PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

Shell model - CSIR NET Physics PYQs

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

6 questions . Answer key included

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Q1. [Dec 2015] . 5.0 marks

Nuclear and Particle Physics > Shell model

CSIR NET	2015 Dec	5 M

The electric quadrupole moment of an odd proton nucleus is $\frac{(2j-1)}{2(j+1)}\langle r^2\rangle$, where j is the total angular momentum. Given that $R_0 = 1.2\text{fm}$, what is the value in barn, of the quadrupole moment of the ^{27}Al nucleus in the shell model?

1. 0.043
2. 0.023
3. 0.915
4. 0

Q2. [June 2015] . 5.0 marks

Nuclear and Particle Physics > Shell model

CSIR NET	2015 June	5 M

Let us approximate the nuclear potential in the shell model by a three dimensional isotropic harmonic oscillator. Since the lowest two energy levels have angular momenta $l = 0$ and $l = 1$ respectively. which of the following two nuclei have magic numbers of protons and neutrons?

1. ${}^{4}_{2}\mathrm{He}$ and ${}^{16}_{8}\mathrm{O}$
2. ${}^{2}_{1}\mathrm{D}$ and ${}^{8}_{4}\mathrm{Be}$
3. ${}^{4}_{2}\mathrm{He}$ and ${}^{8}_{4}\mathrm{Be}$
4. ${}^{4}_{2}\mathrm{He}$ and ${}^{12}_{6}\mathrm{C}$

Q3. [June 2016] . 5.0 marks

Nuclear and Particle Physics > Shell model

CSIR NET	2016 June	5M

According to the shell model, the nuclear magnetic moment of the $^{27}_{13}\mathrm{Al}$ nucleus is (Given that for a proton $g_l = 1, g_s = 5.586$, and for a neutron $g_l = 0, g_s = -3.826$.)

1. $-1.913\mu_N$
2. $14.414\mu_N$
3. $4.793\mu_N$
4. 0

Q4. [Dec 2017] . 5.0 marks

Nuclear and Particle Physics > Shell model

CSIR NET	2017 Dec	5M

The spin-parity assignments for the ground and first excited states of the isotope $^{57}_{28}\mathrm{Ni}$, in the single particle shell model, are

1. $\left(\frac{1}{2}\right)^{-}$ and $\left(\frac{3}{2}\right)^{-}$
2. $\left(\frac{5}{2}\right)^{+}$ and $\left(\frac{7}{2}\right)^{+}$
3. $\left(\frac{3}{2}\right)^{+}$ and $\left(\frac{5}{2}\right)^{+}$
4. $\left(\frac{3}{2}\right)^{-}$ and $\left(\frac{5}{2}\right)^{-}$

Q5. [June 2020] . 5.0 marks

Nuclear and Particle Physics > Shell model

CSIR NET	2020 June	5M

The magnetic moments of a proton and a neutron are $2.792\ \mu_N$ and $-1.913\ \mu_N$, where μ_N is the nucleon magnetic moment. The values of the magnetic moments of the mirror nuclei $^{19}_{9}\mathrm{F}_{10}$ and $^{19}_{10}\mathrm{Ne}_{9}$, respectively, in the Shell model, are closest to

1. $23.652\ \mu_N$ and $-18.873\ \mu_N$
2. $26.283\ \mu_N$ and $-16.983\ \mu_N$
3. $-2.628\ \mu_N$ and $1.887\ \mu_N$
4. $2.628\ \mu_N$ and $-1.887\ \mu_N$

Q6. [Dec 2023] . 5.0 marks

Nuclear and Particle Physics > Shell model

CSIR NET	2023 Dec	5 M

In a shell model description, neglecting Coulomb effects, which of the following statements for the energy and spin-parity is correct for the first excited state of $A = 12$ isobars $^{12}_{5}B$, $^{12}_{6}C$, $^{12}_{7}N$?

1. same for $^{12}_{5}B$, $^{12}_{6}C$ and $^{12}_{7}N$
2. different for each $^{12}_{5}\mathrm{B}$, $^{12}_{6}\mathrm{C}$ and $^{12}_{7}\mathrm{N}$
3. same for $^{12}_{6}C$ and $^{12}_{7}N$, but different for $^{12}_{5}B$
4. same for $^{12}_{5}B$ and $^{12}_{7}N$ but different for $^{12}_{6}C$

Answer Key

6 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Nuclear and Particle Physics	Shell model	**1**
Q2	Nuclear and Particle Physics	Shell model	**1**
Q3	Nuclear and Particle Physics	Shell model	**3**
Q4	Nuclear and Particle Physics	Shell model	**4**
Q5	Nuclear and Particle Physics	Shell model	**4**
Q6	Nuclear and Particle Physics	Shell model	**4**

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