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5. SPECTRA

SOLUTIONS

TEACHING TASK

1. The line spectra of two elements are not identical because :
   A) The elements do not have the same number of neutrons
   B) They have different mass numbers
   C) Their outermost electrons are at different energy levels
   D) All of the above.

Answer:C

Solution: Line spectra are unique to each element due to the distinct energy levels of their electrons. When electrons transition between these levels, they emit or absorb specific wavelengths of light, creating characteristic spectral lines. The number of neutrons (A) or mass numbers (B) do not directly affect the electron energy levels or spectra.

2. The spectrum obtained from incandescent solids is
   A) Continuous B) Line C) Band D) Absorption

Answer:A

Solution: Incandescent solids (like a heated metal filament) emit light across a broad range of wavelengths, producing a continuous spectrum without discrete lines. This is due to the thermal motion of atoms and overlapping emissions.

3. When white light is passed through a prism and if one colour merges into the next, then the type of spectrum is called
   A) Visible Spectrum B) absorption spectrum.
   C) Continuous Spectrum D) Emission Spectrum

Answer:C

Solution:A continuous spectrum shows a smooth gradient of colors (e.g., rainbow) without gaps, typical of white light dispersion

4. Which of the following transition of electron in orbits absorbs more energy
   A) 1^{st} Orbit to 3^{rd} Orbit B) 1^{st} Orbit to 4^{th} Orbit
   C) 1^{st} Orbit to 6^{th} Orbit D) 1^{st} Orbit to 2^{nd} Orbit

Answer:C

Solution: Energy absorption increases with the distance between orbits. Transition from the 1st to the 6th orbit involves the largest energy jump (highest energy photon absorbed).

5. The electron in the Hydrogen atom is excited to the 6^{th} orbit, the number of spectral lines it is expected to emits
   A) 6 B) 10 C) 15 D) 20

Answer:C

Solution: $NumberOfSpectrallines = \frac{n(n-1)}{2} = \frac{6(6-1)}{2} = 15$

6. Which of the following transitions will have minimum wavelength ?

A) $n_4 \rightarrow n_1$ B) $n_2 \rightarrow n_1$ C) $n_4 \rightarrow n_2$ D) $n_3 \rightarrow n_1$

Answer:A

Solution:It involves the highest energy drop (from 4 to 1), hence maximum energy released and minimum wavelength.

7. Identify the correctly matched set?

I) Total no of lines in H-Spectrum for a transition $5 \rightarrow 1$ — a) decreases

II) Intensity of spectral line in line spectrum, as n value increases — b) Simple atomic spectrum

III)Band spectrum is due to — c) 10

IV)The proof for the presence of energy levels in an atom transition — d) Rotations and vibrations of atoms in molecules in addition to electronic e) Increases

A) I – a, II – e, III – d, IV – b V) I – e, II – e, III – d, IV – d

C) I – c, II – a, III – d, IV – b D) I – c, II – e, III – d, IV – b

Answer:C

Solution:

I) Total no of lines in H-Spectrum for a transition $5 \rightarrow 1$

c) $\frac{n(n-1)}{2} = \frac{5\times4}{2} = 10$

II) Intensity of spectral line in line

a) decreases---> As the principal quantum number (n) increases, the intensity of spectral lines decreases (due to lower probability of transitions from higher levels).

III)Band spectrum is due to

d)Band spectrum is due to rotations and vibrations of molecules (not just electronic transitions)

IV)The proof for the presence of

b) Simple atomic spectrum

8. Which one of the following transitions of an electrons in hydrogen atom emits radiation of the highest wavelength

A) $n_2 = \alpha\, to\, n_1 = 2$ B) $n_2 = 4 to n_1 = 2$ C) $n_2 = 3 to n_1 = 2$ D) $n_2 = 5 to n_1 = 2$

Answer:C

Solution:The transition with the smallest energy gap (and thus the highest wavelength) is:C) $n_2 = 3 to n_1 = 2$

9. When the electtron is excited K level to M level, we get

A) $\gamma -$ rays B) cathode rays

C) continuous spectra D) Absorption spectra

Answer:D

Solution:Absorption spectra occur when electrons absorb energy to jump to higher levels, leaving dark lines at specific wavelengths.

