Nuclei JEE Main PYQ - 1

Total Time: 50 Minute **Total Marks:** 80

Instructions

Instructions

1. Test will auto submit when the Time is up.
2. The Test comprises of multiple choice questions (MCQ) with one or more correct answers.
3. The clock in the top right corner will display the remaining time available for you to complete the examination.

Navigating & Answering a Question

1. The answer will be saved automatically upon clicking on an option amongst the given choices of answer.
2. To deselect your chosen answer, click on the clear response button.
3. The marking scheme will be displayed for each question on the top right corner of the test window.

Nuclei

1. **The decay of a proton to neutron is:** **(+4, -1)**

   a. not possible as proton mass is less than the neutron mass

   b. possible only inside the nucleus

   c. always possible as it is associated only with β^+ decay

   d. not possible but neutron to proton conversion is possible

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2. **There are 10^{10} radioactive nuclei in a given radioactive element. Its half-life time is 1 minute. How many nuclei will remain after 30 seconds ? ($\sqrt{2}$ = 1.414)** **(+4, -1)**

   a. 10^5

   b. 2×10^{10}

   c. 7×10^9

   d. 4×10^{10}

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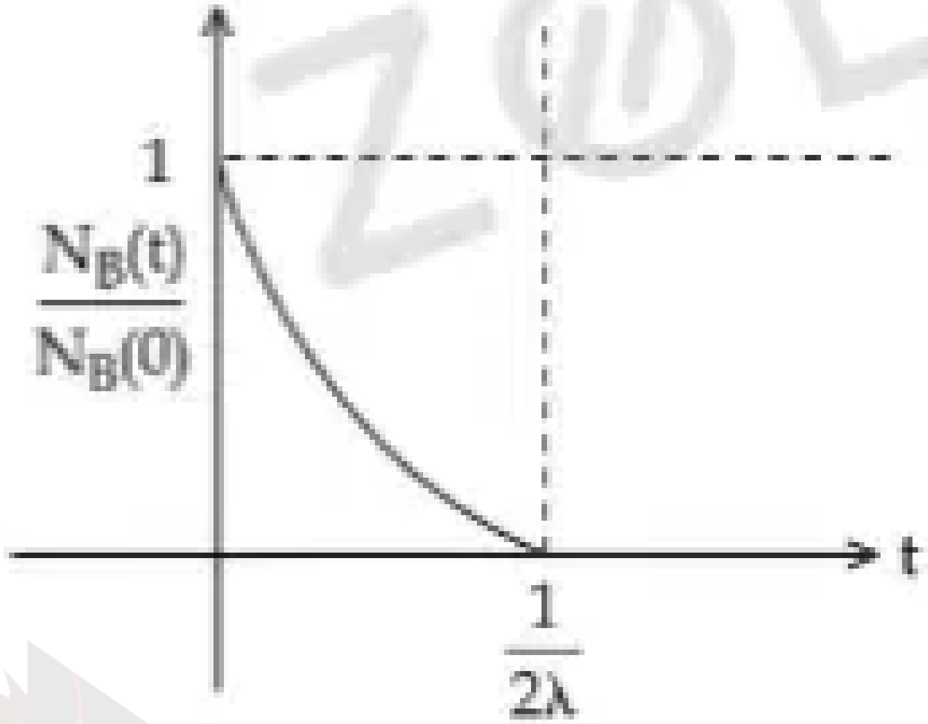
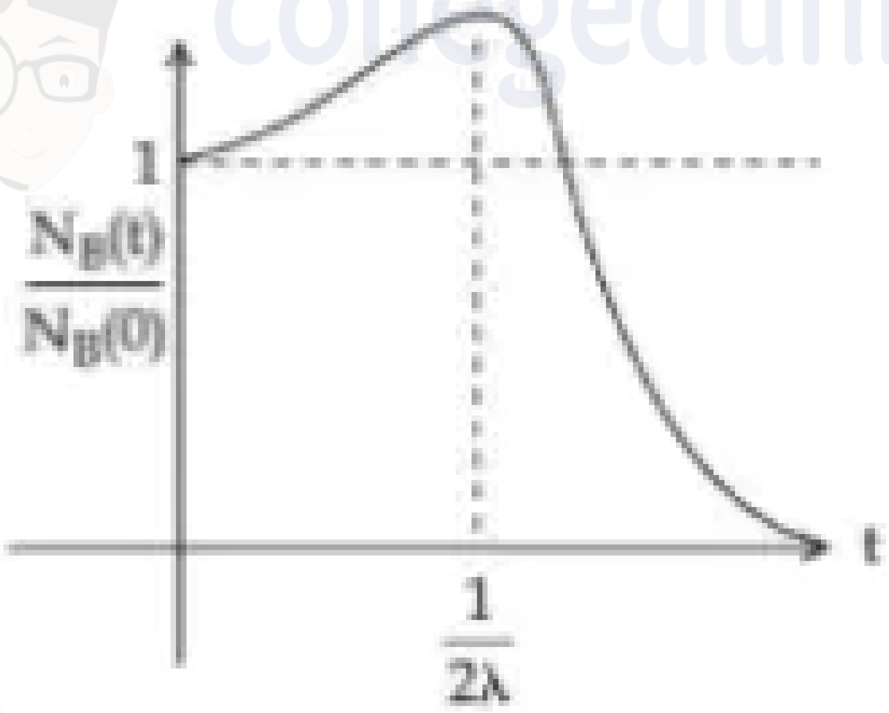
3. **At time t = 0, a material is composed of two radioactive atoms A and B, where $N_A(0) = 2N_B(0)$. The decay constant of both kind of radioactive atoms is λ. However, A disintegrates to B and B disintegrates to C. Which of the following figures represents the evolution of $N_B(t)/N_B(0)$ with respect to time t?** **(+4, -1)**
   [$N_A(0)$ = No. of A atoms at t = 0]
   [$N_B(0)$ = No. of B atoms at t = 0]



