

حلول هيكل الامتحان النهائي 2026م



تم تحميل هذا الملف من موقع المناهج الإماراتية

موقع المناهج ⇨ المناهج الإماراتية ⇨ الصف الثاني عشر المتقدم ⇨ فيزياء ⇨ الفصل الثالث ⇨ ملفات متنوعة ⇨ الملف

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ملفات اكتب للمعلم اكتب للطالب ا اختبارات الكترونية ا اختبارات ا حلول ا عروض بوربوينت ا أوراق عمل
منهج انجليزي ا ملخصات وتقارير ا مذكرات وبنوك ا الامتحان النهائي للمدرس

المزيد من مادة
فيزياء:

التواصل الاجتماعي بحسب الصف الثاني عشر المتقدم



الرياضيات



اللغة الانجليزية



اللغة العربية



التربية الاسلامية



المواد على تلغرام

صفحة المناهج
الإماراتية على
فيسبوك

المزيد من الملفات بحسب الصف الثاني عشر المتقدم والمادة فيزياء في الفصل الثالث

هيكل الامتحان النهائي 2026م غير محلول

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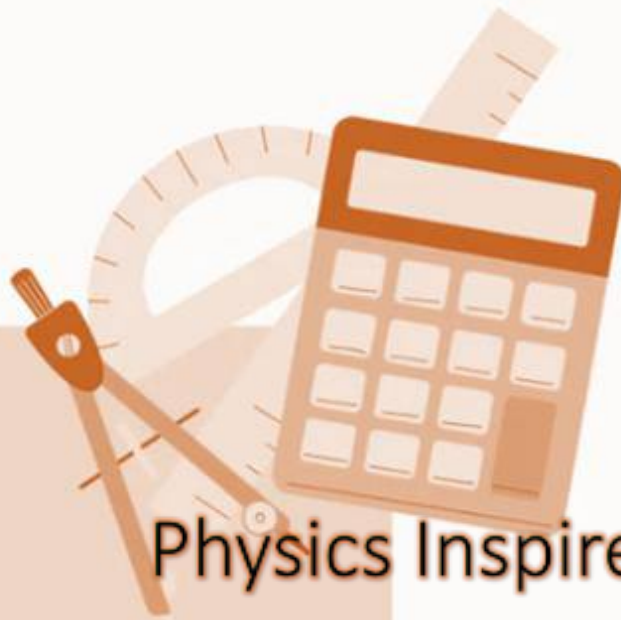
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وزارة التربية والتعليم
MINISTRY OF EDUCATION



Physics Inspire Coverage Grade 12 Advanced Third Term of 2025- 2026

إحجزْ مَكَانَكَ وَاسْتَعِدَّ لِلْإِمْتِحَانِ بِثِقَةٍ كَامِلَةٍ

احصل على الشرح الكامل للصف من خلال:

التواصل والحجز عبر الـ Whatsapp
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للتواصل والحجز



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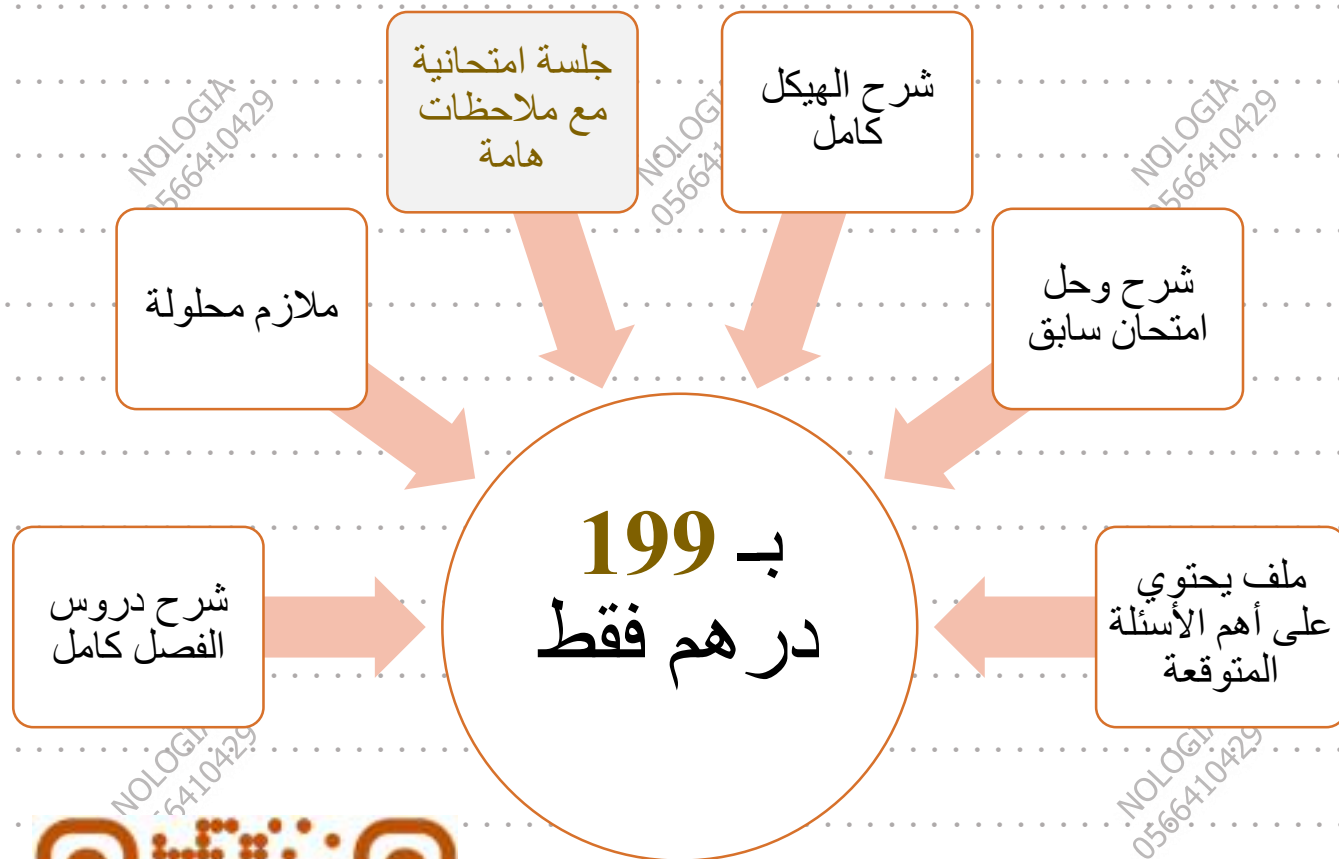


انضم للقناة



NOLOGIA

يمكنكم الحصول على



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Question 1: Explain Planck's concept of quantization of energy.
Calculate the energy emitted or absorbed by a vibrating atom in a
solid using the equation. Page (68 & 72)

MCQ – Objective questions

1. According to Planck's hypothesis, the energy of a vibrating atom can only exist in bundles of specific amounts. This means that energy is:

- | |
|---------------|
| A. Continuous |
| B. Infinite |
| C. Quantized |
| D. Zero |

2. What is a photon's energy if the photon's wavelength is 515nm?

- | |
|-------------------------------|
| A. 3.85×10^{-19} eV. |
| B. 2.41 eV. |
| C. 5 eV. |
| D. 3.85 eV. |

3. A photon's energy is 2.03 eV. What is the photon's wavelength?

A. 6.11×10^{-7} m.

B. 611 m.

C. 6.11 nm.

D. 6.11×10^{-7} nm.

Question 2: Define the photoelectric effect.

Explain how the photoelectric effect occurs when light shines on a metal surface. Page (69)

MCQ – Objective questions

1. What happens when electromagnetic radiation with a frequency above the threshold frequency hits a metal surface?

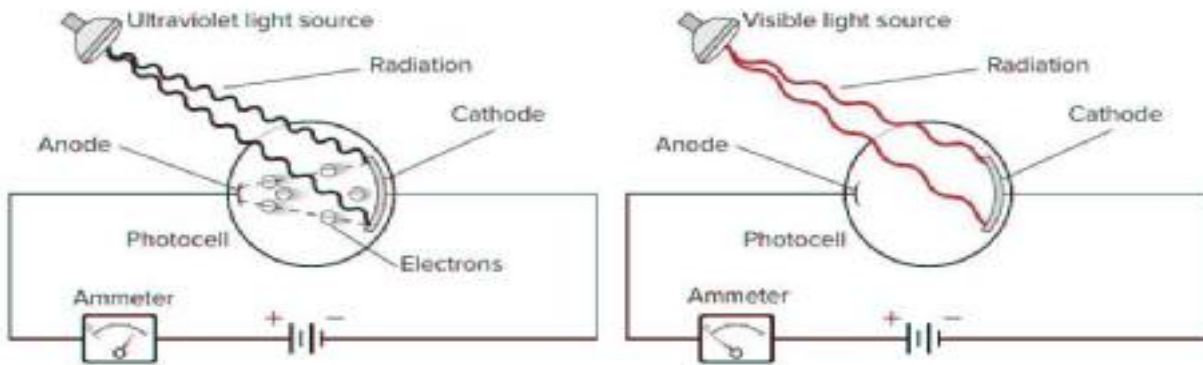
A. The metal becomes radioactive.

