CHEMISTRY

BOOKS - PEARSON IIT JEE FOUNDATION

ATOMIC STRUCTURE

Example

1. What do you mean by emission and absorption spectra ?

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2. What do you mean by stationary orbit ?

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3. How did sommerfeld explain the fine sturcture of hydrogen spectrum ?

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4. Sunny and Bunny have taken spectra for the following transitions .Spectra taken by sunny consited of bright lines on a dark background .Spectra taken by Bunny consisted of dark lines on a bright background .Identify the electronic transitions corrseponding to the spectra taken by sunny and Bunny .What are those spectra called?

(i) n= 5 to n=2

(ii) n=3 to n=6

(iii) n=5 to n=7

(iv) n=3 to n=1

(v) n=1 to n=2

(vi) n=5 to n=3

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5. Why did Sommerfeld extend Bohr's theory ?

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6. Velocity of an electron decreases as we go further from the nucleus. Justify.

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7. Distinguish between orbit and orbital with respect to definition

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8. Why did Sommerfeld introduce azimuthal quantum number?

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9. How does de Broglie's theory support Bohr's theory?

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10. Configurations Designations of sotne orbitals are given below. Identify those configurations that are not possible in an atotn. Arrange the orbitals with possible configurations in the order in which they are

filled with electrons 6s, Sp, 7s, 4d, 2p, 3d, 3f, 4f, 1p.

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11. The valence electronic configuration of an atom is $6s^2$ If d-orbital of the penultimate shell contains two unpaired electrons, calculate the atomic number

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12. An atoin of an element has three electrons in 4p subshell. Calculate the atomic number of the element

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13. What is the maximum number of electrons present in the main energy level in which the 'g' subshell appears for the first time? Find the atomic number of the element to be discovered in which the differentiating

electron is the only electron in the first 'g' subshell

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14. Arrange the following atomic numbers in the increasing order of number of unpaired electrons

A. 16

B. 32

C. 40

D. 57

Answer:

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15. Account for the very stable nitrogen atotn in contrast to its neighbouring carbon and oxygen atoms.

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Very Short Answer Type Question

1. How are the subatomic particles arranged in an atom according to modern structure of the atom

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2. The region having maximum probability of finding an electron in space is known as _____

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3. According to de Broglie, what is the relation between the wave length of the wave associated with the moving electron and momentum of the f electron?

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4. Define an atomic orbital

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5. What is the shape of an 's' orbital? Draw the diagram

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6. What do you mean by degenerate orbitals? Give examples

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7. The valence electronic configuration ofmagnesium is _____

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8. How many nodal surface(s) can 5s orbital have

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9. Magnetic quantum number specifies _____

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10. In the pictorial representation of an orbital, what is the role of different intensity of shading

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11. In the degenerate orbitals, unpaired electrons have _____ spin

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12. Nitrogen atom has _____ unpaired electrons according to _____ rule

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13. The ratio between the number of neutrons present in C^{12} and Si^{30} atoms is _____

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14. The electronic configuration of copper is _____

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15. When a 4p orbital is completely filled then the next electron goes to _____

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16. The number ofunpaired electrons present in Fe^{+3} _____

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17. Which one of the following(a or h) electronic configuration is more stable and why? (a) $3d^4 4s^2$ (b) $3d^5 4s^2$

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Short Answer Type Question

1. What is Heisenberg's uncertainty principal

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2. How many nobes are present in 3s, 3p, and 3d orbitals

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3. Calulate the maxium number of electons in 1 st 2 nd , 3 rd and 4 th shells

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Level 1

1. The dual nature of electron was given by somerfeld

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2. Among 4p,4s,3p and 3d orbital has the least energy

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3. Azimuthal quantam nuber indicates the angular momentum of an electron

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4. Any two electron in an atom can have maxium of three quantam numbers same

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5. Pairing of electron in an degenerate orbitals takes place only when the degenerate orbitals are filled with one eletron each

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6. Bohr's theory can explain the spectra of multielec - tron species

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7. In iron the differentiating electron enters into the orbitals of a penultimate shell

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8. For a given value of 'l' the total number of 'm' values is _____