10. Consider three electrons jumps described below for the hydrogen atom

$x: n = 3 \rightarrow n = 1 \quad y: n = 4 \rightarrow n = 1 \quad z: n = 5 \rightarrow n = 1$

a) The transition 'x' will give the radiation with shortest wavelength
b) The transition 'z' will give the radiation with less frequency
c) The transition 'y' will give the radiation with longest wavelength
d) The transition 'z' will give the radiation with shortest wavelength

Answer:D

Solutions:Highest Energy (Shortest): Transition with largest $\Delta n \rightarrow z(n = 5 \rightarrow n = 1)$

Lowest Energy (Longest): Transition with smallest $\Delta n \rightarrow x(n = 3 \rightarrow n = 1)$.

Frequency: z has highest frequency, x has lowest.

11. With a certain exciting radiation of a particular frequency, to which Li^{2+} ions are exposed, the maximum number of spectral lines obtainable in the emission is 15. The uppermost energy level to which the electron is excited is n =

(A) 4 B) 5 C) 6 D) 7

Answer:C

$$NumberOfLines = \frac{n(n-1)}{2}$$

Solution: $\frac{n(n-1)}{2} = 15$

$$n^2 - n - 30 = 0 \Rightarrow n = 6$$

12. Which of the following wavelengths correctly represents for the following transitions in a gas containing single electron

i) $n = 3 \rightarrow n = 1$ ii) $n = 4 \rightarrow n = 1$ iii) $n = 2 \rightarrow n = 1$

A) 300 A^0, 500 A^0, 600 A^0 B) 400 A^0, 200 A^0, 500 A^0
C) 500 A^0, 400 A^0, 300 A^0 D) 300 A^0, 400 A^0, 500 A^0

Answer:D

Solution:Wavelength (λ): Inversely proportional to the energy of the transition.

$$\lambda \alpha \frac{1}{\Delta E}$$

Energy of Transition (ΔE): Larger jumps (higher n $\rightarrow$ lower n) release more energy, resulting in shorter wavelengths.

The energy gap decreases as the initial level (n) increases.

$n = 2 \rightarrow n = 1$:Largest energy gap $\rightarrow$ shortest wavelength.

$n = 3 \rightarrow n = 1$: Intermediate energy gap $\rightarrow$ intermediate wavelength.

$n = 4 \rightarrow n = 1$:Smallest energy gap $\rightarrow$ longest wavelength.

MULTIPLE CORRECT ANSWER TYPE

13. Which of the following statements are correct

A) The absorption spectrum is formed due to absorbing radiant energy by the matter in lower energy states

B) The emission spectrum is formed due to the emission of radiant energy by the excited matter

C) H-spectrum is an example of line-spectrum

D) Li^+ ion spectrum is equivalent to H-spectrum.

Answer:A,B,C

Solution:The absorption spectrum is formed due to absorbing radiant energy by the matter in lower energy states.

The emission spectrum is formed due to the emission of radiant energy by the excited matter. Hydrogen spectrum is an example of line spectrum.

14. The wavelength & number of spectral lines for an electronic transition is does not depends on

A) Number of electrons undergoing transition

B) Nuclear charge of atom

C) Difference in the energy of energy levels involved in the transition

D) The velocity of an electron undergoing transition.

Answer:A,D

Solution:A) Number of electrons undergoing transition: The wavelength and number of lines depend on the energy levels involved, not the number of electrons.

D) Velocity of the electron: The wavelength is determined by the energy difference between levels, not the electron's velocity.

STATEMENT TYPE

A) Both STATEMENT-I and STATEMENT-II are true and STATEMENT-II is the correct explanation of STATEMENT-I

B) Both STATEMENT-I and STATEMENT-II are true and STATEMENT-II is not the correct explanation of STATEMENT-I

C) STATEMENT-I is true and STATEMENT-II is false

D) STATEMENT-I is false and STATEMENT-II is true

15. **STATEMENT-I :** Line spectrum of Li^{+2} and He^+ are identical
STATEMENT-II Isoelectronic species produce identical spectrum

Answer:E

Solution:Isoelectronic species do not produce identical spectra

COMPREHENSION TYPE

When the electrons are getting de-excited from higher orbit to lower orbit it releases energy in the form of Radiation, when these radiations are passed through the spectroscope shows spectral lines, the number of spectral lines observed during an electron transition can be calculated using the formula

$$\text{Number of spectral lines obtained} = \frac{n(n+1)}{2}$$

where $n = n_2 - n_1$ (n_2 is the orbit from which electron has started and n_1 is the orbit to which electron getting de-excited)

