Tutorial - 03

(01) A bulb in a staircase has two switches, one switch being at the ground floor and the other one at the first floor. The bulb can be turned ON and can be turned OFF and one of the switches irrespective of the state of the other switch.

(a) Draw the truth table for above situation

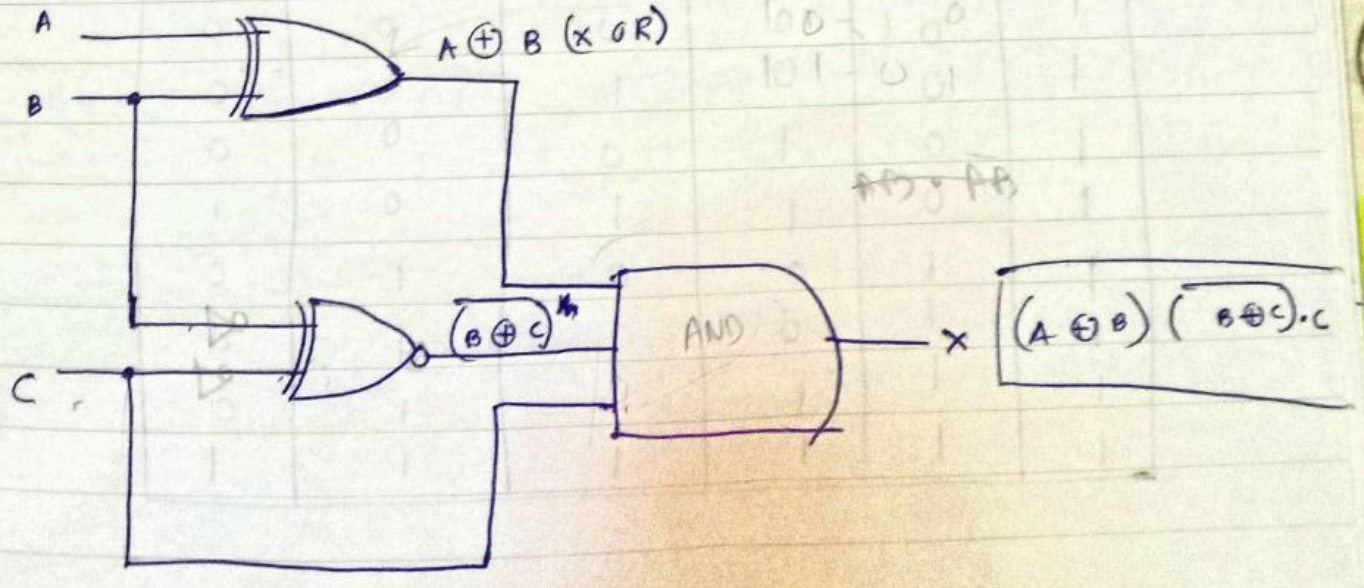
(b) Draw the most suitable logic circuit / gate for this

(02) The Boolean function $Y = AB + CD$ is to realized using only 2 input NAND gates.

(a) Extract the boolean function for NAND gates using the above formula.

(b) Draw the logic circuit for the extracted Boolean function.

(03) What is the boolean expression for the give logic circuit below



Answers

rows → $2^2 = 4$

(b)

(01)

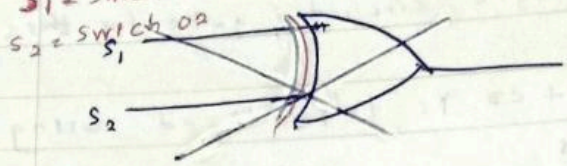
S_1 (A)	S_2 (F)	output
0	0	0
0	1	1
1	0	1
1	1	0

එක වෙලාවක switch දෙකම on නොහොත් දෙකම off වෙලා තියෙනවා නම් විතරයි බල්බය නිවී තියෙන්නේ.

$2^2 = 4$
$2^3 = 8$
$2^4 = 16$

(03)

S_1 = switch 01
S_2 = switch 02



~~XOR~~

(02) (a)

A	B	C	D	AB	CD
0	0	0	0	0	0
0	0	0	1	0	0
0	0	1	0	0	0
0	0	1	1	0	1
0	1	0	0	0	0
0	1	0	1	0	0
0	1	1	0	0	0
0	1	1	1	0	1
1	0	0	0	0	0
1	0	0	1	0	0
1	0	1	0	0	0
1	0	1	1	0	1
1	1	0	0	1	0
1	1	0	1	1	0
1	1	1	0	1	0
1	1	1	1	1	1

(02)

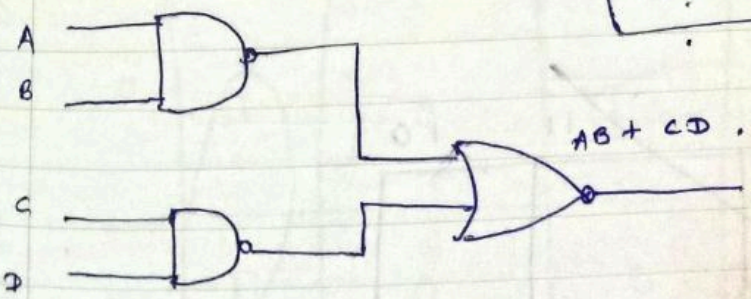
(b) A B C D

(03)

