Topic : Modern Physics and Semiconductor

1. The stopping potential for electrons emitted from a photosensitive surface illuminated by light of wavelength $491\ \mathrm{nm}$ is $0.710\ \mathrm{V}$. When the incident wavelength is changed to a new value, the stopping potential is $1.43\ \mathrm{V}$. The new wavelength is:

A. $400\ \mathrm{nm}$

B. $382\ \mathrm{nm}$

C. $309\ \mathrm{nm}$

D. $329\ \mathrm{nm}$

From the photoelectric effect equation,

$$\frac{hc}{\lambda} = \phi + eV_s$$

where eV_s is the stopping potential and ϕ is the work function of the metal.

So, $eV_{s_1} = \frac{hc}{\lambda_1} - \phi$ ....(i)

$eV_{s_2} = \frac{hc}{\lambda_2} - \phi$ ....(ii)

Subtract equation (i) from equation (ii),

$$eV_{s_1} - eV_{s_2} = \frac{hc}{\lambda_1} - \frac{hc}{\lambda_2}$$

$$V_{s_1} - V_{s_2} = \frac{hc}{e}\left(\frac{1}{\lambda_1} - \frac{1}{\lambda_2}\right)$$

$$0.710 - 1.43 = 1240\left(\frac{1}{491} - \frac{1}{\lambda_2}\right)$$

because $hc = 1240\ \mathrm{eV\text{-}nm}$

On solving this, we get,

$\lambda_2 \approx 382\ \mathrm{nm}$

2. An electron of mass m_e and a proton of mass m_p , where $m_p = 1836\ m_e$ are moving with the same speed . The ratio of their de Broglie wavelength i.e $\frac{\lambda_{\text{electron}}}{\lambda_{\text{proton}}}$ will be :

A. 918

B. 1836

C. 1

D. $\frac{1}{1836}$

Given , Mass of electron $= m_e$
Mass of proton $= m_p$
Also , $m_p = 1836\ m_e$

de Broglie wavelength , $\lambda = \frac{h}{mv}$

$$\frac{\lambda_e}{\lambda_p} = \frac{m_p}{m_e} \qquad [\because \text{The speed is same}]$$

$$\frac{\lambda_e}{\lambda_p} = \frac{1836\ m_e}{m_e} = 1836$$

So , the option (b) is correct .

3. The de-Broglie wavelength of a proton and α-particle are equal. The ratio of their velocities is:

A. $4:2$

B. $4:1$

C. $1:4$

D. $4:3$

From de-Broglie wavelength:

$$\lambda = \frac{h}{mv}$$

$$\Rightarrow v = \frac{h}{\lambda m}$$

We get,

$$\frac{v_p}{v_\alpha} = \frac{m_\alpha}{m_p}$$

As we know, $m_\alpha = 4m_p$

$$\therefore \frac{v_p}{v_\alpha} = \frac{4m_p}{m_p} = \frac{4}{1} = 4:1$$

4. Given below are two statements :

Statement - I : Two photons having equal linear momenta have equal wavelengths.

Statement - II : If the wavelength of a photon is decreased, then its momentum and energy will also decrease.

In the light of the above statements, choose the correct answer from the options given below.

A. Statement - I is false, but Statement - II is true.

B. Both Statement - I and Statement - II are true.

C. Both Statement - I and Statement - II are false.

D. Statement - I is true, but Statement - II is false.

The energy of a photon is given by :

$$E = \frac{hc}{\lambda}$$

$$\Rightarrow E \propto \frac{1}{\lambda}$$

Also, momentum, $p = \frac{\mathrm{E}}{\mathrm{c}}$

$$\Rightarrow p \propto E$$

$$\therefore p \propto E \propto \frac{1}{\lambda}$$

$\Rightarrow$ Two photons having equal linear momenta have equal wavelengths.

$\Rightarrow$ If the wavelength of a photon is decreased, then its momentum and energy will increase.

Hence, option (D) is correct.

5. The de-Broglie wavelength associated with an electron and a proton were calculated by accelerating them through same potential of $100 \mathrm{~V}$. What should nearly be the ratio of their wavelengths?
$(m_p = 1.00727u,\ m_e = 0.00055u)$

A. $(1860)^2 : 1$

B. $43 : 1$

C. $1860 : 1$

D. $41.4 : 1$

De-broglie wavelength is given as:

$$\lambda = \frac{h}{\sqrt{2mqV}}$$

Since magnitude of charge (q) and potential difference (V) through which they are accelerated is same.