16. The number of spectral lines produced when electrons from 4^{th} level of hydrogen atom jump to the ground state is

A) 4 B) 6 C) 8 D) 10

Answer:B

Solution: $N = \frac{n(n-1)}{2} = \frac{4(4-1)}{2} = 6$

17. If 36 spectral lines are produced then which of the following gives the correct difference between two orbits

A) 8 B) 6 C) 10 D) 12

Answer:A

Solution:

$$N = \frac{(n_2 - n_1)(n_2 - n_1 + 1)}{2} = 36$$

$$d = n_2 - n_1$$

$$\frac{d(d+1)}{2} = 36$$

$$d^2 + d - 72 = 0$$

Solving Quadratic equation d=8

INTEGER TYPE

18. In a container a mixture is prepared by mixing of three samples of hydrogen, helium ion (He^+) & lithium (Li^{+2}) ion. In hydrogen sample all the atoms are in the 2^{nd} excited state & in He^+ sample all atoms are in 4^{th} excited state in Li^{+2} all the atoms are in 5^{th} excited state . Find the total number of spectral lines in the visible region when the electrons return back to ground state.

Answer:8

Solution:Visible lines means n_1=2(balmer series)

Hydrogen 2^{nd} excited state n_2=3

$3 \to 2$

He^+ sample all atoms are in 4^{th} excitedn_2=5

$5 \to 2$

$4 \to 2$

$3 \to 2$

Li^{+2} all the atoms are in 5^{th} excited state n_2=6

$6 \to 2$

$5 \to 2$

$4 \to 2$

$3 \to 2$

MATRIX MATCHING TYPE

19.

Number of Spectral Lines	**Transition in orbits**
A) 10 spectral lines	1) 6 to 4
B) 6 spectral lines	2) 5 to 1
C) 3 spectral lines	3) 7 to 2
D) 15 spectral lines	4) 6 to 3

The correct match is

A)A-2,B-3,C-1,D-4 B)A-2,B-4,C-1,D-3

C)A-2,B-4,C-3,D-1 D)A-3,B-1,C- 4,D-24

Answer:B

Solution:

$$N = \frac{(n_2 - n_1)(n_2 - n_1 + 1)}{2}$$

A) 10 spectral lines 2) 5 to 1
B) 6 spectral lines 4) 6 to 3
C) 3 spectral lines 1) 6 to 4
D) 15 spectral lines 3) 7 to 2

LEARNERS TASK

CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ's)

1. Line spectrum is characteristic of
   A) Atoms B) Molecules
   C) Any substance in the solid state
   D) Any substance in the liquid state

Answer:A

Solution:Line spectra are produced by excited atoms when electrons transition between discrete energy levels, emitting or absorbing specific wavelengths.

Molecules produce band spectra due to vibrational and rotational energy levels.

Solids and liquids emit continuous spectra due to closely packed energy levels.

2. The spectrum with all wavelengths may be
   A) Absorption spectrum B) Emission spectrum
   C) Continuous spectrum D) Discontinuous spectrum

Answer:C

Solution:A continuous spectrum contains all wavelengths within a range (e.g., sunlight or incandescent solids).

Absorption and emission spectra are discontinuous (only specific wavelengths appear).

3. A dark line will appear on the bright background in the spectrum then it constitutes
   A) Emission Spectrum B) absorption spectrum.
   C) Band Spectrum D) All the above

Answer:B

Solution:A dark line on a bright background in a spectrum constitutes an absorption spectrum

4. The spectrum obtained by passing electric current at a very low pressure in a discharge tube filled with gas and passing electric current into metallic filament is
   A) Emission Spectrum B) absorption spectrum.
   C) Discontinuous Spectrum D) Continuous spectrum

Answer:A

Solution:When an electric current passes through a gas at low pressure, the electrons in the gas atoms get excited to higher energy levels. When these electrons fall back to their ground state, they emit energy in the form of light, creating a distinct set of discrete wavelengths called an emission spectrum.

5. When bright line will appear on dark background in the spectrum. This bright lines constitutes

A) Continuous Spectrum B) absorption spectrum.

