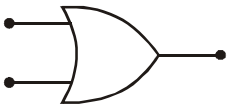
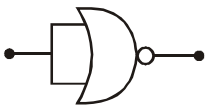
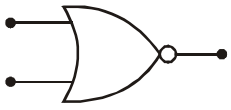
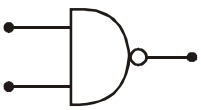
SEMICONDUCTOR

1. Which of the following gives a reversible operation?

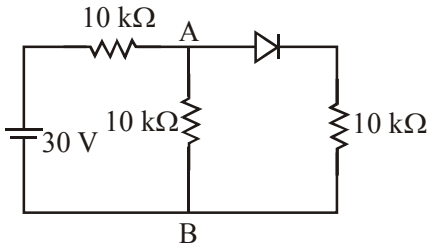
(1) 

(2) 

(3) 

(4) 

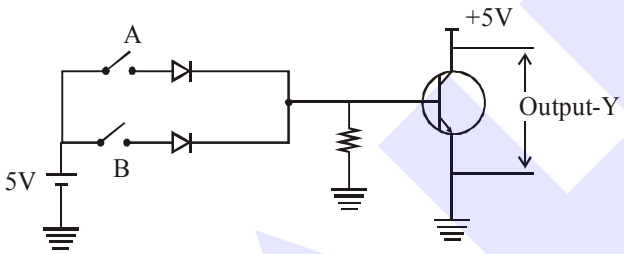
2. In the figure, potential difference between A and B is :



(1) 5V (2) 10 V

(3) zero (4) 15 V

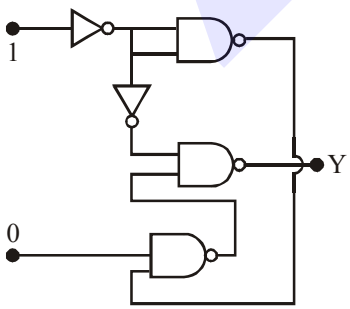
3. Boolean relation at the output stage-Y for the following circuit is :



(1) A + B (2) $\overline{A}+\overline{B}$

(3) $\overline{A}\cdot\overline{B}$ (4) $A\cdot B$

4. In the given circuit, value of Y is :



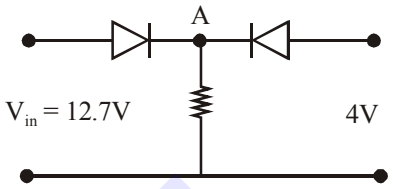
(1) will not execute

(2) 0

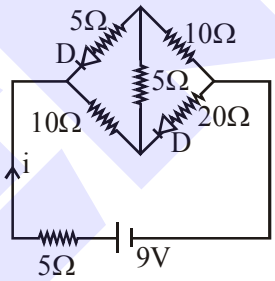
(3) toggles between 0 and 1

(4) 1

5. Both the diodes used in the circuit shown are assumed to be ideal and have negligible resistance when these are forward biased. Built in potential in each diode is 0.7 V. For the input voltages shown in the figure, the voltage (in Volts) at point A is _____ .



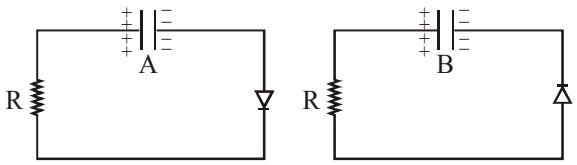
6. The current i in the network is :



(1) 0 A (2) 0.6 A

(3) 0.3 A (4) 0.2 A

7. Two identical capacitors A and B, charged to the same potential 5V are connected in two different circuits as shown below at time t = 0. If the charge on capacitors A and B at time t = CR is Q_A and Q_B respectively, then (Here e is the base of natural logarithm)



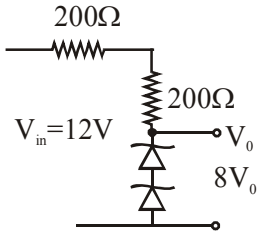
(1) $Q_A = VC, Q_B = \frac{VC}{e}$

(2) $Q_A = \frac{CV}{2}, Q_B = \frac{VC}{e}$

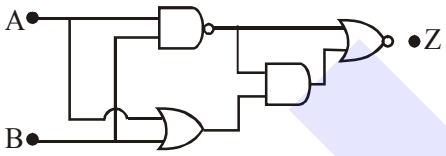
(3) $Q_A = VC$, $Q_B = CV$

(4) $Q_A = \frac{VC}{e}, Q_B = \frac{CV}{2}$

8. The circuit shown below is working as a 8 V dc regulated voltage source. When 12 V is used as input, the power dissipated (in mW) in each diode is; (considering both zener diodes are identical) _____.



