



CHEMISTRY

BOOKS - MAXIMUM PUBLICATION

STRUCTURE OF ATOM

Example

1. Which of the following is not true for cathode rays?

- A. They possess kinetic energy
- B. They are electromagnetic waves
- C. They produce heat
- D. They produce mechanical pressure

Answer: B



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2. The mass of the electron =



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3. Bohr's orbits are called stationary states because

A. Electrons in them are stationary

B. Their orbits have fixed radii

C. The electrons in them have fixed energy

D. The protons remain in the nuclei and are stationary

Answer: C



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4. The metal which gives photoelectrons most easily is

A. Lithium

B. Sodium

C. Calcium

D. Cesium

Answer: D



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5. The orbitals having same energy are calledorbitals



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6. Match the following:

Sodium	f-block
Oxygen	s-block
Uranium	d-block
Silver	p-block



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7. Which of the following set of quantum numbers is correct for an electron in 4f orbital

A. $n=4$ $l=4$ $m_l=-4$ $m_s=+1/2$

B. $n=4$ $l=3$ $m_l=+4$ $m_s=+1/2$

C. $n=4$ $l=3$ $m_l= -3$ $m_s=-1/2$

D. $n=4$ $l=3$ $m_l= +4$ $m_s=-1/2$

Answer: C



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8. The limiting line of Balmer Series has the frequency of



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9. The number of orbitals and the maximum number of electron that can be accommodate in a principal quantum level are



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10. If the uncertainty in position and momentum of a particle like electrons are equal then uncertainty in velocity is



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11. The total energy of an electron in a Bohr orbit is given by



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12. Match the following:

Sodium	f-block
Oxygen	s-block
Uranium	d-block
Silver	p-block



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13. Of the following which is/are correct?

A. $n=2$ $l=1$ $m=0$ $s=+1/2$

B. $n=3$ $l=3$ $m=2$ $s=-1/2$

C. $n=4$ $l=3$ $m=1$ $s=-1/2$

D. $n=3$ $l=2$ $m=3$ $s=+1/2$

Answer: A:C



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14. Match the following:

Sodium	f-block
Oxygen	s-block
Uranium	d-block
Silver	p-block



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15. Calculate the uncertainty in the determination of velocity of a ball of mass 200 g. If the uncertainty in the determination of position is 1\AA .

$$[h = 6.626 \times 10^{-34}]$$



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16. Which among the following sets of quantum numbers is/are not possible?

A. $n=3$ $l=2$ $m=0$ $s=+1/2$

B. $n=2$ $l=1$ $m=0$ $s=+1/2$

C. $n=1$ $l=0$ $m=0$ $s=-1/2$

D. $n=4$ $l=2$ $m=2$ $s=-1/2$

Answer:



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17. How many sub - shells are associated with $n=4$?



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18. How many electrons will be present in the sub- shells having m_s value of $(-1/2)$ for $n=4$?



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19. Name the principle which restricts the pairing of electrons in degenerate orbitals.



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20. How many electrons can be accommodate in the sub-shell having $n=4$ and $l=2$?



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21. If the electron is to be located within $5 \times 10^{-5} \text{ \AA}$, what will be the uncertainty in its velocity?

(Mass of the electron = $9.1 \times 10^{-31} \text{ kg}$)



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22. Nitrogen laser produces a radiation at a wavelength of 337.1 nm. If the number of photons emitted is 5.6×10^{24} per second, calculate the power of this laser.



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23. Fill in the blanks suitably by studying the relationship of the given pairs: a) Lyman: Ultraviolet :: Balmer :



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24. Fill in the blanks suitably by studying the relationship of the given pairs: b) s-subshell : spherical :: p-subshell :



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25. Fill in the blanks suitably by studying the relationship of the given pairs: c) Rydberg's formula : $\left(\frac{1}{\pi}\right) = R \left[\left(\frac{1}{n_1^2}\right) - \left(\frac{1}{n_2^2}\right) \right] ::$ de Broglie relation :



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26. Fill in the blanks.