B. The metal melts.

C. Electrons are emitted from the surface.

D. Protons are ejected from the nucleus.

2. In the left photocell diagram, the ammeter shows a current because:



- A. Electrons are emitted from the cathode
- B. The anode emits electrons
- C. Visible light has low energy
- D. The circuit is broken

3. In the right diagram, visible light does not produce current because:

- A. The photocell is damaged
- B. The battery is disconnected
- C. The light frequency is too low
- D. The anode blocks the light

Question 3: Explain that electrons are ejected from the surface of a metal only if the frequency of the radiation is greater than a threshold frequency. Page (70)

MCQ – Objective questions

1. For a specific metal, the minimum frequency of incident radiation required to eject an electron is called the:

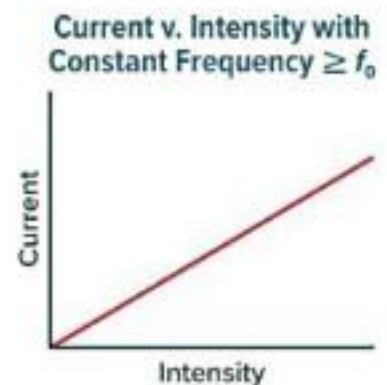
- | |
|-------------------------|
| A. Critical frequency. |
| B. Threshold frequency. |
| C. Planck frequency. |
| D. Quantized frequency. |

2. What is the threshold frequency in the photoelectric effect?

- | |
|---|
| A. The maximum frequency of light. |
| B. The minimum frequency needed to eject electrons. |
| C. The intensity of radiation. |
| D. The speed of electrons. |

D. The metal melts.

D. Very low



Question 4: Calculate the energy of a photon given its wavelength or frequency.

Calculate the maximum kinetic energy of an electron ejected due to the photoelectric effect. Page (74 & 76)

MCQ – Objective questions

1. What is the energy in eV of a violet light photon with a wavelength of 425 nm?

- | |
|------------|
| A. 1.96 eV |
| B. 4.02 eV |
| C. 2.92 eV |
| D. 0.96 eV |

2. The work function for cesium is 1.96 eV. If violet light (2.92 eV) falls on it, what is the maximum kinetic energy of the ejected photoelectrons?

- | |
|------------|
| A. 1.96 eV |
| B. 4.88 eV |
| C. 2.92 eV |
| D. 0.96 eV |

Question 5: Explain that the maximum kinetic energy of photoelectrons is independent of the intensity of incident electromagnetic radiation. Explain that the current due to photoelectrons (photoelectric current) is proportional to the intensity of incident electromagnetic radiation. Page (70 - 73)

MCQ – Objective questions

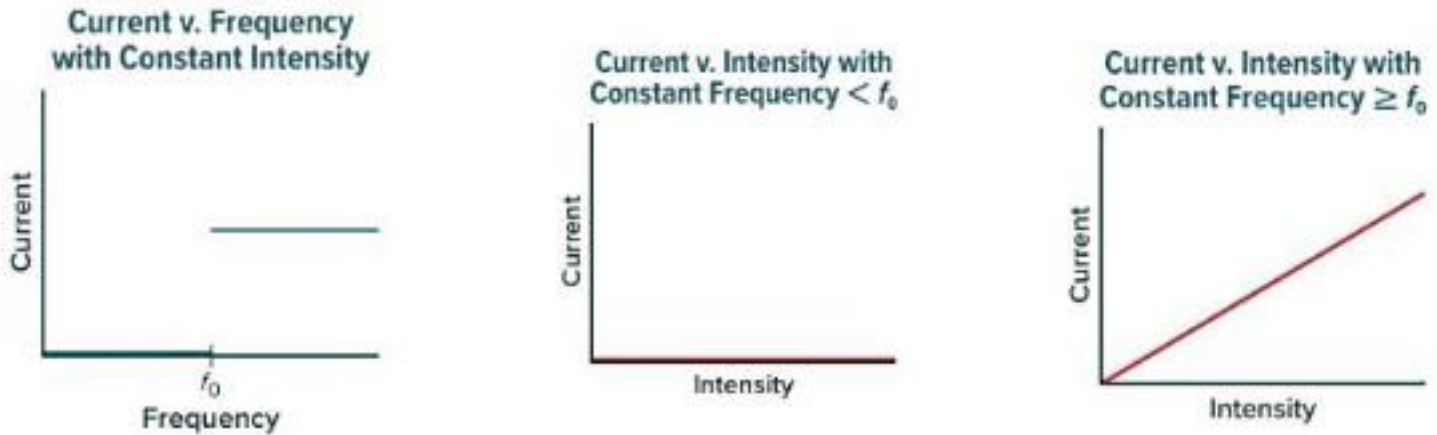
1. In a photoelectric experiment, if you keep the frequency constant (above f_0) but double the intensity of the light, which of the following will occur?

- | |
|---|
| A. The KE_{max} of the photoelectrons will double. |
| B. The number of emitted electrons (current) will increase. |
| C. The threshold frequency will decrease. |
| D. The stopping potential will increase. |

2. Which statement is correct regarding Einstein's theory of the photoelectric effect?

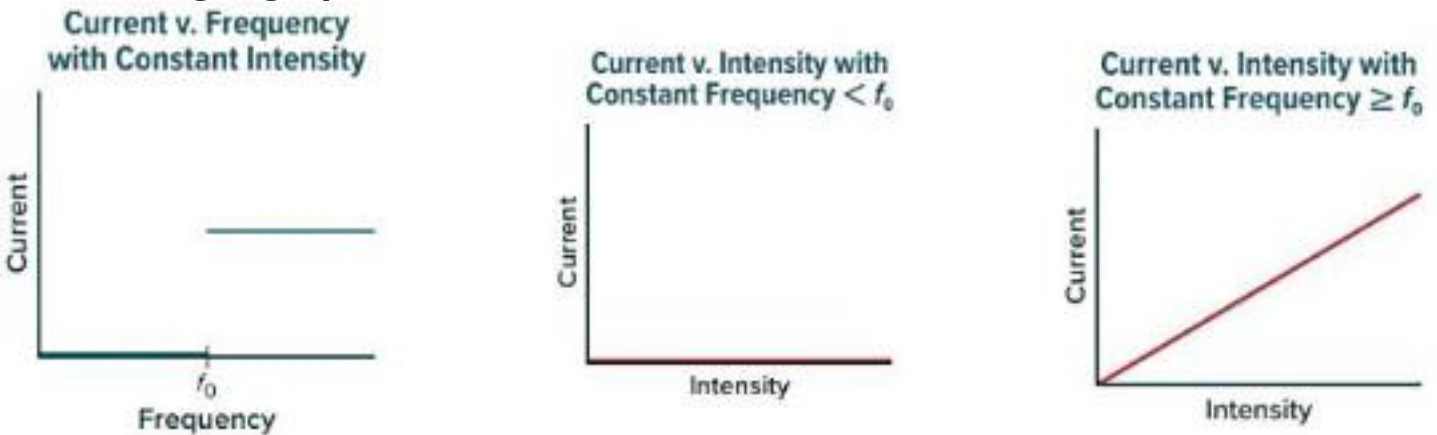
- | |
|---|
| A. Brighter light ejects faster electrons. |
| B. Intensity determines the energy of each photon. |
| C. A single photon interacts with a single electron. |
| D. Low-frequency light can eject electrons if the intensity is very high. |

3. The center graph demonstrates that:



- A. Intensity alone cannot eject electrons if frequency is too low
- B. High intensity always causes electron emission.
- C. Frequency does not matter
- D. Current decreases with intensity

4. In the right graph, current increases because:



- A. Frequency is below f_0
- B. Intensity increases while frequency is at or above f_0
- C. The metal changes
- D. Photon energy decreases

Question 6: Interpret the graph of maximum kinetic energy of an electron ejected from a metal versus the frequency of incident photon and determine graphically the threshold frequency and Planck's constant. Page (75)

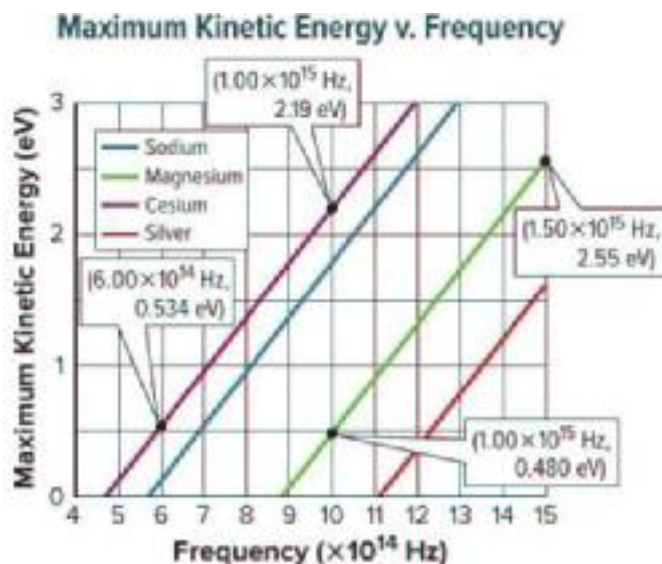
MCQ – Objective questions

1. In the graph of maximum kinetic energy vs. frequency, the x-intercept represents:

- A. Planck's constant
- B. Work function
- C. Threshold frequency
- D. Intensity of light

2. According to the graph, all lines have the same slope because:

- A. All metals have the same work function
- B. The slope equals Planck's constant
- C. Frequency is constant
- D. Kinetic energy is the same

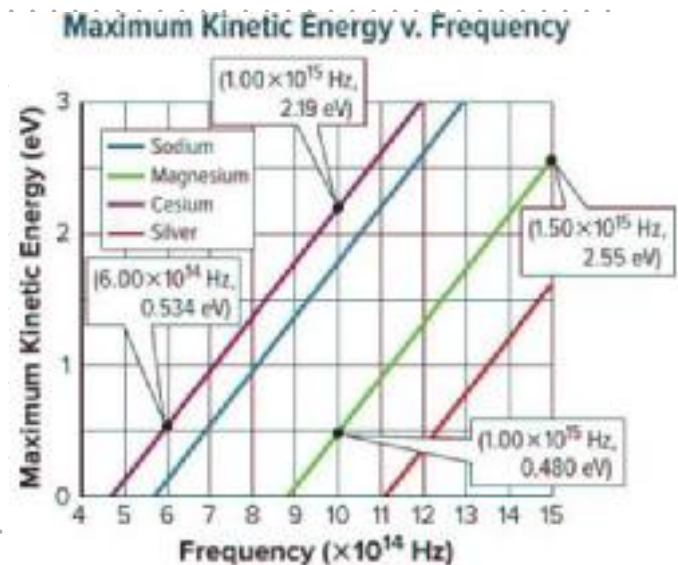


3. From the graph, increasing frequency above f_0 causes:

- A. A decrease in electron energy
- B. No emission of electrons
- C. An increase in maximum kinetic energy
- D. A decrease in Planck's constant

4. The approximate value of Planck's constant from the graph is:

- A. $6.63 \times 10^{-34} \text{ J.s}$
- B. $300 \times 10^8 \text{ m/s}$
- C. $1.60 \times 10^{-19} \text{ C}$
- D. $9.11 \times 10^{-31} \text{ Kg}$



5. What does the slope of the graph represent?

- A. Threshold wavelength
- B. Photon energy
- C. Planck's constant h
- D. Electron charge

Question 7: Describe the de Broglie wavelength as the wavelength associated with a moving particle.