C) Visible Spectrum D) Emission Spectrum

Answer:D

Solution:Emission spectra are produced when a substance emits light, and this light is then separated into its constituent wavelengths, creating a pattern of bright lines against a dark background. These bright lines correspond to specific wavelengths of light emitted by the substance.

6. Which statement is correct

A) Hydrogen has only one electron in its orbit but produces several spectral lines

B) There are many excited energy levels available in a sample of Hydrogen gas

C) Both are correct D) None

Answer:C

Solution:A) A single hydrogen electron can transition between multiple energy levels (e.g., Balmer, Lyman series), producing many spectral lines.

B) In a gas sample, many hydrogen atoms are excited to different energy levels, leading to multiple spectral lines.

JEE MAIN LEVEL QUESTIONS

1. Which of the following statement is true

A) Absorption spectrum consists of some bright lines separated by dark spaces.

B) Emission spectrum consists of dark lines.

C) A & B are true D) A & B are False

Answer:D

Solution:Absorption spectrum: Dark lines (missing wavelengths) on a bright continuous background.

Emission spectrum: Bright lines (specific wavelengths) on a dark background.

Both statements (A & B) are incorrect because they reverse the descriptions.

2. The wave length of a spectral line for an electronic transition is inversely related to

A) Velocity of electron undergoing transition

B) Number of elctrons undergoing transaction

C) The difference in energy levels involved in the transition D) None of these

Answer:C

Solution:The wavelength is determined by the energy difference: $\Delta E = \frac{hc}{\lambda} \Rightarrow \lambda \alpha \frac{1}{\Delta E}$

3. Which of the following gives neither emission spectrum nor absorption spectrum?

A) He^+ B) H_2 C) H^+ D) He

Answer:C

Solution: H^+ is just a proton with no electrons, so it cannot undergo electronic transitions (no spectrum).

4. The number of spectral lines possible when electron from 5^{th} excited state to 2^{nd} excited state

A) 4 B) 3 C) 6 D) 0

Answer:C

Solution:5th excited state = n=6 (since ground state is n=1).

2nd excited state = n=3.

The number of possible transitions is the difference in energy levels:

$$N = \frac{(n_2 - n_1)(n_2 - n_1 + 1)}{2} = \frac{(6-3)(6-3+1)}{2} = 6$$

5. Electron in He^+ ion falls from seventh level and subsequent lower level to first level then

   A) total of 15 emission lines are obtained B) total of 16 emission lines are obtained

   D) total of 17 emission lines are obtained D) total of 18 emission lines are obtained

Answer:None

Solution: $N = \frac{n(n-1)}{2} = \frac{7(7-1)}{2} = \frac{7(6)}{2} = 21$

6. Supposing the electron is present in the 4th energy level of H- atom. When the electron returns to ground state the possible transitions would be :

   A) $4 \rightarrow 1$ B) $4 \rightarrow 2,\ 2 \rightarrow 1$ C) $4 \rightarrow 3,\ 3 \rightarrow 2,\ 2 \rightarrow 1$ D) All the above

Answer:D

Solution: The electron can return to the ground state (n=1) via direct or stepwise transitions:

Direct transition: $4 \rightarrow 1$ (emits a single photon).

Stepwise transitions:

$4 \rightarrow 2 \rightarrow 1$ (two photons emitted).

$4 \rightarrow 3 \rightarrow 2 \rightarrow 1$ (three photons emitted).

7. A certain transition in the hydrogen atom from ground state in one or more steps gives rise to a total of twenty one lines. Orbit to which electron is exited is

   A) 3 B) 7 C) 6 D) 5

Answer:B

Solution:For 21 lines, solve for n:

$$N = \frac{n(n-1)}{2} = \frac{7(7-1)}{2} = \frac{7(6)}{2} = 21$$

$$N = \frac{n(n-1)}{2} = 21$$

$$n = 7$$

8. In a hydrogen like sample two different types of photons A and B are produced by electronic transition. Photon B has less wavelength and photon A has low frequency than B, then which of the following statement is true

   A) $A: n=3 \rightarrow n=1,\ B: n=4 \rightarrow n=1$ B) $A: n=5 \rightarrow n=2,\ B: n=6 \rightarrow n=1$

   C) $A: n=5 \rightarrow n=1,\ B: n=4 \rightarrow n=2$ D) All the above

Answer:A,B

Solution:

Option A:

- Photon A: $n = 3 \to n = 1$

$$E_A = 13.6 \quad 1 - \frac{1}{9} \quad = 12.09\,\text{eV}$$

- Photon B: $n = 4 \to n = 1$

$$E_B = 13.6 \quad 1 - \frac{1}{16} \quad = 12.75\,\text{eV}$$

- Comparison: $E_B > E_A$ (consistent with given conditions).