$$\frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_p}{m_e}} = \sqrt{\frac{1.00727}{0.00055}}$$

$$\frac{\lambda_e}{\lambda_p} = \sqrt{1831} \simeq 43$$

6. An electron of mass m and a photon have the same energy E. The ratio of wavelength of electron to that of photon is -

$[c =$ speed of light$]$

A. $\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

B. $\frac{1}{c}\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

C. $c(2mE)^{\frac{1}{2}}$

D. $\frac{1}{c}\left(\frac{2m}{E}\right)^{\frac{1}{2}}$

For electron,

$$\lambda_e = \frac{h}{\sqrt{2mE}} \quad \ldots(1)$$

For photon,

$$\lambda_p = \frac{hc}{E} \quad \ldots(2)$$

So,

$$\frac{\lambda_e}{\lambda_p} = \frac{\frac{h}{\sqrt{2mE}}}{\frac{hc}{E}} \quad [\text{From (1) and (2)}]$$

$$\Rightarrow \frac{\lambda_e}{\lambda_p} = \sqrt{\frac{E}{2mc^2}} = \frac{1}{c}\left(\frac{E}{2m}\right)^{\frac{1}{2}}$$

7. A particle is travelling 4 times as fast as an electron. Assuming the ratio of de-Broglie wavelength of a particle to that of electron is $2:1$, the mass of the particle is:

A. $\frac{1}{16}$ times of mass of e^-

B. 16 times of mass of e^-

C. $\frac{1}{8}$ times of mass of e^-

D. 8 times of mass of e^-

De-broglie wavelength, $\lambda = \frac{h}{p} = \frac{h}{mv}$

Let λ_p and λ_e be the wavelength of particle and electron respectively.

$$\Rightarrow \frac{\lambda_p}{\lambda_e} = \frac{\frac{h}{m_p v_p}}{\frac{h}{m_e v_e}} = \frac{m_e v_e}{m_p v_p}$$

$$\Rightarrow \frac{2}{1} = \frac{m_e}{m_p} \times \frac{v_e}{4v_e}$$

$$\Rightarrow m_p = \frac{m_e}{8}$$

So mass of the particle is $\frac{1}{8}$ times the mass of electron.

8. The speed of electrons in a scanning electron microscope is $1 \times 10^7 \mathrm{~ms}^{-1}$. If the protons having the same speed are used instead of electrons, then the resolving power of the scanning proton microscope will be changed by a factor of :

A. $\frac{1}{\sqrt{1837}}$

B. $\sqrt{1837}$

C. 1837

D. $\frac{1}{1837}$

We know that Resolving Power (RP) of a microscope, $RP \propto \frac{1}{\lambda}$

Also, $\lambda = \frac{h}{p} = \frac{h}{mv}$

So, $\lambda \propto \frac{1}{m}$ (For same speed)

Hence, $RP \propto m$

$\therefore \frac{RP_p}{RP_e} = \frac{m_p}{m_e} = \frac{1.673 \times 10^{-27}}{9.109 \times 10^{-31}} = 1836.6 \approx 1837$

9. A nucleus of mass M emits γ-ray photon of frequency ν. The loss of internal energy by the nucleus is :

Take c as the speed of electromagnetic wave.

A. $h\nu$

B. 0

C. $h\nu\left[1-\frac{h\nu}{2Mc^2}\right]$

D. $h\nu\left[1+\frac{h\nu}{2Mc^2}\right]$

Energy of γ-ray, $E_\gamma = h\nu$

Momentum of γ-ray, $p_\gamma = \frac{h}{\lambda} = \frac{h\nu}{c}$

As, the total momentum is conserved.

$$\overrightarrow{p_\gamma} + \overrightarrow{p_n} = 0$$

$$\Rightarrow \left|\overrightarrow{p_\gamma}\right| = \left|\overrightarrow{p_n}\right|$$

$$\Rightarrow \frac{h\nu}{c} = p_n$$

Further, KE of nuclei,

$$KE_n = \frac{1}{2}Mv^2 = \frac{p_n^2}{2M} = \frac{1}{2M}\left[\frac{h\nu}{c}\right]^2$$

Now, loss in internal energy,

$$\Delta E = E_\gamma + KE_n$$

$$\Rightarrow \Delta E = h\nu + \frac{1}{2M}\left[\frac{h\nu}{c}\right]^2$$

$$\Rightarrow \Delta E = h\nu\left[1+\frac{h\nu}{2Mc^2}\right]$$

Hence, option (D) is the correct answer.