Name	Dimension	Example
Cubic	$a=b=c, \alpha=\beta=\gamma=(a)$	(b)
Orthorhombic	(c) (d)	Rhombic Sulphur
(e)	$a=b \neq c, \alpha=\beta=(f) \gamma=(g)$	(h)



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27. Filling of electrons in the orbitals on a ground state atom is governed by three rules.

a) Which are the three rules?



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28. Filling of electrons in the orbitals on a ground state atom is governed by three rules.

b) State any one of them.



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29. During a class room discussion one of your friends argued that , " We can't determine both position and velocity of an electron".

a) Is it true?



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30. During a class room discussion one of your friends argued that , " We can't determine both position and velocity of an electron".

b) Which principle is behind your answer?



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31. During a class room discussion one of your friends argued that , " We can't determine

both position and velocity of an electron".

c) State it.



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32. The argument of two students is as given :

Student 1 : "We need four quantum numbers to represent an electron in a multi- electron atom."

Student 2 : " We ned only first three quantum numbers to represent an electron in a multi-

electron atom."

a) Which are the four quantum numbers?



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33. The argument of two students is as given :

Student 1 : "We need four quantum numbers to represent an electron in a multi- electron atom."

Student 2 : " We ned only first three quantum numbers to represent an electron in a multi-

electron atom."

b) Who is correct? Why?



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34. The argument of two students is as given :

Student 1 : "We need four quantum numbers to represent an electron in a multi- electron atom."

Student 2 : " We ned only first three quantum numbers to represent an electron in a multi- electron atom."

c) Write the possible four quantum numbers of the valence electron of Na atom.



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35. Match the following:

Sodium	f-block
Oxygen	s-block
Uranium	d-block
Silver	p-block



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36. Explain the experiment done by Rutherford and give its observations.



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37. Write the conclusions of the experiment.



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38. The 4s subshell has more energy than 3p subshell.

Is it true ? Justify your answer.



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39. The 4s subshell has more energy than 3p subshell.

State Aufbau principle.



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40. Two students were analysing the electronic configurations of the first 30 elements of the Periodic Table as part of an assignment. They

found that two elements showed difference from other twenty eight elements.

a) Which are the two elements?



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41. Two students were analysing the electronic configurations of the first 30 elements of the Periodic Table as part of an assignment. They found that two elements showed difference from other twenty eight elements.

Write their electronic configurations.



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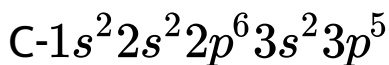
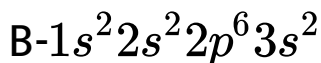
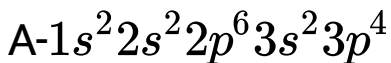
42. Two students were analysing the electronic configurations of the first 30 elements of the Periodic Table as part of an assignment. They found that two elements showed difference from other twenty eight elements.

Why they show this anomalous behavior?



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43. The electronic configuration of the elements are given below.

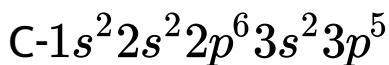
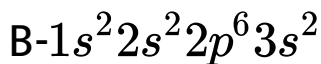
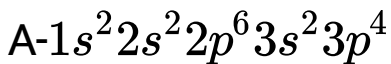


$\text{D-}1s^2 2s^2 2p^6 3s^1$ Which is the period number of the element A? What is the basis of your findings?



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44. The electronic configuration of the elements are given below.



D- $1s^2 2s^2 2p^6 3s^1$ Which is the period number of the element A? What is the basis of your findings?



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45. J.J.Thomson proposed his atom model in 1898.

a) Explain Thomson's model of atom



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46. J.J.Thomson proposed his atom model in 1898.

b) Why Thomson's atom model is called plum pudding model or watermelon model?



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47. J.J.Thomson proposed his atom model in 1898.

c) What is the limitation of Thomson's atom model?



