$\boxed{\text{NOTE:}}$

a) Diode pointing $\boxed{\text{outwards}}$ ⟹ $\boxed{\text{AND gate}}$

b) Diodes pointing $\boxed{\text{Inwards}}$ ⟹ $\boxed{\text{OR gate.}}$

☆ Number Systems: (Positional weighted Number System)

		Base / Radix
1)	Decimal	10 (0, 1, 2, ..., 9)
2)	Binary	2 (0, 1).
3)	Hexadecimal	16 (0, 1, ..., 8, 9, A, B, C, D, E, F).
4)	octal	8 (0, 1, ... 6, 7).

Ex-1 → $\boxed{\text{Digit '6'} \Rightarrow \text{Base} \geq 7.}$

$\cancel{b=6}$ ⟹ 0, 1, 2, 3, 4, 5, 6

✓ b=7 ⟹ 0, 1, ..., 6.

✓ b=8 ⟹ 0, 1, ..., 6, 7.

✓ → Digit '9' ⟹ Base ≥ 10.

✓ → Digit 'E' ⟹ Base ≥ 15.

NOTE:

Diode pointing	+ve Logic	-ve Logic
→ ←	OR	AND
← →	AND	OR

① $1101101.10101_2 = X_{16}$.

$\rightarrow$ 110 1101 . 1010 1   1000

$0110 \rightarrow 6$ $1101 \rightarrow 13 \rightarrow D$ $1010 \rightarrow 10 \rightarrow A$ $1000 \rightarrow 8$

Ans: $(6D.A8)_{16}$.

Ex 2: How many bits are required to represent 6728_{10} in binary.

Ans: $2^n > 6728_{10}$

$n = 13$ bits. $2^{12} = 4096$

$2^{13} = 8192$

Ex-3: $6728_{10} \longrightarrow X_2 =$

$6728_{10} \rightarrow X_{16} \rightarrow X_2$

16	6728	
16	420	8
16	26	4
	1	10 (A)
		1

$(1A48)_{16} = (6728)_{10}$

Now, 1 A 4 8

$1 \rightarrow 0001$, $A \rightarrow 1010$, $4 \rightarrow 0100$, $8 \rightarrow 1000$

0001 1010 0100 1000

$(6728)_{10} = (0001101001001000)_2$

Ex-3 How many bits are required to represent a 32 digit decimal no.?

Ans:

$$2^n > 10^{32}$$

$$n \ln 2 > 32 \ln 10$$

$$\therefore n > 32\left(\frac{\ln 10}{\ln 2}\right).$$

$$n > 106.30 \Rightarrow \boxed{n = 107}$$

Ex-4 Determine the base of the following relations.

ⓐ $24 + 17 = 40 \Rightarrow$ max digit $= 7$ hence base ≥ 8.

Let, base $=$ 'b'

$$\therefore (2b^1 + 4b^0) + (1b^1 + 7b^0) = (4b^1 + 0).$$

$$\therefore 2b + 4 + b + 7 = 4b.$$

$$\therefore \boxed{b = 11}$$

Note:

$$36_8 \xrightarrow{3\times 8^1 + 6\times 8^0} X_{10}$$

$$AF_{16} \xrightarrow{10\times 16^1 + 15\times 16^0} X_{10}$$

$$24_b \xrightarrow{2\times b^1 + 4\times b^0} X_{10}$$

(b) $\sqrt{41} = 5$.

→ Let, Base = b. $\sqrt{4 \times b^1 + 1 \times b^0} = 5 \times b^0$

$\therefore 4b + 1 = 25$

$4b = 24$

$\therefore$ $\boxed{\cancel{b = 4}}$ $\boxed{b = 6}$

(c) Roots of $x^2 - 11x + 22 = 0$ are 3 and 6

b = ?. Max digit = 6, Base ≥ 7.

Ans:

$x(x-3)(x-6) = b$

$\therefore x \quad x^2 - 9x + 18$

let, roots are $x_1 = 3$, $x_2 = 6$.

$\therefore x_1 + x_2 = -b/a$.

$3_{base} + 6_{base} = -\frac{(-11)}{1} = 11_{base}$

$\therefore (3 \times base^0) + (6 \times base^0) = (base + 1)$

$\therefore 3 + 6 = base + 1$

$\boxed{base = 8}$

(OR)

$x_1 \cdot x_2 = c/a$.

$\therefore 3_{b_1} \times 6_{b_1} = \frac{22}{1} = 22_{b_1}$

$\therefore 3 \times 6 = 2b_1 + 2$.

$\therefore 18 = 2b_1 + 2$

$2b_1 = 16$

$\boxed{b_1 = 8}$

Ex 5 What is the min decimal value of $11C_x = ?$

max digit C, so base ≥ 13.

Ans: $(x^2 + x + 12x^0)_{10}$ Base ≥ 13.

$= (x^2 + x + 12)_{10}$

Min decimal occures when base is minimum i.e. $b = 13$.

$\therefore = 13^2 + 13 + 12$

$= 194_{10}$.

Ex 6

$$\begin{array}{r} 1.2_4 \\ +\ 2.3_4 \\ \hline (10.1)_4 \end{array}$$

1. $(2\times 4^{-1}) = (1.5)_{10}$

2. $3/4 = (2.75)_{10}$

$$\begin{array}{r} (1.5)_{10} \\ (2.75)_{10} \\ \hline 4.25 \end{array}$$

$0.25\times 4 = 1.0$

$= 1$

$10.(\frac{2}{4} + \frac{5}{16})$

10.1.

Ex 7

$$\begin{array}{r} A\cancel{B}\cancel{D} \\ +\ 3\cancel{D}\cancel{D} \\ \hline 200 \end{array}$$

~~B = 11~~

~~D = 13~~

~~24~~

~~A = 10~~

~~+ 3~~

+ 3

16

$8 \,|\, 24$ 3 0

$8 \,|\, 16$ 2 0

Ex 8 A

b) $\overset{1}{A}\ B_H$

$+\ 3\ D_H$

$(E8)_{16}$

$B = 11$

$D = 13$

$(24)_{10}$

$$\begin{array}{c|c} 16 & 24 \\ \hline & 1 \end{array} \quad 8$$

$(18)_{16}$

$A = 10$

$+\ 1$

$+\ 3$

14

Ex-8

$b=1$ $\overset{11}{\ }$ $1D_H$

$2\ D_H$

$-\ AE_H$

$-7\ F_H$

$D = 13$

$E = 14.$

$11_{16} \rightarrow 17_{10}$

$\therefore 17 - 10 = 7$

$1D_H = 29_{10}$

$-\ E_H = -14_{10}$

$F_H \leftarrow 15_{10}$