(A)



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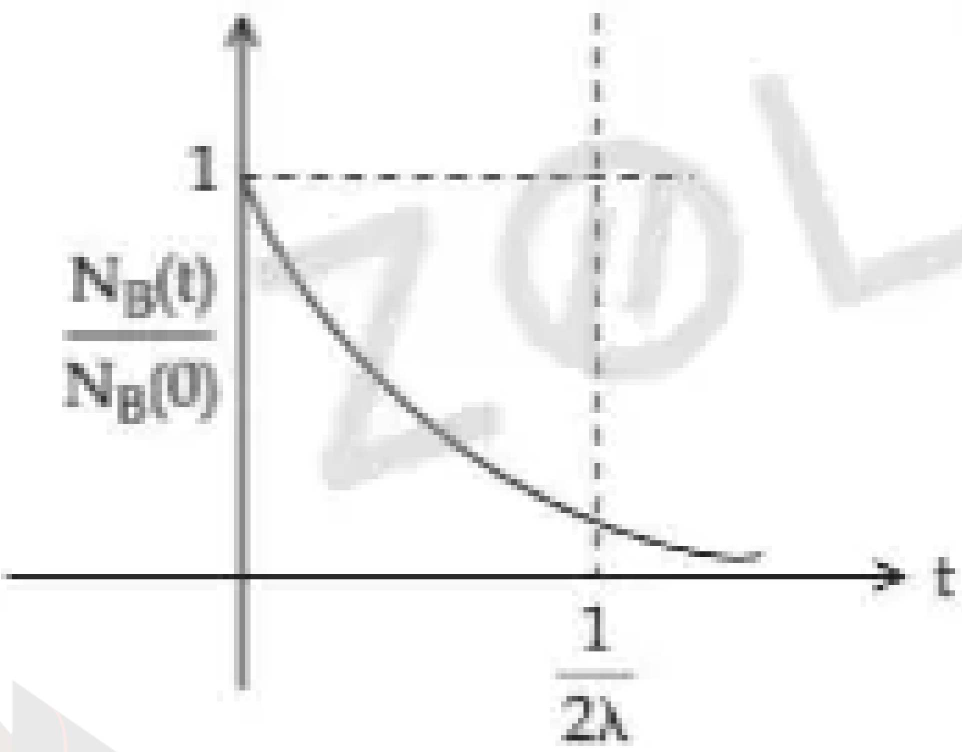
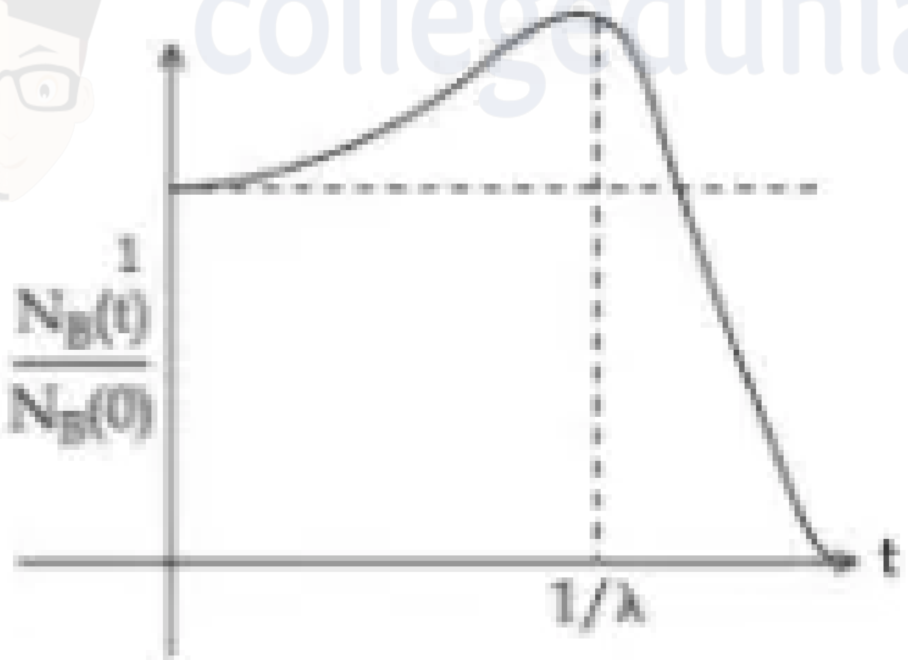


(C)



(D)

a. A

b. B

c. C

d. D

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4. The disintegration energy Q for the nuclear fission of $^{235}U \rightarrow {}^{140}Ce + {}^{94}Zr + n$ is _____ MeV. **(+4, -1)**

Given atomic masses:
^{235}U = 235.0439 u
^{140}Ce = 139.9054 u
^{94}Zr = 93.9063 u
n = 1.0086 u

Value of c² = 931 MeV/u.

---

5. A nucleus has mass number A_1 and volume V_1. Another nucleus has mass number A_2 and volume V_2. If the relation between mass numbers is $A_2 = 4A_1$, then $\frac{V_2}{V_1} =$ _______. **(+4, -1)**

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6. The mass number of nucleus having radius equal to half of the radius of nucleus with mass number 192 is: **(+4, -1)**

a. 24

b. 32

c. 40

d. 20

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7. A nucleus at rest disintegrates into two smaller nuclei with their masses in the ratio of 2:1. After disintegration they will move **(+4, -1)**

a. In opposite directions with speed in the ratio of 1:2 respectively

b. In opposite directions with speed in the ratio of 2:1 respectively

c. In the same direction with same speed.

d. In opposite directions with the same speed.