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48. A student argued that the 3d orbitals will be filled only after the 4s orbital is completely filled in accordance with aufbau principle. Then another student opposed by saying that

it is not true for certain elements like Cr and Cu.

Whose argument is correct?



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49. A student argued that the 3d orbitals will be filled only after the 4s orbital is completely filled in accordance with aufbau principle. Then another student opposed by saying that it is not true for certain elements like Cr and Cu.

Write electronic configuration of Cr_{24} and Cu_{29} .

Justify your answer.



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50. What are the atomic numbers of elements whose outemost electronic configurations are given by



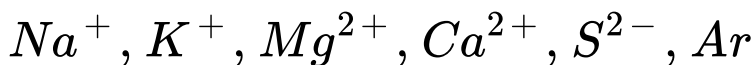
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51. What are the atomic numbers of elements whose outemost electronic configurations are given by



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52. Which of the following are isoelectronic species?



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53. What will be the wavelength of a ball of mass 0.1 kg moving with a velocity of 10 m s^{-1} .



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54. Quantum numbers are a set of four numbers used to designate electron in an atom.

i) How many electron in an atom can have the following quantum numbers , $n=1, l=0$?



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55. Quantum numbers are a set of four numbers used to designate electron in an atom.

ii) Give the quantum numbers of the valence electron of an atom with atomic number 13.



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56. Quantum numbers are a set of four numbers used to designate electron in an

atom.

Draw the shape of orbital having $n=1$ and $l=0$.



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57. What is meant by line spectra or atomic spectra?



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58. Name the series of lines in the hydrogen spectrum belonging to the visible region.



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59. What is the wavelength of light emitted when the electron in a hydrogen atom undergoes transmission from $n=4$ to $n=2$? (

$$R_H = 109677\text{cm}^{-1})$$



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60. State the principles /rules for filling of orbitals in atoms.



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61. Line emission spectra are often called finger print of atoms.

a) Justify the above statement



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62. Line emission spectra are often called finger print of atoms.

Yellow light emitted from a sodium lamp has a wavelength (λ) of 580 nm. Calculate the

frequency and wave number of this yellow light.



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63. How many orbitals are possible in a p-subshell. Which are they?



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64. What is the shape of p-orbital?

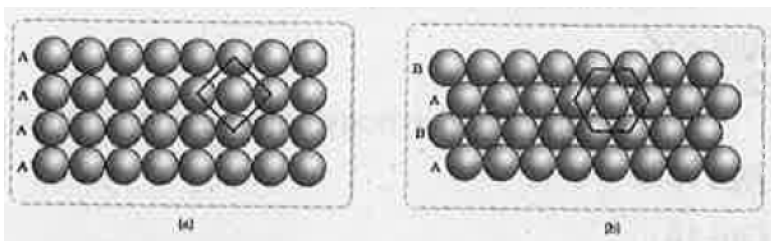


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65. Sketch the boundary surface diagrams of 2p orbitals.



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Explain them.



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67. What is the uncertainty in position of an electron if the uncertainty in its velocity is 5.7×10^5 m/s ?



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68. Bohr's model of hydrogen atom is a modification of Rutherford's model.

a) Write any two merits of Bohr's model



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69. Bohr's model of hydrogen atom is a modification of Rutherford's model.

Write any two demerits of Bohr's model



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70. Consider the statement, "The two electrons of He atom have the same set of quantum numbers."

Do you agree?



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71. Consider the statement, "The two electrons of He atom have the same set of quantum numbers."

b) Name the principle applied here.