10. The radiation corresponding to $3 \rightarrow 2$ transition of a hydrogen atom falls on a gold surface to generate photoelectrons. These electrons are passed through a magnetic field of 5×10^{-4} T. Assume that the radius of the largest circular path followed by these electrons is 7 mm, the work function of the metal is :

Mass of electron $= 9.1 \times 10^{-31}$ kg

- **A.** 1.36 eV
- **B.** 1.88 eV
- **C.** 0.16 eV
- **D.** 0.82 eV ✓

For hydrogen, energy of an electron in n^{th} orbit is given by,

$$E_n = \frac{E_1}{n^2}$$

Where, $E_1 = -13.6$ eV

-1.51 eV ———— n=3

-3.40 eV ———— n= 2

-13.6 eV ———— n=1

Now, $r = \frac{mv}{qB} \Rightarrow mv = p = qrB$

And, $E = \frac{p^2}{2m} = \frac{(qrB)^2}{2m}$

$$E = \frac{(1.6 \times 10^{-19} \times 7 \times 10^{-3} \times 5 \times 10^{-4})^2}{2 \times 9.1 \times 10^{-31}}$$

$$E = 1.72 \times 10^{-19} \text{ J} = 1.075 \text{ eV}$$

The work function is given by,

$$\phi = E_0 - E = [-1.51 - (-3.40)] - 1.075 \approx 0.82 \text{ eV}$$

Hence, option (D) is the correct answer.

11. Two radioactive substances X and Y originally have N_1 and N_2 nuclei, respectively. The half-life of X is half of the half-life of Y. After three half-lives of Y, numbers of nuclei of both are equal, the ratio $\frac{N_1}{N_2}$ will be equal to :

A. $\frac{8}{1}$

B. $\frac{1}{8}$

C. $\frac{3}{1}$

D. $\frac{1}{3}$

We know that, after n half-life, number of nuclei undecayed,

$$N = \frac{N_o}{2^n}$$

Given:

$$T_{1/2} \text{ of X} = \frac{1}{2} T_{1/2} \text{ of Y}$$

$$\Rightarrow T_{1/2} \text{ of Y} = 2\, T_{1/2} \text{ of X}$$

$$\Rightarrow 3\, T_{1/2} \text{ of Y} = 6\, T_{1/2} \text{ of X}$$

$$\therefore \frac{N_2}{2^3} = \frac{N_1}{2^6}$$

$$\Rightarrow \frac{N_1}{N_2} = \frac{8}{1}$$

12. A radioactive sample is undergoing $\alpha-$decay. At any time t_1, its activity is A and at another time t_2, the activity is $A/5$. What is the average life-time for the sample?

A. $\dfrac{t_2 - t_1}{\ln 5}$

B. $\dfrac{\ln(t_2 - t_1)}{2}$

C. $\dfrac{t_1 - t_2}{\ln 5}$

D. $\dfrac{\ln 5}{t_2 - t_1}$

For activity of radioactive sample,

$A = A_o e^{-\lambda t_1} \quad \ldots(1)$, and,

$\dfrac{A}{5} = A_o e^{-\lambda t_2} \quad \ldots(2)$

Dividing equation (1) by (2), we get,

$5 = e^{\lambda(t_2 - t_1)}$

$\Rightarrow \ln 5 = \lambda(t_2 - t_1)$

$\Rightarrow \lambda = \dfrac{\ln 5}{t_2 - t_1}$

Now, average life-time,

$t_{\text{av}} = \dfrac{1}{\lambda} = \dfrac{t_2 - t_1}{\ln 5}$

13. Calculate the time interval between 33% decay and 66% decay if half-life of a substance is 20 minutes:

A. 40 minutes

B. 20 minutes

C. 60 minutes

D. 13 minutes

We know that,

$$N_t = N_0 e^{-\lambda t}$$

$$\Rightarrow ln\left(\frac{0.66}{N_0}\right) = -\lambda t_1 \quad ...(1)$$

and $ln\left(\frac{0.33}{N_0}\right) = -\lambda t_2 \quad ...(2)$

Equation (1) $-$ Equation (2):

$$\Rightarrow \lambda(t_2 - t_1) = ln\left(\frac{0.66}{0.33}\right) = ln2$$

$$\Rightarrow t_2 - t_1 = \frac{ln2}{\lambda} = t_{1/2} = 20 \text{ min}$$

14. The half-life of Au^{198} is 2.7 days. The activity of $1.50\ \mathrm{mg}$ of Au^{198}, if its atomic weight is $198\ \mathrm{g\ mol^{-1}}$is:
$(N_A = 6 \times 10^{23}/\mathrm{mol})$.