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8. The mass defect in a particular reaction is $0.4\,\mathrm{g}$. The amount of energy liberated is $n \times 10^7\,\mathrm{kWh}$, where $n =$ _____. (speed of light $= 3 \times 10^8\,\mathrm{m/s}$) (+4, -1)

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9. The electric potential at the surface of an atomic nucleus $(z = 50)$ of radius 9×10^{-13} cm is _______ $\times 10^6 V$. (+4, -1)

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10. In a nuclear fission reaction of an isotope of mass M, three similar daughter nuclei of the same mass are formed. The speed of a daughter nuclei in terms of mass defect ΔM will be: (+4, -1)

a. $c\sqrt{\frac{c\Delta M}{M}}$

b. $c\sqrt{\frac{2\Delta M}{M}}$

c. $\frac{\Delta M c^2}{3}$

d. $\sqrt{\frac{2c\Delta M}{M}}$

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11. Two lighter nuclei combine to from a comparatively heavier nucleus by the relation given below: ${}_1^2X + {}_1^2X = {}_2^4Y$. The binding energies per nucleon for, ${}_1^2X$ and ${}_2^4Y$ are 1.1 MeV and 7.6 MeV respectively. The energy released in the process is ______ MeV. (+4, -1)

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12. Mass numbers of two nuclei are in the ratio of $4 : 3$. Their nuclear densities will be in the ratio of (+4, -1)

a. $4 : 3$

b. $\left(\frac{3}{4}\right)^{\frac{1}{3}}$

c. $1 : 1$

d. $\left(\frac{4}{3}\right)^{\frac{1}{3}}$

13. A radioactive sample decays 7/8 times its original quantity in 15 minutes. The half-life of the sample is **(+4, -1)**

a. 5 min

b. 7.5 min

c. 15 min

d. 30 min

14. A nucleus of mass M at rest splits into two parts having masses $\frac{M\prime}{3}$ and $\frac{2M\prime}{3}(M\prime < M)$. **(+4, -1)**

a. 1 : 2

b. 2 : 1

c. 1 : 1

d. 2 : 3

15. The disintegration rate of a certain radioactive sample at any instant is 4250 disintegrations per minute. 10 minutes later, the rate becomes 2250 disintegrations per minute. The approximate decay constant is (Take $\log_{10}1.88 = 0.274$) **(+4, -1)**

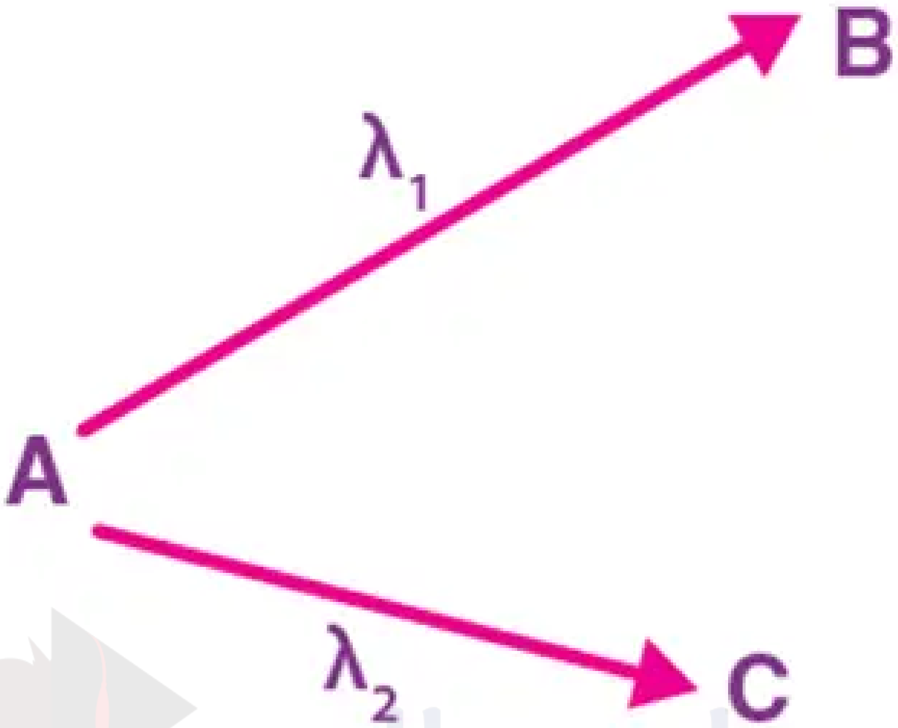
a. 0.02 min^{-1}

b. 2.7 min^{-1}

c. 0.063 min^{-1}

d. 6.3 min^{-1}

16. A radioactive nucleus can decay by two different processes. Half-life for the first process is 3.0 hours while it is 4.5 hours for the second process. The effective half-life of the nucleus will be: **(+4, -1)**