Option B:

- Photon A: $n = 5 \to n = 2$

$$E_A = 13.6 \quad \frac{1}{4} - \frac{1}{25} \quad = 2.86\,\text{eV}$$

- Photon B: $n = 6 \to n = 1$

$$E_B = 13.6 \quad 1 - \frac{1}{36} \quad = 13.22\,\text{eV}$$

- Comparison: $E_B > E_A$ (consistent with given conditions).

Option C:

- Photon A: $n = 5 \to n = 1$

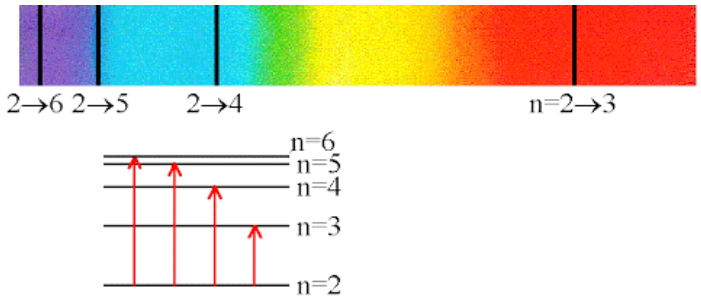
$$E_A = 13.6 \quad 1 - \frac{1}{25} \quad = 13.06\,\text{eV}$$

- Photon B: $n = 4 \to n = 2$

$$E_B = 13.6 \quad \frac{1}{4} - \frac{1}{16} \quad = 2.55\,\text{eV}$$

- Comparison: $E_B < E_A$ (violates the given condition $E_B > E_A$).

9



Which of the following statements is correct reg. above diagram

A) Higher the transition, higher is the energy absorbed

B) Higher the transition, appearance of dark line shifts towards violet region in Visible ray spectrum

C) Both A and B are true D) Both A and B are true

Answer:C

Solution:Explanation for A:

Higher transitions (e.g., n=1 → n=4 vs n=1 → n=2) require more energy because the energy difference between levels increases.

Explanation for B:

Higher-energy transitions correspond to shorter wavelengths (violet shift in the visible spectrum). In absorption spectra, dark lines appear at these shorter wavelengths for larger transitions.

10. In which of the following process emission spectrum is observed

A) Deexcitation of electrons B) Substance heated to high temperature

C) passing electric current at a very low pressure D) All the above

Answer:D

Solution:A) Deexcitation of electrons (e.g., electrons dropping to lower energy levels) emits photons → Emission spectrum.

B) Heating a substance (e.g., a metal filament) excites electrons, which then emit light upon returning to ground state → Emission spectrum.

C) Electric discharge in a low-pressure gas (e.g., neon signs) excites atoms, causing them to emit specific wavelengths → Emission spectrum.

11. Which of the following is correct about line spectra

A) Obtained when electric discharge is passed through a gas at low pressure

B) Each line in the spectrum corresponds to a particular wavelength

C) Each element gives its own characteristic line spectrum D) All are correct

Answer:D

Solution:A) Electric discharge excites gas atoms, producing distinct lines (e.g., hydrogen Balmer series).

B) Each line represents a specific electron transition with a unique wavelength.

C) Line spectra are elemental "fingerprints" (e.g., sodium's yellow doublet).

12. Which of the following statement is incorrect

A) White light from any source gives continuous spectrum

B) Passing electric current into metallic filament gives Emission spectrum

C) Energy of radiation released is directly proportional to wave length

D) All are incorrect

Answer:C

Solution:Energy (E) is inversely proportional to wavelength

ADVANCED LEVEL QUESTIONS

MULTIPLE CORRECT ANSWER TYPE

13. Which of the following statements are incorrect

A) In absorption spectrum, the bright lines are formed on dark back ground

B) In emission spectrum, dark spectral lines are formed on bright back ground

C) Hydrogen spectrum is an example of absorption spectrum

D) The intensity of spectral lines depends on population of energy levels between which electronic transition takes place.