A. $252\ \mathrm{Ci}$

B. $357\ \mathrm{Ci}$

C. $240\ \mathrm{Ci}$

D. $535\ \mathrm{Ci}$

Activity is given as:

$$A = \lambda N$$

$$A = \frac{ln2}{T_{1/2}} \times \frac{1.5 \times 10^{-3}}{198} \times 6 \times 10^{23}\ \mathrm{decay/s}$$

$$A = \frac{0.693}{2.7 \times 24 \times 3600} \times \frac{1.5 \times 10^{-3}}{198} \times \frac{6 \times 10^{23}}{3.7 \times 10^{10}}\mathrm{Ci}$$

$$A = 365\ \mathrm{Ci}$$

$\therefore$ Approximately the correct option is (b).

15. A radioactive sample disintegrates via two independent decay processes having half lives $T_{\frac{1}{2}}^{(1)}$ and $T_{\frac{1}{2}}^{(2)}$ respectively. The effective half - life, $T_{\frac{1}{2}}$ of the nuclei is:

A. None of these

B. $T_{\frac{1}{2}}=T_{\frac{1}{2}}^{(1)}+T_{\frac{1}{2}}^{(2)}$

C. $T_{\frac{1}{2}}=\dfrac{T_{\frac{1}{2}}^{(1)}+T_{\frac{1}{2}}^{(2)}}{T_{\frac{1}{2}}^{(1)}-T_{\frac{1}{2}}^{(2)}}$

D. $T_{\frac{1}{2}}=\dfrac{T_{\frac{1}{2}}^{(1)}T_{\frac{1}{2}}^{(2)}}{T_{\frac{1}{2}}^{(1)}+T_{\frac{1}{2}}^{(2)}}$

We know that:

$$\left(-\frac{dN}{dt}\right)_1=N\lambda_1,\left(-\frac{dN}{dt}\right)_2=N\lambda_2$$

Now, $\dfrac{dN}{dt}=\left(\dfrac{dN}{dt}\right)_1+\left(\dfrac{dN}{dt}\right)_2$

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

$$\frac{1}{T_{\frac{1}{2}}}=\frac{1}{T_{\frac{1}{2}}^{(1)}}+\frac{1}{T_{\frac{1}{2}}^{(2)}}$$

$$T_{\frac{1}{2}}=\frac{T_{\frac{1}{2}}^{(1)}T_{\frac{1}{2}}^{(2)}}{T_{\frac{1}{2}}^{(1)}+T_{\frac{1}{2}}^{(2)}}$$

16. The wavelength of the photon emitted by a hydrogen atom when an electron makes a transition from $n=2$ to $n=1$ state is:

A. $194.8 \mathrm{~nm}$

B. $490.7 \mathrm{~nm}$

C. $913.3 \mathrm{~nm}$

D. $121.8 \mathrm{~nm}$

$\Delta E=10.2 \mathrm{~eV}$ is the energy difference between the state $n=2$ and $n=1$.

$$\Delta E=-3.4-(-13.6)=10.2 \mathrm{~eV}$$

$$\frac{hc}{\lambda}=10.2 \mathrm{~eV}$$

$$\lambda=\frac{hc}{10.2e} \mathrm{m}$$

where, $e=1.6 \times 10^{-19} \mathrm{~J/V}$

$$\lambda=\frac{12400}{10.2} Å$$

(because $hc=12400 \mathrm{~eV}.A^{\circ}$)

$\lambda \simeq 121.8 \mathrm{~nm}$

17. An X-ray tube is operated at 1.24 million volt. The shortest wavelength of the produced photon will be:

A. $10^{-2} \mathrm{~nm}$

B. $10^{-3} \mathrm{~nm}$

C. $10^{-4} \mathrm{~nm}$

D. $10^{-1} \mathrm{~nm}$

The minimum wavelength of the photon will correspond to the maximum energy due to accelerating by V volts in the tube.

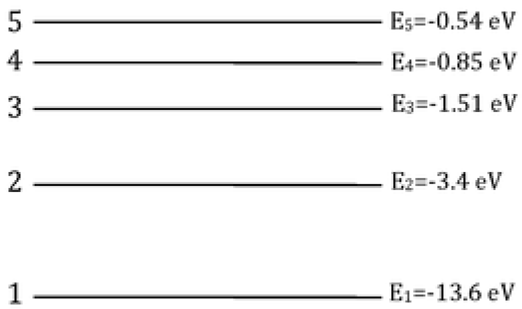
$$\lambda_{\min}=\frac{hc}{eV}$$

$$\lambda_{\min}=\frac{1240}{1.24 \times 10^{6}}$$

$$\lambda_{\min}=10^{-3} \mathrm{~nm}$$

18. According to Bohr's atomic model, in which of the following transitions will the frequency be maximum?

- ✔ **A.** $n=2$ to $n=1$
- ✘ **B.** $n=4$ to $n=3$
- ✘ **C.** $n=5$ to $n=4$
- ✘ **D.** $n=3$ to $n=2$

