

انسباير ملزمة الوحدة الثانية تحليل أسئلة الفيزياء النووية حول النواة والاضمحلال الإشعاعي



تم تحميل هذا الملف من موقع المناهج الإماراتية

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

تاريخ إضافة الملف على موقع المناهج: 2026-05-02 14:30:52

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

المزيد من مادة
فيزياء:

التواصل الاجتماعي بحسب الصف الثاني عشر المتقدم



صفحة المناهج
الإماراتية على
فيسبوك

الرياضيات

اللغة الانجليزية

اللغة العربية

التربية الاسلامية

المواد على تلغرام

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

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Topic 7 – Nuclear Physics

Subtopic 7.1: Some Properties of Nuclei

KPI 7.1.1

1. The nucleus of an atom is made up of which of the following?

- A. Electrons and protons
- B. Electrons and neutrons
- C. Protons and neutrons
- D. Electrons, protons and neutrons

KPI 7.1.2

2. The atomic number of a given element is equivalent to which of the following?

- A. Proton number in the nucleus
- B. Neutron number in the nucleus
- C. Number of electrons in the outer shell
- D. Sum of protons and neutrons

KPI 7.1.2

3. If there are 146 neutrons in ^{238}U , how many neutrons are found in the nucleus of ^{235}U ?

- A. 141
- B. 143
- C. 145
- D. 147

KPI 7.1.2

4. Which term refers to the total number of protons and neutrons in a nucleus?

- A. Atomic number
- B. Electron number
- C. Nucleon number
- D. Avogadro's number

KPI 7.1.3

5. Which of the following best defines isotopes?

- A. Atoms of the same element with different numbers of electrons.
- B. Atoms of the same element with different numbers of protons.
- C. Atoms of the same element with different numbers of neutrons.
- D. Atoms with the same mass number but different atomic numbers.

KPI 7.1.4

6. A nucleus represented by the symbol ${}_Z^AX$ has —.

- A. Z neutrons and A-Z protons
- B. Z protons and A-Z neutrons
- C. Z protons and A+Z neutrons
- D. A protons and A-Z neutrons

KPI 7.1.4

7. Which of the following pair of atoms are isotopes of the element ${}^{16}_8\text{X}$?

- A. ${}^{16}_7\text{X}$
- B. ${}^{16}_9\text{X}$
- C. ${}^{17}_8\text{X}$
- D. ${}^{17}_9\text{X}$

KPI 7.1.5

8. What is the charge of a single proton?

- A. 0
- B. $-e$
- C. $+e$
- D. $+2e$

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Mr. Abdulrahman Esam Eid

0509886279

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KPI 7.1.6

9. How does the mass of a proton (m_p) compare to the mass of an electron (m_e)?

- A. $m_p = 2m_e$
- B. $m_p = 100m_e$
- C. $m_p = 1836m_e$
- D. $m_p = (1/1836)m_e$

KPI 7.1.6

10. Which of the following correctly ranks the subatomic particles in increasing order of mass?

- A. Electron < Proton $\approx$ Neutron
- B. Proton < Neutron < Electron
- C. Electron < Neutron < Proton
- D. Neutron < Proton < Electron

KPI 7.1.7

11. What is the definition of one unified atomic mass unit (u)?

- A. The mass of one proton
- B. The mass of one neutron
- C. 1/12th the mass of a carbon-12 atom
- D. The mass of an electron

KPI 7.1.7

12. The energy equivalent in joules of the mass of $2.0 \times 10^{-31} \text{ kg}$ ____.

- A. $2.0 \times 10^{-31} \text{ J}$
- B. $6.0 \times 10^{-23} \text{ J}$
- C. $1.8 \times 10^{-14} \text{ J}$
- D. $8.2 \times 10^{-14} \text{ J}$

KPI 7.1.7

13. What is the energy equivalent of 1 atomic mass unit (u) in MeV?

- A. 1 MeV
- B. 13.6 MeV
- C. 931.5 MeV
- D. $1.5 \times 10^{-10} \text{ MeV}$

KPI 7.1.8

14. What is the nature of the nuclear force between nucleons?

- A. Long-ranged and weak
- B. Short-ranged and strong
- C. Long-ranged and repulsive
- D. Short-ranged and repulsive

KPI 7.1.9

15. What is the band of stability in the N versus Z plot?

- A. A region where stable nuclei exist.
- B. A zone where all nuclei undergo spontaneous decay.
- C. A curve showing the maximum number of neutrons a nucleus can have.
- D. A line representing isotopes with equal numbers of protons and neutrons.

KPI 7.1.9

16. What happens to nuclei that lie outside the band of stability?

- A. They become inert and non-reactive.
- B. They disappear from existence.
- C. They are stable and do not undergo decay.
- D. They typically undergo radioactive decay to move toward stability.