(02) $y = AB + CD$ ⟹ $y = \overline{AB + CD}$

$y = \overline{\overline{A \cdot B} + \overline{C \cdot D}}$

$y = (\overline{AB}) \cdot (\overline{CD})$



De. Morgan's Law

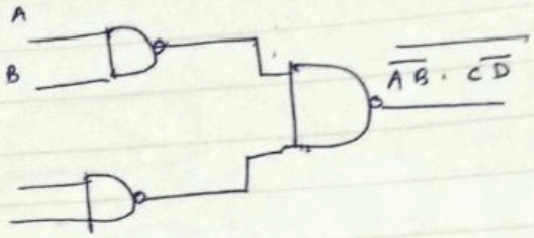
$(\overline{x+y}) = \bar{x}\,\bar{y}$

$\overline{x \cdot y} = (\bar{x} + \bar{y})$

$Y = AB + CD$

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

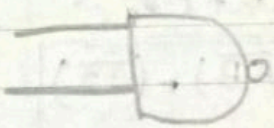
$= \overline{\overline{AB} \cdot \overline{CD}}$



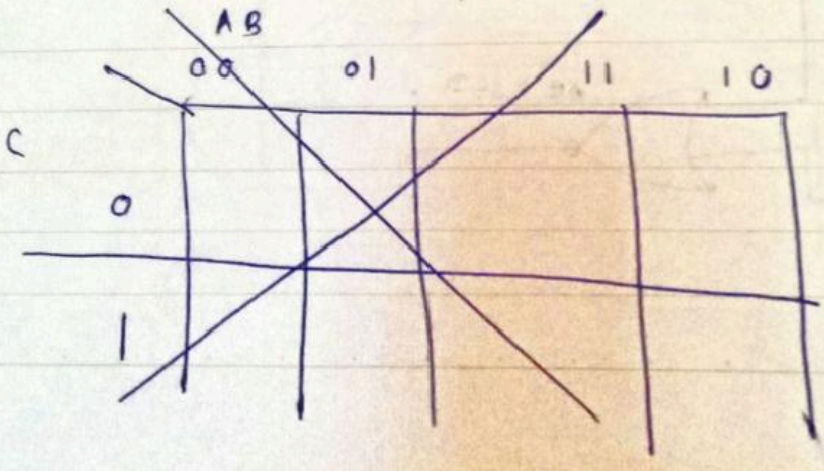
26 · 05 · 2023

①

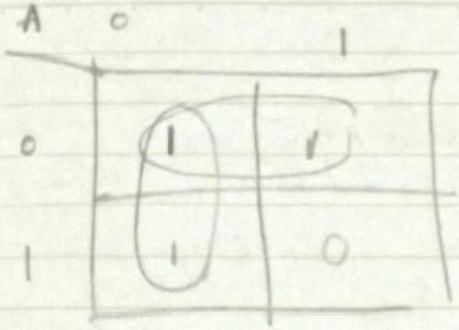
A	B	F
0	0	1
0	1	1
1	0	1
1	1	0



NAND gate



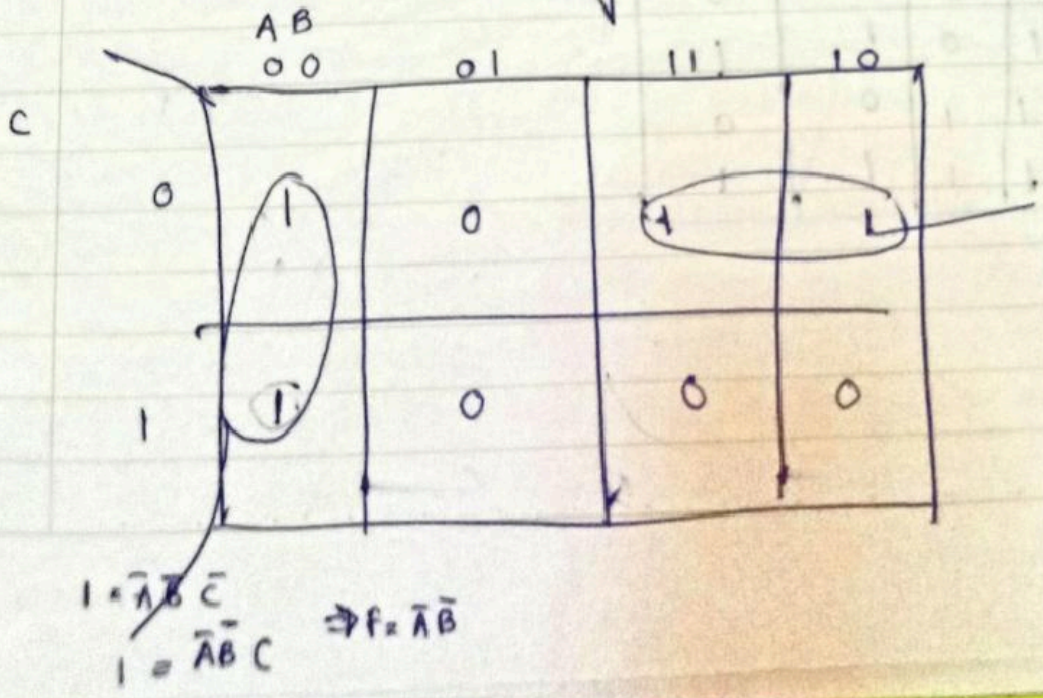
$F = \bar{A}\bar{B} + \bar{A}B + A\bar{B}$