Calculate the de Broglie wavelength for a moving particle ($\lambda = \frac{h}{p} = \frac{h}{mv}$) . Page (80)

MCQ – Objective questions

Universal Constant & Values:

Planck's Constant (h) = $6.63 \times 10^{-34} \text{ J.s}$

Electron Mass (m_e) = $9.11 \times 10^{-31} \text{ Kg}$

Elementary Charge (e) = $-1.602 \times 10^{-19} \text{ C}$

Proton Mass (m_p) = $1.67 \times 10^{-27} \text{ Kg}$

Core Equation & Pipelines:

De Broglie Wavelength: $\lambda = \frac{h}{p} = \frac{h}{mv}$

Kinetic Energy (from Voltage): $KE = -e\Delta V$

Kinetic Energy (from Motion): $KE = \frac{1}{2}mv^2$

Momentum: $p = mv$

1. What is the de Broglie wavelength and speed of an electron accelerated by a potential difference of 250 V?

- | |
|--|
| A. $5.1 \times 10^6 \text{ m/s}$; $1.4 \times 10^{-10} \text{ m}$ |
| B. $9.4 \times 10^6 \text{ m/s}$; $7.7 \times 10^{-11} \text{ m}$ |
| C. $3.0 \times 10^6 \text{ m/s}$; $2.4 \times 10^{-10} \text{ m}$ |
| D. $1.8 \times 10^3 \text{ m/s}$; $4.0 \times 10^{-7} \text{ m}$ |

2. A 7.0-kg bowling ball rolls with a velocity of 8.5 m/s. What is its de Broglie wavelength?

- | |
|------------------------------------|
| A. $1.2 \times 10^{-34} \text{ m}$ |
| B. $1.1 \times 10^{-35} \text{ m}$ |
| C. $7.7 \times 10^{-11} \text{ m}$ |
| D. $9.1 \times 10^{-31} \text{ m}$ |

3. What potential difference (voltage) is needed to accelerate an electron so it has a 0.125-nm wavelength?

- | |
|-----------|
| A. 75 V |
| B. 96.5 V |
| C. 125 V |
| D. 250 V |

Question 8: Describe that the more precisely a particle's position is measured, the more the uncertainty in simultaneously measuring the particle's momentum, and vice versa. Page (81)

MCQ – Objective questions

1. According to the Heisenberg uncertainty principle, what happens to the uncertainty in a particle's momentum as its position is measured more precisely?

- | |
|--------------------------|
| A. It decreases. |
| B. It increases. |
| C. It remains unchanged. |
| D. It becomes zero. |

2. What primary phenomenon causes a change in a particle's momentum when high-energy, short-wavelength radiation is used to measure its location?

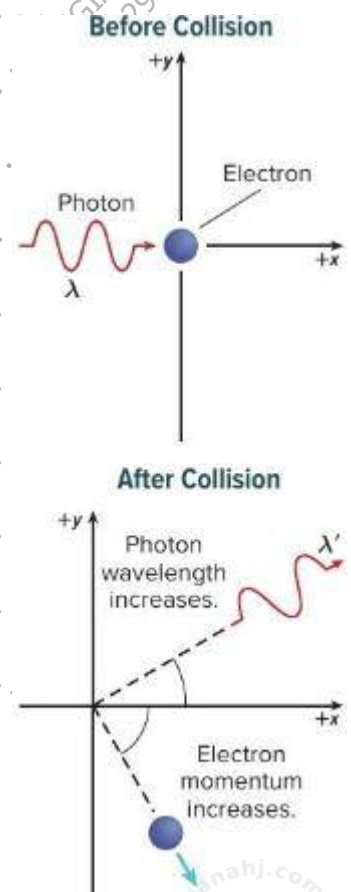
- | |
|--------------------------------------|
| A. Photoelectric effect. |
| B. Diffraction limit. |
| C. The Compton effect. |
| D. De Broglie wave-particle duality. |

3. Why do physicists use shorter-wavelength radiation when they want to minimize the uncertainty in a particle's location?

- A. It decreases diffraction, making the position easier to locate exactly.
- B. It decreases the energy transferred to the particle during collision.
- C. It increases the wavelength of the reflected photon.
- D. It completely eliminates the wavelike properties of the particle.

4. According to the analysis of Figure 12, what does the change in the photon's wavelength after colliding with the electron indicate about the photon's energy?

- A. The photon's energy increases.
- B. The photon's energy decreases.
- C. The photon's energy stays constant.
- D. The photon's energy is converted entirely into mass.



5. Which of the following pairs of variables cannot be simultaneously measured with absolute precision according to Werner Heisenberg's work?

- | |
|------------------------------|
| A. Position and momentum. |
| B. Mass and velocity. |
| C. Wavelength and frequency. |
| D. Time and mass. |

6. If the momentum of an atomic particle is known with absolute precision, what can be concluded about its position according to the text?

- | |
|---|
| A. The position becomes infinitely accurate. |
| B. The position of the particle becomes less certain. |
| C. The position matches the wavelength of the photon perfectly. |
| D. The position can be calculated using Newton's classical equations. |

7. According to the Heisenberg uncertainty principle, what happens if the measurement of a particle's position is made more precise?

- | |
|---|
| A. The uncertainty in its momentum decreases. |
| B. The uncertainty in its momentum increases. |
| C. The momentum becomes exactly zero. |
| D. The particle's velocity becomes constant. |

Question 9: Describe the electron distribution within the atom according to Thomson's model.

Describe how Rutherford's alpha particles scattering experiment led to the revision of Thomson's model of the atom and the introduction of the atomic nucleus. Page (82 & 83)

MCQ – Objective questions

1. What was the major conclusion of Rutherford's alpha-scattering experiment regarding the structure of the atom?

- | |
|--|
| A. Positive charge is spread evenly like "raisins in a muffin." |
| B. All of an atom's positive charge and most of its mass are concentrated in a tiny nucleus. |
| C. Electrons are located at the very center of the atom. |
| D. Atoms are solid, indivisible spheres. |

2. In his experiment, Rutherford used alpha (α) particles to bombard the gold foil. what are the primary characteristics of these particles?

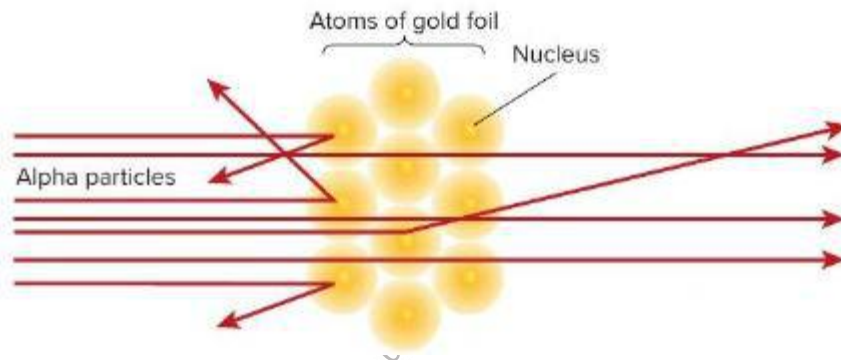
- A. They are tiny, negatively charged electrons moving at low speeds.
- B. They are neutral particles with no charge and high mass.
- C. They are massive, positively charged particles that move at high speeds.
- D. They are high-energy photons (gamma radiation) with no mass.

3. Why did Rutherford choose an "extremely thin sheet" of gold foil for this experiment, as shown in Figure 13?

- A. Because gold is the only element that can reflect alpha particles.
- B. To ensure that the alpha particles would interact with as few atoms as possible, ideally passing through a single layer.
- C. Because gold is radioactive and emits its own alpha particles.
- D. To absorb all the alpha particles and measure the heat generated.

4. Looking at Figure, what does the fact that "most of the alpha particles passed through the foil without deflection" indicate about the atom?

- A. The atom is composed mostly of empty space.
- B. The atom is a solid sphere of positive charge.
- C. The electrons are the most massive part of the atom.
- D. The nucleus is much larger than the overall atom.



5. According to Rutherford's nuclear model, what percentage of an atom's mass is contained within its nucleus?

- A. Less than 10%
- B. Approximately 50%
- C. Exactly 75%
- D. More than 99.9%

Question 10: Explain how the composition of an unknown gas sample can be determined using its emission and absorption spectrum.