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72. Consider the statement, "The two electrons of He atom have the same set of quantum numbers."

c) State the principle



73. Consider the statement, "The two electrons of He atom have the same set of quantum numbers."

d) Write the all quantum numbers of outer electrons of the atom



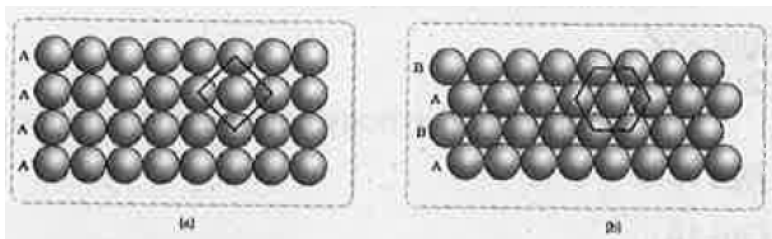
(i) Complete the following table by finding $a_1, a_2, a_3, a_4, a_5, a_6, a_7$ and $b_1, b_2, b_3, b_4, b_5, b_6, b_7$

θ	120°	330°	240°	420°	390°	450°	300°
sine	a_1	a_2	a_3	a_4	a_5	a_6	a_7
cosine	b_1	b_2	b_3	b_4	b_5	b_6	b_7

74.



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75.

Explain them.



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76. Match the following:

Sodium	f-block
Oxygen	s-block
Uranium	d-block
Silver	p-block



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77. Quantum numbers are the address of an electron in an atom. Justify the statement by explaining different quantum numbers.



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78. Dual nature of matter was proposed by Louis de Broglie.

a) Calculate the de Broglie wavelength associated with an electron with velocity equal to that of light .



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79. Dual nature of matter was proposed by Louis de Broglie.

State Heisenberg's uncertainty principle and give its mathematical expression.



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80. Rutherford's atom model had strong similarity to a small scale solar system.

What are the important features of Rutherford's nuclear model of atom?



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81. Rutherford's atom model had strong similarity to a small scale solar system.

What are the drawbacks of Rutherford's model of atom?



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82. Calculate the momentum of a particle which has de Broglie wave length of 250 pm.



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83. The distribution of electron into orbitals of an atom is called its electronic configuration.

Give the electronic configuration of chromium atom.



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84.

Which among the following configuration is more stable, d^4 or d^5 ? Justify your answer.



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85. Name and state the principle, which restrict the maximum numbers of electrons in an orbital to be two.



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86. Using s, p, d, f notation represent the subshell with the following quantum numbers.

i) $n=1, l=0$



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87. Using s, p, d, f notation represent the subshell with the following quantum numbers.

$$n=4, l=3$$



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88. The uncertainty in the position and velocity of a particle are 10cm and 5.27×10^3 m/s respectively. Calculate the mass of the particle ($h = 6.626 \times 10^{-34}$ J s)



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89. The photoelectric effect was first observed by H.Hertz.

What is photoelectric effect?



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90. The photoelectric effect was first observed by H.Hertz.

b) What are the observations of photoelectric effect experiment?



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91. A mathematical representation is given below:

$$\Delta X \times \Delta p_x \geq \frac{h}{4\pi}$$

a) Which principle is illustrated by this equation?



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92. A mathematical representation is given below:

$$\Delta X \times \Delta p_x \geq \frac{h}{4\pi}$$

b) If the position of the electron is measured within an accuracy of ± 0.002 nm. Calculate the uncertainty in the momentum of the electron.



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93. Using s, p, d notation represent the subshell with the following quantum numbers:

$$n=5 \quad l=1$$



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94. Using s, p, d notation represent the subshell with the following quantum numbers:

$$n=3 \quad l=2$$



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Exercise

1. Calculate the number of electrons which will together weigh one gram.



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2. Calculate the mass and charge of one mole of electrons .



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3. Write the complete symbol for the atom with the given atomic number (Z) and atomic mass(A) :

i) $Z= 17, A=35$



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4. Write the complete symbol for the atom with the given atomic number (Z) and atomic mass(A) :

$$Z= 92, A=233$$



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5. Write the complete symbol for the atom with the given atomic number (Z) and atomic mass(A) :

$$Z= 4, A=9$$





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6. Electromagnetic radiation of wavelength 242 nm is just sufficient to ionise the sodium atom. Calculate the ionisation energy of sodium in kJ mol^{-1}



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7. What is the number of photons of light with a wavelength of 4000 pm that provide 1 J energy?



