

PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

Particle physics - CSIR NET Physics PYQs

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

19 questions . Answer key included

www.physicsbyaaryan.com . www.csirnetphysics.com

Contact: 9501976811

Q1. [Dec 2015] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2015 Dec	5 M
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Consider the following processes involving free particles

$$(i) \bar{n} \rightarrow \bar{p} + e^+ + \bar{\nu}_e$$

$$(ii) \bar{p} + n \rightarrow \pi^-$$

$$(iii) p + n \rightarrow \pi^+ + \pi^0 + \pi^0$$

$$(iv) p + \bar{\nu}_e \rightarrow n + e^+$$

Which of the following statements is true?

1. Process (i) obeys all conservation laws
2. Process (ii) conserves baryon number, but violates energy-momentum conservation
3. process (iii) is not allowed by strong interaction but is allowed by weak interactions
4. Process (iv) conserves baryon number, but violates lepton number conservation

Q2. [June 2015] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2015 June	5 M
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The charm quark is assigned a charm quantum number $C = 1$. How should the Gellmann-Nishijima formula for electric charge be modified for four flavours of quarks?

1. $I_3 + \frac{1}{2}(B - S - C)$
2. $I_3 + \frac{1}{2}(B - S + C)$
3. $I_3 + \frac{1}{2}(B + S - C)$
4. $I_3 + \frac{1}{2}(B + S + C)$

Q3. [June 2015] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2015 June	5 M
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The reaction ${}^2_1\text{D} + {}^2_1\text{D} \rightarrow {}^4_2\text{He} + \pi^0$ cannot proceed via strong interactions because it violates the conservation of

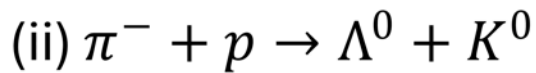
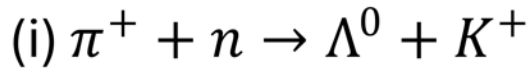
1. angular momentum
2. electric charge
3. baryon number
4. isospin

Q4. [Dec 2016] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2016 Dec	5M
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Which of the following reaction(s) is/are allowed by the conservation laws?



1. both (i) and (ii)
2. only (i)
3. only (ii)
4. neither (i) nor (ii)

Q5. [Dec 2016] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2016 Dec	5M
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A particle, which is a composite state of three quarks u, d and s , has electric charge, spin and strangeness respectively, equal to

1. $1, \frac{1}{2}, -1$
2. $0, 0, -1$
3. $0, \frac{1}{2}, -1$
4. $-1, -\frac{1}{2}, +1$

Q6. [Dec 2017] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2017 Dec	5M
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Which of the following process is not allowed by the strong interaction but is allowed by the weak interaction?

1. $K^0 + \pi^0 \rightarrow \bar{K}^0 + \pi^+ + \pi^-$
2. $p + n \rightarrow d + p + \bar{p}$
3. $\Delta^+ + K^0 \rightarrow p + n$
4. $p + \Delta^+ \rightarrow \bar{n} + \Delta^{++}$

Q7. [June 2017] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2017 June	5M
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A baryon X decays by strong interaction as $X \rightarrow \Sigma^+ + \pi^- + \pi^0$, where Σ^+ is a member of the isotriplet $(\Sigma^+, \Sigma^0, \Sigma^-)$. The third component I_3 of the isospin of X is

1. 0
2. $\frac{1}{2}$
3. 1
4. $\frac{3}{2}$

Q8. [June 2018] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2018 June	5M
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Which of the following elementary particle processes does not conserve strangeness?

1. $\pi^0 + p \rightarrow k^+ + \Lambda^0$
2. $\pi^- + p \rightarrow k^0 + \Lambda^0$
3. $\Delta^0 \rightarrow \pi^0 + n$
4. $K^0 \rightarrow \pi^+ + \pi^-$

Q9. [June 2018] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2018 June	5M
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A deuteron d captures a charged pion π^- in the $l = 1$ state, and subsequently decays into a pair of neutrons (n) via strong interaction. Given that the intrinsic parities of π^- , d and n are -1 , $+1$ and $+1$ respectively, the spin wavefunction of the final state neutrons is.

1. linear combination of a singlet and a triplet
2. Singlet
3. Triplet
4. doublet

Q10. [Dec 2019] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2019 Dec	5M
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Which of the following decay processes is allowed?

1. $K^0 \rightarrow \mu^+ + \mu^-$
2. $\mu^- \rightarrow e^- + \gamma$
3. $n \rightarrow p + \pi^-$
4. $n \rightarrow \pi^+ + \pi^-$

Q11. [June 2019] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2019 June	5M
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The mean life-time of the following decays:

$\rho_0 \rightarrow \pi^+ + \pi^-$, $\pi^0 \rightarrow \gamma + \gamma$, $\mu^- \rightarrow e^- + \bar{\nu}_e + \nu_\mu$, are τ_ρ , τ_π and τ_μ respectively.

