Q1. [June 2016] . 5.0 marks

Nuclear and Particle Physics > Radioactivity

CSIR NET	2016 June	5M

A radioactive element X decays to Y, which in turn decays to a stable element Z. The decay constant from X to Y is λ_1, and that from Y to Z is λ_2. If, to begin with, there are only N_0 atoms of X, at short times $\left(t \ll 1/\lambda_1 \text{ as well as } 1/\lambda_2\right)$ the number of atoms of Z will be

1. $\frac{1}{2}\lambda_1\lambda_2 N_0 t^2$
2. $\frac{\lambda_1\lambda_2}{2(\lambda_1+\lambda_2)} N_0 t$
3. $(\lambda_1+\lambda_2)^2 N_0 t^2$
4. $(\lambda_1+\lambda_2) N_0 t$

Q2. [June 2016] . 5.0 marks

Nuclear and Particle Physics > Radioactivity

CSIR NET	2016 June	5M

In the large hadron collider (LHC), two equal energy proton beams traverse in opposite directions along a circular path of length 27 km . If the total centre of mass energy of a proton-proton pair is 14 TeV , which of the following is the best approximation for the proton time taken by a proton to traverse the entire path?

1. $12\ \text{ns}$
2. $1.2\mu s$
3. $1.2\ \text{ns}$
4. $0.12\mu s$

Q3. [June 2017] . 5.0 marks

Nuclear and Particle Physics > Radioactivity

CSIR NET	2017 June	5M

If in a spontaneous α - decay of $^{232}_{92}U$ at rest, the total energy released in the reaction is Q, then the energy carried by the α-particle is

1. $57Q/58$
2. $Q/57$
3. $Q/58$
4. $23Q/58$

Q4. [Dec 2018] . 5.0 marks

Nuclear and Particle Physics > Radioactivity

CSIR NET	2018 Dec	5M

A nucleus decays by the emission of a gamma ray from an excited state of spin parity $2^+$to the ground state with spin-parity 0^+what is the type of the corresponding radiation?

1. magnetic dipole
2. electric quadrupole
3. electric dipole
4. magnetic quadrupole

Q5. [June 2018] . 5.0 marks

Nuclear and Particle Physics > Radioactivity

CSIR NET	2018 June	5M

The reaction ${}^{63}\mathrm{Cu}_{29} + p \rightarrow {}^{63}\mathrm{Zn}_{30} + n$ is followed by a prompt β-decay of zinc ${}^{63}\mathrm{Zn}_{30} \rightarrow {}^{63}\mathrm{Cu}_{29} + e^{+} + \nu_e$. If the maximum energy of the position is 2.4 MeV , the Q value of the original reaction in MeV is nearest to [Take the masses of electron, proton and neutron to be $0.5MeV/c^2, 938MeV/c^2$ and $939.5\mathrm{MeV}/c^2$, respectively.]

1. -4.4
2. -2.4
3. -4.8
4. -3.4

Q6. [June 2019] . 5.0 marks

Nuclear and Particle Physics > Radioactivity

CSIR NET	2019 June	5M

An excited state of a ${}^{8}_{4}\mathrm{Be}$ nucleus decays into two α-particles which are in a spin-parity 0^{+} state. If the mean life-time of this decay is $10^{-22}s$, the spin-parity of the excited state of the nucleus is

1. 2^{+}
2. 3^{+}
3. 0^{-}
4. 4^{-}

Q7. [June 2021] . 5.0 marks

Nuclear and Particle Physics > Radioactivity

CSIR NET	2021 June	5M

The nuclei of ^{137}Cs decay by the emission of β-particles with a half-life of 30.08 years. The activity (in units of disintegrations per second or Bq) of a 1mg source of ^{137}Cs, prepared on January 1, 1980, as measured on January 1, 2021 is closest to

1. 1.79×10^{16}
2. 1.79×10^{9}
3. 1.24×10^{16}
4. 1.24×10^{9}

Q8. [June 2021] . 5.0 marks

Nuclear and Particle Physics > Radioactivity

CSIR NET	2021 June	5M

A ^{60}Co nucleus β-decays from its ground state with $J^P = 5^+$ to a state of ^{60}Ni with $J^P = 4^+$. From the angular momentum selection rules, the allowed values of the orbital angular momentum L and the total spin S of the electron-antineutrino pair are

1. $L = 0$ and $S = 1$
2. $L = 1$ and $S = 0$
3. $L = 0$ and $S = 0$
4. $L = 1$ and $S = 1$

Q9. [June 2021] . 5.0 marks

Nuclear and Particle Physics > Radioactivity

CSIR NET	2021 June	5M

The Q-value of the α-decay of $^{232}\mathrm{Th}$ to the ground state of $^{228}\mathrm{Ra}$ in 4082 keV. The maximum possible kinetic energy of the α-particle is closest to

