



## PHYSICS

### BOOKS - NCERT PHYSICS (HINGLISH)

# SEMICONDUCTOR ELECTRONICS: MATERIAL, DEVICES AND SIMPLE CIRCUIT

## Semiconductor Electronics Material Devices And Simple Circuit

1. The conductivity of a semiconductor increases with increase in temperature because

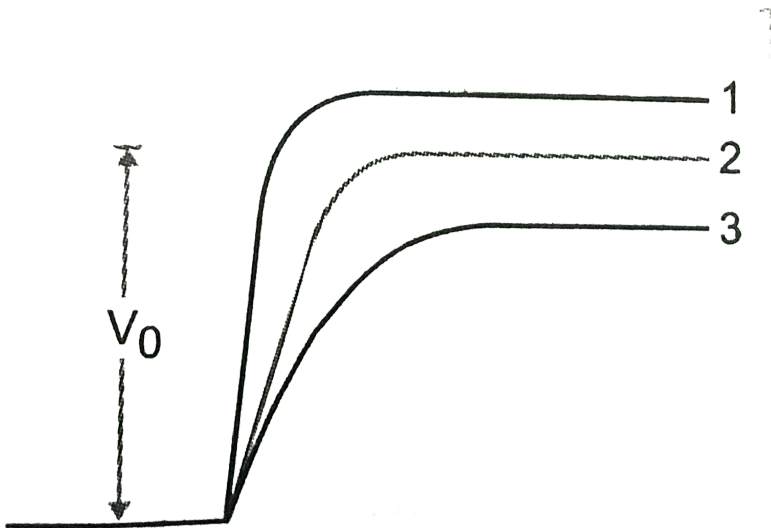
- A. number density of free current increase
- B. relaxation time increases
- C. both number density of carries and relaxation time increase

D. number density of carries increases relaxation time decreases but effect of decrease in relaxation time is much less than increase in number density

Answer: d

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2. In Fig .  $V_0$  is the potential barrier across a p-n junction, when no battery is connected across the junction



A. 1 and 3 both correspond to forward bias of junction

B. 3 corresponds to forward bias of junction and 1 corresponds to reverse bias of junction

C. 1 corresponds to forward bias and 3 corresponds to reverse bias of junction

D. 3 and 1 both correspond to reverse bias of junction

**Answer: b**



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3. When a nucleus in an atom undergoes a radioactive decay, the electronic energy levels of the atom.

A. do not change for any type of radioactivity

B. change for  $\alpha$  and  $\beta$  – radioactivity but not for  $\gamma$  – radioactivity

C. change for  $\alpha$  – radioactivity but not for other

D. change for  $\beta$  – radioactivity but not for other

**Answer: b**



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4.  $M_x$  and  $M_y$  denote the atomic masses of the parent and the daughter nuclei respectively in a radioactive decay. The  $Q$  - value for a  $\beta^-$  decay is  $Q_1$  and that for a  $\beta^+$  decay is  $Q_2$ . If  $m_e$  denotes the mass of an electron, then which of the following statements is correct?

A.  $Q_1 = (M_x - M_y)c^2$  and  $Q_2 = [M_x - M_y - 2m_e]c^2$

B.  $Q_1 = (M_x - M_y)c^2$  and  $Q_2 = (M_x - M_y)c^2$

C.  $Q_1 = (M_x - M_y)c^2$  and  $Q_2 = (M_x - M_y + 2m_e)c^2$

D.  $Q_1 = (M_x - M_y + 2m_e)c^2$  and  $Q_2 = (M_x - m_y + 2m_e)c^2$

**Answer: a**



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5. Tritium is an isotope of hydrogen whose nucleus triton contains 2 neutrons and 1 proton . Free neutrons decay into  $p + \bar{e} + \bar{\nu}$ . If one of the neutrons in Triton decays , it would transform into  $He^3$  nucleus. This does not happen. This is because

A. Triton energy is than that of  $He^3$  nucleus

B. the electron created in the beta decay process cannot remain in the nucleus

C. both the neutons in triton have to decay simulataneously resulting in a nucleus with 3 protons which is not a  $He^3$  nucleus.