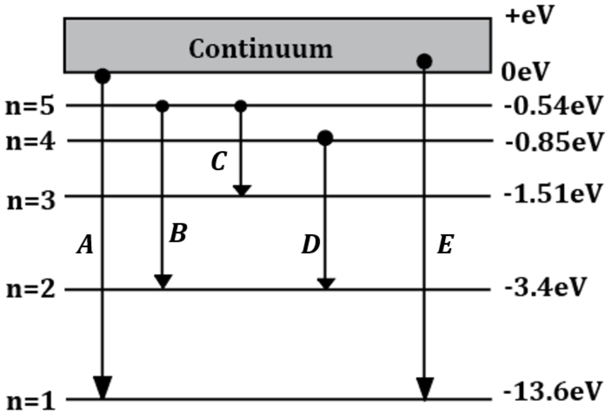


$\Delta E = hf$

$$\Delta E = 13.4Z^2\left[\frac{1}{n_2^2} - \frac{1}{n_1^2}\right]$$

Since, ΔE is maximum for the transition from $n=2$ to $n=1$, frequency (f) is more for the transition from $n=2$ to $n=1$.

19. In the given figure, the energy levels of hydrogen atom have been shown along with some transitions marked as A, B, C, D and E.
The transitions A, B and C respectively represents :



A. The series limit of Lyman series, third member of Balmer series and second member of Paschen series.

B. The first member of the Lyman series, third member of Balmer series and second member of Paschen series.

C. The ionization potential of hydrogen, second member of Balmer series and third member of Paschen series.

D. The series limit of Lyman series, second member of Balmer series and second member of Paschen series.

We know that for,
(1). Lyman Series - $n_1 = 1,\ n_2 = 2, 3, 4, \ldots..$

(2). Balmer Series - $n_1 = 2,\ n_2 = 3, 4, 5, \ldots..$

(3). Paschen Series - $n_1 = 3,\ n_2 = 4, 5, 6, \ldots..$

Here, for transition A, $n_1 = 1,\ n_2 = \infty$
$\Rightarrow$ Series limit of Lyman series.

For transition B, $n_1 = 2, n_2 = 5$
$\Rightarrow$ Third member of Balmer series.

For transition C, $n_1 = 3, n_2 = 5$
$\Rightarrow$ Second member of Paschen series.

Hence, option (A) is correct.

20. An α - particle and a proton are accelerated from rest by a potential difference of $200 \mathrm{~V}$. After this, their de Broglie wavelengths are λ_α and λ_p respectively. The ratio $\frac{\lambda_p}{\lambda_\alpha}$ is :

A. 8

B. 2.8

C. 3.8

D. 7.8

We know that,

$$\lambda=\frac{h}{p}=\frac{h}{\sqrt{2 m q V}}$$

$$\therefore \frac{\lambda_p}{\lambda_\alpha}=\sqrt{\frac{m_\alpha q_\alpha}{m_p q_p}}=\sqrt{\frac{4 \times 2}{1 \times 1}}=2.8$$

21. Match List I with List II.

List I	List II
a. Rectifier b. Stabilizer c. Transformer d. Filter	i. Used either for stepping up or stepping down the A.C. Voltage. ii. Used to convert A.C. voltage into D.C. voltage. iii. Used to remove any ripple in the rectified output voltage. iv. Used for constant output voltage even when the input voltage or load current change.

Choose the correct answer from the options given below:

A. $(a)-(ii),(b)-(i),(c)-(iv),(d)-(iii)$

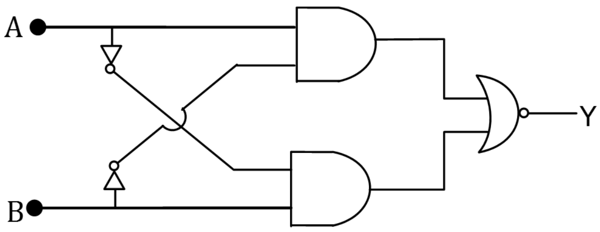
B. $(a)-(ii),(b)-(iv),(c)-(i),(d)-(iii)$

C. $(a)-(ii),(b)-(i),(c)-(iii),(d)-(iv)$

D. $(a)-(iii),(b)-(iv),(c)-(i),(d)-(ii)$

(a) Rectifier:- used to convert A.C voltage into D.C. Voltage.
(b) Stabilizer:- used for constant output voltage even when the input voltage or load current change
(c) Transformer:- used either for stepping up or stepping down the A.C. voltage.
(d) Filter:- used to remove any ripple in the rectified output voltage.