a. 3.75 hours

b. 0.56 hours

c. 0.26 hours

d. 1.80 hours

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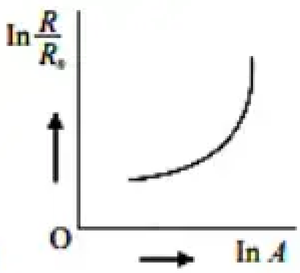
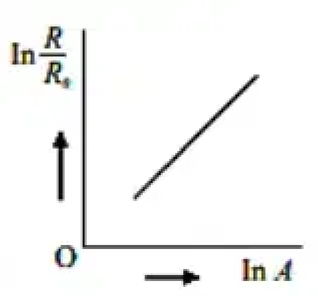
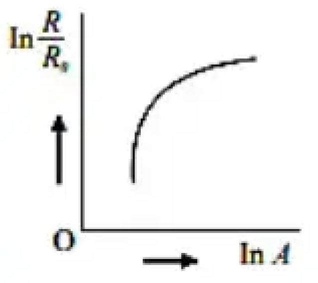
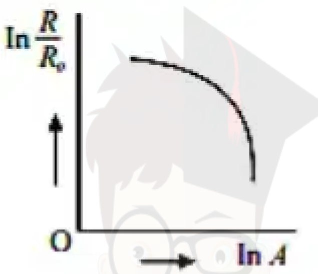
17. Which of the following figure represents the variation of $ln(\frac{R}{R_0})$ with $ln\ A$? **(+4, -1)**
(if R = radius of a nucleus and A = its mass number)

a. 

b. 

c. 

d. 

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18. The disintegration rate of a certain radioactive sample at any instant is 4250 disintegrations per minute 10 minutes later, the rate becomes 2250 disintegrations per minute The approximate decay constant is : (Take $\log_{10} 188 = 0274$) **(+4, -1)**

a. 0.02 min^{-1}

b. 2.7 min^{-1}

c. 0.063 min^{-1}

d. 6.3 min^{-1}

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19. If the amplitude of an oscillating magnetic field is 1.67×10⁻ Tesla. Then, the value of is(Given, amplitude of electric field is $_0$ = 50 /). **(+4, -1)**

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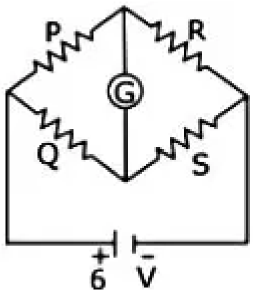
20. In the Wheatstone network given, = 10Ω, = 20Ω, = 15Ω, = 30Ω the current passing through the battery (of negligible internal resistance) is: **(+4, -1)**



a. (A) 0.36

b. (B) Zero

c. (C) 0.18

d. (D) 0.72

Answers

1. **Answer: b**

Explanation:

Step 1: A free proton is stable and cannot decay into a heavier neutron $(m_p < m_n)$ because it would violate conservation of energy.
Step 2: However, inside a nucleus, a proton can convert into a neutron via β^+ decay ($p \to n + e^+ + \nu$).
Step 3: This is possible because the required energy comes from the **binding energy** of the surrounding nucleus.

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2. **Answer: c**

Explanation:

Step 1: Understanding the Question:
We are given the initial number of radioactive nuclei, the half-life of the element, and a specific time. We need to calculate the number of nuclei that have not yet decayed after this time.
Step 2: Key Formula or Approach:
The law of radioactive decay gives the number of undecayed nuclei N at time t as:

$$N = N_0 \left(\frac{1}{2}\right)^{t/T_{1/2}}$$

where: - N_0 is the initial number of nuclei. - $T_{1/2}$ is the half-life. - t is the elapsed time.
Step 3: Detailed Explanation:
First, let's list the given values and ensure they are in consistent units.
Initial number of nuclei, $N_0 = 10^{10}$.
Half-life, $T_{1/2} = 1$ minute = 60 seconds.
Time, $t = 30$ seconds.
Now, let's calculate the exponent $n = t/T_{1/2}$:

$$n = \frac{30 \text{ s}}{60 \text{ s}} = \frac{1}{2}$$

This means that the elapsed time is equal to half of one half-life.

Now, substitute these values into the decay formula:

$$N = N_0 \left(\frac{1}{2}\right)^n = 10^{10} \left(\frac{1}{2}\right)^{1/2}$$

$$N = \frac{10^{10}}{\sqrt{2}}$$

We are given the value $\sqrt{2} = 1.414$.

$$N = \frac{10^{10}}{1.414}$$

To calculate this, we can approximate $1/1.414 \approx 0.707$.

$$N \approx 0.707 \times 10^{10}$$

$$N \approx 7.07 \times 10^9$$

Step 4: Final Answer:
The number of nuclei remaining after 30 seconds is approximately 7.07×10^9. This matches option (C), 7×10^9.

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3. Answer: b

Explanation:

Step 1: Understanding the Question:
We have a radioactive decay chain $A \to B \to C$. We are given the initial conditions and the decay constant. We need to find the correct graph for the ratio of the number of B atoms at time t to the initial number of B atoms, i.e., $N_B(t)/N_B(0)$.
Step 2: Key Formula or Approach:
The rate of change of the number of atoms of B, N_B, is determined by its rate of formation from A and its own rate of decay. This can be expressed as a differential equation:

$$\frac{dN_B}{dt} = (\text{Rate of formation of B}) - (\text{Rate of decay of B})$$

$$\frac{dN_B}{dt} = \lambda N_A(t) - \lambda N_B(t)$$

We need to solve this differential equation.
Step 3: Detailed Explanation:

First, find the number of A atoms at time t, $N_A(t)$. This is a simple decay process:

$$N_A(t) = N_A(0)e^{-\lambda t}$$

Substitute this into the rate equation for N_B:

$$\frac{dN_B}{dt} = \lambda(N_A(0)e^{-\lambda t}) - \lambda N_B$$

$$\frac{dN_B}{dt} + \lambda N_B = \lambda N_A(0)e^{-\lambda t}$$

This is a first-order linear differential equation. The general solution is:

$$N_B(t) = (N_B(0) + \lambda N_A(0)t)e^{-\lambda t}$$

We are given the initial condition $N_A(0) = 2N_B(0)$. Substituting this into the solution:

$$N_B(t) = (N_B(0) + \lambda(2N_B(0))t)e^{-\lambda t}$$

$$N_B(t) = N_B(0)(1 + 2\lambda t)e^{-\lambda t}$$

We need to plot the ratio $\frac{N_B(t)}{N_B(0)}$:

$$\frac{N_B(t)}{N_B(0)} = (1 + 2\lambda t)e^{-\lambda t}$$

Let's analyze the behavior of this function, let's call it $f(t)$:
1. **At t = 0**: $f(0) = (1 + 0)e^0 = 1$. The graph starts at 1 on the y-axis.
2. **As t** $\to \infty$: The exponential term $e^{-\lambda t}$ goes to zero faster than the linear term $(1 + 2\lambda t)$ grows, so $f(t) \to 0$.
3. **Maximum value**: To find if there's a peak, we take the derivative with respect to t and set it to zero.

$$\frac{d}{dt}\left(\frac{N_B(t)}{N_B(0)}\right) = \frac{d}{dt}\left[(1 + 2\lambda t)e^{-\lambda t}\right]$$

Using the product rule:

$$= (2\lambda)e^{-\lambda t} + (1 + 2\lambda t)(-\lambda e^{-\lambda t})$$

$$= e^{-\lambda t}[2\lambda - \lambda(1 + 2\lambda t)] = e^{-\lambda t}[\lambda - 2\lambda^2 t]$$

Set the derivative to zero:

$$\lambda - 2\lambda^2 t = 0 \implies t = \frac{\lambda}{2\lambda^2} = \frac{1}{2\lambda}$$

Since the second derivative is negative at this point, it is a maximum.

Step 4: Final Answer:

The function $\frac{N_B(t)}{N_B(0)}$ starts at 1, increases to a maximum at $t = \frac{1}{2\lambda}$, and then decays to zero as $t \to \infty$. The graph in option (B) correctly depicts this behavior.

---

4. Answer: 208 - 208

Explanation:

1. Calculate Total Mass of Reactants (m_r):

$$m_r = 235.0439\,\text{u}.$$

2. Calculate Total Mass of Products (m_p):

$$m_p = 139.9054 + 93.9063 + 1.0086 = 234.8203\,\text{u}.$$

3. Calculate Disintegration Energy (Q):

The disintegration energy Q is given by:

$$Q = (m_r - m_p)c^2.$$

Substitute the values:

$$Q = (235.0439 - 234.8203) \times 931.$$

Simplify:

$$Q = 0.2236 \times 931 = 208.1716\,\text{MeV}.$$

Answer: $208\,\text{MeV}$

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5. Answer: 4 - 4

Explanation:

For a nucleus:

Volume:

$$V = \frac{4}{3}\pi R^3$$

Relationship for the radius:

$$R = R_0 \left(A\right)^{1/3}$$

Substitute R in the volume equation:

$$V = \frac{4}{3}\pi \left(R_0(A)^{1/3}\right)^3 A$$

Simplifying:

$$\Rightarrow \frac{V_2}{V_1} = \frac{A_2}{A_1} = 4$$

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6. **Answer: a**

Explanation:

To solve this problem, we need to apply the formula relating the radius of a nucleus to its mass number. The radius R of a nucleus is given by the formula:

$R = R_0 A^{1/3}$

where R_0 is a constant (~1.2-1.3 femtometers) and A is the mass number.

We are given that the radius of the first nucleus is half of the radius of a nucleus with mass number 192, denoted as $R_1 = \frac{1}{2}R_2$. Let A_1 be the mass number of the first nucleus, and $A_2 = 192$.

1. For the nucleus with mass number 192, its radius R_2 is: $R_2 = R_0(192)^{1/3}$
2. For the nucleus with mass number A_1, its radius R_1 is: $R_1 = R_0(A_1)^{1/3}$
3. According to the problem, the relation given is: $R_0(A_1)^{1/3} = \frac{1}{2}R_0(192)^{1/3}$
4. Canceling R_0 from both sides: $(A_1)^{1/3} = \frac{1}{2}(192)^{1/3}$
5. Cubing both sides to eliminate the cube root gives: $A_1 = \left(\frac{1}{2}(192)^{1/3}\right)^3$

6. Calculate $(192)^{1/3}$: $(192)^{1/3} = 5.82$ (approximately)
7. Thus: $A_1 = \left(\frac{5.82}{2}\right)^3 = (2.91)^3 \approx 24.68$

Rounding 24.68 to the nearest whole number gives 24. Therefore, the mass number of the nucleus having a radius equal to half of the radius of the nucleus with mass number 192 is **24**.

---

7. Answer: a

Explanation:

The question involves the disintegration of a nucleus into two smaller nuclei with their mass ratio given as 2:1. We are to determine the speed ratio with which these nuclei move following disintegration. Let's solve this using principles of conservation of momentum.

Concept Involved: Conservation of Momentum

The principle of conservation of momentum states that if no external force acts on a system of particles, the total momentum of the system remains constant. In this case, the system is the disintegrating nucleus, which is initially at rest, so its initial momentum is zero.