Free Response:

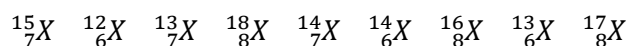
KPI 7.1.2, 7.1.4

1. A neutral atom is designated by ${}^{40}_{18}\text{X}$. Complete the table below with the number of protons, neutrons, electrons and nucleons this neutral atom has.

Number of Protons	
Number of Neutrons	
Number of Electrons	
Number of Nucleons	

KPI 7.1.4

2. The isotopes of some elements are given below. Form three groups of isotopes of the elements in the table.



Group 1	
Group 2	
Group 3	

KPI 7.1.5, 7.1.6

3. Complete the table below with the relative mass and charge of electron, proton and neutron.

	Electron	Proton	Neutron
Relative Mass			
Relative charge			

KPI 7.1.8

4. Why do stable nuclei exist despite the repulsive Coulomb force between protons?

Term 3**Mr.Abdulrahman Esam Eid**

0509886279



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Subtopic 7.2: Binding Energy

KPI 7.2.1

1. What is the mass defect of a nucleus?

- A. The mass lost due to electron capture.
- B. The additional mass gained during nuclear fusion.
- C. The difference in mass between an atom and its nucleus.
- D. The difference between the total mass of the individual nucleons and the actual mass of the nucleus.

KPI 7.2.2

2. What is the formula used to calculate the mass defect (Δm) of a nucleus?

- A. $\Delta m = (Zm_p + Nm_n) - m_{nucleus}$
- B. $\Delta m = m_{nucleus} - (Zm_p + Nm_n)$
- C. $\Delta m = E/c$
- D. $\Delta m = m_p + m_n$

KPI 7.2.3

3. What is the definition of binding energy?

- A. The energy stored in the electron shells
- B. The energy required to remove one electron from an atom.
- C. The energy needed to hold the protons together in the nucleus.
- D. The energy required to break a nucleus into its individual nucleons.

KPI 7.2.3

4. Which equation relates the mass defect (Δm) to binding energy (E_b)?

- A. $E_b = m_{nucleus}c^2$
- B. $E_b = Zm_p c^2 + Nm_n c^2$
- C. $E_b = \Delta m c^2$
- D. $E_b = 1/2mv^2$

KPI 7.2.4

5. Which statement best explains why the mass defect occurs?

- A. Some mass is converted into energy when the nucleus is formed.
- B. The mass of protons is always greater than the mass of neutrons.
- C. Some electrons escape from the nucleus, causing a loss in mass.
- D. The binding energy reduces the size of the nucleus, making it appear less massive.

KPI 7.2.4

6. What happens to the missing mass in a nucleus due to the mass defect?

- A. It is lost in the form of heat.
- B. It is converted into extra protons.
- C. It is absorbed by electrons to form stable atoms.
- D. It is converted into binding energy that holds the nucleus together.

KPI 7.2.4

7. The mass of the nucleus is less than the total mass of its nucleons. This fact indicates that some of the mass has been converted to ____.

- A. thermal energy
- B. binding energy
- C. kinetic energy
- D. potential energy

KPI 7.2.5

8. If the mass defect of a nucleus is given as 0.025 u, what is the equivalent energy in MeV?

- A. 12.5 MeV
- B. 18.3 MeV
- C. 23.3 MeV
- D. 33.3 MeV

KPI 7.2.6

9. What does the plot of binding energy per nucleon as a function of mass number show?

- A. The repulsive forces in the nucleus.
- B. The variation of nuclear charge with atomic n.umber.
- C. The stability of nuclei across different mass numbers
- D. How the mass of a nucleus changes with the number of protons

KPI 7.2.6

10. Which nucleus is at the peak of the binding energy per nucleon curve, representing the most stable element?

- A. Iron-56
- B. Hydrogen-1
- C. Uranium-238
- D. Plutonium-239

Free Response:

KPI 7.2.2, 7.2.3

1. True or False?

- a. The total mass of a nucleus is always less than the sum of the masses of its nucleons.
- b. The total energy of the bound system (the nucleus) is more than the combined energy of the separated nucleons.
- c. Binding energy is the energy given out when the separate nucleons combine to form the nucleus.
- d. Binding energy is the energy required for a nucleus to break it apart into its separated neutrons and protons.

2. A helium-4 nucleus consists of two protons and two neutrons. Calculate the mass defect of helium-4 in atomic mass units (u), given the following masses:

- Mass of a proton = 1.00728 u
- Mass of a neutron = 1.00866 u
- Mass of a helium-4 nucleus = 4.00150 u

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Mr.Abdulrahman Esam Eid

 0509886279

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3. The atom ${}^{14}_7N$ has a mass of 14.0031 u .

a. Calculate the mass defect for ${}^{14}_7N$.

b. Calculate the binding energy per nucleon for ${}^{14}_7N$.

c. Explain why the mass of an assembled nucleus is less than the sum of the masses of all its nucleons.