9. In the following digital circuit, what will be the output at 'Z', when the input (A, B) are (1,0), (0,0), (1,1), (0,1):



(1) 1, 0, 1, 1

(2) 0, 1, 0, 0

(3) 0, 0, 1, 0

(4) 1, 1, 0, 1

10. When a diode is forward biased, it has a voltage drop of 0.5 V. The safe limit of current through the diode is 10 mA. If a battery of emf 1.5 V is used in the circuit, the value of minimum resistance to be connected in series with the diode so that the current does not exceed the safe limit is :

(1) 100 Ω

(2) 50 Ω

(3) 300 Ω

(4) 200 Ω

11. If a semiconductor photodiode can detect a photon with a maximum wavelength of 400 nm, then its band gap energy is:

Planck's constant $h = 6.63 \times 10^{-34}$ J.s.

Speed of ligh $c = 3 \times 10^8$ m/s

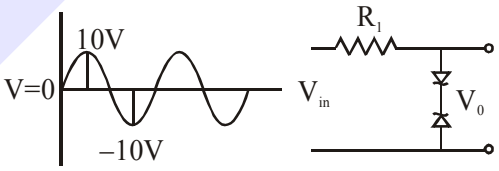
(1) 2.0 eV

(2) 1.5 eV

(3) 3.1 eV

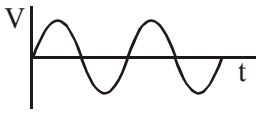
(4) 1.1 eV

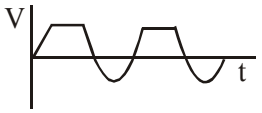
12. Take the breakdown voltage of the zener diode used in the given circuit as 6V. For the input voltage shown in figure below, the time variation of the output voltage is : (Graphs drawn are schematic and not to scale)



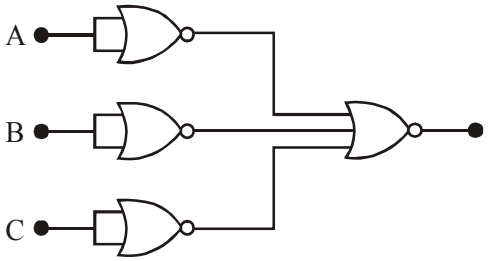
(1) 

(2)


(3)


(4)


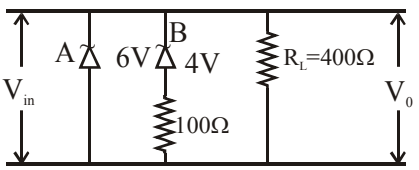
13. Identify the operation performed by the circuit given below :

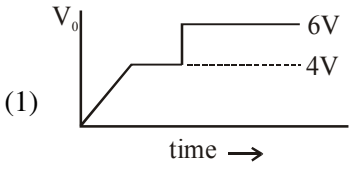


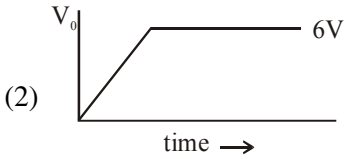
(1) AND (2) NAND
(3) OR (4) NOT

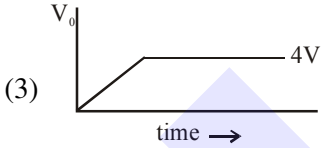
14. With increasing biasing voltage of a photodiode, the photocurrent magnitude :
(1) increases initially and saturates finally
(2) increases initially and after attaining certain value, it decreases
(3) increases linearly
(4) remains constant

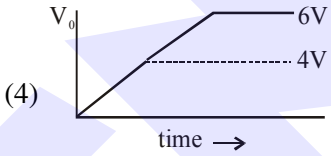
15. Two Zener diodes (A and B) having breakdown voltages of 6V and 4V respectively, are connected as shown in athe circuit below. The output voltage V_0 variation with input voltage linearly increasing with time, is given by :
(V_{input} = 0V at t = 0) (figures are qualitative)