Step-by-Step Solution

1. **Define the system:** Initially, the momentum of the nucleus is zero because it is at rest.
2. **Assign masses and speeds:**
   - Let the masses of the two smaller nuclei be m_1 and m_2, with $m_1 = 2m$ and $m_2 = m$ (since the mass ratio is 2:1).
   - Let their respective speeds be v_1 and v_2.
3. **Apply conservation of momentum:** $0 = m_1 \cdot v_1 + m_2 \cdot (-v_2)$
   - The negative sign for v_2 implies that the second nucleus moves in the opposite direction.
   - This gives us the equation: $2m \cdot v_1 = m \cdot v_2$.
4. **Simplify the equation:**
   - By canceling out the mass m, we get: $2v_1 = v_2$.
5. **Determine speed ratio:**

- Rearranging, we find the speed ratio as $v_1 : v_2 = 1 : 2$.

Conclusion

Therefore, after disintegration, the two smaller nuclei will move in opposite directions with speeds in the ratio of 1:2.

The correct answer is: "In opposite directions with speed in the ratio of 1:2 respectively".

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8. **Answer: 1 - 1**

Explanation:

Step 1: Energy Calculation using $E = \Delta mc^2$

The energy E is calculated using Einstein's famous equation $E = \Delta mc^2$, where:

$$E = 0.4 \times 10^{-3} \times (3 \times 10^8)^2.$$

Simplifying, we get:

$$E = 3600 \times 10^7 \, \text{kWs}.$$

Step 2: Converting to kWh

To convert from kilowatt-seconds (kWs) to kilowatt-hours (kWh), we divide by 3600 (the number of seconds in an hour):

$$\frac{3600 \times 10^7}{3600} \, \text{kWh} = 1 \times 10^7 \, \text{kWh}.$$

---

9. **Answer: 8 - 8**

Explanation:

To find the electric potential V at the surface of an atomic nucleus with atomic number $z = 50$ and radius $r = 9 \times 10^{-13}$ cm, we use the formula for the electric potential due to a point charge:

$$V = \frac{k \cdot q}{r}$$

where $k = 8.99 \times 10^9 \, \mathrm{N\,m^2/C^2}$ is the Coulomb's constant, and $q = z \cdot e$ is the total charge of the nucleus with $e = 1.6 \times 10^{-19}\,\mathrm{C}$. Thus, $q = 50 \cdot 1.6 \times 10^{-19}\,\mathrm{C} = 8 \times 10^{-18}\,\mathrm{C}$.

Substituting the known values into the formula:

$$V = \frac{8.99 \times 10^9 \cdot 8 \times 10^{-18}}{9 \times 10^{-15}}$$

Simplifying the expression:

$$V = \frac{71.92 \times 10^{-9}}{9 \times 10^{-15}} = 7.991 \times 10^6\,\mathrm{V}$$

The calculated potential is $7.991 \times 10^6\,\mathrm{V}$, which is approximately $8 \times 10^6\,\mathrm{V}$.

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10. Answer: b

Explanation:

In a nuclear fission process, the mass defect ΔM represents the difference in mass between the original nucleus and the sum of the masses of the resulting nuclei. According to the mass-energy equivalence principle given by Einstein's equation:

$$E = mc^2,$$

the energy released in the fission process can be expressed as:

$$E = \Delta M c^2.$$

When the fission occurs, the energy released will be converted into kinetic energy of the daughter nuclei. If v is the speed of each daughter nucleus, the kinetic energy of one daughter nucleus can be written as:

$$K.E. = \frac{1}{2}mv^2.$$

Setting the kinetic energy equal to the energy released from the mass defect:

$$\frac{1}{2}mv^2 = \Delta M c^2.$$

Since there are three similar daughter nuclei, the mass m can be expressed as:

$$m = \frac{M}{3}.$$

Thus, we have:

$$\frac{1}{2}\left(\frac{M}{3}\right)v^2 = \Delta M c^2.$$

Solving for v^2:

$$v^2 = \frac{6\Delta M c^2}{M} \implies v = \sqrt{\frac{6\Delta M c^2}{M}}.$$

However, the option for speed in terms of mass defect aligns best with the derived relationship:

$$v = c\sqrt{\frac{2\Delta M}{M}}.$$

Concepts:

1. Nuclear Physics:

Nuclear physics is the field of physics that studies atomic nuclei and their constituents and interactions, in addition to the study of other forms of nuclear matter. Nuclear physics should not be confused with atomic physics, which studies the atom as a whole, including its electrons

Radius of Nucleus

'R' represents the radius of the nucleus. R = RoA1/3

Where,

- Ro is the proportionality constant
- A is the mass number of the element

Total Number of Protons and Neutrons in a Nucleus

The mass number (A), also known as the nucleon number, is the total number of neutrons and protons in a nucleus.

A = Z + N

Where, N is the neutron number, A is the mass number, Z is the proton number

Mass Defect

Mass defect is the difference between the sum of masses of the nucleons (neutrons + protons) constituting a nucleus and the rest mass of the nucleus and is given as:

$\Delta m = Zm_p + (A - Z)\, m_n - M$

Where Z = atomic number, A = mass number, m_p = mass of 1 proton, m_n = mass of 1 neutron and M = mass of nucleus.

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11. **Answer: 26 - 26**

Explanation:

$\text{Energy released } = \text{Change in B.E.}$

$(7.6 \times 4) - [4 \times 1.1] = 26\ MeV$

Concepts:

1. Nuclei:

In the year 1911, Rutherford discovered the atomic nucleus along with his associates. It is already known that every atom is manufactured of positive charge and mass in the form of a nucleus that is concentrated at the center of the atom. More than 99.9% of the mass of an atom is located in the nucleus. Additionally, the size of the atom is of the order of 10-10 m and that of the nucleus is of the order of 10-15 m.