Answer:A,B,C

Solution:A) Incorrect. Absorption spectra show dark lines (missing wavelengths) on a bright continuous background (e.g., sunlight passing through cooler gas).

B) Incorrect. Emission spectra show bright lines (emitted wavelengths) on a dark background (e.g., neon signs).

C) Incorrect. Hydrogen spectrum can be both emission and absorption, depending on experimental conditions (e.g., discharge tube vs. starlight absorption).

D) Correct. Intensity depends on the number of electrons transitioning between levels (higher population = stronger spectral lines).

14. Which of the following statement is true

A) Hydrogen gas has only one electron in its orbit but produces several spectral lines

B) There are many excited energy levels available in a sample of Hydrogen gas

C) In Hydrogen as there one orbit no de-excitation of electron takes palce

D) Hydrogen will have the simplest line spectrum

Answer:A,B,D

Solution:

A) True. A single electron can transition between multiple energy levels (e.g., Lyman, Balmer series), producing many spectral lines.

B) True. In a gas sample, hydrogen atoms occupy various excited states (n=2, n=3, etc.), enabling diverse transitions.

C) False. De-excitation does occur (e.g., n=2 $\rightarrow$ n=1 emits a photon). Hydrogen has multiple orbits (n=1, 2, 3...), not just one.

D) True. Hydrogen's spectrum is the simplest among elements due to its single electron, but it still has multiple lines.

STATEMENT TYPE

A) Both STATEMENT-I and STATEMENT-II are true and STATEMENT-II is the correct explanation of STATEMENT-I

B) Both STATEMENT-I and STATEMENT-II are true and STATEMENT-II is not the correct explanation of STATEMENT-I

C) STATEMENT-I is true and STATEMENT-II is false

D) STATEMENT-I is false and STATEMENT-II is true

15. **STATEMENT-I :** It is not essential that all the lines available in the emission spectrum will also be available in the absorption spectrum
STATEMENT-II : The spectrum of hydrogen atom is only absorption spectrum

Answer:C

Solution:Statement-I is correct, but Statement-II is incorrect.

The hydrogen spectrum is not exclusively absorption; it exhibits both types under different circumstances.

COMPREHENSION TYPE

COMPREHENSION-I

To explain the nature of radiations , James Clark Maxwell in 1864 put forward 'Electromagnetic wave theory'. This theory could explain the phenomena of interference and diffraction. A substance gets excited on heating at a very high temperature or by giving energy, when analysed through spectrometer emission emission spectrum is observed. White light from any source such as sun or bulb is analysed by passing through a prism, it splits up into seven colors and one colour merges into other which is called Continuous spectrum. When an electric discharge is passed through a gas at low pressure. it is found that some isolated bright coloured lines are obtained on a photographic plate separated from each other by dark spaces. This spectrum is called line spectrum. is called line spectrum.

16. Which of the following statements is incorrect about electromagnetic wave theory ?
A) Energy is emitted continuously from the source
B) Radiations are associated with electric and magnetic fields
C) Radiations can travel even through vacuum
D) The velocity of any radiation depends upon the nature of the radiation.

Answer:D

Solution:According to Maxwell's theory, all electromagnetic waves travel at the same speed (velocity of light, *c*) in a vacuum, regardless of their wavelength or frequency.

17. Which of the following statement is correct
A) Continuous spectrum is observed on analysing sun rays
B) element gives its own characteristic spectrum in line sepctrum.
C) Each line in the line spectrum corresponds to a particular wavelength
D) All are correct

Answer:D

Solution:A) True. Sunlight produces a continuous spectrum (rainbow) due to thermal emission, though absorption lines (Fraunhofer lines) are superimposed.

B) True. Line spectra are elemental "fingerprints" (e.g., sodium's yellow doublet, hydrogen's Balmer series).

C) True. Each spectral line represents a specific electron transition with a unique wavelength (e.g., red Hα line at 656 nm).

INTEGER TYPE

18. In a single isolated atom an electron make transition from 5^{th} excited state to 2^{nd} state then maximum number of different types of photons observed is

Answer:4

Solution: The electron transitions from the 5th excited state (n=6) to the 2nd state (n=2).

The maximum number of different types of spectral lines (or photons) that can be observed during a transition from n2 to n1 is given by the formula:

Maximum Spectral Lines=n_2-n_1

- Here, n_2=6(the initial state) and n_1=2(the final state).