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9. If the azimuthal quantam number of an electron is 2 then the shape of orbitals is _____

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10. The value of planck's constant is

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11. The ratio of energy to frequency of electromagnetic radiation is equal to _____

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12. The minimum angular momentum of an electron with the magnetic quantum numbers $-1, 0, +1$

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13. Bohar's model introduced the concept of quantisation of _____

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14. The ratio of the energies of two different radiation whose frequenceies are 3×10^{14}Hz and 5×10^{14}Hz is _____

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15. The Bohar's model could successfully explain

A. the stabilty of the atom

B. the atomic spectra of hydrozen atom

C. the calculation of energy of the electron in a particular orbit of hydrogen atom

D. all of the above

Answer: D

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16. Among the following , the orbitals that has the lowest energy is

A. 5f

B. 4f

C. 6s

D. 6p

Answer: C

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17. What is the maxiumum number of electron , present in an orbit whose angular momentmum is $\frac{2h}{\pi}$

A. 18

B. 2

C. 32

D. 8

Answer: C

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18. The simultaneus location of both the position and the velocity of an electron in

motion cannot be found with desired accuary '

This was proposed by

A. Bohr

B. Heisenberg

C. Sommerfeld

D. de Broglie

Answer: B

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19. Which of the following sets of quantam numbers represent electron in hydrozen atom

A. 1,1,0 $+(1/2)$

B. 1,0,0, $+(1/2)$

C. 3,0,0 $-(1/2)$

D. 4,2,1 $-(1/2)$

Answer: B

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20. The eloctronic configureation of chromium is

A. $[Ar]3d^5 4s^1$

B. $3d^5 4s^1$

C. $[Ar]3d^4 4s^2$

D. $3d^4 4s^2$

Answer: A

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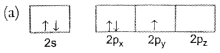
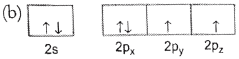
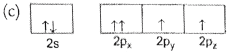
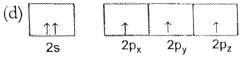
21. The electronic configureation in which Pauli's exclusion principal or Hund's rule is not violated is

A. 

B. 

C. 

D. 

Answer: B

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22. In the following pairs , identify the pair having a different (n+l) value

A. 4s'3p

B. 3d,4p

C. 4s,3d

D. 4d,5p

Answer: C

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23. The maxium value of l for n =4 is

A. 2

B. 4

C. 3

D. 5

Answer: C

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24. The maxium number of electron that electron that can be accomodated in p-subshell in 3rd orbital

A. 2

B. 4

C. 6

D. 10

Answer: C

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25. Which of the following sets of quantam numbers is correct for an electron in 3d orbitals

A. 3,0,0, $+(1/2)$

B. 3,1,1, $-(1/2)$

C. 3,2,1, $+(1/2)$

D. 3,2,3, $-(1/2)$

Answer: C

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26. Probilty of finding a d_{yz} electron is zero along the

A. x-axis

B. y-axis

C. z-axis

D. all of these

Answer: D

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27. Heisenberg's uncertainty principal is not applicable to

A. all the bodies moving with high speed

B. protons

C. electrons

D. all the microparticales moving with high speed

Answer: A

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28. If 20 electrons are present in the 4th orbit then the atomic number of that element is

A. 58

B. 59

C. 56

D. 60

Answer: B

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29. Zeeman and Stark effects can be explained by _ quantam number

A. principal

B. azimuthal

C. magnetic

D. spin

Answer: C

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30. Discovries of isotopes and isobars contradict some of the postulates of _ atomic theory

A. Bohr's

B. Dalton's

C. Rutherford's

D. Thomson's

Answer:

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31. According to _____ atomic model positive charge is thinly spread throghout the atom

A. Bohr's

B. Dalton's

C. Rutherford's

D. Thomson's

Answer:

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32. Which of the following statements is false

A. Bohr's theory explains only the spectra of single electron specis

B. The energy of an electron remains constant during electronic transition

C. The angular momentum of an electron is quantised

D. According to Bohr's theory , electron revolve around the nucels in circular

orbits

Answer:

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33. The difference in energy of radition emitted (or) absorted during electronic transition is