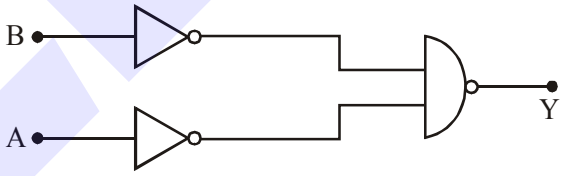
(1)


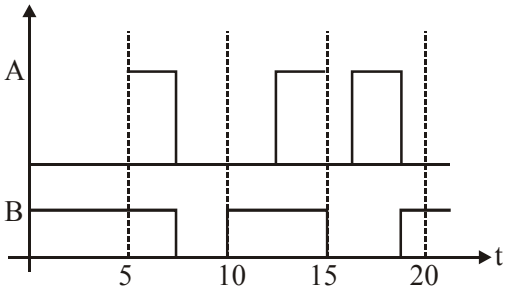
(2)


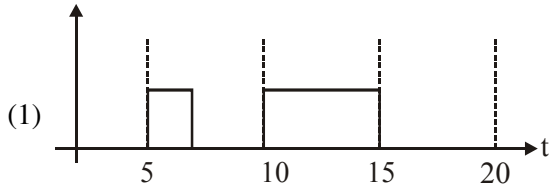
(3)


(4)


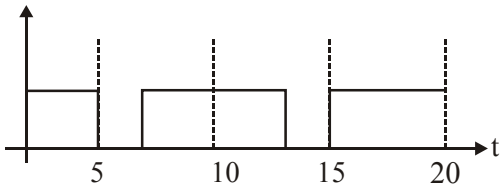
16. Identify the correct output signal Y in the given combination of gates (as shown) for the given inputs A and B.



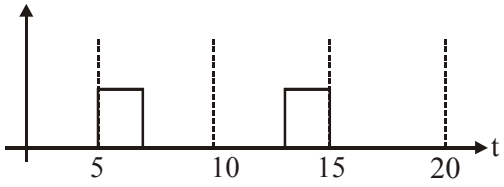


(1)


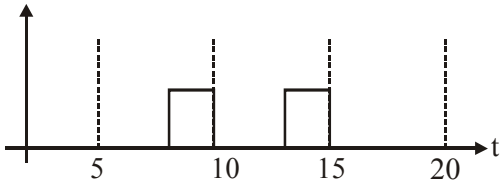
(2)



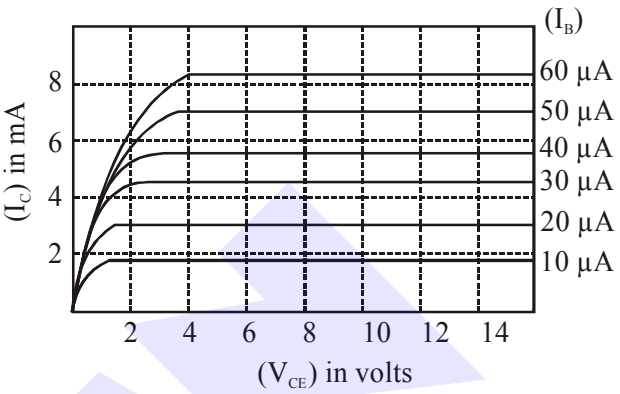
(3)



(4)



17. The output characteristics of a transistor is shown in the figure. When V_{CE} is 10 V and 1_C = 4.0 mA, then value of β_{ac} is _____ .

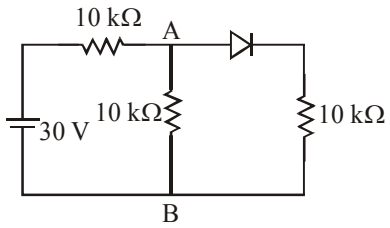


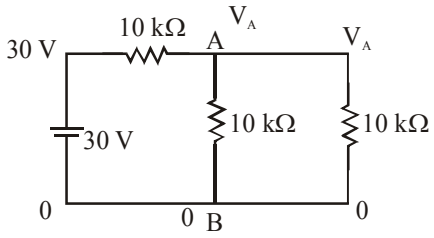
SOLUTION

1. Official Ans. by NTA (2)

2. Official Ans. by NTA (2)

Sol.





$$\frac{30-V_A}{10}+\frac{0-V_A}{10}+\frac{0-V_A}{10}=0$$

$$3=\frac{3V_A}{10}$$

$V_A = 10$ V

3. Official Ans. by NTA (3)

Sol.