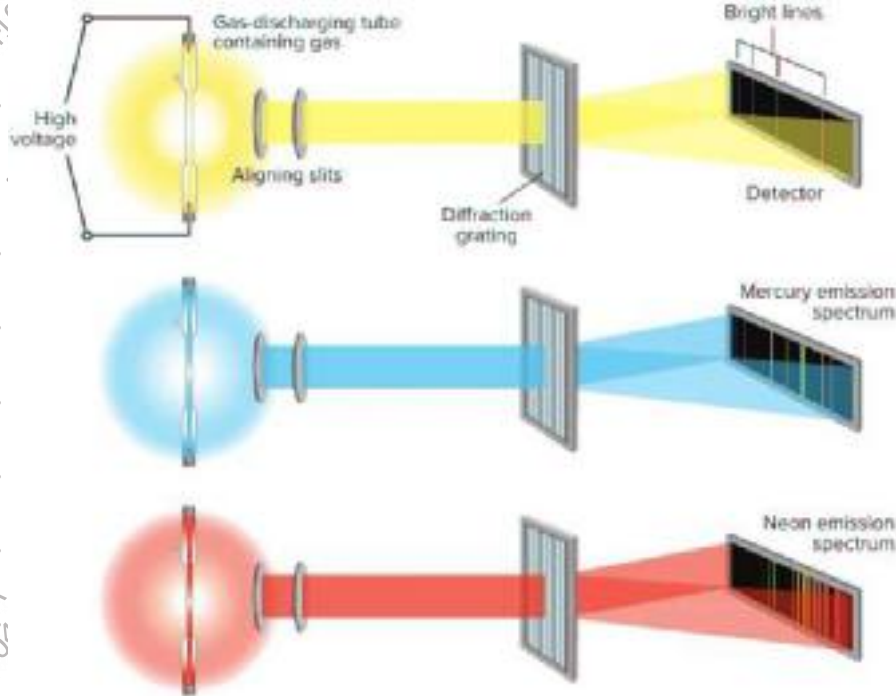
Page (84 & 85)

MCQ – Objective questions

1. Why is the emission spectrum of a gaseous element described as a "fingerprint" of that element?

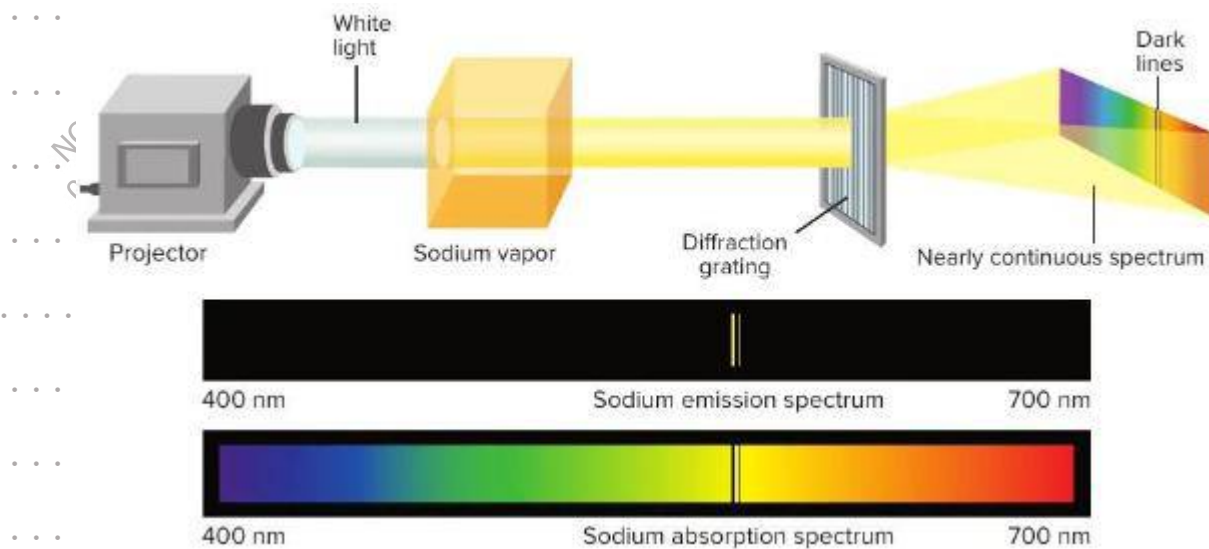
- | |
|--|
| A. Because every gas glows with the same color when heated. |
| B. Because the spectrum consists of a continuous band of all colors. |
| C. Because each element produces a unique pattern of distinct wavelengths (lines). |
| D. Because the intensity of the light is the same for all elements. |

2. Look at Figure, What is the role of the diffraction grating in this setup?



- | |
|--|
| A. To heat the gas to a high voltage. |
| B. To separate the light emitted by the gas into its component wavelengths |
| C. To focus the light into a single bright spot. |
| D. To absorb the dark lines from the spectrum. |

3. According to Figure, how is an absorption spectrum produced?



- A. By heating a gas until it emits bright colored lines.
- B. By passing white light through a vacuum.
- C. By passing white light through a sample of gas, which absorbs specific wavelengths.
- D. By reflecting white light off a mirror.

4. If a sample contains a mixture of several different elements, how can an observer identify them using a photograph of their spectrum?

- A. By looking at the overall brightness of the light.
- B. By comparing the positions and relative intensities of the lines to the spectra of known gases.
- C. By counting the total number of lines regardless of their color.
- D. Elements cannot be identified if they are mixed together.

5. How do the emission spectra of incandescent solids and atomic gases differ?

- A. Solids produce discrete lines, while gases produce continuous bands.
- B. Solids produce a continuous band of colors, while gases produce a set of discrete lines.
- C. They both produce identical patterns of light.
- D. Solids do not produce any spectra; only gases do.

Question 11: Explain that the absorption spectrum of an element is a unique pattern, which serves as a fingerprint of that element.

Page (85 & 86)

MCQ – Objective questions

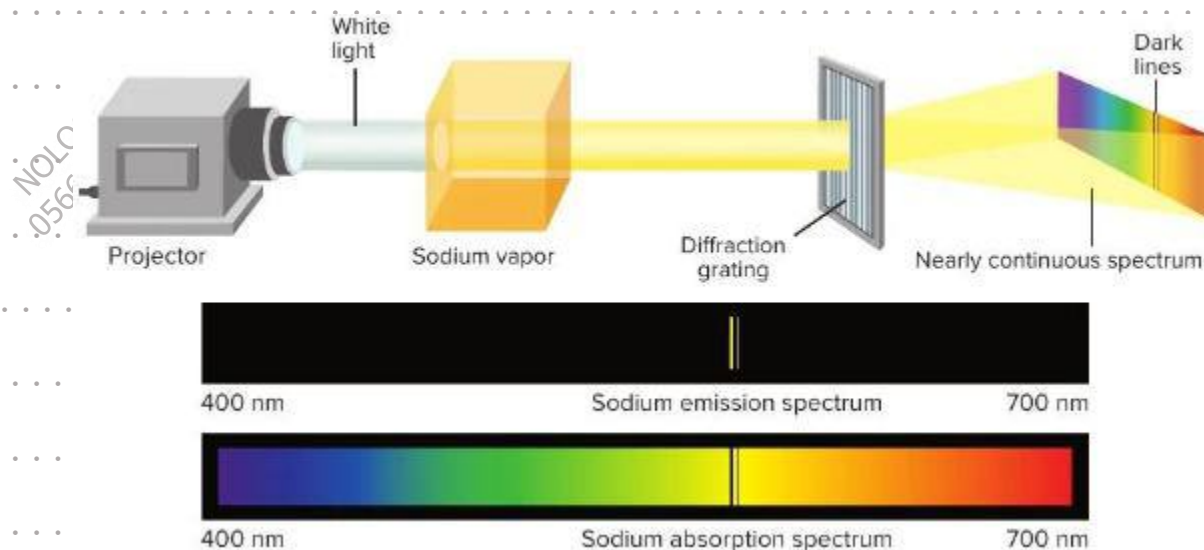
1. An absorption spectrum is best described as:

- A. A series of bright colored lines against a black background.
- B. A continuous spectrum of all colors crossed by specific dark lines.
- C. A completely dark image with no visible radiation.
- D. A pattern of light produced only by high-voltage solids.

2. In industrial settings, like steel mills, why is spectroscopy considered an effective tool for analyzing materials?

- A. It can only identify the weight of the material.
- B. It requires a very large sample of the metal to work.
- C. The exact composition of a sample can be determined in minutes through spectral analysis.
- D. It converts the metal into a gaseous state permanently.

3. Look at Figure. What must happen for the sodium vapor to produce the dark lines shown in the absorption spectrum?



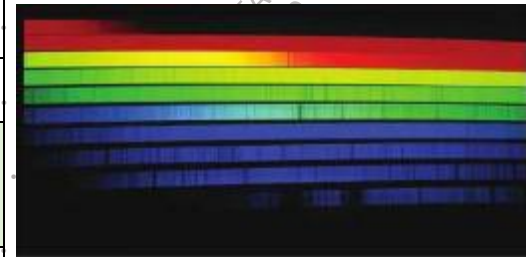
- A. The sodium vapor must be heated until it glows.
- B. White light from a projector must pass through the cool sodium vapor.
- C. The sodium vapor must be placed in a high-voltage tube.
- D. The diffraction grating must be removed from the setup.

4. How do the dark lines in an element's absorption spectrum relate to the bright lines in its emission spectrum?

- A. They appear at completely different wavelengths.
- B. The dark lines are always twice as wide as the bright lines.
- C. The dark lines occur at the exact same wavelengths as the bright lines.
- D. There is no relationship between the two types of spectra.

5. Look at Figure. These dark lines, discovered by Joseph von Fraunhofer in the Sun's spectrum, are used by astronomers to:

- A. Measure the temperature of the Sun's core.
- B. Determine the distance between the Earth and the Sun.
- C. Identify the chemical elements present in the Sun's atmosphere.
- D. Calculate the speed of light in a vacuum.



6. What is the primary reason for the appearance of dark lines in the absorption spectrum of a gas?

- A. The gas reflects all incoming light.
- B. The gas increases the frequency of the light.
- C. The atoms in the gas absorb specific wavelengths of the incident white light.
- D. The spectroscope is unable to detect those specific colors.

Question 12: Explain that an atom can transition from an initial energy state (E_i) to a final energy state (E_f) by absorbing or emitting a photon whose energy equals the difference between the two states.