22. The correct truth table for the following logic circuit is:



A.

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	0

B.

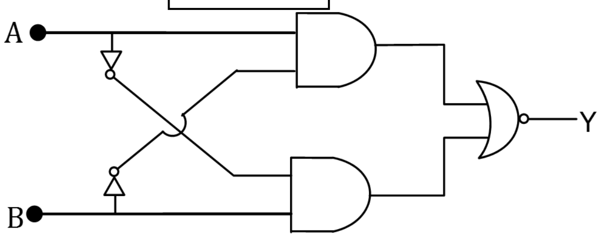
A	B	Y
0	0	0
0	1	1
1	0	0
1	1	1

C.

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

D.

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1



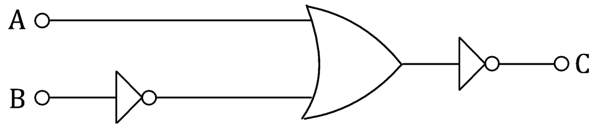
If $A = B = 0$, then output $y = 1$
If $A = B = 1$, then output $y = 1$

23. Zener breakdown occurs in a pn junction having p and n both:

- **A.** lightly doped and have wide depletion layer.
- **B.** heavily doped and have narrow depletion layer.
- **C.** heavily doped and have wide depletion layer.
- **D.** lightly doped and have narrow depletion layer.

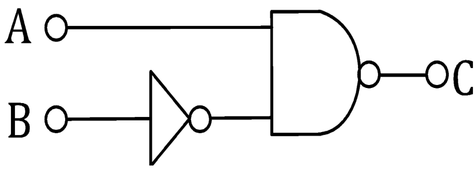
The Zener breakdown occurs in the heavily doped pn junction diode. Heavily doped pn junction diodes have narrow depletion region. The narrow depletion layer width leads to a high electric field, which causes the pn junction breakdown.

24.

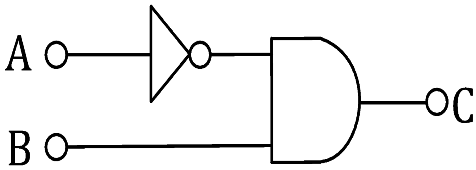


The logic circuit shown above is equivalent to:

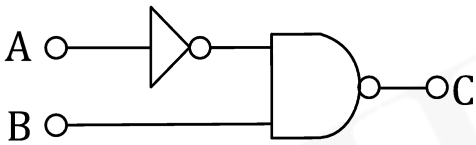
A.



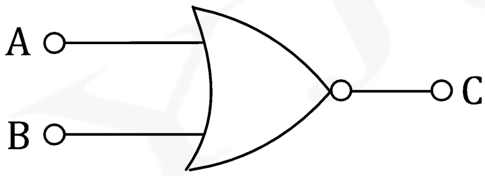
B.



C.



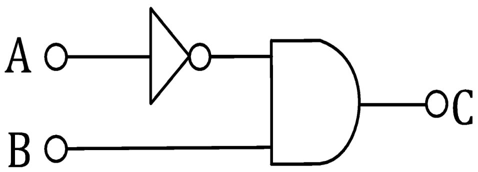
D.



From the question, $C = \overline{A + \overline{B}}$

$\Rightarrow C = \overline{A} \cdot \overline{\overline{B}} = \overline{A} \cdot B$

For option (B),



Output is also, $C = \overline{A} \cdot B$

25. Given below are two statements:

Statement I : PN junction diodes can be used to function as transistor, simply by connecting two diodes, back to back, which acts as the base terminal.

Statement II : In the study of transistor, the amplification factor β indicates ratio of the collector current to the base current.

In the light of the above statements, choose the correct answer from the options given below:

- **A.** Statement I is false but Statement II is true. ✔
- **B.** Both Statement I and Statement II are true. ✖
- **C.** Statement I is true, but Statement II is false. ✖
- **D.** Both Statement I and Statement II are false. ✖

Statement I is false because in case of two discrete back to back connected diodes, there are four doped regions instead of three and there is nothing that resembles a thin base region between an emitter and a collector.