$F = \bar{B} + \bar{A}$

②

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



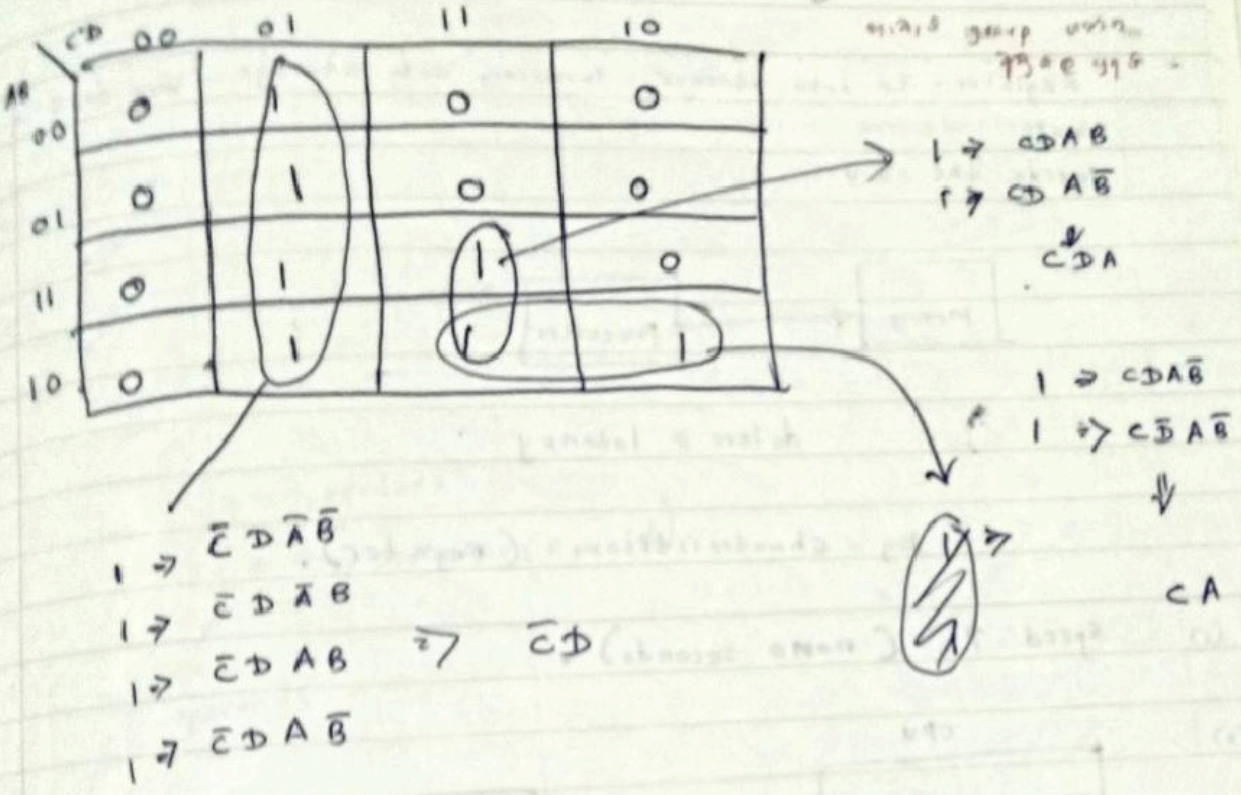
$F = \overline{A}\overline{B} + A\overline{C}$

$F = \overline{A}\overline{B}\overline{C} + \overline{A}\overline{B}C + A\overline{B}C + AB\overline{C}$

③

A	B	C	D	out
0	0	0	0	0
0	0	0	1	1
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

→ $F = \overline{A}B\overline{C}D + \overline{A}B\overline{C}D + A\overline{B}\overline{C}D + A\overline{B}CD + \overline{A}\overline{B}CD + ABCD + ABC\overline{D}$

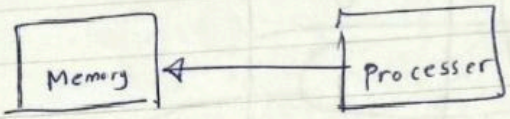


$$F = \bar{C}\bar{D} + CA + CDA$$

H.W

02.06.2023.