Page (85 & 86)

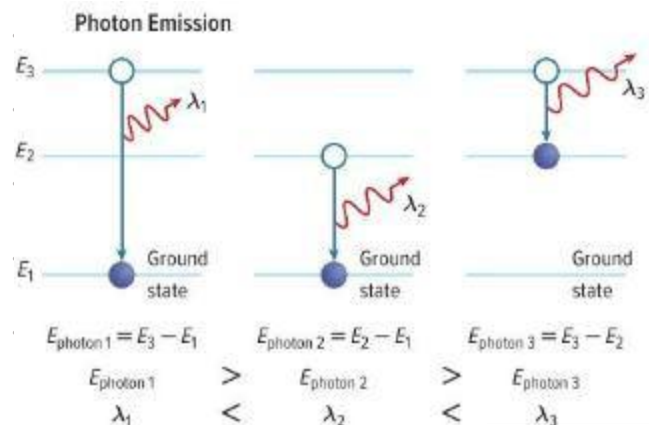
MCQ – Objective questions

1. According to the Bohr model, what happens to an atom's energy when it absorbs a photon?

- A. The atom's energy decreases.
- B. The atom's energy increases by an amount equal to the photon's energy.
- C. The atom's energy remains constant, but its mass increases.
- D. The atom's energy becomes zero.

2. Look at Figure. Which of the following transitions in the diagram would produce a photon with the greatest frequency (f)?

- A. Transition from E_3 to E_2 (λ_3)
- B. Transition from E_2 to E_1 (λ_2)
- C. Transition from E_3 to E_1 (λ_1)
- D. All transitions produce the same frequency.



3. A mercury atom drops from an energy state of 8.82 eV to a state of 6.67 eV.

What is the energy of the emitted photon?

A. 15.49 eV

B. 2.15 eV

C. 1.32 eV

D. 0.75 eV

4. Which equation correctly represents the relationship between the energy of an emitted photon and the change in the atom's energy levels?

A. $E_{\text{photon}} = E_f - E_i$

B. $E_{\text{photon}} = E_i - E_f$

C. $E_{\text{photon}} = E_i + E_f$

D. $E_{\text{photon}} = \frac{h}{\lambda}$

5. If a particular transition in a mercury atom releases 2.15 eV of energy, what is the wavelength of the emitted light? (Use $hc = 1240 \text{ eV} \cdot \text{nm}$)

A. 436 nm

B. 578 nm

C. 254 nm

D. 185 nm

6. Based on the "stairs" analogy in Figure, why can't an electron exist between energy levels?

- | |
|---|
| A. Because the nucleus repels it. |
| B. Because it moves too fast to be caught. |
| C. Because atomic energy levels are quantized, meaning only specific energy values are allowed. |
| D. Because gravity only works at specific heights. |

Question 13: Describe Rutherford's nuclear model of the atom, as a small dense positively charged nucleus surrounded by orbiting electrons (planetary model), and explain why this model cannot explain the stability and the observed line emission spectra of atoms. Page (86 & 87)

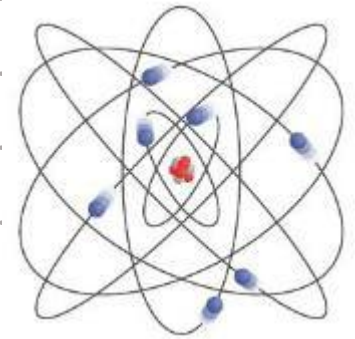
MCQ – Objective questions

1. Which of the following best describes Rutherford's nuclear model of the atom as proposed in the early 20th century?

- | |
|--|
| A. Electrons are embedded in a uniform sphere of positive charge. |
| B. The atom is a solid sphere with no internal empty space. |
| C. A small, dense, positively charged nucleus surrounded by orbiting electrons. |
| D. Protons and neutrons are distributed evenly throughout the entire volume of the atom. |

2. Look at Figure 19. Why is this representation of the atom often called the "planetary model"?

- A. Because the nucleus is made of the same material as the Sun.
- B. Because electrons orbit the nucleus in fixed paths, similar to how planets orbit the Sun.
- C. Because the forces involved are purely gravitational.
- D. Because the atom is the same size as a solar system on a microscopic scale.

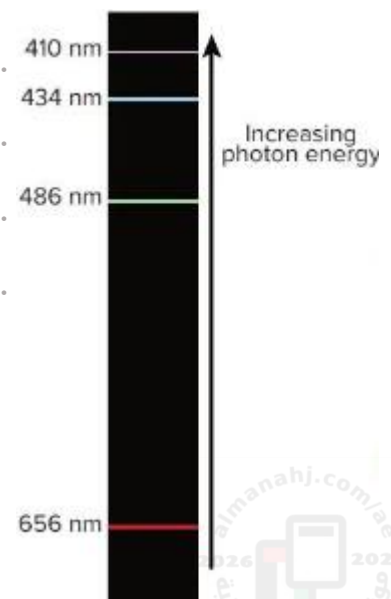


3. According to the laws of classical electromagnetism, why was Rutherford's planetary model considered unstable?

- A. The positive nucleus would eventually push the electrons away.
- B. Accelerating electrons should radiate energy and spiral into the nucleus within a fraction of a second.
- C. The electrons would collide with each other and fly out of the atom.
- D. The nucleus would grow too large and explode.

4. Compare Figure with the predictions of the planetary model. What was the discrepancy regarding light emission?

- A. The model predicted no light, but atoms emit visible light.
- B. The model predicted only red light, but atoms emit blue light.
- C. The model predicted a continuous spectrum, but atoms emit only specific wavelengths (line spectra).
- D. The model predicted light only from the nucleus, not the electrons.



5. According to the Section Review in the Teacher's Guide, what are the two main problems with the planetary model?

- | |
|---|
| A. It cannot explain mass or charge. |
| B. It predicts that atoms are unstable and should radiate at all wavelengths. |
| C. it assumes electrons have no mass and the nucleus is neutral. |
| D. It contradicts the existence of neutrons and protons. |

Question 14: Calculate the total energy of a Hydrogen atom.

Describe that the radius of the electron's orbit in Hydrogen atom is proportional to n^2 , while the energy of the atom is inversely proportional to n^2 . Page (92)

MCQ – Objective questions

1. Based on the energy formula $E_n = -13.6 \text{ eV} \times \left(\frac{1}{n^2}\right)$, what is the energy of a hydrogen atom in the third energy level ($n = 3$)?

- | |
|--------------|
| A. -13.6 eV |
| B. -3.40 eV |
| C. -1.51 eV |
| D. -0.85 eV. |

2. If the innermost orbital radius (r_1) of the hydrogen atom is 0.053 nm, what is the radius associated with the fourth energy level ($n = 4$)?

A. 0.106 nm

B. 0.212 nm

C. 0.477 nm

D. 0.848 nm

3. Calculate the energy difference (ΔE) for a hydrogen atom when an electron transitions from the $n = 2$ level to the $n = 3$ level.

A. 10.2 eV

B. 1.89 eV

C. 0.66 eV

D. 12.1 eV

Question 15: Explain that the Lyman, Balmer and Paschen series and the energy levels and transitions correspond to them. Page (91)

MCQ – Objective questions

1. Which spectral series is produced when an electron in a hydrogen atom drops from higher energy levels directly to the ground state ($n = 1$)?

A. Lyman series

B. Balmer series

C. Paschen series

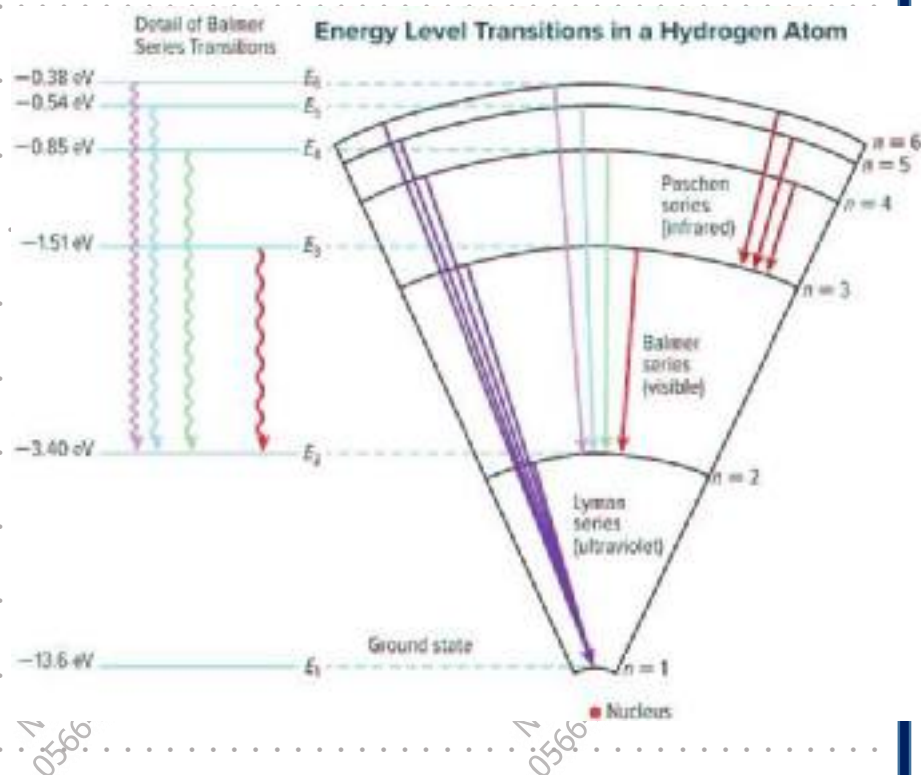
D. Pfund series

2. The only spectral lines of hydrogen that are visible to the human eye belong to the Balmer series. These lines occur when electrons transition to which energy level?