D. Free neutrons decay due to external perturbations which is absent in triton nucleus

**Answer: a**



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6. Heavy stable nuclei have more neutrons than protons. This is because of the fact that

- A. neutrons are heavier than protons
- B. electrostatic force between protons are repulsive
- C. neutrons decay into protons through beta decay
- D. nuclear forces between neutrons are weaker than that between protons

**Answer: b**



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7. In a nuclear reactor, moderators slow down the neutrons which come out in a fission process. The moderator used have light nuclei. Heavy nuclei will not serve the purpose because

- A. they will break up

B. elastic collision of neutrons with heavy nuclei will not slow them down

C. the net weight of the reactor would be unbearably high

D. substances with heavy nuclei do not occur in liquid or gaseous state at room temperature

**Answer: b**



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8. Fusion processes, like combining two deuterons to form a  $He$  nucleus are impossible at ordinary temperature and pressure. The reasons for this can be traced to the fact:

A. nuclear forces have short range

B. nuclei are positively charged

C. the original nuclei must be completely ionized before fusion can take place

D. the original nuclei must first break up before combining with each other

**Answer: a,b**

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9. Sample of two radioactive nuclides  $A$  and  $B$  are taken.  $\lambda_A$  and  $\lambda_B$  are the disintegration constants of  $A$  and  $B$  respectively. In which of the following cases, the two sample can simultaneously have the same decay rate at any time ?

A. initial rate of decay of  $A$  is twice the initial rate of decay of  $B$  and

$$\lambda_A = \lambda_B$$

B. initial rate of decay of  $A$  is twice the initial rate of decay of  $B$  and

$$\lambda_A > \lambda_B$$

C. Initial rate of decay of  $B$  is twice the initial rate of decay of  $A$  and

$$\lambda_A > \lambda_B$$



D. Initial rate of decay of B is same as the rate of decay of A at  $t = 2h$

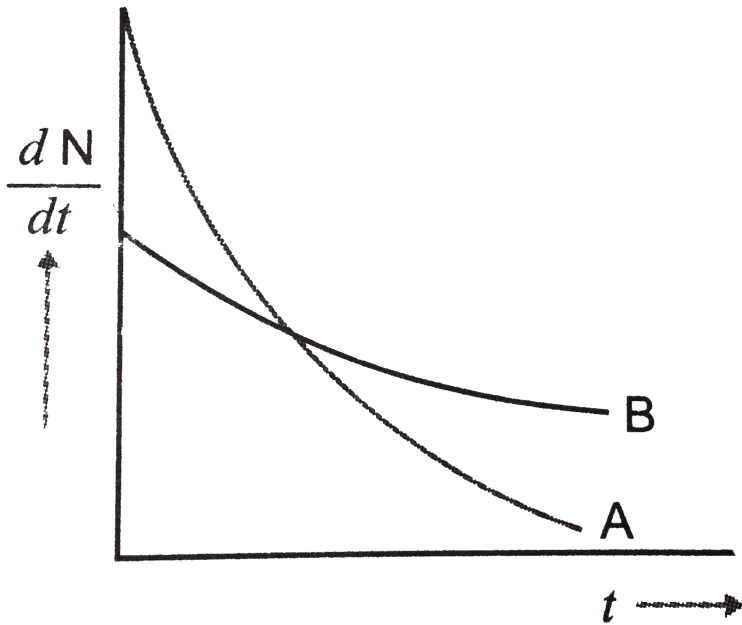
and  $\lambda_B < \lambda_A$

**Answer: b,d**



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**10.** The variation of decay rate of two radioactive samples A and B with time is shown in fig.



Which of the following statements are true?

- A. Decay constant of A is greater than that of B hence A always decays faster than B
- B. Decay constant of B is greater than that of A but its decay rate is always smaller than that of A
- C. Decay constant of A is greater than that of B but it does not always decay faster than B

D. Decay constant of B is smaller than that of A but still its decay rate becomes equal to that of A at a later instant

**Answer: c,d**

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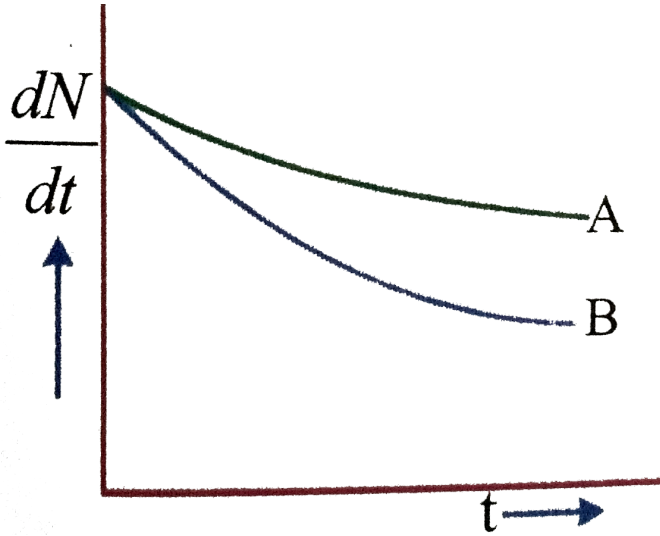
11.  $He_2^3$  and  $He_1^3$  nuclei have the same mass number. Do they have the same binding energy ?