Register - To data storage - Temperary data storage. Very fast but small
Inside the CPU

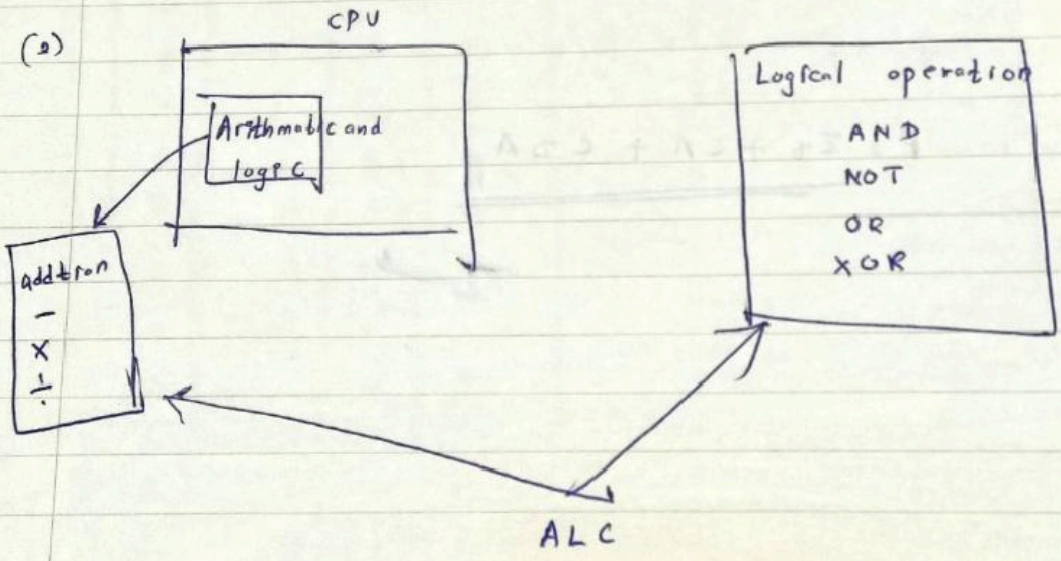


delare → latency

key - charoteristics. (Register).

(1) speed ↑ (nano seconds).

(2)



Arithmatic and logical expressions.

(3) small

(4) 8 - 64 bit store.

(5) 32 - 64 normal register bits

(6) ~~Registers~~

Purpuse

main pupurse data storing.

① Registers

Can store the operands

General — Special purpuse

⇓

Use to operands.

operaters'

x ⊞ y = z ⇒ outcome (Result),

operands

General

* Intermediate result produced

* int count = 0;

loop parameters

* Void function parament int x, int y.

} stored.

Special purpuse

desinated task.

specidic functrons. (cpu and operations control).

* Program Counters. (address of the current excution).

* stac registers. (They manage the stac).

(3) What is the typical range of sizes for registers in a computer system

(c) 32 to 64 bits

(4) How do registers Contribute to the performance of a computer system?

* By storing intermediate results during arithmetic operations.
b By minimizing the impact of memory latency.

(5) Which component of the CPU contains registers?

* Arithmetic logic unit (ALU).

(6) What is the purpose of general-purpose registers in computer architecture and how are they typically used?

* used for either memory address or data whenever needed.

(7) How does the program counter register contribute to the execution of a program in a CPU?

Theory NOTE 09.06.2023

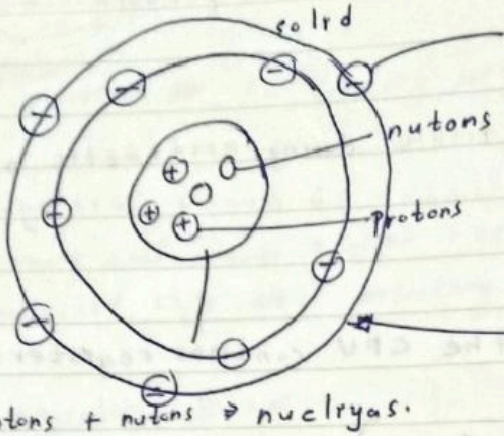
Date

Basic Electricity And Diodes

lecture note

Matter - basic unit of matter.
has mass and occupied space

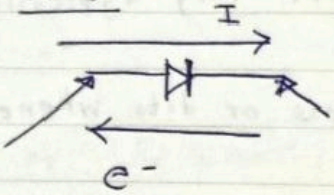
Matter ⇒ air
liquid
solid



Protons + nutons ⇒ nucleyas.

electricity ⇒ is a form of energy.

Diods



Semiconduted divice. It has capable of go to one direction.
but eletrons goes to opposite side

Common terms

① V is voltage (volts : V);

voltage eletrical pertential difference between two points in a curcut

② I is current (amps : A);

The rate of flow of eletric (eletric charge) change threw a conduter.

③ R is resistance (ohms : Ω);

Resistance is the opposition to the flow of eletric current in curcuit.