- A. $n = 1$
- B. $n = 2$
- C. $n = 3$
- D. $n = \infty$

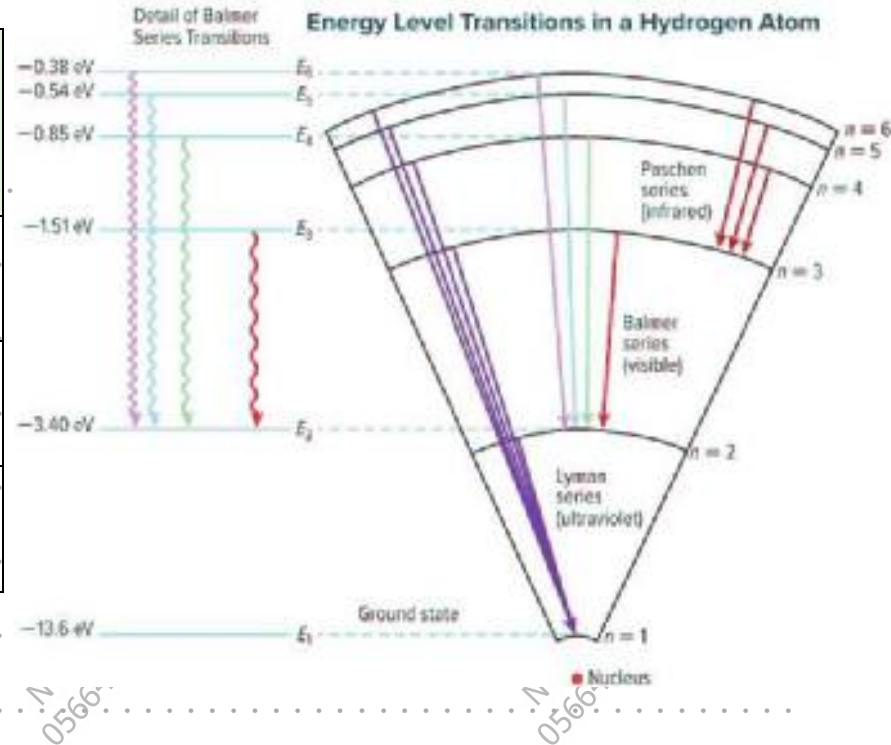
3. Look at Figure. Transitions from down to result in the emission of which type of electromagnetic radiation?

- A. X-rays
- B. Visible light
- C. Ultraviolet light
- D. Infrared radiation



4. Based on Figure, why do Lyman series transitions generally emit photons with higher energy than Balmer series transitions?

- A. Because the energy difference (ΔE) between higher levels and $n = 1$ is much larger than transitions to $n = 2$.
- B. Because $n = 1$ is the outermost orbit.
- C. Because ultraviolet light has a longer wavelength than visible light.
- D. Because electrons move slower when dropping to $n = 1$.



5. Match the series correctly with its destination level and region:

- A. Lyman: $n = 2$, Visible
- B. Paschen: $n = 1$, UV
- C. Balmer: $n = 2$, Visible
- D. Lyman: $n = 3$, Infrared

Question 16: Calculate the energy, frequency, and wavelength of an emitted or absorbed photon as an atom transition from an initial energy level to a final energy level. Page (93)

MCQ – Objective questions

1. An excited electron in a hydrogen atom drops from the $n = 2$ energy level ($E_2 = -3.40 \text{ eV}$) to the ground state ($n = 1, E_1 = -13.6 \text{ eV}$). What is the energy of the emitted photon?

A. 3.40 eV
B. 10.2 eV
C. 13.6 eV
D. 17.0 eV

2. For a particular transition, a mercury atom drops from an energy state of 8.82 eV to 6.67 eV. What is the wavelength of the emitted photon? (Use $hc = 1240 \text{ eV} \cdot \text{nm}$)

A. 254 nm
B. 436 nm
C. 578 nm
D. 656 nm

3. The ground state of a helium ion is -54.4 eV . A transition to the ground state emits a 304-nm photon. What was the energy of the excited state?

A. -4.08 eV

B. -50.3 eV

C. -54.4 eV

D. -58.5 eV

Question 17: Illustrate that, in the Bohr model, the circumference of a stable electron orbit must be an integer multiple of the de Broglie wavelength ($2\pi r = n\lambda$), as a result of combining de Broglie and Bohr ideas.
Page (95)

MCQ – Objective questions

1. According to the combination of Bohr's and de Broglie's theories, what is the required condition for an electron's orbit to be stable?

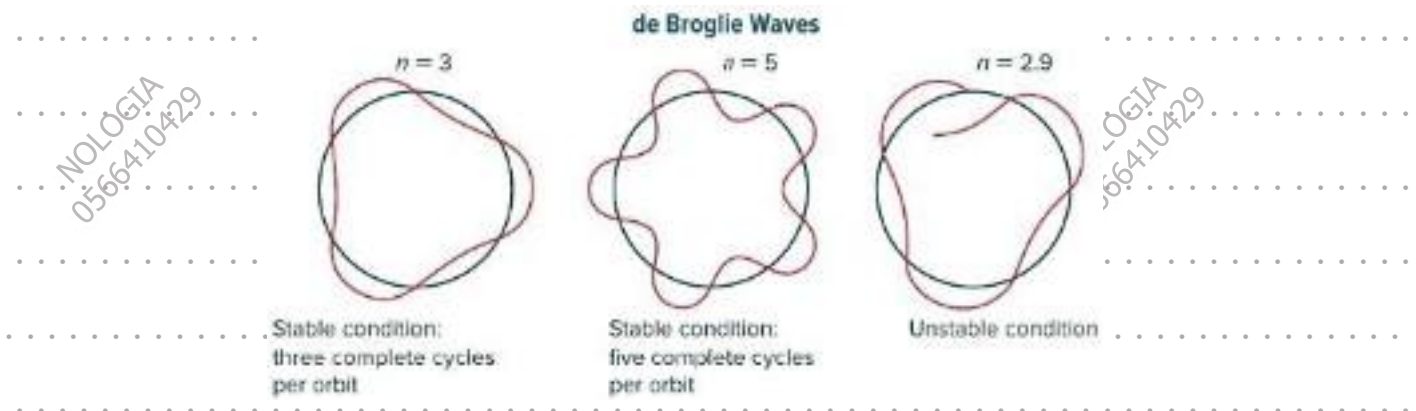
A. The orbit's radius must be equal to the wavelength.

B. The circumference of the orbit must be a whole-number multiple of the de Broglie wavelength.

C. The velocity of the electron must be equal to the speed of light.

D. The energy of the electron must be zero.

2. Look at Figure. Why is the orbit labelled $n = 2.9$ considered an unstable condition?

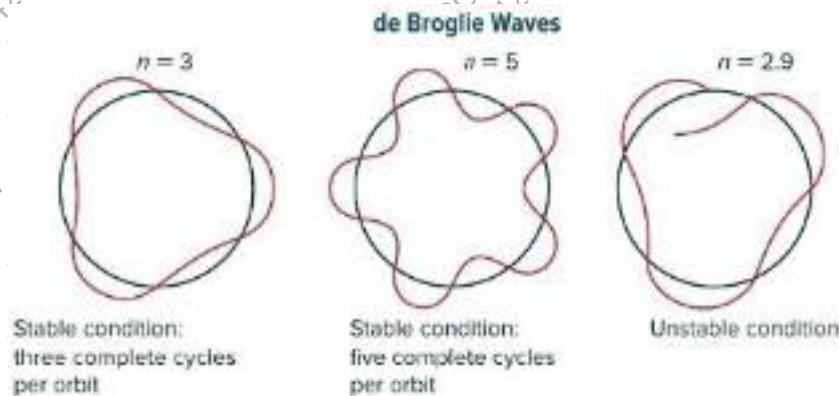


- | |
|---|
| A. Because the wavelength is too short. |
| B. Because it represents a ground state. |
| C. Because the waves do not close in on themselves (they are not in step), leading to destructive interference. |
| D. Because n must be an even number. |

3. If an electron in a hydrogen atom is in the $n = 3$ energy level and has a de Broglie wavelength of 1.0 nm , what is the circumference of its orbit?

- | |
|------------------------|
| A. 1.0 nm . |
| B. 2.0 nm . |
| C. 3.0 nm . |
| D. 0.33 nm . |

4. Based on Figure, if a diagram shows a stable electron orbit with five complete wave cycles around the nucleus, what is the value of the principal quantum number (n)?



A. $n = 1$

B. $n = 3$

C. $n = 5$

D. $n = 10$

5. How did de Broglie explain Bohr's assumption that only certain energy levels (orbits) are allowed in an atom?

A. By proving that electrons have no mass.

B. By showing that only orbits where waves are in phase and "in step" can exist without being destroyed by interference.

C. By measuring the exact position of the electron.

D. By proving that the nucleus is neutral.

6. Starting from Bohr's quantized angular momentum ($mvr = n \frac{h}{2\pi}$), which step leads directly to the stable orbit circumference equation?

A. $2\pi r = n \left(\frac{h}{mv} \right)$
B. $2\pi r = \frac{hf}{c}$
C. $2\pi r = n^2 \lambda$
D. $2\pi r = \frac{1}{2} mv^2$

Question 18: Define the mass number, A, as the total number of nucleons (protons and neutrons) in an atomic nucleus ($A=Z + N$).
Represent nuclei of isotopes using the notation, where 'Z' is the atomic number and 'A' is the mass number. Page (107 & 108 & 109)

MCQ – Objective questions

1. Protons and neutrons are collectively referred to by which of the following terms?

A. Isotopes
B. Nucleons
C. Photons
D. Electrons

2. The total number of nucleons (protons plus neutrons) in an atom is defined as the:

- | |
|------------------------------|
| A. Mass number (A) |
| B. Atomic number (Z) |
| C. Neutron number (N) |
| D. Elementary charge (e) |

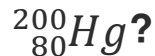
3. In the standard nuclear notation ${}_Z^AX$, what does the subscript Z represent?

- | |
|---|
| A. The total number of protons and neutrons. |
| B. The number of neutrons in the nucleus. |
| C. The atomic number (the number of protons). |
| D. The total mass of the atom in kilograms. |

4. An atom of Uranium-235 is represented as ${}_{92}^{235}\text{U}$. How many neutrons are in the nucleus of this isotope?