4. The nucleus of magnesium, ${}^{24}_{12}Mg$ has a mass of 23.9850 u .

a. Calculate the mass defect of the given nucleus.

b. Calculate the binding energy of magnesium in *MeV* and in *Joules*

5. Answer the following questions on Binding energy.

a. Define binding energy and describe its significance in nuclear stability.

b. Why does nuclear fission release energy in heavy elements like Uranium-235?

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Mr.Abdulrahman Esam Eid

 0509886279

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Subtopic 7.3: Radioactivity

KPI 7.3.1

1. What does the activity of a radioactivity sample represent?

- A. The total number of nuclei in the sample.
- B. The number of alpha particles emitted per hour.
- C. The total number of nuclei that decay in one second.
- D. The amount of energy released during radioactive decay.

KPI 7.3.1

2. Which statement is true about the activity of a radioactive sample?

- A. Activity decreases as more nuclei decay.
- B. Activity remains constant regardless of time.
- C. Activity increases as the number of undecayed nuclei decreases.
- D. Activity is unrelated to the number of decaying nuclei.

KPI 7.3.2

3. If the initial number of radioactive nuclei is $N_0/2$, how many remain after one half-life?

- A. $N_0/4$
- B. $N_0/2$
- C. N_0
- D. $2N_0$

KPI 7.3.2

4. A sample has a half-life of 5 hours. How much of the sample remains after 15 hours?

- A. $N_0/16$
- B. $N_0/8$
- C. $N_0/4$
- D. $N_0/2$

KPI 7.3.2

5. A sample of californium-239 has an activity of 4000 Bq. The half-life of californium-239 is 1 minute. What will the activity be after 4 minutes?

- A. 250 Bq
- B. 500 Bq
- C. 1000 Bq
- D. 2000 Bq

KPI 7.3.3

6. If the decay constant of a radioactive nuclide is high, then _____.

- A. Its activity is low.
- B. It decays slowly.
- C. It has a longer half-life.
- D. It has a short half-life and high activity.

KPI 7.3.3

7. Which of the following is true regarding the unit for the decay constant λ ?

- A. Bq s^{-1}
- B. s^{-1}
- C. s
- D. The decay constant has no unit.

KPI 7.3.3, 7.3.6

8. A sample has 5000 undecayed nuclei and a decay constant of ($\lambda = 0.001 \text{ s}^{-1}$). What is its activity?

- A. 0.005 Bq
- B. 0.50 Bq
- C. 5.0 Bq
- D. 50 Bq

KPI 7.3.3, 7.3.6

9. A sample has an activity of 600 Bq and 2000 undecayed nuclei. What is the decay constant?

- A. 0.03 s^{-1}
- B. 0.06 s^{-1}
- C. 0.30 s^{-1}
- D. 3.0 s^{-1}

KPI 7.3.4

10. What does the law of radioactive decay state?

- A. The rate of decay increases with time.
- B. The number of nuclei increases over time.
- C. The activity of a radioactive sample remains constant.
- D. The rate of decay is directly proportional to the number of undecayed nuclei.

KPI 7.3.4, 7.3.5

11. A radioactive sample has an initial number of nuclei ($N_0 = 10\,000$) and the decay constant of ($\lambda = 0.002 \text{ s}^{-1}$). How many nuclei remain after 200 s?

- A. 1353
- B. 2000
- C. 5000
- D. 6703

KPI 7.3.4, 7.3.5

12. If a sample's initial activity is ($A_0 = 800 \text{ Bq}$) and the decay constant of ($\lambda = 0.005 \text{ s}^{-1}$). How many nuclei remain after 100 s?

- A. 300 Bq
- B. 485 Bq
- C. 640 Bq
- D. 800 Bq

KPI 7.3.7

13. A radioactive material has a half-life of 100 seconds. What is the decay constant?

- A. 0.003 s^{-1}
- B. 0.0069 s^{-1}
- C. 0.030 s^{-1}
- D. 0.069 s^{-1}

KPI 7.3.7

14. Which of the following statements is true about the relationship between half-life and decay constant?

- A. Half-life increases as decay constant decreases.
- B. A substance with a smaller decay constant decays faster.
- C. A substance with a larger decay constant has a longer half-life.
- D. Half-life and decay constant are directly proportional.

KPI 7.3.8

15. The number of undecayed nuclei of a sample at various times is shown below:

Time (s)	Number of Nuclei
0	8000
10	4000
20	2000
30	1000

What is the half-life of this radioactive sample?

- A. 5.0 s
- B. 10 s
- C. 20 s
- D. 30 s

KPI 7.3.8

16. A radioactive substance shows the following activity data:

Time (min)	Activity (Bq)
0	160
15	80
30	40
45	20

What is the decay constant?