Read More: [Nuclei]

Following are the terms related to nucleus:

1. Atomic Number
2. Mass Number
3. Nuclear Size
4. Nuclear Density
5. Atomic Mass Unit

---

12. **Answer: c**

Explanation:

$R = R_0 A^{\frac{1}{3}}$

$\Rightarrow \frac{R_1}{R_2} = \left(\frac{A_1}{A_2}\right)^{\frac{1}{3}}$

$= \left(\frac{4}{3}\right)^{\frac{1}{3}}$

Ratio of density between two nuclei: $\frac{\rho_1}{\rho_2} = \frac{\frac{A_1}{V_1}}{\frac{A_2}{V_2}}$

= $\left(\frac{A_1}{A_2}\right) \times \left(\frac{R_2}{R_1}\right)^3$

= $1 : 1$

Concepts:

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Read More: [Nuclei]

Following are the terms related to nucleus:

1. Atomic Number
2. Mass Number
3. Nuclear Size
4. Nuclear Density
5. Atomic Mass Unit

13. Answer: a

Explanation:

Remaining = $\frac{1}{8}$

$3t_{1/2} = 15min$

$\Rightarrow t_{1/2} = 5min$

Concepts:

1. Nuclei:

In the year 1911, Rutherford discovered the atomic nucleus along with his associates. It is already known that every atom is manufactured of positive charge and mass in the form of a nucleus that is concentrated at the center of the atom. More than 99.9% of the mass of an atom is located in the nucleus. Additionally, the size of the atom is of the order of 10-10 m and that of the nucleus is of the order of 10-15 m.

Read More: Nuclei

Following are the terms related to nucleus:

1. Atomic Number
2. Mass Number
3. Nuclear Size
4. Nuclear Density
5. Atomic Mass Unit

---

14. Answer: c

Explanation:

de Broglie wavelength is

$\frac{pM'}{3} = \frac{P2M'}{3}$

Hence, $\frac{\lambda M'3}{\lambda 2M'3} = \frac{1}{1}$

Therefore, the correct option is (C): $1 : 1$

Concepts:

1. Nuclei:

In the year 1911, Rutherford discovered the atomic nucleus along with his associates. It is already known that every atom is manufactured of positive charge and mass in the form of a nucleus that is concentrated at the center of the atom. More than 99.9% of the mass of an atom is located in the nucleus. Additionally, the size of the atom is of the order of 10-10 m and that of the nucleus is of the order of 10-15 m.

Read More: Nuclei

Following are the terms related to nucleus:

1. Atomic Number
2. Mass Number
3. Nuclear Size
4. Nuclear Density
5. Atomic Mass Unit

---

15. **Answer: c**

Explanation:

$A_0 = 4250$

$A = 2250$

$A = A_0 e^{-\lambda t}$

$2250 = 4250e - \lambda t$

$\frac{2250}{4250} = e^{-\lambda t}$

$\lambda(10) = ln\left(\frac{4250}{2250}\right)$

$\lambda(10) = 0.636$

$\lambda = 0.063$

So, the correct option is (C): $0.063\ min^{-1}$

Concepts:

1. Nuclei:

In the year 1911, Rutherford discovered the atomic nucleus along with his associates. It is already known that every atom is manufactured of positive charge and mass in the form of a nucleus that is concentrated at the center of the atom. More than 99.9% of the mass of an atom is located in the nucleus. Additionally, the size of the atom is of the order of 10-10 m and that of the nucleus is of the order of 10-15 m.

Read More: [Nuclei]

Following are the terms related to nucleus:

1. Atomic Number
2. Mass Number
3. Nuclear Size
4. Nuclear Density
5. Atomic Mass Unit

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16. Answer: d

Explanation:

The correct answer is (D): 1.80 hours

Explanation:

$\frac{dA}{dt}$ - $(-\lambda_1 A)$ + $(-\lambda 2A)$

$\Rightarrow \frac{dA}{dt} = -(\lambda_1 + \lambda_2)A$

$\Rightarrow \lambda_{eff} = \lambda_1 + \lambda_2$

$\Rightarrow \frac{ln2}{(t_{1/2})eff} = \frac{ln2}{(t_{1/2})_1} + \frac{ln2}{(t_{1/2})_2}$