- | |
|--------|
| A. 92 |
| B. 235 |
| C. 143 |
| D. 327 |

5. How many neutrons are present in the nucleus of the mercury isotope



A. 80
B. 120
C. 200
D. 280

6. An isotope of oxygen has a mass number of 15. Given that oxygen's atomic number (Z) is 8, how many neutrons does this specific isotope have?

A. 15
B. 8
C. 7
D. 23

7. Which of the following symbols correctly represents an isotope of hydrogen that contains two neutrons in its nucleus?

A. ^1_1H
B. ^2_1H
C. ^3_1H
D. ^4_1H

8. Look at Figure 3. What is the main difference between the three isotopes of hydrogen shown?

Isotopes of Hydrogen and Helium

Hydrogen isotopes

1 p
0 n



1 p
1 n



1 p
2 n



Helium isotopes

2 p
1 n



2 p
2 n



- | |
|--|
| A. They have different numbers of protons. |
| B. They have different numbers of neutrons. |
| C. They have different numbers of electrons. |
| D. They belong to different chemical elements. |

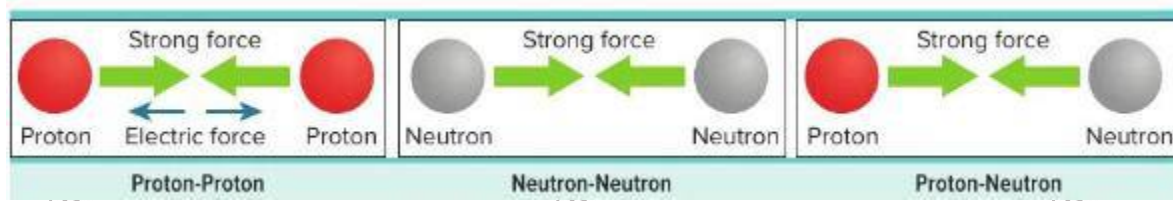
Question 19: Define the strong nuclear force as a very short-range attractive force that acts between nucleons (proton-proton, neutron-neutron, and proton-neutron) when they are very close together, as in the atomic nucleus. Define the mass defect as the difference between the actual mass of an atomic nucleus and the sum of the masses of its constituting nucleons. Page (109)

MCQ – Objective questions

1. The attractive force that acts between nucleons (protons and neutrons) and holds the nucleus together is known as the:

- | |
|--------------------------|
| A. Electromagnetic force |
| B. Gravitational force |
| C. Strong nuclear force |
| D. Weak nuclear force |

2. Look at Figure. According to the diagram and the text, between which pairs of nucleons does the strong nuclear force act?



- A. Only between two protons.
- B. Only between two neutrons.
- C. Only between a proton and a neutron.
- D. Between all nucleon pairs (p-p, n-n, and p-n) equally.

3. How does the strength and range of the strong nuclear force compare to the electromagnetic force?

- A. It is weaker but has an infinite range.
- B. It is 10 times stronger and acts over the entire atom.
- C. It is more than 100 times stronger but only acts over a very short distance ($1.4 \times 10^{-15} \text{ m}$).
- D. It is exactly equal to the electromagnetic force but acts in the opposite direction.

4. What is "mass defect" in nuclear physics?

- A. The loss of electrons during beta decay.
- B. The difference between the sum of the masses of individual nucleons and the actual mass of the assembled nucleus.
- C. The increase in mass when an atom is ionized.
- D. The mass of the neutrons alone in an isotope.

5. Why don't the protons in a nucleus fly apart due to their mutual electromagnetic repulsion?

- | |
|--|
| A. Because the strong nuclear force provides a much stronger attraction between them at short distances. |
| B. Because gravity is stronger than the electric force at the nuclear level. |
| C. Because neutrons have a negative charge that cancels the protons' charge. |
| D. Because the electrons inside the nucleus pull the protons inward. |

Question 20: Calculate the mass defect of an atomic nucleus.
Calculate the binding energy of an atomic nucleus.

Page (111)

MCQ – Objective questions

1. The mass of the tritium isotope (${}^3_1\text{H}$) is 3.016049 u. Given the mass of a hydrogen atom ($1p + 1e$) is 1.007825 u and the mass of a neutron is 1.008665 u, what is the mass defect (Δm) of tritium?

- | |
|---------------|
| A. 0.002388 u |
| B. 0.008665 u |
| C. 0.009106 u |
| D. 3.025155 u |

2. Based on the mass defect of tritium (0.009106 u), what is its binding energy in MeV? (Use $1u = 931.49 \text{ MeV}$)

- | |
|---------------|
| A. 2.22 MeV |
| B. 7.48 MeV |
| C. 8.48 MeV |
| D. 931.49 MeV |

3. The carbon isotope $^{12}_6\text{C}$ has a measured mass of exactly 12.000000 u. What is its mass defect?

- | |
|----------------|
| A. 0.048940 u |
| B. 0.098940 u |
| C. 0.113169 u |
| D. 12.098940 u |

4. A nitrogen isotope ($^{15}_7\text{N}$) has a mass of 15.010109 u. What is its binding energy?

- | |
|---------------|
| A. 92.16 MeV |
| B. 105.44 MeV |
| C. 106.18 MeV |
| D. 127.62 MeV |

Question 21: Compare alpha, beta, and gamma decays in terms of the particles emitted their electric charge, their penetrating ability, and the resulting nuclear transmutation.

Page (114)

MCQ – Objective questions

1. Which type of radiation has the highest penetrating ability and requires several centimeters of lead to be stopped?

A. Alpha particles (α)
B. Beta particles (β)
C. Gamma rays (γ)
D. Neutrons

2. Match the radiation type with its correct electric charge:

A. Alpha: -1 , Beta: $+2$, Gamma: 0
B. Alpha: $+2$, Beta: -1 , Gamma: 0
C. Alpha: 0 , Beta: $+1$, Gamma: -2
D. Alpha: $+1$, Beta: 0 , Gamma: $+2$

3. When a nucleus undergoes alpha decay, how do its mass number (A) and atomic number (Z) change?

- | |
|--|
| A. A increases by 4, Z increases by 2. |
| B. A decreases by 4, Z decreases by 2. |
| C. A remains the same, Z increases by 1. |
| D. A decreases by 2, Z remains the same. |

4. During beta-minus (β^-) decay, what occurs inside the nucleus to produce the emitted electron?

- | |
|---|
| A. A proton changes into a neutron. |
| B. A neutron changes into a proton. |
| C. The nucleus splits into two equal parts. |
| D. A photon is converted into mass. |

5. Which of the following is TRUE regarding gamma (γ) decay?

- | |
|--|
| A. It results in a change of the element's identity. |
| B. It emits a particle with a mass of 4 u. |
| C. It involves a redistribution of energy within the nucleus without changing A or Z . |
| D. It occurs only in nuclei with less than 100 nucleons. |

6. Which radiation type is correctly identified with its physical nature?

A. Alpha particle: Helium nucleus (${}^4_2H$)
B. Beta particle: High-energy photon
C. Gamma ray: Fast-moving positron
D. Alpha particle: Lone electron

7. According to the Section Review, why does an alpha particle have very little penetrating power compared to others?

A. Because it has no mass.
B. Because it is large and has a charge, causing it to interact strongly with matter and lose energy quickly.
C. Because it travels at the speed of light.
D. Because it is not affected by electric fields.

Question 22: Explain that electric charge is conserved in a nuclear reaction, so the total charge is the same on both sides of the nuclear equation. Page (116)

MCQ – Objective questions

1. In any balanced nuclear equation, what must be true regarding the electric charge?

- | |
|--|
| A. The total charge on the right side must be greater than the left. |
| B. The total charge is only conserved if gamma radiation is emitted. |
| C. The sum of the subscripts (atomic numbers, Z) on the left side must equal the sum of the subscripts on the right side. |
| D. The number of neutrons must always equal the number of protons. |

2. The Radium isotope $^{226}_{88}\text{Ra}$ undergoes alpha decay to become Radon ($^{222}_{86}\text{Rn}$). Which of the following checks proves that charge is conserved in this reaction?

- | |
|--------------------------|
| A. $88 = 86 + 2$ |
| B. $226 = 222 + 4$ |
| C. $88 - 86 = 226 - 222$ |
| D. $88 + 226 = 86 + 222$ |

3. A Lead isotope $^{209}_{82}Pb$ decays into Bismuth $^{209}_{83}Bi$ by emitting a beta particle ($^0_{-1}e$) and an antineutrino. How is the charge balanced in this equation?

- | |
|-------------------------|
| A. $82 = 83 + 1$ |
| B. $82 = 83 + (-1) + 0$ |
| C. $209 = 209 + 0$ |
| D. $82 = 83 - 209$ |

4. Consider the reaction: $^{234}_{92}U \rightarrow ^{230}_{90}Th + X$. To conserve both mass number and charge, what must particle X be?

- | |
|-----------------------------------|
| A. An alpha particle (^4_2H) |
| B. A beta particle ($^0_{-1}e$) |
| C. A proton (^1_1H) |
| D. A neutron (^1_0n) |

5. A proton (^1_1H) collides with Nitrogen-15 ($^{15}_7N$) to produce an alpha particle (^4_2H) and a new isotope. Use charge conservation to find the atomic number (Z) of the new isotope.

- | |
|-----------------------|
| A. $Z = 5$ (Boron) |
| B. $Z = 6$ (Carbon) |
| C. $Z = 8$ (Oxygen) |
| D. $Z = 7$ (Nitrogen) |

Question 23: Write a balanced nuclear equation to describe a simple nuclear reaction, such as the bombardment of a nucleus by an alpha particle. Page (117)

MCQ – Objective questions

1. When Nitrogen-14 (${}^{14}_7\text{N}$) is bombarded with alpha particles (${}^4_2\text{H}$), a proton (${}^1_1\text{H}$) is emitted along with a new isotope: ${}^4_2\text{H} + {}^{14}_7\text{N} \rightarrow {}^1_1\text{H} + {}^A_Z\text{X}$. What are the values of A and Z for the new isotope?