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

4. Official Ans. by NTA (2)

Sol. $Y = \overline{\overline{AB}.A}$

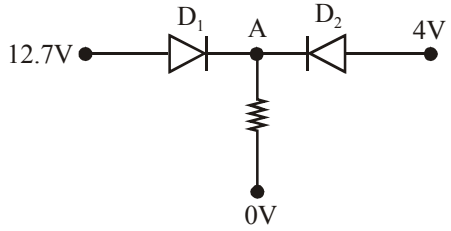
$= \overline{\overline{AB}}+\overline{A}$

$= 0 + 0$

$= 0$

5. Official Ans. by NTA (12.00)

Sol.

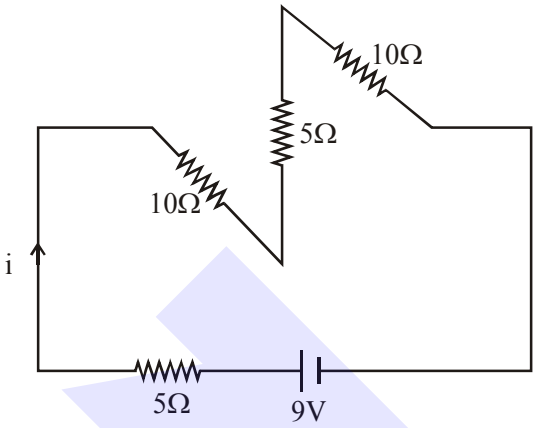


Diode D_1 is forward biased and D_2 is reverse biased.

$\therefore\ V_A = 12.7 - 0.7 = 12V.$

6. Official Ans. by NTA (3)

Sol.

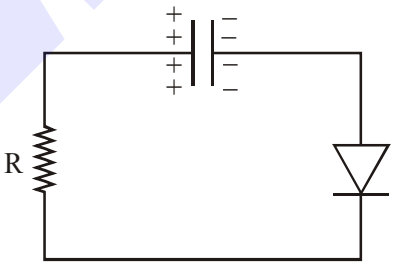


$$i=\frac{9}{(5+10+5+10)}=\frac{9}{30}A$$

$\therefore$ Correct answer (3)

7. Official Ans. by NTA (1)

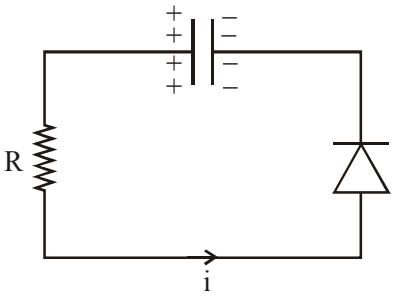
Sol. For (A)



No current flows

Hence $Q_A = CV$

For (B)



$$i=\frac{V}{R}e^{-\frac{t}{RC}}$$

$$q=CVe^{-\frac{t}{RC}}$$

at t = CR

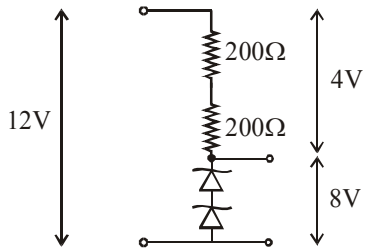
$$Q_B = CVe^{-1} = \frac{CV}{e}$$

$\therefore$ Correct answer (1)

8. Official Ans. by NTA (12.00)

ALLEN Ans. (40.00)

Sol.



Current in circuit = $\frac{4}{400} = \frac{1}{100}$A

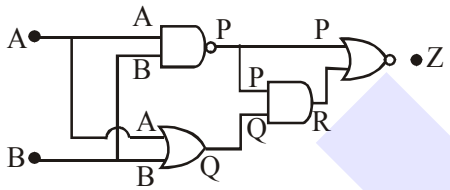
So power dissipited in each diode = VI

$$= 4 \times \frac{1}{100} \text{W} = 40 \times 10^{-3} \text{ mW}$$

$\therefore$ Correct answer 40

9. Official Ans. by NTA (3)

Sol.



$Z = (\overline{P+R})$

$Z = (\overline{P+PQ})$

$Z = (\overline{P(1+Q)})$

$Z = (\overline{P})$ [Using Identity $(1+A)=1$]

$Z = \overline{(\overline{AB})}$

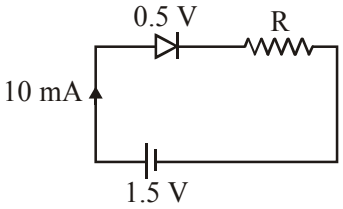
$Z = AB$

Truth table for Z = AB

A	B	Z
1	0	0
0	0	0
1	1	1

10. Official Ans. by NTA (1)

Sol.