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8. Calculate the wavelength of an electron moving with a velocity of $2.05 \times 10^7 \text{ m s}^{-1}$



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9. Dual nature of matter was proposed by Louis-de-Broglie.

a) Calculate the de-Broglie wavelength

associated with an electron with velocity

$$1.6 \times 10^6 \text{ m s}^{-1}.$$



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10. Dual nature of matter was proposed by Louis-de-Broglie.

b) State Paul's exclusion principle and Hund's rule of maximum multiplicity.



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11. Neils Bohr was the first to explain quantitatively the general features of hydrogen atom structure and its spectrum.

a) Give the main postulates of Bohr's model.



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12. Neils Bohr was the first to explain quantitatively the general features of hydrogen atom structure and its spectrum.

b) Find the maximum number of emission

lines, when the excited electron of hydrogen atom in $n=6$, drops to the ground state ($n=1$).



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13. Neils Bohr was the first to explain quantitatively the general features of hydrogen atom structure and its spectrum.

Calculate the wave number of radiation due to transition of an electron from fourth orbit to second orbit. ($R_H = 109677\text{cm}^{-1}$)



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14. During Rutherford α - ray experiment, it was observed that most of the α particles passed through the Gold foil without any deflection, a small fraction deflected by small angles and very few bounced back.

a) What are the main conclusions made by Rutherford?



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15. During Rutherford α - ray experiment, it was observed that most of the α particles passed through the Gold foil without any deflection, a small fraction deflected by small angles and very few bounced back.

b) Give the atom model proposed by him.



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16. During Rutherford α - ray experiment, it was observed that most of the α particles

passed through the Gold foil without any deflection, a small fraction deflected by small angles and very few bounced back.

c) What are the main drawbacks of this model and how Niels Bohr overcome these defects in his model?



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17. Based on his α -ray scattering experiment, Rutherford proposed the nuclear model of an atom.

a) Give the main postulates of Rutherford's atom model.



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18. Based on his α -ray scattering experiment, Rutherford proposed the nuclear model of an atom.

Write the important demerits of the Rutherford model.



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19. Based on his α -ray scattering experiment, Rutherford proposed the nuclear model of an atom.

The threshold frequency γ_0 for a metal is $6.2 \times 10^3 \text{ s}^{-1}$. Calculate the K. E. emitted of an electron when the radiation f_0 frequency $\nu = 8.7 \times 10^{14} \text{ s}^{-1}$ strikes the metal.



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20. The electron in an atom are designed by a set of quantum numbers labeled as n , l , m and

s.

Give the values of n , l , m and s for the valence electron of sodium atom (atomic number =11)



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21. The electron in an atom are designed by a set of quantum numbers labeled as n , l , m and s .

b) Which of the following set of quantum numbers are not allowed?

A. $n= 3$, $l=3$, $m=-3$, $s=+1/2$

B. $n=2, l=1, m=0, s=-1/2$

C. $n=1, l=0, m=0, s=+1/2$

D. $n=0, l=0, m=0, s=+1/2$

Answer:



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22. The results fo Rutherford's α -ray scattering experiment were quite unexpected.

a) Write the observation of Rutherford's α -ray scattering experiment which leads to the

conclusion that most of the space in an atom is empty.



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23. The results fo Rutherford's α scattering experiment were quite unexpected.

Mention drawbacks of Rutherford's nuclear model of an atom.



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24. The photon has a momentum as well as a wavelength .

Which property of matter is revealed in the above statement ?



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25. The photon has a momentum as well as a wavelength .

A photon has a mass of 8.6×10^{-30} kg.

Calculate the wavelength.

[Planck's constant, $h = 6.626 \times 10^{-34}$ Js]



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26. Heisenberg's uncertainty principle rules out the existence of definite paths for electrons and other similar particles.

State Heisenberg's uncertainty principle.