A. $A = 18, Z = 9$

B. $A = 17, Z = 8$

C. $A = 17, Z = 9$

D. $A = 18, Z = 8$

2. Based on the reaction in the previous question, which element is represented by the symbol X (where $Z = 8$)?

A. Nitrogen

B. Fluorine

C. Oxygen

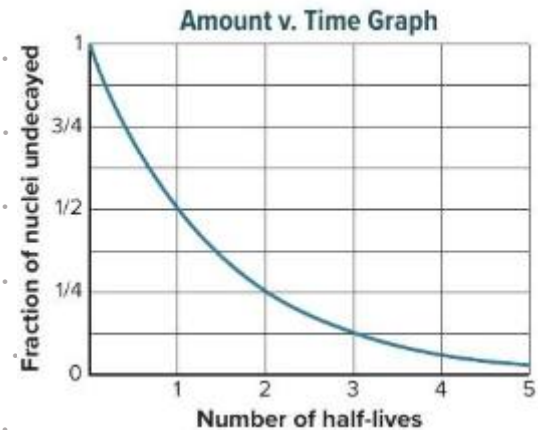
D. Carbon

Question 24: Analyze a graph of the number of undecayed radioactive nuclei versus time, and determine the half-life and the amount of radioactive nuclei present at a certain time t . Calculate the amount of radioactive nuclei remaining in a sample. Page (117 & 118 & 119)

MCQ – Objective questions

1. Look at Figure. After a period of time equal to three half-lives, what fraction of the original radioactive nuclei remains undecayed?

- A. $1/2$
- B. $1/4$
- C. $1/8$
- D. $1/16$



2. A 1.0-g sample of tritium (${}^3_1\text{H}$) is produced. Given that the half-life of tritium is 12.3 years, how much of the sample will remain after 24.6 years?

- A. 0.50 g
- B. 0.25 g
- C. 0.125 g
- D. 0.00 g

3. A sample of polonium-210 has an initial activity of 2×10^6 Bq. If the sample is kept for a duration equal to two half-lives, what will its activity be?

- | |
|-------------------------|
| A. 1×10^6 Bq |
| B. 5×10^6 Bq |
| C. 2.5×10^5 Bq |
| D. 4×10^6 Bq |

4. which of the following best defines the "half-life" of a radioactive isotope?

- | |
|---|
| A. Half the time it takes for the entire sample to decay. |
| B. The time required for half of the atoms in any given quantity of the isotope to decay. |
| C. The time it takes for the atomic number to double. |
| D. The total lifespan of a radioactive nucleus. |

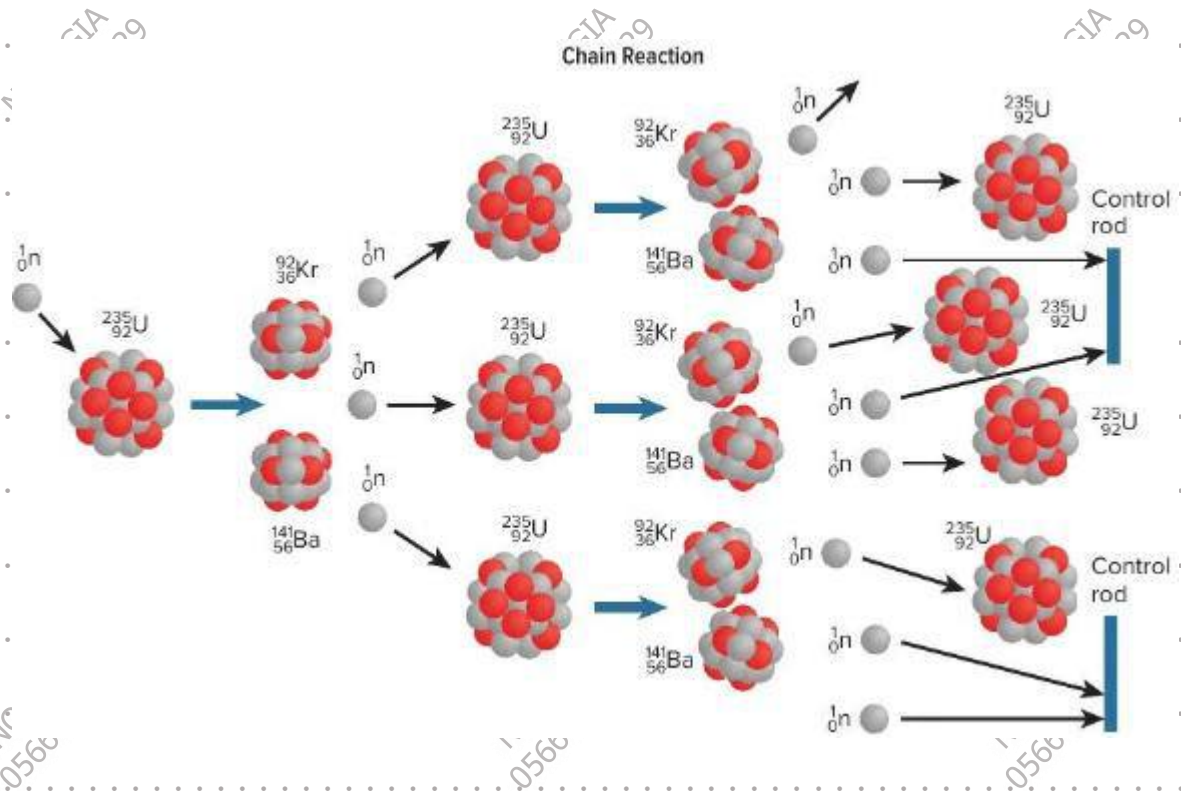
Question 25: Define and describe nuclear fission and nuclear fusion. Page (119 - 123)

MCQ – Objective questions

1. The process in which a heavy nucleus divides into two or more fragments, releasing a large amount of energy and additional neutrons, is called:

- | |
|---------------------|
| A. Nuclear fission |
| B. Nuclear fusion |
| C. Beta decay |
| D. Electron capture |

2. Look at Figure 12 on page 121. What causes a "chain reaction" to continue in a sample of Uranium-235?



- | |
|---|
| A. The emission of alpha particles that hit other nuclei. |
| B. The neutrons released during one fission event trigger further fissions in neighboring nuclei. |
| C. The high temperature of the surroundings causes the nuclei to melt together. |
| D. The absorption of gamma rays by the fuel rods. |

3. In a nuclear reactor, what is the specific purpose of Cadmium control rods, as shown in the diagram on page 122?

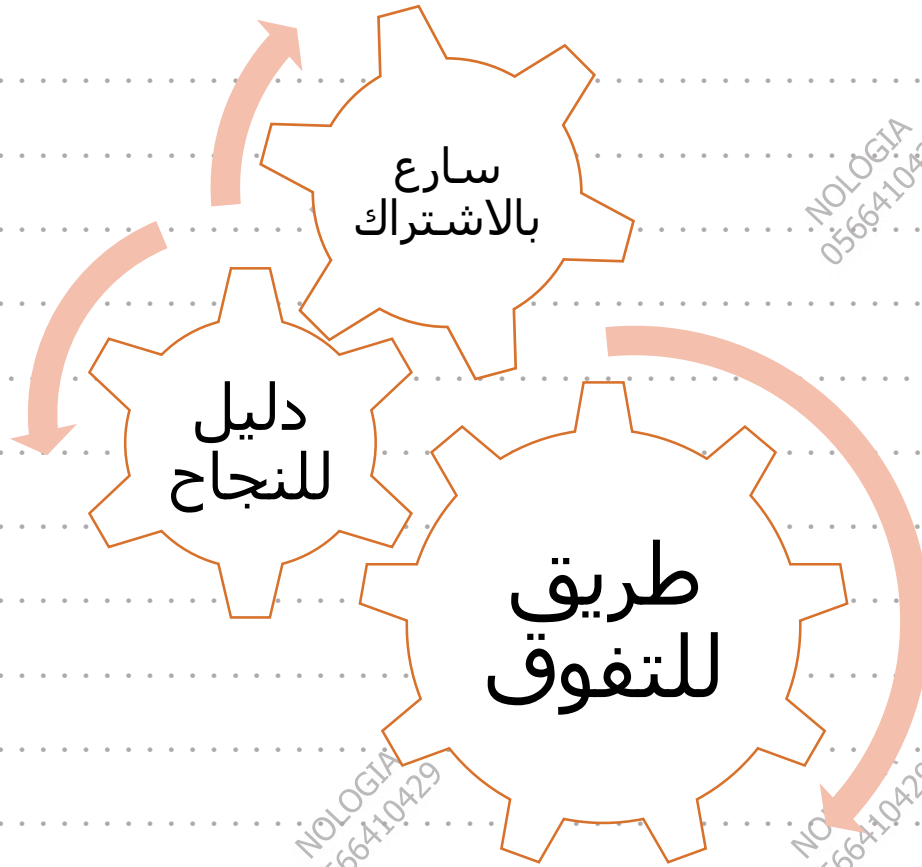
- | |
|---|
| A. To slow down fast neutrons. |
| B. To act as the primary fuel source. |
| C. To absorb neutrons and control the rate of the chain reaction. |
| D. To reflect neutrons back into the core. |

4. Nuclear fusion is the process in which:

- | |
|---|
| A. A large nucleus splits into smaller parts. |
| B. Nuclei with small masses combine to form a nucleus with a larger mass. |
| C. Protons are converted into electrons. |
| D. An atom loses all of its orbital electrons. |

5. Why does nuclear fusion (like the proton-proton chain in the Sun) require extremely high temperatures (around 2×10^7 K)?

- | |
|--|
| A. To increase the mass of the hydrogen atoms. |
| B. To provide the nuclei with enough kinetic energy to overcome the massive electrical repulsion between them. |
| C. To prevent the neutrons from escaping the Sun's gravity. |
| D. To convert the helium back into hydrogen. |



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