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12. Draw a graph showing the variation of decay rate with number of active nuclei.

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13. Which sample *A* or *B* shown in figure has shorter mean-life ?



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14. Which one of the following cannot emit radiation and why ? Excited nucleus excited electron.

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15. In pair annihilation an electron and a positron destroy each other to produce gamma radiations . How is the momentum conserved ?



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16. Why do stable nuclei never have more protons than neutrons ?



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17. Consider a radioactive nucleus A which decays to a stable nucleus C through the following sequence



Here B is an intermediate nuclei which is also radioactive. Considering that there are  $N_0$  atoms of A initially , plot the graph showing the variation of number of atoms of A and B versus time.



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18. A piece of wood from the ruins of an ancient building was found to have a  $C^{14}$  activity of 12 disintegrations per minute per gram of its carbon content. The  $C^{14}$  activity of the living wood is 16

disintegrations/minute/gram. How long ago did the trees, from which the wooden sample came, die? Given half-life of  $C^{14}$  is 5760 years.

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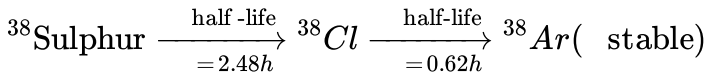
**19.** Are the nucleons fundamental particles or do they consist of still smaller parts? One way to find out is to probe a nucleon just as Rutherford probed an atom. What should be the kinetic energy of an electron for it to be able to probe a nucleon? Assume the diameter of a nucleon to be approximately  $10^{-15} m$ .

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**20.** A nuclide 1 is said to be the mirror isobar of nuclide 2 if  $Z_1 = N_2$  and  $Z_2 = N_1$ . (a) What nuclide is a mirror isobar of  ${}_{11}^{23}\text{Na}$ ? (b) Which nuclide out of the two mirror isobars has greater binding energy and why?

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21. Sometimes a radioactive nucleus decays into a nucleus which itself is radioactive . An example is



Assume that we start with  $1000 {}^{38}\text{S}$  nuclei at time  $t=0$ . the number of  ${}^{38}\text{Cl}$  of count zero at  $t=0$  and will again be zero at  $t = \infty$ . At what value of  $t$ , would the number of counts be a maximum?

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22. Deuteron is a bound state of a neutron and a proton with a binding energy  $B = 2.2\text{MeV}$ . A  $\gamma$ -ray of energy  $E$  is aimed at a deuteron nucleus to try to break it into a (neutron +proton) such that the n and p move in the direction of the incident  $\gamma$ -rays. If  $E=B$ , show that this can not happen. Hence, calculate how much bigger than  $B$  must  $E$  be for such a process to happen.

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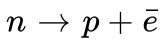
23. The deuteron is bound by nuclear forces just as H-atom is made up of p and e bound by electrostatic forces. If we consider the forces between neutron and proton in deuteron as given in the form of a Coulomb force but with an effective charge  $e'$ :  $F = \frac{1}{4\pi\epsilon_0} \frac{e'^2}{r^2}$

estimate the value of  $(e' / e)$  given that the following binding energy of a deuteron is 2.2MeV.



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24. Before the neutrino hypothesis the beta decay process was thought to be the transition.



If this was true show that if the neutron was at rest the proton and electron would emerge with fixed energies and calculate them.

Experimentally the electron energy was found to have a large range.



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25. The activity  $R$  of an unknown radioactive nuclide is measured at hourly intervals. The results found are tabulated as follows

$t(\text{h})$	0	1	2	3	4
$R(\text{MBq})$	100	35.36	12.51	4.42	1.56

- (i) Plot the graph of  $R$  versus  $t$  and calculate half-life from the graph.
- (ii) Plot the graph of  $\ln \left( \frac{R}{R_0} \right)$  versus  $t$  and obtain the value of half-life from the graph.

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26. Nuclei with magic no. of proton  $Z=2,8,20,28,50,52$  and magic no. of neutrons  $N=2,8,20,28,50,82$  and 126 are found to be stable. (i) Verify this by calculating the proton separation energy  $S_p$  for  $^{120}\text{Sn}(Z=50)$  and  $^{121}\text{Sb}(Z=51)$ .

The proton separation energy for a nuclide is the minimum energy required to separate the least tightly bound proton from a nucleus of that nuclide. It is given by

$$S_p = (M_{Z-1,N} + M_H - M_{Z,N})c^2.$$

given

$$.^{119}Sn_{49} = 118.9058u, .^{120}Sn_{50} = 119.902199u, .^{121}Sb_{51} = 120.903824u, .^{122}Te_{52} = 121.9034u$$

(ii) what does the existence of magic number indicate?



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