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27. Heisenberg's uncertainty principle rules out the existence of definite paths for electrons and other similar particles.

b) Calculate the uncertainty in the velocity of a cricket ball of mass 130 g, if the uncertainty in its position is of the order of 1.2 \AA



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28. In order to specify the size energy, shape and orientation of orbitals and spin of the

electrons , we need 4 quantum numbers.

Write the 4 quantum numbers.



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29. In order to specify the size energy, shape and orientation of orbitals and spin of the electrons , we need 4 quantum numbers.

Represent the orbital with the following quantum numbers, $n=4$ and $l=0$.



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30. State the rules behind the electronic configuration in an atom.



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31. Photoelectric effect was first observed by Heinrich Hertz.

a) The number of electrons ejected in the photoelectric effect is proportional to of light used. (frequency, intensity)



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32. Photoelectric effect was first observed by Heinrich Hertz.

b) Select the correct statement related to the photoelectric effect:

A. Threshold frequency is the minimum frequency required to cause photoelectric emission from a particular metal.

B. The kinetic energy of the photoelectrons is directly proportional to the frequency

of incident light.

C. Work function is the same for all metals

D.

Answer:



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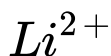
33.

Write any postulate of the Bohr's model of the hydrogen atom



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34. Calculate the radius of the second orbit of



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35. The dual behaviour of matter was proposed by the French physicist , de Broglie.

a) State the dual behaviour of matter.



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36. The dual behaviour of matter was proposed by the French physicist , de Broglie.

b) A moving electron has a de Broglie wavelength of 7×10^{-7} m. Calculate its kinetic energy. (Plank's constant, = 6.626×10^{-34} Js),(Mass of an electron = 9.1×10^{-31} kg.)



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37. A large number of orbitals are possible in an atom. Using s, p,d or f notation describe

the orbital with the following quantum numbers .

i) $n=4$, $l=0$



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38. A large number of orbitals are possible in an atom. Using s, p,d or f notation describe the orbital with the following quantum numbers .

ii) $n=3$, $l=2$



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39. The Balmer series of lines in the hydrogen spectrum appear in the visible region of the electromagnetic spectrum . Calculate the wave number of the second line in the Balmer series. (Rydberg constant for hydrogen is 109677 cm^{-1})



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40. Bohr model of hydrogen atom contradicts dual behaviour of matter and Heisenberg's

uncertainty principle. Justify.



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41. The number of electrons, protons and neutrons in a species are equal to 18, 16 and 16 respectively. Assign the proper symbol to the species.

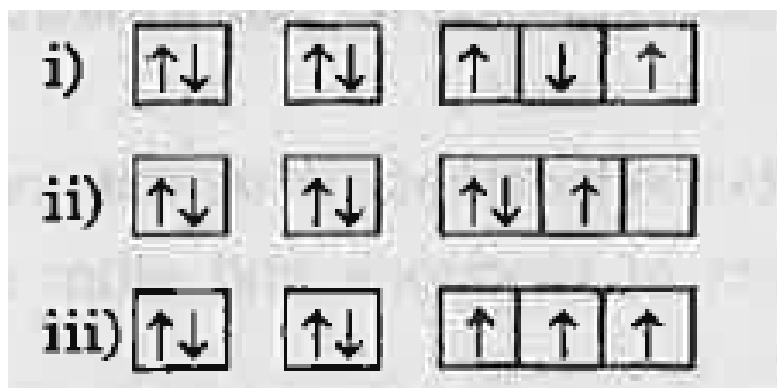


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42. Write any two drawbacks of the Rutherford model of an atom.

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43. Among the following electronic configurations, which one is correct?



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44. Write the subshellwise electronic configurations of the following elements:

i) Cu ($Z=29$)

Give reasons for the extra stability of these atoms.



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45. Write the subshellwise electronic configurations of the following elements:

ii) Cr($Z=24$)

Give reasons for the extra stability of these atoms.



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46. Canal rays were discovered by discharge tube experiments conducted in a modified cathode ray tube. Give any two characteristics of canal rays.



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47. A microscope with suitable photons is employed to locate an electron in an atom within a distance of 0.4λ . What is the uncertainty involved in the measurement of its velocity?



