Q1 (20 July 2021 Shift 1)

The Azimuthal quantum number for the valence electrons of Ga^{+} ion is ___

(Atomic number of Ga = 31)

Q2 (20 July 2021 Shift 2)

Outermost electronic configuration of a group 13 element, E, is $4\ s^2, 4p^1$. The electronic configuration of an element of p-block period-five placed diagonally to element, E is :

(1) $[Kr]3\ d^{10}4\ s^2 4p^2$

(2) $[Ar]3\ d^{10}4\ s^2 4p^2$

(3) $[Xe]5\ d^{10}6\ s^2 6p^2$

(4) $[Kr]4\ d^{10}5\ s^2 5p^2$

Q3 (20 July 2021 Shift 2)

Which one of the following species doesn't have a magnetic moment of 1.73BM, (spin only value) ?

(1) O_2^+

(2) CuI

(3) $\left[Cu(NH_3)_4\right] Cl_2$

(4) O_2^-

Q4 (20 July 2021 Shift 2)

The wavelength of electrons accelerated from rest through a potential difference of 40kV is $x \times 10^{-12}$ m. The value of x is ___ (Nearest integer)

Given : Mass of electron $= 9.1 \times 10^{-31}$ kg

Charge on an electron $= 1.6 \times 10^{-19}$C

Planck's constant $= 6.63 \times 10^{-34}$ J_S

Q5 (22 July 2021 Shift 1)

Number of electrons that Vanadium $(Z = 23)$ has in p-orbitals is equal to _____.

Q6 (25 July 2021 Shift 1)

A source of monochromatic radiation of

wavelength 400 nm provides 1000 J of energy in 10 seconds. When this radiation falls on the surface of sodium, $x \times 10^{20}$ electrons are ejected per second. Assume that wavelength 400 nm is sufficient for ejection of electron from the surface of sodium metal. The value of x is

(Nearest integer) $\left(h = 6.626 \times 10^{-34} Js\right)$

Q7 (25 July 2021 Shift 2)

The spin only magnetic moments (in BM) for free Ti^{3+}, V^{2+} and Sc^{3+} ions respectively are (At.No. Sc : 21, Ti : 22, V : 23)

(1) $3.87, 1.73, 0$

(2) $1.73, 3.87, 0$

(3) $1.73, 0, 3.87$

(4) $0, 3.87, 1.73$

Q8 (25 July 2021 Shift 2)

An accelerated electron has a speed of 5×10^6 ms^{-1} with an uncertainty of 0.02%. The uncertainty in finding its location while in motion is $x \times 10^{-9}$ m. The value of x is . (Nearest integer) [Use mass of electron $= 9.1 \times 10^{-31}$ kg, $h = 6.63 \times 10^{-34} Js, \pi = 3.14$]

Q9 (27 July 2021 Shift 1)

Given below are two statements:
Statement I : Rutherford's gold foil experiment cannot explain the line spectrum of hydrogen atom. Statement II : Bohr's model of hydrogen atom contradicts Heisenberg's uncertainty principle. In the light of the above

statements, choose the

most appropriate answer from the options given

below:

(1) Statement I is false but statement II is true.

(2) Statement I is true but statement II is false.

(3) Both statement I and statement II are false.

(4) Both statement I and statement II are true.

Q10 (27 July 2021 Shift 2)

If the Thompson model of the atom was correct, then the result of Rutherford's gold foil experiment

would have been:

(1) All of the α -particles pass through the gold foil without decrease in speed.

(2) α -Particles are deflected over a wide range of angles.

(3) All α -particles get bounced back by 180°

(4) α -Particles pass through the gold foil deflected by small angles and with reduced speed.

Answer Key

Q1 (0) **Q2** (4) **Q3** (2) **Q4** (6)

Q5 (12) **Q6** (2) **Q7** (2) **Q8** (58)

Q9 (4) **Q10** (4)

Q1

$Ga^{+}: Is^2 2\,s^2 2p^6 3\,s^2 3p^6 3\,d^{10} 4\,s^2$

The azimuthal quantum number for the valence electrons (4s-subshell) of Ga+ ion is zero (0).

Q2

The element E is Ga and the diagonal element of 5^{th} period is $_{50}Sn$ having outer electronic configuration will be $[Kr]5\,s^2 4\,d^{10} 5p^2$.