19. In a unielectron atomic gas the electron is getting de-excited from 8th orbit to its next subsequent orbit and then to 4nd orbit, then number of spectral lines obtained is_____

Answer:10

Solution:$8 \to 7 \to 4$: 2 transitions ($8 \to 7$ and $7 \to 4$).

$8 \to 6 \to 4$: 2 transitions.

$8 \to 5 \to 4$: 2 transitions.

Direct transitions: $8 \to 7$, $8 \to 6$, $8 \to 5$, $8 \to 4$ (4 lines).

Total lines: 6 (indirect) + 4 (direct) = 10.

20. If 36 spectral lines were observed during transition to 2nd orbit then the orbit from which the electron getting de-excited is_____

Answer:10

Solution: $N = \frac{(n_2 - n_1)(n_2 - n_1 + 1)}{2}$

$$N = \frac{(n_2 - n_1)(n_2 - n_1 + 1)}{2} = \frac{(6-2)(6-2+1)}{2} = 10$$

$$N = 36, n_1 = 2$$

$$36 = \frac{(n_2 - 2)(n_2 - 2 + 1)}{2} \Rightarrow 72 = (n_2 - 2)(n_2 - 1)$$

$$n_2^2 - n_2 - 2n_2 + 2 = 72$$

$$n_2^2 - 3n_2 + 70 = 0$$

$$n_2 = 10$$

21. Two diffrent gases (unielectronic species) are taken in two discharge tubes and one discharge, in one discharge tube electron transition is taking place from 6th orbit to 4rd orbit and in other tube electrons transition is taking place from 7th orbit to 2nd orbit then the number of spectral lines obtained in 2nd gas is _____ times more tham 1st gas

Answer:5

Solution:Gas 1 ($6 \to 4$): $N = \frac{(n_2 - n_1)(n_2 - n_1 + 1)}{2} = \frac{(6-4)(6-4+1)}{2} = 3$

Gas 2 ($7 \to 2$): $N = \frac{(n_2 - n_1)(n_2 - n_1 + 1)}{2} = \frac{(7-2)(7-2+1)}{2} = 15$

Ratio: 15/3=5

MATRIX MATCHING TYPE

22. **List - I** **List - II**

I) Absorption Spectrum a) Characteristic feature of molecules
II) Line Spectrum b) Passing electric current into metallic filament
III) Band Spectrum c) Characteristic feature of atoms
IV) Emission Spectrum d) white light of an incandescent substance

The correct match is

A) I-b,II-c,III-d,IV-a B)I-d,II-c,III-b,IV-a
C) I-d,II-c,III-a,IV-b D)I-c,II-d, III-b,IV-a

Answer:C

Solution:

I) Absorption Spectrum → d) White light of an incandescent substance

Reason: Absorption spectra are observed when white light (e.g., from the Sun or a bulb) passes through a cooler gas. Dark lines appear where specific wavelengths are absorbed by the gas (e.g., Fraunhofer lines in sunlight).

II) Line Spectrum → c) Characteristic feature of atoms

Reason: Line spectra (sharp, distinct lines) are produced by isolated atoms (e.g., hydrogen in a discharge tube) due to electron transitions between quantized energy levels.

III) Band Spectrum → a) Characteristic feature of molecules

Reason: Band spectra (groups of closely spaced lines) arise from molecules due to combined vibrational, rotational, and electronic transitions (e.g., nitrogen or carbon dioxide spectra).

IV) Emission Spectrum →b) Passing electric current into metallic filament

Reason: Emission spectra are produced when excited substances (e.g., heated metals or gases) emit light. A metallic filament (like in a light bulb) emits a continuous spectrum, while gases emit line spectra under electric discharge.

KEY

Teaching Task

1	2	3	4	5	6	7	8	9	10
C	A	C	C	C	A	C	C	D	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	
C	D	ABC	AD	E	B	A	8	B	

Learners Task

Conceptual Understanding Questions (CUQ's)

1	2	3	4	5	6				
A	C	B	A	D	C				

JEE MAIN & ADVANCED LEVEL

1	2	3	4	5	6	7	8	9	10
D	C	C	C	none	D	B	A,B	C	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
D	C	ABC	ABD	C	D	D	4	10	10
21	**22**								
5	C								