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48. The number of protons, electrons and neutrons in a species are equal to 17, 18 and 18 respectively. Which will be the proper symbol of this species?



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49. Based on alpha ray scattering experiment Rutherford proposed the nuclear model of atom. Give the main postulates of rutherford's nuclear model of an atom.



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50. Rutherford atom model has strong similarity with small scale solar system. Write

the two main drawbacks of Rutherford's atomic model.



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51. Representation of the orbital with quantum numbers $n=3, l=1$ is



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52. Which of the following sets of quantum numbers are NOT possible?

A. $n=2$, $l=2$, $m_l = 0$, $m_s = +1/2$

B. $n=1$, $l=0$, $m_l = 0$, $m_s = +1/2$

C. $n=3$, $l=2$, $m_l = -3$, $m_s = +1/2$

D. $n=2$, $l=1$, $m_l = 1$, $m_s = +1/2$

Answer:



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53. Do eukaryotic cells have restriction endonucleases? Justify your answer.



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54. Write any two observations of the photoelectric effect experiment.



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55. The quantum numbers provide valuable information regarding electrons in an atom.

a) Which one of the following statement is CORRECT about quantum numbers?

A. The principal quantum number can have fractional values.

B. The magnetic quantum number defines the three dimensional shape of the orbital.

C. The magnetic quantum number determines the size of the orbital.

D. Spin quantum number gives information about the spatial orientation of the

orbital with respect to standard set of coordinate axes.

Answer:



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56. A photon has a wavelength of 3.5\AA .

Calculate its mass (Plank's constant, =

6.626×10^{-34} Js . Velocity of light =

$3 \times 10^8 \text{ms}^{-1}$)



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57. The uncertainty principle contributed significantly in the formulation of the quantum mechanical model of atom.

a) Which of the following information is CORRECT about the uncertainty principle?

A. The exact position and exact momentum of an electron in an atom can be determined simultaneously.

B. It is a consequence of the dual behaviour of matter and radiation.

C. It is significant only for motion of microscopic objects and is negligible for that of macroscopic objects.

D. It supports the existence of definite paths or trajectories of electrons and other similar particles.

Answer:



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58. An electron is moving with a velocity of $2.5 \times 10^6 \text{ m s}^{-1}$. If the uncertainty in its velocity is 0.1% , calculate the uncertainty in its position.

(Plank's constant, $h = 6.626 \times 10^{-34} \text{ Js}$),(Mass of the electron = $9.1 \times 10^{-31} \text{ kg}$.)



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59. In order to specify size, energy, shape and spin of electrons we need quantum numbers.

a) write the four quantum numbers



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60. Atomic orbitals are precisely distinguished by what are known as quantum numbers.

Represent the orbitals given below.

i) $n=1, l=0$



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61. Atomic orbitals are precisely distinguished by quantum numbers.

Represent the orbitals given below.

$$n=2, l=1$$



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62. The number of unpaired electrons present in Ni is (Atomic number of Ni = 28)



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63. Bohrs model of hydrogen atom is the modification of Rutherfords model of atom.

a) Write any two merits of Bhors atom model



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64. Bohr was the first to explain the structure of hydrogen atom and spectrum.

Calculate the wavelength of the first line in the Lyman series of the hydrogen spectrum. ($R = 109677 \text{ cm}^{-1}$)





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65. State and explain Hund's rule of maximum multiplicity.



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66. Quantum number gives address of electrons. Explain the quantum number which determines:

i) Distance of electron from nucleus.



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67. Quantum number gives address of electrons. Explain the quantum number which determines:

ii) The orbital angular momentum of electron.



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68. Write the electronic configuration of chromium ($Z = 24$)



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69. Find the number of electrons in the subshells with azimuthal quantum number $l=2$.



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70. Represent the orbital with quantum numbers $n=1$ and $l=0$



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71. Give the mathematical representation of Heisenberg's uncertainty principle and its one important significance.



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