PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

"LS, JJ and other interactions" - CSIR NET Physics PYQs

Atomic and Molecular Physics . All PYQs (2015-2025) with answer key

11 questions . Answer key included

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Q1. [Dec 2015] . 5.0 marks

Atomic and Molecular Physics > "LS, JJ and other interactions"

CSIR NET	2015 Dec	5 M

The LS configurations of the ground state of $^{12}\mathrm{Mg}$, $^{13}\mathrm{Al}$, $^{17}\mathrm{Cl}$ and $^{18}\mathrm{Ar}$ are, respectively,

1. $^3S_1$, $^2P_{1/2}$, $^2P_{1/2}$ and $^1S_0$
2. $^3S_1$, $^2P_{3/2}$, $^2P_{3/2}$ and $^3S_1$
3. $^1S_0$, $^2P_{1/2}$, $^2P_{3/2}$ and $^1S_0$
4. $^1S_0$, $^2P_{3/2}$, $^2P_{1/2}$ and $^3S_1$

Q2. [June 2015] . 5.0 marks

Atomic and Molecular Physics > "LS, JJ and other interactions"

CSIR NET	2015 June	5 M

Of the following term symbols of the np^2 atomic configurations, $^1\mathrm{S}_0$, $^3\mathrm{P}_0$, $^3\mathrm{P}_1$, $^3\mathrm{P}_2$ and $^1\mathrm{D}_2$, which is the ground state?

1. $^3\mathrm{P}_0$
2. $^\mathrm{I}\mathrm{S}_0$
3. $^3\mathrm{P}_2$
4. $^3\mathrm{P}_1$

Q3. [Dec 2016] . 5.0 marks

Atomic and Molecular Physics > "LS, JJ and other interactions"

CSIR NET	2016 Dec	5M

In the $L-S$ coupling scheme, the terms arising from two non-equivalent p-electrons are

1. ^{3}S, ^{1}P, ^{3}P, ^{1}D, ^{3}D
2. ^1S, ^3S, ^1P, ^1D
3. ^1S, ^3S, ^3P, ^3D
4. ^1S, ^3S, ^1P, ^3P, ^1D, ^3D

Q4. [Dec 2016] . 5.0 marks

Atomic and Molecular Physics > "LS, JJ and other interactions"

CSIR NET	2016 Dec	5M

The total spin of a hydrogen atom is due to the contribution of the spins of the electron and the proton. In the high temperature limit, the ratio of the number of atoms in the spin-1 state to the number in the spin-0 state is

1. 2
2. 3
3. $1/2$
4. $1/3$

Q5. [June 2016] . 5.0 marks

Atomic and Molecular Physics > "LS, JJ and other interactions"

CSIR NET	2016 June	5M

The ground state electronic configuration of $^{22}\mathrm{Ti}$ is $[\mathrm{Ar}]3d^2 4s^2$. Which state, in the standard spectroscopic notations, is not possible in this configuration?

1. $^1F_3$
2. $^1S_0$
3. $^1D_2$
4. $^3P_0$

Q6. [Dec 2017] . 5.0 marks

Atomic and Molecular Physics > "LS, JJ and other interactions"

CSIR NET	2017 Dec	5M

The separations between the adjacent levels of a normal multiplet are found to be $22\,\mathrm{cm}^{-1}$ and $33\,\mathrm{cm}^{-1}$. Assume that the multiplet is described well by the $L-S$ coupling scheme and the Lande's interval rule, namely $E(J)-E(J-1)=AJ$, where A is a constant. The term notaions for this multiplet is

1. $^3P_{0,1,2}$
2. $^3F_{2,3,4}$
3. $^3G_{3,4,5}$
4. $^3D_{1,2,3}$

Q7. [Dec 2017] . 5.0 marks

Atomic and Molecular Physics > "LS, JJ and other interactions"

CSIR NET	2017 Dec	5M

If the fine structure splitting between the $2\,^2P_{3/2}$ and $2\,^2P_{3/2}$ levels in the hydrogen atom is $0.4\,\mathrm{cm}^{-1}$, the corresponding splitting in Li^{2+} will approximately be

1. $1.2\,\mathrm{cm}^{-1}$
2. $10.8\,\mathrm{cm}^{-1}$
3. $32.4\,\mathrm{cm}^{-1}$
4. $36.8\,\mathrm{cm}^{-1}$

Q8. [Dec 2019] . 5.0 marks

Atomic and Molecular Physics > "LS, JJ and other interactions"

CSIR NET	2019 Dec	5M

The outermost shell of an atom of an element is $3d^3$. The spectral symbol for the ground state is

1. $^4F_{3/2}$
2. $^4F_{9/2}$
3. $^4D_{7/2}$
4. $^4D_{1/2}$

Q9. [June 2022] . 5.0 marks

Atomic and Molecular Physics > "LS, JJ and other interactions"

CSIR NET	2022 June	5M

The electronic configuration of ^{12}C is $1s^2 2s^2 2p^2$. Including LS coupling, the correct ordering of its energies is

1. $E(^3P_2) < E(^3P_1) < E(^3P_0) < E(^1D_2)$
2. $E(^3P_0) < E(^3P_1) < E(^3P_2) < E(^1D_2)$
3. $E(^1D_2) < E(^3P_2) < E(^3P_1) < E(^3P_0)$
4. $E(^3P_1) < E(^3P_0) < E(^3P_2) < E(^1D_2)$

Q10. [Dec 2024] . 5.0 marks

Atomic and Molecular Physics > "LS, JJ and other interactions"

CSIR NET	2024 Dec	5M

The hyperfine splitting of the ground state of the hydrogen atom is given as

$$\Delta E \propto \frac{g_p g_e}{m_p m_e a^3}$$

where g_p and g_e are the nuclear and electron Landê g factors respectively, and a is the orbital radius of the ground state. It is given that g (proton) $= 5.59$. In Hydrogen, transition between these split levels corresponds to radiation of wavelength 21 cm .

If the proton is replaced by a positron, the corresponding wavelength would be

1. 2.6 mm
2. 3.2 mm
3. 3.2 cm
4. 2.6 cm

Q11. [Dec 2024] . 5.0 marks

Atomic and Molecular Physics > "LS, JJ and other interactions"

CSIR NET	2024 Dec	5M

Consider the Bromine ion Br^{+}in its ground state. The atomic number of Br is 35. The fine structure term symbol $\left({}^{2S+1}L_J\right)$ under the LS coupling scheme for the lowest energy state of this ion would be

1. ${}^3P_2$
2. ${}^3P_0$
3. ${}^1D_2$
4. ${}^4S_{3/2}$

Answer Key

11 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Atomic and Molecular Physics	"LS, JJ and other interactions"	**3**
Q2	Atomic and Molecular Physics	"LS, JJ and other interactions"	**1**
Q3	Atomic and Molecular Physics	"LS, JJ and other interactions"	**4**
Q4	Atomic and Molecular Physics	"LS, JJ and other interactions"	**2**
Q5	Atomic and Molecular Physics	"LS, JJ and other interactions"	**1**
Q6	Atomic and Molecular Physics	"LS, JJ and other interactions"	**4**
Q7	Atomic and Molecular Physics	"LS, JJ and other interactions"	**3**
Q8	Atomic and Molecular Physics	"LS, JJ and other interactions"	**1**
Q9	Atomic and Molecular Physics	"LS, JJ and other interactions"	**2**
Q10	Atomic and Molecular Physics	"LS, JJ and other interactions"	**1**
Q11	Atomic and Molecular Physics	"LS, JJ and other interactions"	**1**

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