Q3

Species must not contain single unpaired

$(1) O_2^{+} \rightarrow \sigma_{1\,s}^2 < \sigma_{1\,s}^{+2} < \sigma_{2\,s}^2 < \sigma_{2\,s}^2 < \sigma_{2px}^2 < \pi_{2px}^2 = \pi_{2py}^2 < \pi_{2px}^{*x} = \pi_{2py}^{*}$

unpaired $e^{-} = 1 \therefore \mu = 1.73BM$

(1) $Cu^{+} \Gamma Cu^{+} \rightarrow [Ar]3\,d^{10} \therefore$ unpaired $e^{-} = 0$

$\Gamma \rightarrow [Xe] \therefore$ unpaired $e^{-} = 0$

therefore $\mu = 0$

3. $\left[Cu(NH_3)_4\right] Cl_2$

$Cu \rightarrow [A]3\,d^3 \therefore$ unpaired $= 1 \therefore \mu = 1.73BM$

4. $O_2^{-} \rightarrow d$

$\sigma_{1s}^2 < \sigma_{1s}^{*2} < \sigma_{2s}^2 < \sigma_{2s}^{*2} < \sigma_{2px}^2 < \pi_{2p\pi}^2 = \pi_{2py}^2 < \pi_{2px}^{*1} = \pi_{2py}^{*}$

$(11e^{-})$

$\therefore$ unpaired $\therefore \mu = 1.73BM$

Q4

De-broglie-wave length of electron:

$$\lambda_e = \frac{h}{\sqrt{2\,m(KE)}} \begin{cases} \because e^{-} \text{is accelerated} \\ \text{from rest} \\ \Rightarrow KE = q \times V \end{cases}$$

$$\lambda = \frac{h}{\sqrt{2mqv}}$$

$= \frac{6.63\times10^{-34}}{\sqrt{2\times1.6\times10^{-19}\times9.1\times10^{-31}\times40\times10^{3}}}$

$= 0.614 \times 10^{-11}$ m

$= 6.14 \times 10^{-12}$ m

Nearest integer $= 6$

OR

$\lambda = \frac{12.3}{\sqrt{\nabla}}$Ã . . .

$= \frac{12.3}{200} = 6.15 \times 10^{-12}$ m

Ans. is 6

Q5

$_{23}$ V : $1\,s^2 2\,s^2 2p^6 3\,s^2 3p^6 3\,d^3 4\,s^2$

Number of electrons in p-orbitals is equal to 12.00

Q6

Total energy provided by Source per second $= \frac{1000}{10} = 100$ J

Energy required to eject electron $= \frac{hc}{\lambda}$

$= \frac{6.626\times10^{-34}}{400\times10^{-9}} \times 3 \times 10^{8}$

Number of electrons ejected

$= \frac{400\times10^{-7}\times10^{26}}{6.626\times3}$

$= \frac{40\times10^{-20}}{6.626\times3}$

$= 2.01 \times 10^{20}$

Q7

$\mu = \sqrt{n(n+2)}BM$

$Ti^{+3} = [Ar]3\,d^1$	$n = 1$	$\mu = 1.73BM$
$V^{+2} = [Ar]3\,d^3$	$n = 3$	$\mu = 3.87BM$
$Sc^{+3} = [Ar]3\,d^0 4\,s^0$	$n = 0$	$\mu = 0$

Q8

$\Delta v = \frac{0.02}{100} \times 5 \times 10^6 = 10^3 \text{ m/s}$

$\Delta x \cdot \Delta v = \frac{h}{4\pi m}$

$x \times 10^{-9} \times 10^3 = \frac{6.63 \times 10^{-34}}{4 \times 3.14 \times 9.1 \times 10^{-31}}$

$x \times 10^{-9} \times 10^3 = 0.058 \times 10^{-3}$

$x = \frac{0.058 \times 10^{-6}}{10^{-9}} = 58$

Q9

Rutherford's gold foil experiment only proved that electrons are held towards nucleus by electrostatic forces of attraction and move in circular orbits with

very high speeds.

Bohr's model gave exact formula for simultaneous calculation of speed \& distance of electron from

the nucleus, something which was deemed impossible according to Heisenberg.

Q10

As in Thomson model, protons are diffused (charge is not centred) $\alpha-$ particles deviate by small angles and due to repulsion from protons, their speed decreases.