$1.5 - 0.5 - R \times 10 \times 10^{-3} = 0$

$\therefore$ R = 100 Ω

11. Official Ans. by NTA (3)

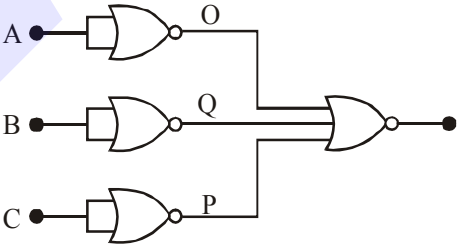
Sol. $\Delta E = \frac{\lambda c}{\lambda e} = 3.1 eV$

12. Official Ans. by NTA (2)

Sol. As there are two zener diodes in reverse polarity so if one is in forward bias the other will be in reverse bias and above 6V the reverse bias will too be in conduction mode. Therefore when voltage is more than 6V the output will be constant. And when it is less than 6V it will follow the input voltage so correct answer is two.

13. Official Ans. by NTA (1)

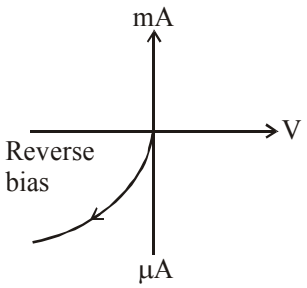
Sol.



A	B	C	
0	0	0	0
1	0	0	0
0	1	0	0
0	0	1	0
1	1	0	0
1	0	1	0
0	1	1	0
1	1	1	1

14. Official Ans. by NTA (1)

Sol. I-V characteristic of a photodiode is as follows:



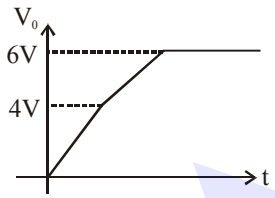
On increasing the potential difference the current first increases and then attains a saturation.

15. Official Ans. by NTA (4)
Official Ans. by ALLEN (2)

Sol. Till input voltage Reaches 4V No zener is in Breakdown Region So $V_0 = V_i$ Then Now when V_i changes between 4V to 6V One Zener with 4V will Breakdown are P.D. across This zener will become constant and Remaining Potential will drop. acro

Resistance in series with 4V Zener.

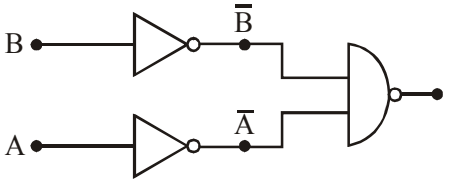
Now current in circuit increases Abruptly and source must have an internal resistance due to which. Some potential will get drop across the source also so correct graph between V_0 and t. will be



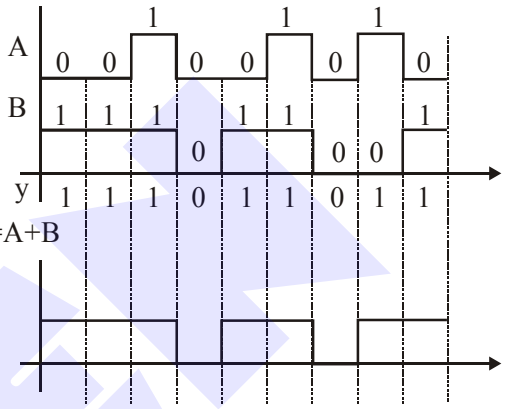
We have to Assume some resistance in series with source.

16. Official Ans. by NTA (3)
Official Ans. by ALLEN None (Approx Ans can be 2)

Sol.



$y = \overline{\overline{A}.\overline{B}} = \overline{\overline{A}} + \overline{\overline{B}} = A + B$



17. Official Ans. by NTA (150.00)

Sol. $\Delta I_B = (30 - 20) = 10\mu A$

$\Delta I_C = (4.5 - 3)\ mA = 1.5mA$

$$\beta_{ac} = \frac{\Delta I_C}{\Delta I_B} = \frac{1.5mA}{10\mu A} = 150$$

$\beta_{ac} = 150$