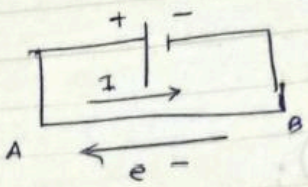
④ C is capacitance (farods : F);

The ability of a capacitor to store and eletric current. When a voltage is apply

⑤ P is power (watt : W)

Power is the rate at which energy is transfered in an eletrical curcut.

Electric Current



$I \Rightarrow 1\ C$

1. electric current is the "rate of flow of electric charges".
2. The unit used to measure the "charge" is Coulomb (C)
3. One coulomb of negative charge is the charge of 6.24×10^{18} eletrons.
4. rate of flow - one coulomb per second is called. $\frac{1\ C}{1\ s} = A$.

seconds

Potential Difference (V) = $\frac{\text{Work done (J)}}{\text{charge (C)}}$

$V = \frac{1\ J}{1\ C}$.

Ohm's Law

$V = IR$

$\frac{V}{R} = I$

$\frac{V}{I} = R$

Power

$P = IV$

$P = \frac{V}{R} \times V$

$P = \frac{V^2}{R}$

$P = IV$

$= I \times IR$

$P = I^2R$

(01) A circuit has a resistance of 10 ohms and current of 2 ampers, what is the voltage across the circuit.

$R = 10$

$I = 2$

$V = IR$

$= 10 \times 2$

$= 20\ V$

(02) If a power supply provides a voltage of 12 volts and the circuit has a resistance of 4 ohms, what is the current flowing through the circuit?

$V = 12$

$R = 4$

$V = IR$

$\frac{V}{R} = I$

$\frac{12}{4} = I$

$3\ A = I$

(03) A light bulb has a resistance of 50 ohms and operates at a voltage of 120 volts. How much current does it draw?

$R = 50$

$V = 120$

$V = IR$

$\frac{V}{R} = I$

$\frac{120}{50} = I$

$2.5\ A = I$

(4) A circuit has a current of 5 amperes and a voltage of 20 volts. What is the resistance of the circuit?

$I = 5A$

$V = 20V$

$V = IR$

$\frac{V}{I} = R$

$\frac{20V}{5A} = R$

$4\Omega = R$

(5) A resistor dissipates power at a rate of 12 watts when a current of 2 amperes passes through it. What is the resistance of the resistor?

* $P = IV$.

$I = 2A$

$P = 12$

$P = I^2R$

$\frac{P}{I^2} = R$

$\frac{12}{4} = R$

$3\Omega = R$

(6) A circuit has a resistance of 8 ohms and draws a current of 3 amperes. What is the power dissipated by the circuit?

* $R = 8\Omega$.

$I = 3A$

$P = I^2R$

$= 3^2 \times 8$

$= 9 \times 8$

$= 72W$

(4) A power supply delivers a current of 2 amperes to a circuit with a resistance of 15 ohms. What is the power supplied by the source?

* $I = 2A$
  $R = 15\ \Omega$

$P = I^2R$

$= 2^2 \times 15$

$= 60\ W$

(5) A device operates at a power of 60 watts and has a voltage of 120 volts. What is the current consumed by the device?

* $P = 60$
  $V = 120\ V$

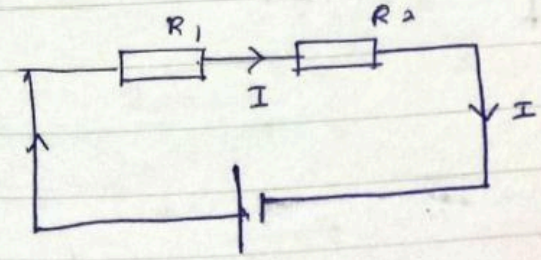
$P = IV$

$\frac{P}{V} = I$

$\frac{60}{120} = I$

$\frac{1}{2}\ A = I$

Question



$R = R_1 + R_2$

~~$= 18 + 6 \quad 12 + 12$~~

~~$= 12\ \Omega \quad 24\ \Omega$~~

$= 6\ \Omega + 12\ \Omega$

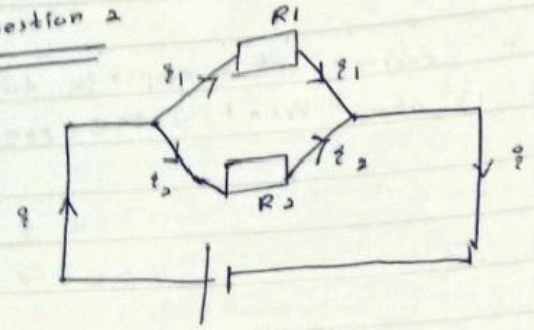
$= 18\ \Omega$

$i = 1\ A \qquad V = IR$

$= 1 \times 18$

$= 18\ V$

Question 2



$R_1 = 6\Omega$

$R_2 = 12\Omega$

$i = 1A$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$= \frac{1}{6} + \frac{1}{12}$$

$$= \frac{2+1}{12}$$

$$= \frac{3}{12}\ 4$$

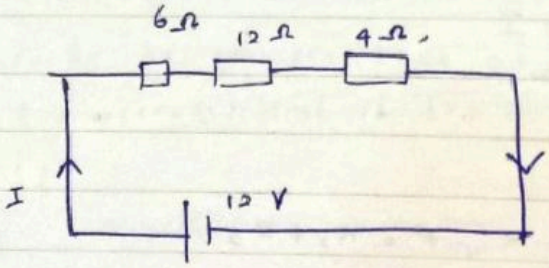
$$R = 4\Omega$$

$V = IR$

$= 1 \times 4$

$= 4V$

(3)



6Ω, 12Ω, 4Ω.