A. directly proportional to frequency

B. directly proportional to wavelenght

C. inversely proportional to frequency

D. inversely proportional to velocity of light

Answer:

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34. Which of the following statements regarding orbit -als is false

A. 1s orbitals has one nodal region

B. 2s orbitals is spherical with one nodal region

C. 2px orbital is dumb bell with one nodel plane

D. 3d orbitals has two nodal planes

Answer:

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35. Quantam theory of radiation was proposed by

A. Pauli

B. Planck

C. Hund

D. Aufbau

Answer:

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36. The azimuthal quantam number of an electron is zero , then the shape of its orbitals will be

A. circular

B. spherical

C. elliptical

D. dumbbell

Answer:

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37. The number of nodes of an s-orbitals increases with

A. the increases in n value

B. the decreases in n value

C. the increases in 1 value

D. the decreases in 1 value

Answer:

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38. The statement given below are the postulates of various atomic models . Arrange them in their chronological order

Fine structure is due to the presence of subshells in the main energy level

The size of an atom is much larger than the size of its nucleus

As long as the electron is present in a particular orbit , its energy remains constant

Negative charged particals are uniformly spread in the lump of positive charge

A. 4,3,2,1

B. 2,3,4,1

C. 4,2,3,1

D. 3,4,2,1

Answer:

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39. (1) As long as an electron revolves in a particular orbit , the electron does not lose its energy Therefore, these orbits are called

stationary orbits and the electrons are said to be in station-ary energy state

(2) Each orbit or shell is associated with a definite amount of energy . Hence , these are also called energy levels

An electron jumps from a lower energy level to a higher energy level , by absorting energy . It jumps from a higher energy to a lower level by emmitting energy in the form of electromagnetic radiation

Electrons move around the nucels in specified circular paths called orbits or shells or energy levels and are designated as K,L,M and N shells

respectively

Arrange the above postulates of Bohr's theory in a correct sequence

A. 4,1.3,2

B. 4,2,1,3

C. 4,1,2,3

D. 2,4,1,3

Answer:

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40. (1) The probability of finding an electron is maxium at certain places in space

(2) Energy change takes place only during excitation or deexcitation of electron

(3) Electron has both particle and wave nature

(4) Angular momentum of the electron revolving in different ellipticals orbits is quantised

Arrange the above statements of different models or principals in the chronological order , which ultimately led to the development of modern structure of the atom

A. 1,2,3,4

B. 2,4,3,1

C. 4,3,2,1

D. 2,3,1,4

Answer:

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41. Energy of an electron in a particular orbit of single electron species of beryllium is the same as the energy of an electron in the

ground state of hydrogen atom . Identify the orbit of beryllium

A. 1

B. 2

C. 3

D. 4

Answer:

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42. The difference between the angular momentum of two orbits of $He^{+2}$is $\frac{2h}{\pi}$ The energy of an electron present in the higher orbit is -1.51 eV. Identify the lower orbit

A. 1

B. 2

C. 3

D. 4

Answer:

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43. Velocity of the electron in electron microscope is $1.6 \times 106 m / s$.What would be the wavelenght of the electron

A. $5.39 Å$

B. $4.55 Å$

C. $3.54 Å$

D. 6.78 Å`

Answer:

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44. An atom of an element has nine electrons with l=0 value 18 electrons with l=1 value and 10 electrons with l=2 value . Calculate the atomic nuber of the element

A. 37

B. 41

C. 38

D. 39

Answer:

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Level 2

1. p' orbital has a nodal plane while 's' orbital has a nodal region . Elaborate with the help of a diagram

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2. What is the common nodal plane of d_{xy} and d_{zx}

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3. The number of nodal regions for an 's' orbital is given by (n - 1). How do you account for this

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4. Compare the energy released during direct electronic transition from 4th orbit to lst orbit with the energy released during successive electronic transi tions between the same orbits in H-atom. Is the energy of all successive transitions between the 4th orbit and 1st orbit equal

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5. Wave nature of matter is applicable only for sub- atomic particles and not for larger objects. justify this statement.