Statement II is true as,

$$\beta = \frac{I_C}{I_B}$$

26. If the emitter current is changed by $4 \mathrm{~mA}$, the collector current changes by $3.5 \mathrm{~mA}$, the value of β will be -

A. 7

B. 0.875

C. 0.5

D. 3.5

Given,
$\Delta I_E = 4 \mathrm{~mA}$
$\Delta I_C = 3.5 \mathrm{~mA}$

We know that, $\alpha = \dfrac{\Delta I_C}{\Delta I_E}$

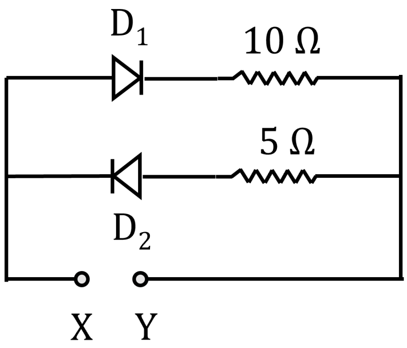
$$\Rightarrow \alpha = \frac{3.5}{4} = \frac{7}{8}$$

Also, $\beta = \dfrac{\alpha}{1-\alpha}$

$$\Rightarrow \beta = \frac{7/8}{1-7/8}$$

$$\Rightarrow \beta = 7$$

27. A $5\ \mathrm{V}$ battery is connected across the points X and Y. Assume $\mathrm{D_1}$ and $\mathrm{D_2}$ to be normal silicon diodes. Find the current supplied by the battery if the positive terminal of the battery is connected to point X.



A. $\sim 0.86\ \mathrm{A}$

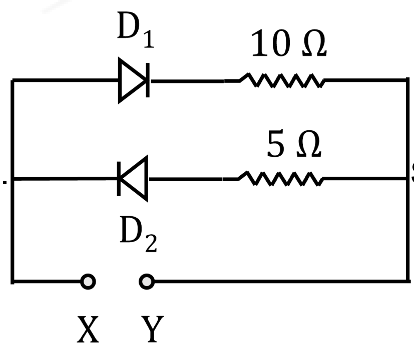
B. $\sim 0.50\ \mathrm{A}$

C. $\sim 0.43\ \mathrm{A}$ ✔

D. $\sim 1.50\ \mathrm{A}$

Voltage drop across normal silicon diode is $0.7\ \mathrm{V}$.

If the positive terminal of the battery is connected to X then only diode $\mathrm{D_1}$ will conduct current. So, current supplied by the battery,



$$i = \frac{5 - 0.7}{10} = 0.43\ \mathrm{A}$$

28. LED is constructed from $Ga - As - P$ semiconducting material. The energy gap of this LED is 1.9 eV. Calculate the wavelength of light emitted and its colour.
$[h = 6.63 \times 10^{34} \text{J s}$ and $c = 3 \times 10^{8} \text{ ms}^{-1}]$

A. 654 nm and red colour

B. 1046 nm and blue colour

C. 1046 nm and red colour

D. 654 nm and orange colour

We know that $E = \dfrac{hc}{\lambda}$

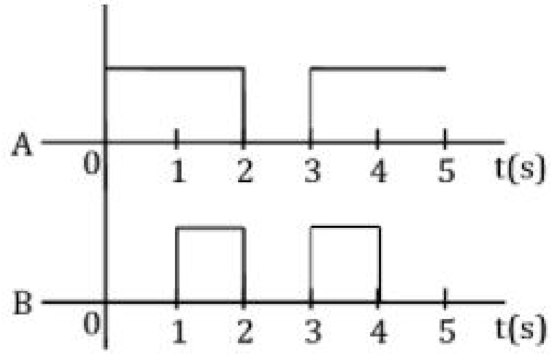
$$\lambda = \frac{hc}{E} \Rightarrow \lambda(\text{in nm}) = \frac{1240}{E(\text{in eV})}$$

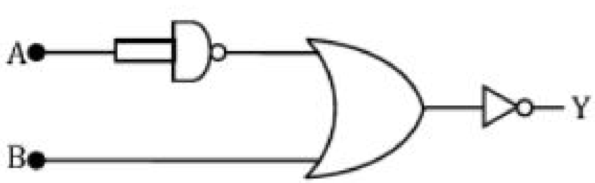
$$\lambda = \frac{1240}{1.9} = 652.63 \text{ nm} = 654 \text{ nm}$$

Wavelength of red light is 620 nm to 750 nm

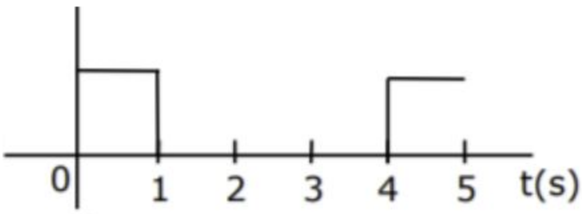
So, option (a) is the correct answer .