- A. 0.023 min^{-1}
- B. 0.046 min^{-1}
- C. 0.069 min^{-1}
- D. 0.693 min^{-1}

Free Response:

KPI 7.3.2

1. Answer the following questions on half-life.

- a. Define the term half-life of a radioactive nuclide.

- b. Describe what happens to the number of undecayed nuclei in a sample over successive half-lives. Tick the correct box(es).

KPI 7.3.2

2. A sample of radioactive iodine has an initial activity of 800 counts per minute. Its half-life is 8 days.

- a. What is the activity of the sample after 8 days?

- b. How many days will it take for the activity to fall to 100 counts per minute?

- c. Explain why the sample never fully decays to zero activity, even after a long time.

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Mr.Abdulrahman Esam Eid



0509886279



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KPI 7.3.3

3. Answer the following questions on decay constant and its role in radioactive decay.

- a. Define the decay constant (λ) in the context of radioactive decay.
- b. How does the value of (λ) affect the rate of radioactive decay?
- c. If the decay constant of a sample is 0.001 s^{-1} and the sample has 5.0×10^6 undecayed nuclei, calculate the activity.

KPI 7.3.4, 7.3.6

4. The activity of a sample drops from 1000 Bq to 250 Bq. If $\lambda = 0.002 \text{ s}^{-1}$, how much time has passed?

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Mr.Abdulrahman Esam Eid

 **0509886279**

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KPI 7.3.4, 7.3.5

5. A radioactive sample contains $N_0 = 5.0 \times 10^6$ nuclei. The decay constant is ($\lambda = 0.002 \text{ s}^{-1}$).

- a. State the law of radioactive decay.

- b. Calculate the number of undecayed nuclei after 200 seconds.

KPI 7.3.4, 7.3.5

6. A radioactive substance initially contains 1.2×10^7 nuclei. After some time, only 3.0×10^6 nuclei remain. If the decay constant is ($\lambda = 0.001 \text{ s}^{-1}$), calculate the time elapsed.

KPI 7.3.4, 7.3.6

7. A radioactive sample has an initial activity ($A_0 = 2000 \text{ Bq}$) and a decay constant ($\lambda = 0.0005 \text{ s}^{-1}$). Find its activity after 1 hour.

KPI 7.3.7

8. If the decay constant of a substance is ($\lambda = 0.002 \text{ s}^{-1}$), what is its half-life?

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 0509886279

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KPI 7.3.4, 7.3.5, 7.3.7

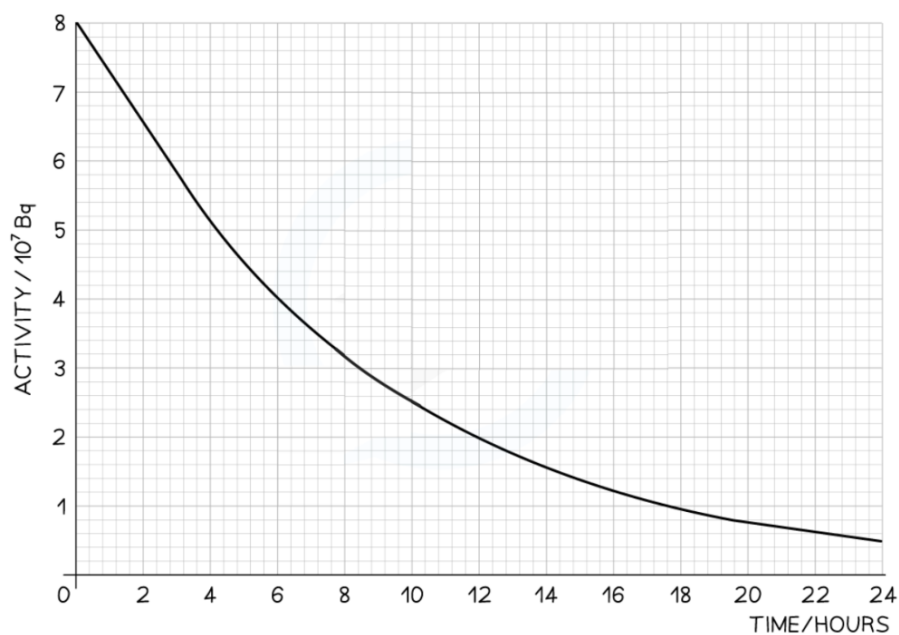
9. Palladium-100 has a half-life of 3.6 days.

a. Find the decay constant for the sample?

b. If there are 6.02×10^{23} atoms at the start, how many atoms would be present after 20.0 days?

KPI 7.3.8

10. The radioisotope technetium is used extensively in medicine. The graph below shows how the activity of a sample varies with time.



Determine the half-life of this material.

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