$12V$

(I)

$R = R_1 + R_2 + R_3$

$= 6 + 12 + 4$

$= 22\Omega$

(II)

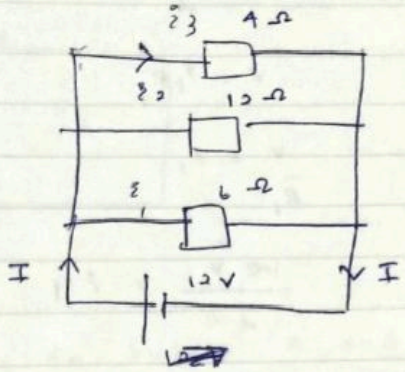
$V = IR \Rightarrow \frac{V}{R} = I \Rightarrow \frac{12V}{\frac{6}{11}\Omega} = I$

$\frac{1}{\text{Problem}} = I$

series ofn :

16.06.2023

① The resistors 4Ω, 12Ω, 6Ω



(i) resistance (total) = $\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{R}$.

$$\frac{1}{4} + \frac{1}{12} + \frac{1}{6} = \frac{1}{R}$$

$$\frac{3 + 1 + 2}{12} = \frac{1}{R}$$

$$\frac{6}{12} = \frac{1}{R}$$

$$\frac{12}{6} = R$$

$$R = 2\ \Omega$$

(ii) what current is gained from the eletric supply?

$$V = IR$$

$$I = \frac{V}{R}$$

$$= \frac{12}{2}$$

$$I = 6\ A$$

(3)

(iv) ~~Voltage~~ current flowing through 6Ω.

$$V = I_1 R_1$$

$$\frac{V}{R_1} = I_1$$

$$\frac{12\ V}{6\ \Omega} = I_1$$

$$2A = I_1$$

(I)

(v) Current flowing through 12Ω.

$$V = I_2 R_2$$

$$\frac{V}{R_2} = I_2$$

$$\frac{12\ V}{12\ \Omega} = I_2$$

$$1\ A = I_2$$

(vi) Current flowing through 4Ω

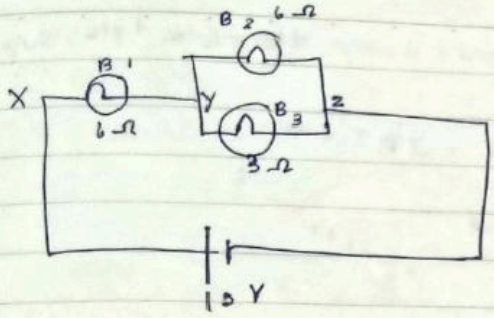
$$V = I_3 R_3$$

$$\frac{V}{R_3} = I_3$$

$$\frac{12\ V}{4\ \Omega} = I_3$$

$$3\ A = I_3$$

③ A circuit of 3 Resistors 3Ω 6Ω with 12V



(I) total resistance the two bulbs B_2 and B_3 (between Y and Z)

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$= \frac{1}{6} + \frac{1}{3}$$

$$\frac{1 + 2}{6}$$

$$\frac{1}{R} = \frac{3}{6}$$

$$R = \frac{6}{3}\Omega$$

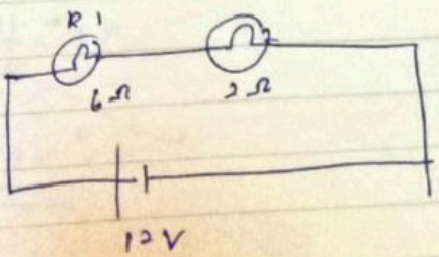
$$R = 2\Omega$$

(II) total resistance between the two points X and Z

$$r = R_3 + R$$

$$= 6 + 2$$

$$r = 8\Omega$$



(iii) What is the current gained from the electric supply

$V = IR$

$I = \frac{V}{R}$ Ω

12 ohms

$I = \frac{12}{8} A = 1.5\ A$

(iv) do potential difference V between x and y

$V = IR$

$= \frac{12}{8}^{3} \times 6^{3}$

$9\ V$

(v) Calculate the potential difference between Y and Z

$V = IR$

$= \frac{12}{8}^{3} \times 2^{1}$

$= 3V$

(vi) current flowing through B_2 bulb

$$V = IR$$

$$I = \frac{V}{R}$$

$$= \frac{3}{6}$$

$$= \frac{1}{2} A = 0.5 A$$

(vii) current through the bulb B_3

$$I = \frac{V}{R}$$

$$I = I_1 + I_2$$

$$= \frac{3}{3}$$

$$= 1 A$$

(viii) if B_3 is removed, Then what would be the current gain from the electric supply