1. 4082 keV
2. 4050 keV
3. 4035 keV
4. 4012 keV

Q10. [Dec 2023] . 5.0 marks

Nuclear and Particle Physics > Radioactivity

CSIR NET	2023 Dec	5 M

The ground state of $^{207}_{82}\mathrm{Pb}$ nucleus has spin-parity $J^{\pi} = \left(\frac{1}{2}\right)^{-}$, while first excited state has $J^{\pi} = \left(\frac{5}{2}\right)^{-}$. For the transition from the first excited state to the ground state, possible multipolarities of emitted electromagnetic radiation are

1. E2, E3
2. M2, M3
3. M2, E3
4. E2, M3

Q11. [June 2023] . 5.0 marks

Nuclear and Particle Physics > Radioactivity

CSIR NET	2023 June	5M

The nucleus of $^{40}\mathrm{K}$ (of spin-parity 4^+ in the ground state) is unstable and decays to $^{40}\mathrm{Ar}$. The mass difference between these two nuclei is $\Delta \mathrm{Mc}^2 = 1504.4\,\mathrm{keV}$. The nucleus $^{40}\mathrm{Ar}$ has an excited state at 1460.8 keV with spinparity 2^+. The most probable decay mode of $^{40}\mathrm{K}$ is by

1. a β^+-decay to the 2^+ state of $^{40}\mathrm{Ar}$
2. an electron capture to the 2^+ state of $^{40}\mathrm{Ar}$
3. an electron capture to the ground state of $^{40}\mathrm{Ar}$
4. a β^+-decay to the ground state of $^{40}\mathrm{Ar}$

Q12. [Dec 2024] . 5.0 marks

Nuclear and Particle Physics > Radioactivity

CSIR NET	2024 Dec	5M

The masses of proton, neutron, Polonium and Lead nuclei are as follows:

$$m_p = 1.007825 \text{ a.u}, m_n = 1.008665 \text{ a.u}$$
$$m\left(^{210}_{84}\text{Po}\right) = 209.982876 \text{ a.u},$$
$$m\left(^{206}_{82}\text{Pb}\right) = 205.974455 \text{ a.u.}$$

Binding energy of $^{4}_{2}\text{He}$ is 28.80 MeV and

$$1\text{a.u} = 931.99 \frac{\text{MeV}}{\text{c}^2}$$

The binding energies of $^{210}_{84}\text{Po}$, $^{206}_{82}\text{Pb}$ and the Q value of the α-decay of $^{210}_{84}\text{Po}$ are closest to

1. $1645.21\text{MeV}, 1622.33\text{MeV}, 5.92\text{MeV}$
2. $1645.21\text{MeV}, 1622.33\text{MeV}, -5.92\text{MeV}$
3. $1545.21\text{MeV}, 1522.33\text{MeV}, -5.92\text{MeV}$
4. $1645.21\text{MeV}, 1522.33\text{MeV}, 5.92\text{MeV}$

Q13. [Dec 2024] . 5.0 marks

Nuclear and Particle Physics > Radioactivity

CSIR NET	2024 Dec	5M

Naturally occurring uranium is a mixture of the $^{238}U(99.28\%)$ and $^{235}U(0.72\%)$ isotopes. The life times are $\tau(^{235}U) = 1 \times 10^9$ years and $\tau(^{238}U) = 6.6 \times 10^9$ years. What is the closest value of the age of the solar system if one assumes that at its creation both isotopes were present in equal quantities?

1. 6.2×10^9 years
2. 5.8×10^9 years
3. 4.7×10^9 years
4. 7.2×10^9 years

Q14. [June 2024] . 5.0 marks

Nuclear and Particle Physics > Radioactivity

CSIR NET	2024 June	5M

π^-has spin 0 and negative intrinsic parity. In a reaction a deuteron in its ground state ($J = 1$, parity +1) captures a π^-in p-wave to produce a pair of neutrons (intrinsic parity is +1). The neutrons will be produced in a state with

1. $l = 1, S = 0$
2. $l = 0, S = 1$
3. $l = 1, S = 1$
4. $l = 0, S = 0$

Answer Key

14 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Nuclear and Particle Physics	Radioactivity	**1**
Q2	Nuclear and Particle Physics	Radioactivity	**1**
Q3	Nuclear and Particle Physics	Radioactivity	**1**
Q4	Nuclear and Particle Physics	Radioactivity	**2**
Q5	Nuclear and Particle Physics	Radioactivity	**1**
Q6	Nuclear and Particle Physics	Radioactivity	**1**
Q7	Nuclear and Particle Physics	Radioactivity	**4**
Q8	Nuclear and Particle Physics	Radioactivity	**1**
Q9	Nuclear and Particle Physics	Radioactivity	**4**
Q10	Nuclear and Particle Physics	Radioactivity	**4**
Q11	Nuclear and Particle Physics	Radioactivity	**2**
Q12	Nuclear and Particle Physics	Radioactivity	**1**
Q13	Nuclear and Particle Physics	Radioactivity	**2**
Q14	Nuclear and Particle Physics	Radioactivity	**4**

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