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6. Are the magnetic quantum number and angular momentum of an electron related to each other? Explain

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7. What is the maximum number of electrons present in the main energy level in which the g subshell appears for the first time? Find the atomic number of the element to be discovered in which the dif- ferentiating electron is the only electron in the first 'g' subshell.

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8. If the angular momentum of an electron is $3.16 \times 10^{-34} kgm^2/s$ and the radius and

energy of an orbit in which the above electron is present is $0.6 \times 10^{-10} m$ and 2.4×10^{-18} respectively then eal-culate the radius and energy of 2nd orbit of that atom.

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9. When the electrons are successively filled in the orbitals of same shell, orbital, Which is filled at the end, requires less energy to remove electron. Justify.

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10. Atomic number of an element is 42. Find out the number of electrons present in the valence shell.

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11. Arrange the following ions in the increasing order of unpaired electrons $Na^{+}, Cu^{+1}, N^{-3}, O^{-}, P$ and Cr

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12. Arrange the following orbitals in the order in which they are filled with electrons and justify the order: 6s, 5d, 6p, 75, Sf.

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13. Given that the N shell of an element contains 10 electrons, write the electronic configuration of the stable ion.

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14. If an atom of an element has eight electrons in a subshell having five orientations of 4th energy level, write the electronic configuration of the element and four quantum numbers for valence electrons

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15. The energy of an electron in a particular orbit of Li^{+2} is -30.6 eV. What is the energy of an electron in the same orbit of Be^{+3} ?

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16. The angular momentum of an electron in a particular orbit of H atom is $5.27310^{-34} kgm^2/s$. Calculate the radius of the particular orbit of lithium.

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17. How did Sommerfeld explain the fine structure of hydrogen spectrum?

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18. Electrons occupy the degenerate orbitals with par allel spins. How can you justify this statement with respect to stability

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19. 'p'- orbital hasa nodal plane while 's'- orbital hasa nodal region. Elaborate with the help of a diagram

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20. he atomic number of an atom A is x. Valence elec tronic configuration of another atom B is $6s^{25}d^3$ and its atomic number is (x + 5). Write the elec-tronic configuration of A.

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21. The ratio of atomic numbers of two elements X and Y is 1 : 7. Radius of 5th orbit ofsingle electron species of X is 3.3 $\mathring{A}$. Write

the electronic con figuration of Y and four quantum numbers for the valence electrons

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22. An electron is revolving in an orbit with a veloc- ity of $5.46 \times 107 cms^{-1}$. Calculate the wave length associated with the electron.

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23. A spherical orbital has three nodal regions and it contains a pair ofelectrons. If this is the only orbital that is occupied with electrons in that main energy level, and the penultimate shell is completely filled, calculate its atomic number

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24. The sum of all the quantum numbers of all the A valence electrons of an atom of an inert

gas is 22. Identify the inert gas

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Level 3

1. Energy of an electron increases with increase in distance from the nucleus. Comment on the change in kinetic energy and potential energy.

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2. Do all the single electron species of various ele- ments possess same energy for the electron in the ground state? Give reason.

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3. Two electronic transitions were found to take place in a single electron species. One is deactivation of electron from the 5^{th} shell to the 4^{th} shell and the other is from the 2^{nd}nd shell to the l^{st} shell. Do the energies emitted

due to the above transitions have the same wavelength? justify

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4. An electron is present in a hydrogen atom in the ground state and another electron is present in a smgle electron species of beryllium. In both the species the distance between the nucleus and electren 18 same. Calculate the difference in their energies.

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5. One electron is made to revolve around a pro ton and it possesses the least possible energy and another electron is made to revolve around an α-particle with the same energy. Calculate the ratio of the distances of the electrons from the respective species

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6. The principal and azimuthal quantum numbers associated with a subshell are a and

a 4, respec tively. Predict the shape of that subshelli f the shape of another subshell having azimuthal .quantum number a-5 is spherical. If that subshell is half filled, predict the atomic number of the element

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7. Are the magnetic quantum number and angular momentum of an electron related to each other? Explain.

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8. The larger the value of '1' belonging to the same main energy, higher is the energy associated with it' Comment on this statement.

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