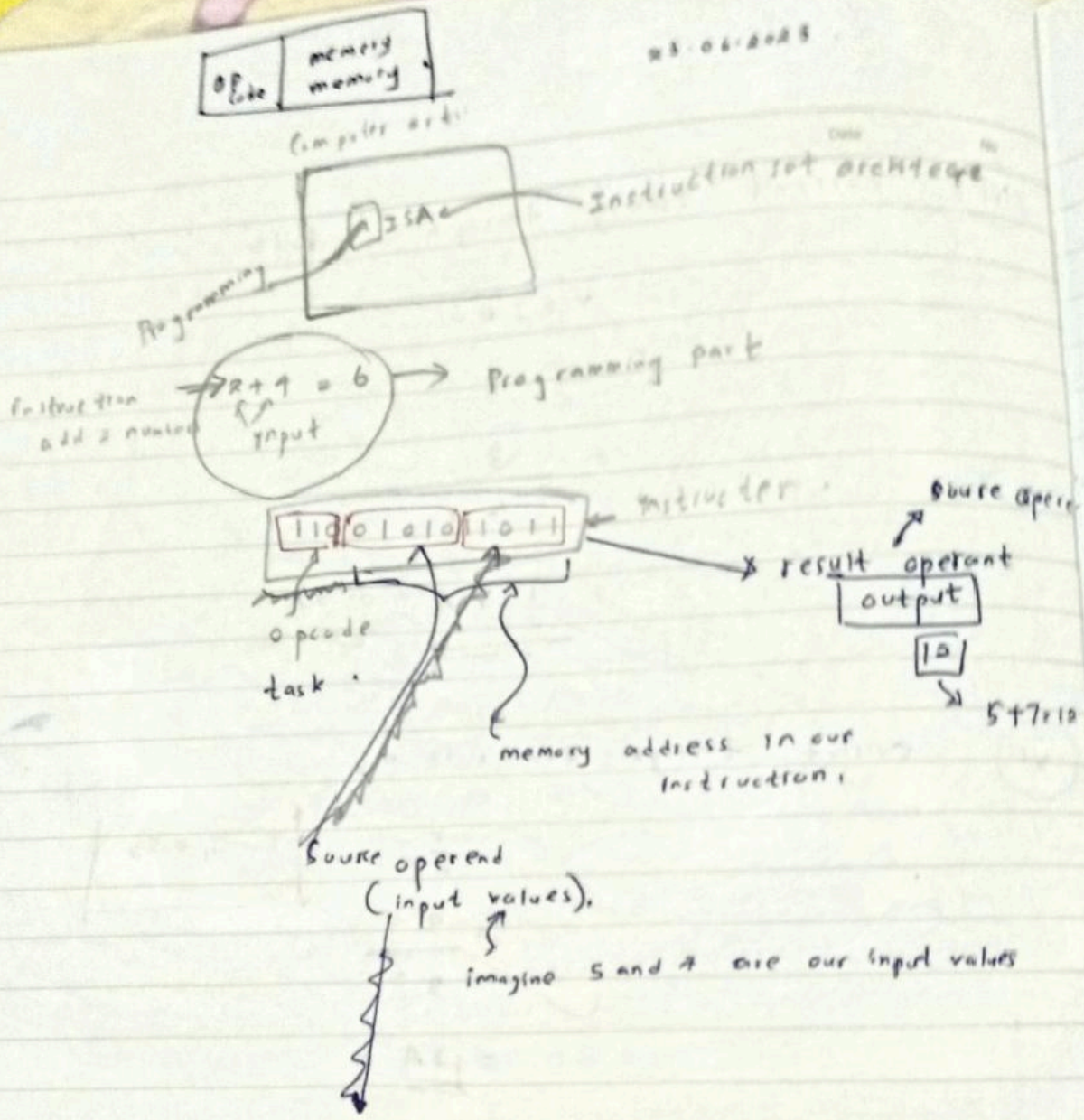
$$R = 12 \Omega$$

$$V = IR$$

$$\frac{V}{R} = I$$

$$\frac{12 V}{12 \Omega} = I$$

$$1 A = I$$



Instruction store (register, memory)

Explicit ⇒ instruction ...