They satisfy

1. $\tau_\pi < \tau_\rho < \tau_\mu$
2. $\tau_\mu < \tau_\rho < \tau_\pi$
3. $\tau_\rho < \tau_\pi < \tau_\mu$
4. $\tau_\rho < \tau_\mu < \tau_\pi$

Q12. [June 2020] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2020 June	5M
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Charged pions π^- decay to muons μ^- and anti-muon neutrinos $\bar{\nu}_\mu$; $\pi^- \rightarrow \mu^- + \bar{\nu}_\mu$. Take the rest masses of a muon and a pion to be 105 MeV and 140 MeV, respectively. The probability that the measurement of the muon spin along the direction of its momentum is positive, is closest to

1. 0.5
2. 0.75
3. 1
4. 0

Q13. [June 2021] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2021 June	5M
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In the reaction $p + n \rightarrow p + K^+ + X$ mediated by strong interaction, the baryon number B , strangeness S and the third component of isospin I_3 of the particle X are, respectively

1. $-1, -1$ and -1
2. $+1, -1$ and -1
3. $+1, -2$ and $-\frac{1}{2}$
4. $-1, -1$ and 0

Q14. [Dec 2023] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2023 Dec	5 M
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Atmospheric neutrinos are produced from the cascading decays of cosmic pions (π^\pm) to stable particles. Ignoring all other neutrino sources, the ratio of muon neutrino ($\nu_\mu + \bar{\nu}_\mu$) flux to electron neutrino ($\nu_e + \bar{\nu}_e$) flux in atmosphere is expected to be closest to

1. 2:3
2. 1:1
3. 1:2
4. 2:1

Q15. [Dec 2024] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2024 Dec	5M
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For the decay of the Δ -baryons, the ratio of the

decay rates $\frac{\Gamma(\Delta^- \rightarrow n\pi^-)}{\Gamma(\Delta^0 \rightarrow p\pi^-)}$ is best approximated by

1. $\frac{3}{2}$
2. 3
3. 1
4. $\frac{2}{3}$

Q16. [June 2024] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2024 June	5M
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The Δ^{++} can be produced by colliding a pion beam onto a H_2 target, in a reaction $\pi^+ + p \rightarrow \Delta^{++} \rightarrow \pi^+ + p$. In the rest frame of Δ^{++} , the energy and momentum of the pion in the final state (in MeV) are closest to (assume $c = 1$, and $m_\pi \approx 140\text{MeV}$, $m_p \approx 1\text{GeV}$, $m_{\Delta^{++}} \approx 1.2\text{GeV}$)

1. 210,156
2. 230,182
3. 175,105
4. 190, 130

Q17. [Dec 2025] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2025 Dec	5M	NPP
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Consider the cross-sections

$$\sigma_1 = \sigma(p + n \rightarrow \Delta^+ + n) \text{ and } \sigma_2 \\ = \sigma(p + n \rightarrow \Delta^0 + p)$$

where the (Δ^+, Δ^0) are part of the baryon decuplet.

Then

1. one of the $\sigma_{1,2}$ vanishes identically.
2. $\sigma_1 \gg \sigma_2$, with both being non-zero.
3. $\sigma_1 \ll \sigma_2$, with both being non-zero.
4. $\sigma_1 \approx \sigma_2$.

Q18. [June 2025] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2025 June	5M	NPP
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When a neutron of 1 keV kinetic energy impinges on a ^{12}C target, the total scattering cross section is 1000 barns. The approximate value of the phase shift δ_0 is

1. 18°
2. 108°
3. 90°
4. 36°

Q19. [June 2025] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2025 June	5M	NPP
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The ρ -mesons are $J^P = 1^-$ particles that decay strongly into pions. The ratio of the particle decay

widths $\frac{\Gamma(\rho^0 \rightarrow \pi^0 \pi^0)}{\Gamma(\rho^+ \rightarrow \pi^+ \pi^0)}$ is closest to

1.1

2. $\frac{1}{2}$

3.0

4.2

Answer Key

19 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Nuclear and Particle Physics	Particle physics	2
Q2	Nuclear and Particle Physics	Particle physics	4
Q3	Nuclear and Particle Physics	Particle physics	4
Q4	Nuclear and Particle Physics	Particle physics	1
Q5	Nuclear and Particle Physics	Particle physics	3
Q6	Nuclear and Particle Physics	Particle physics	1
Q7	Nuclear and Particle Physics	Particle physics	1
Q8	Nuclear and Particle Physics	Particle physics	4
Q9	Nuclear and Particle Physics	Particle physics	2
Q10	Nuclear and Particle Physics	Particle physics	1
Q11	Nuclear and Particle Physics	Particle physics	3
Q12	Nuclear and Particle Physics	Particle physics	3
Q13	Nuclear and Particle Physics	Particle physics	2
Q14	Nuclear and Particle Physics	Particle physics	4
Q15	Nuclear and Particle Physics	Particle physics	2
Q16	Nuclear and Particle Physics	Particle physics	4
Q17	Nuclear and Particle Physics	Particle physics	4
Q18	Nuclear and Particle Physics	Particle physics	4
Q19	Nuclear and Particle Physics	Particle physics	3

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9501976811