29. Draw the output Y in the given combination of gates.

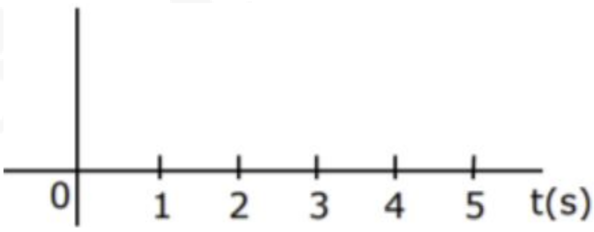




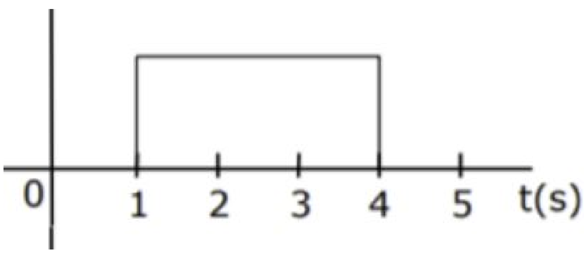
A.



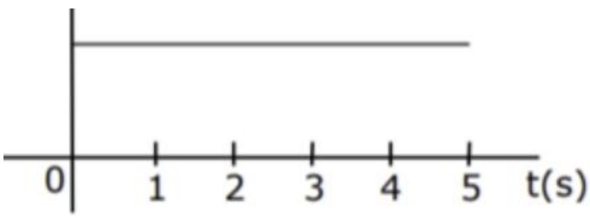
B.

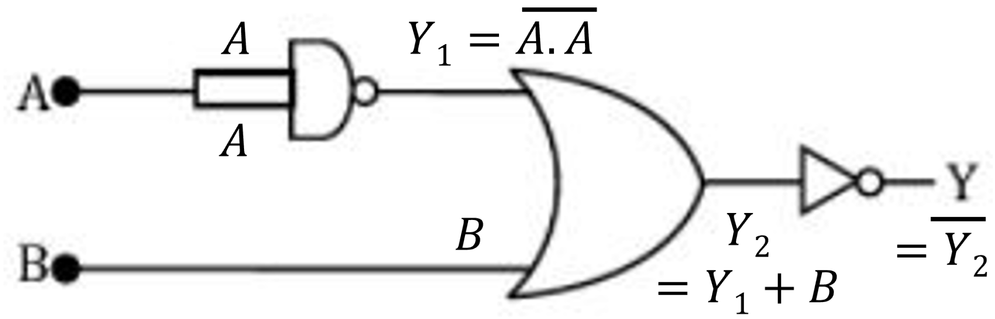


C.



D.





From figure,

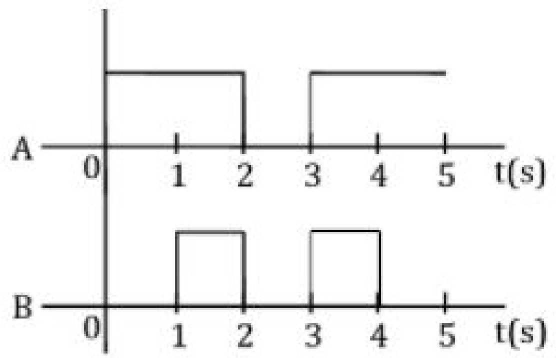
$$Y = \overline{Y_2} = \overline{Y_1 + B}$$

$$\Rightarrow Y = \overline{Y_1}.\overline{B} \quad \text{(De-Morgan's Theorem)}$$

$$\Rightarrow Y = \overline{\overline{A.A}}.\overline{B}$$

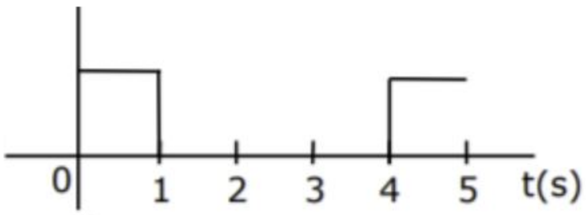
$$\Rightarrow Y = (A.A).\overline{B}$$

$$\Rightarrow Y = A.\overline{B}$$

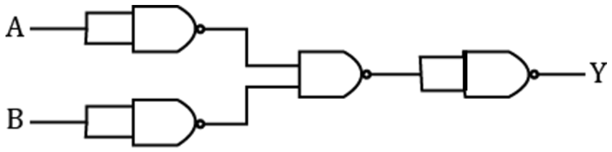


A	B	$\overline{B}$	$Y = A.\overline{B}$
0	0	1	0
0	1	0	0
1	0	1	1
1	1	0	0

Output Y,



30. The following logic gate is equivalent to:



A. NOR Gate

B. AND Gate

C. OR Gate

D. NAND Gate

$Y = \overline{\overline{\bar{A} \cdot B}} = \bar{A} \cdot B$

Truth table:

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

So, given logic gates circuit is a NOR gate.