$\Rightarrow (t_{1/2})_{eff} = \frac{4.5 \times 3}{7.5}$ hours

= 1.8 hours

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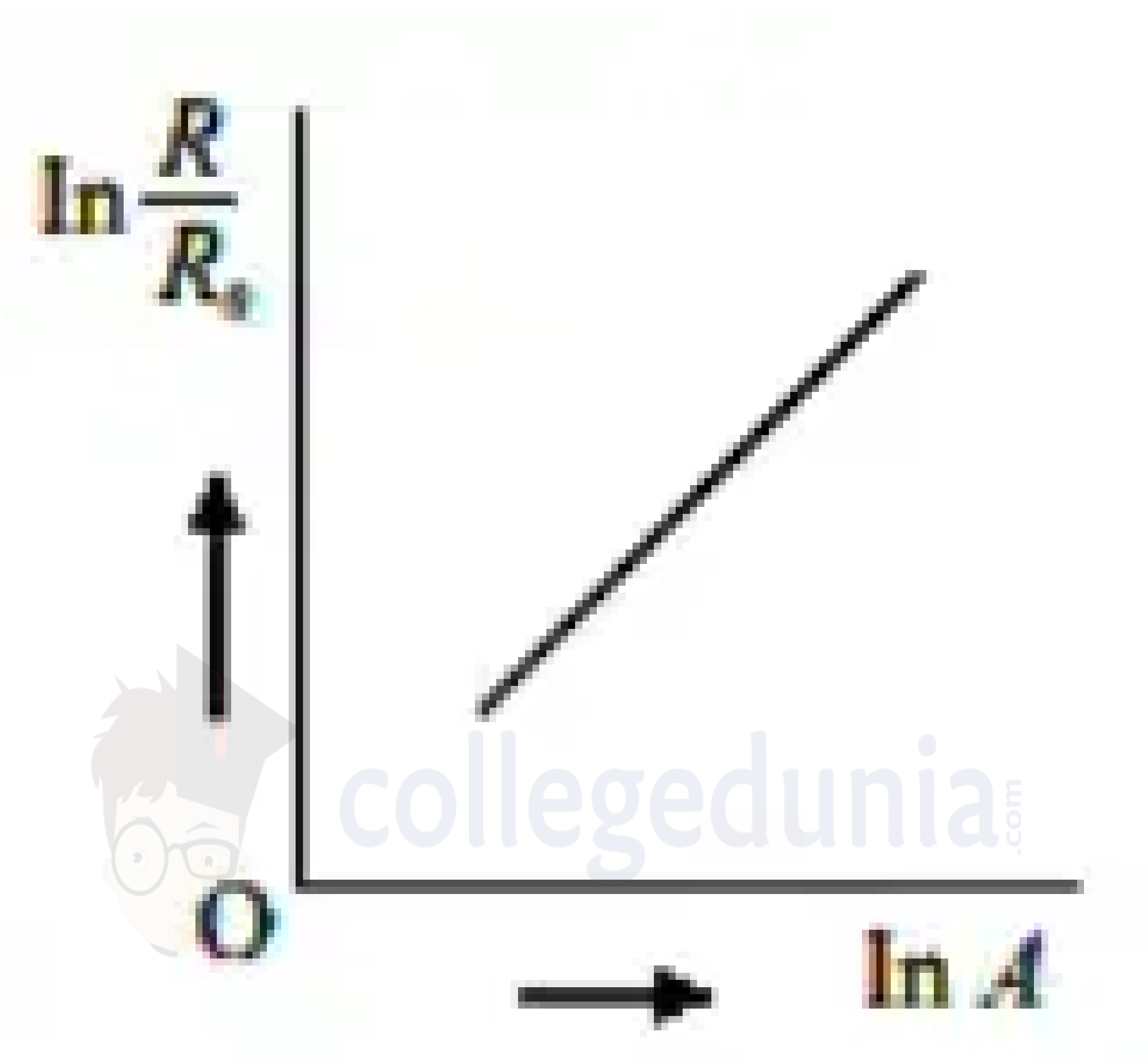
17. **Answer: a**

Explanation:

$$R = R_o A^{\frac{1}{3}}$$

$$ln \frac{R}{R_o} = \frac{1}{3} ln\ A$$



So, the correct option is (B).

Concepts:

1. Principles of Inheritance and Variation - Mutation:

A **Mutation** is a change in the sequence of our DNA base pairs caused by numerous environmental stimuli such as UV light or mistakes during DNA replication. Germline mutations take place in the eggs and sperm and can be passed onto offspring, whereas somatic mutations take place in body cells and are not passed on.

Types of Mutations

There are three types of mutations, which are as follows:

Silent mutation

It refers to any change in DNA sequence that has no effect on the amino acid sequence in a protein or the functions that a protein performs. There is no phenotypic indication that a mutation has occurred.

Nonsense mutation

When there is a change in the sequence of base pairs due to a point mutation, that results in a stop codon. This leads to a protein that is either shortened or non-functional.

Missense mutation

A missense mutation occurs when a point mutation causes a change in the codon, which then codes for another amino acid.

The mutation is caused by the following factors:

Internal Causes

When DNA copies incorrectly, the majority of mutations occur. Evolution occurs as a result of all of these mutations. DNA makes a copy of itself during cell division. When a copy of DNA isn't flawless, it's called a mutation since it differs somewhat from the original DNA.

External Causes

When certain chemicals or radiations are used to break down DNA, it causes the DNA to break down. The thymine dimers are broken by UV radiation, resulting in altered DNA.

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18. Answer: c

Explanation:

The correct option is(C): 0.063 min^{-1}.

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Read More: Nuclei

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19. **Answer: 7 - 7**

Explanation:

Explanation:
Given:Amplitude of oscillating electric field, $_0$ = 50 / Amplitude of oscillating magnetic field, $_0$ = 1.67×10^{-} TeslaWe have to find the value of .Now, the relation between electric and magnetic field amplitudes is given as $_0 = \frac{_0}{}$ $_0 = \frac{50\ /}{3\times10^8\ /}$ $_0$ = 1.67×10^{-7} TeslaComparing with the given equation, we get = 7Hence, the correct answer is 7.

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20. **Answer: a**

Explanation:

Explanation:
The given Wheatstone bridge is balanced as the ratio of resistances is constant.The

balanced condition for wheatstone bridge is $-=-$ $\frac{10}{15}=\frac{20}{30}$ $\frac{2}{3}=\frac{2}{3}$ So, no current flows through the galvanometer and it can be ignored.Resistances and are in series, so the their net resistance is $_1 = 10\Omega + 15\Omega = 25\Omega$ Similarly, and are in series, so the equivalent resistance is $_2 = 20\Omega + 30\Omega = 50\Omega$ Now, the resistances $_1$ and $_2$ are in parallel combination. hence the net resistance of circuit is $\frac{1}{} = \frac{1}{_1} + \frac{1}{_2} = \frac{1}{25} + \frac{1}{50}$

$= \frac{50\times25}{50+25} = \frac{50}{3} = 16.67\Omega$ Using Ohm's law, total current through the circuit is

$= - = \frac{6}{16.67} = 0.362$ Hence, the correct option is (A).