Implicit ⇒ processor ... assumption ...

operator

a [a = 5] result

operand

Instruction Format

) Instruction format has 16 bit

0 decimal input

↓

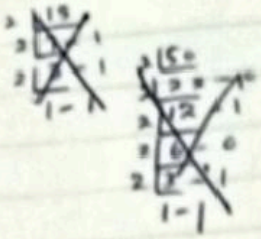
ASCII value

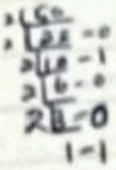
[48]

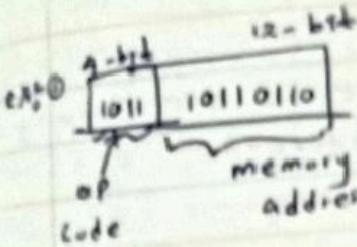
↓

Then convert the binary

binary ⇒ 1 1 0 0 1 0₂







How many operations ⇒ (Instruction). $2^{\text{size of op code}}$.

$= 2^4 = 16$.

How many memory addresses generated by the task?

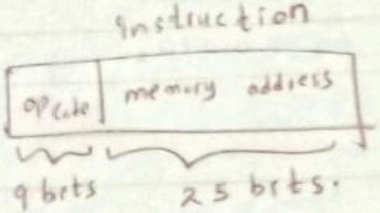
memory field size.

$= 2^{12}$

Consider a computer that is used for simple numerical problems. It uses 9 bits for an opcode, and 25 bits for a memory address.

(a) What is the size of its instruction? 34 bits

(b) How many different instructions can it have? 2^9



size of the instruction = size of the OP code + size of the memory address.

= 9 + 25

= 34 bits.

(c) What is the maximum memory size that it can address?
(Hint: Assume that 2^{20} is about 1M)

How many memory addresses. = 2 size of address field.

$= 2^{25} = 2^{20} \times 2^5$

$= 1M \times 32$

$= 32M$

28-06-2023

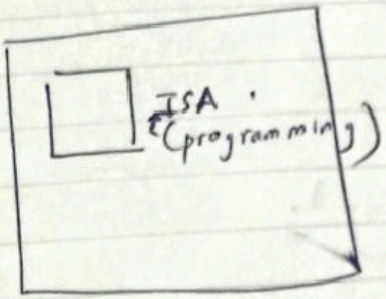
Instruction :

Computer give a command.

Instruction ⇒ ② + ④ function

~~Total function~~

Total of instruction ⇒ function.



ISA implement hardware :

- data types :
- Instructions
- registers :

0 num x = 0

exception handling

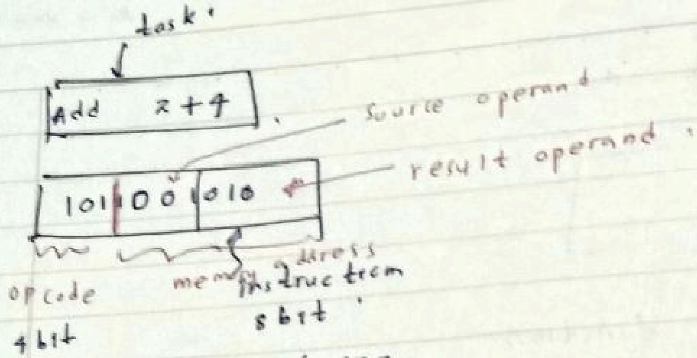
error.

Input 2 ⇒ ascii value : 50 ⇒ 50 in binary 110010₂ :

2 | 50
2 | 25 - 0
2 | 12 - 1
2 | 6 - 0
2 | 3 - 0
| - 1

result operand → 6
Soure code → input

opcode →



instruction storing

- register
- memory

explicate → ඇතුල කරලා තියෙනවා [illegible].
implicate → තියෙනවා පෙන්වන් නෑ. පෙනුනා [illegible] assumption එකක් [illegible] [illegible]

* operation ගාන
  [size of the opcode.]
  2

$2^4 = 16$ (opcode එකේ operation ගාන).

* Memory address: Can a task generate
  [size of the address field].

$= 2^{?}$

$= 2^{8}$

$= 256$

Instruction format

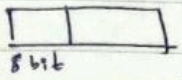
Quick Review Question 2

memory locations.

Given a CPU with a 8-bit word, 8 registers, and instructions that are exactly 1 word long and which has 2 operands,

(a) How long can the op code field be in an instruction?

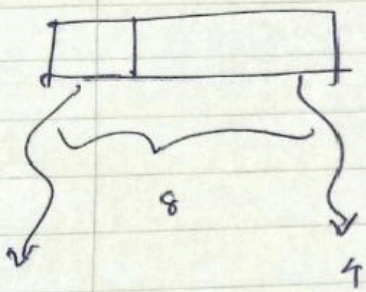
(b) How many instructions can the CPU support?



(a) ~~instruction 8 = 256~~

(b)

$2^8 = 256$



memory address ও op Code এর মধ্যে ভাগ করে দেয়া হয়েছে।

8 bit (instruction size).

(a) $2^4 = 16$

* Consider a computer that is used for simple numerical problems. It uses 6 bits for an opcode, and 12 bits for a memory address.

(a) What is the size of its instruction? ~~18~~ 18 bits.

(b) How many different instructions can it have? = ~~2^18 bits~~ 2^6 bits

(c) What is the maximum memory size that it can address? 2^{12}

(Hint: Assume the 2^{10} is about 1K)