Set 01

1.(a) Assumptions for the parameters of an ideal op-amp -

i) Infinite open loop gain. 0.5

ii) Infinite input resistance. 0.5

iii) Zero output resistance. 0.5

no partial marks here

(b) $V_o = \frac{-1}{RC}\int V_i dt$ 1

no partial marks here

(c) Because of non-linear I-V characteristic.

no partial marks here

(d)

F.B:- $i_D > 0$ 1

R.B:- $V_D \leq V_{DO}$ 1

no partial marks here

Set 02

1. (a) Same as 1(a) [Set 01]

(b) $V_o = -RC\frac{d}{dt}V_i$

(c) Same as 1(c) [Set 01]

(d)

F.B.:- $i_D > 0$

R.B:- $V_D \leq 0$

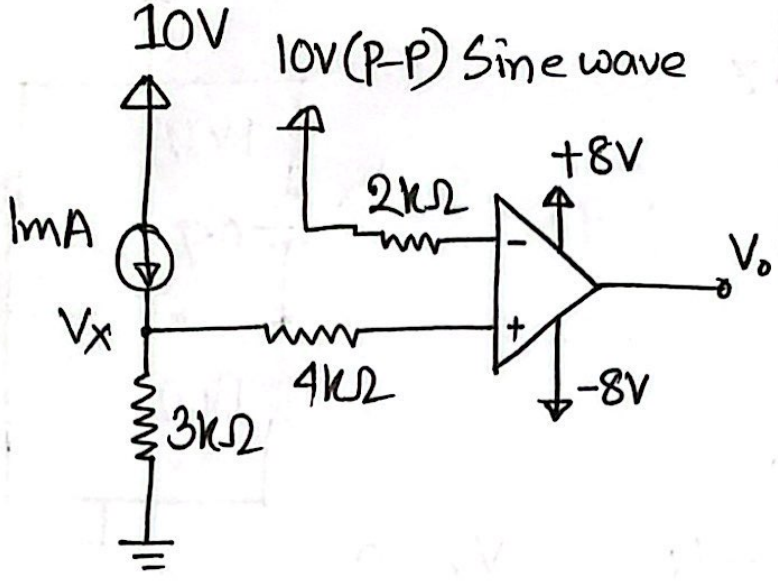
Same as Set-01

Set-01

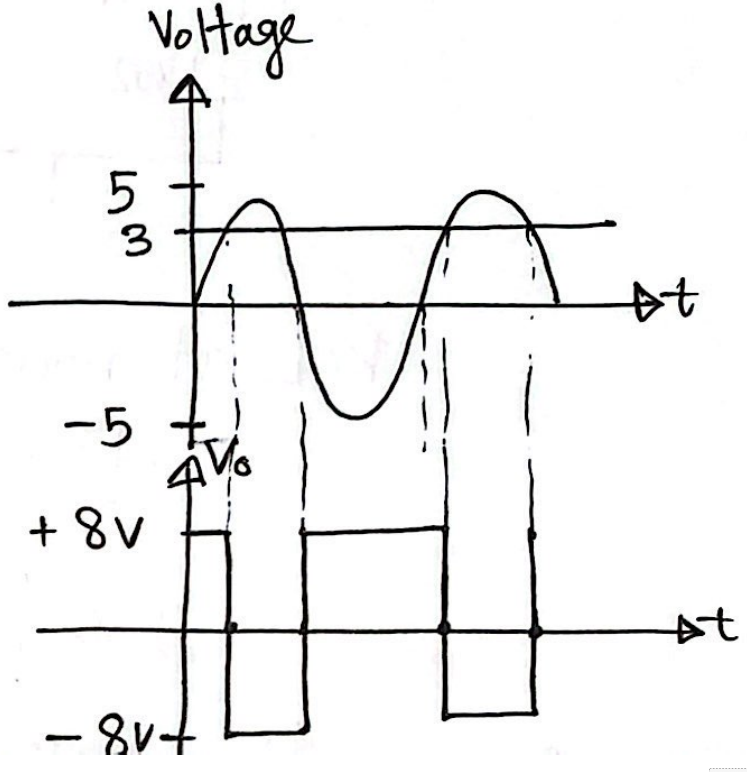
Calculation of Vx - 1
Waveform drawing - 3
Graph Label - 1

Q2

(a)



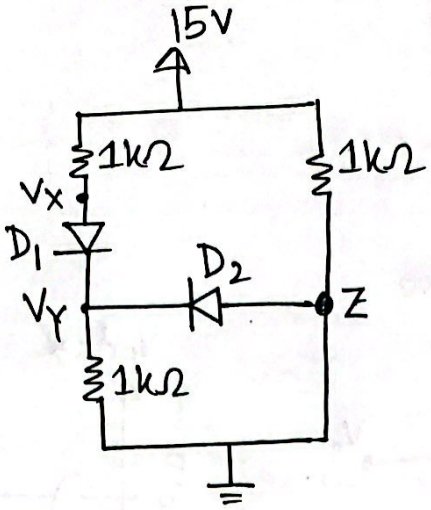
$$V_x = (1 \times 3)\,V = 3V$$



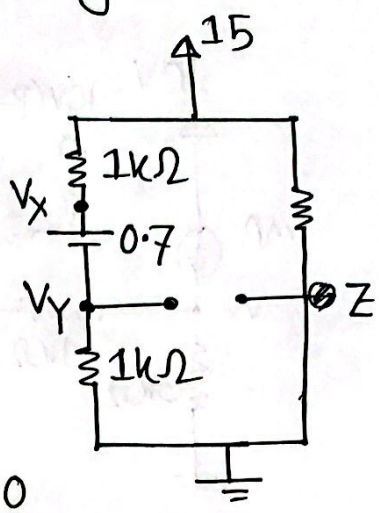
(b)

Vx - 1
Vy - 1
Id1 - 1
Id2 - 1

Valdating Assumption - 1



Assuming D_1 on and D_2 off



If the whole math is wrong due to a single variable, just penalize for that quantity & give the rest of the mark.

if the assumption is wrong but the process is ok, give 3 out of 5.

KCL at node Y-

$$\frac{15-0.7-V_Y}{1} = \frac{V_Y-0}{1}$$

$$\Rightarrow \boxed{V_Y = 7.15\,V} \qquad \therefore \boxed{V_X = 7.85\,V}$$

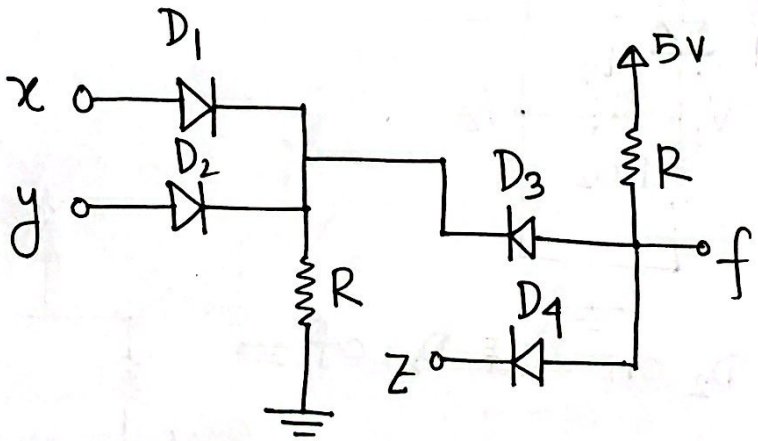
Assumption validation:-

$$\boxed{I_{D1} = 7.15\,mA \\ I_{D2} = 0\,mA}$$

$$I_{D1} = \frac{15-7.15-0.7}{1} > 0$$

$$V_{D2} = V_Z - V_Y = 0 - 7.15 < V_{D02}$$

(c)

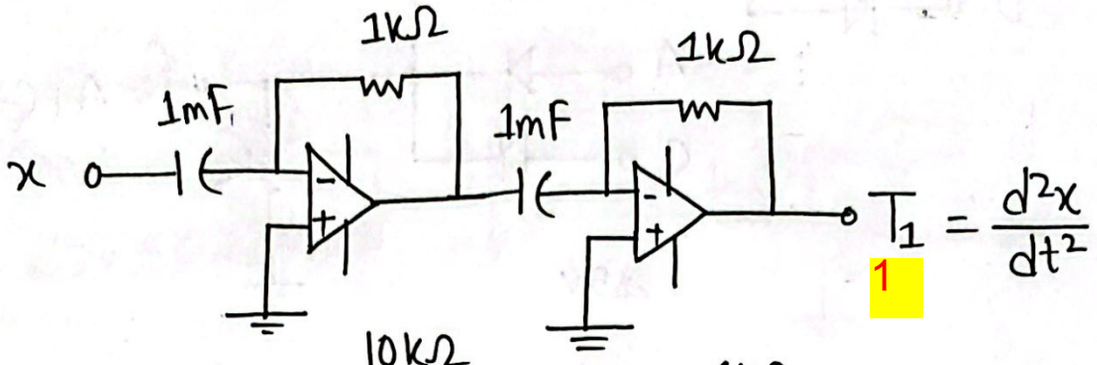


$$\boxed{f = (x|y).z} \quad \text{or} \quad \boxed{f = (x+y).z}$$ 1

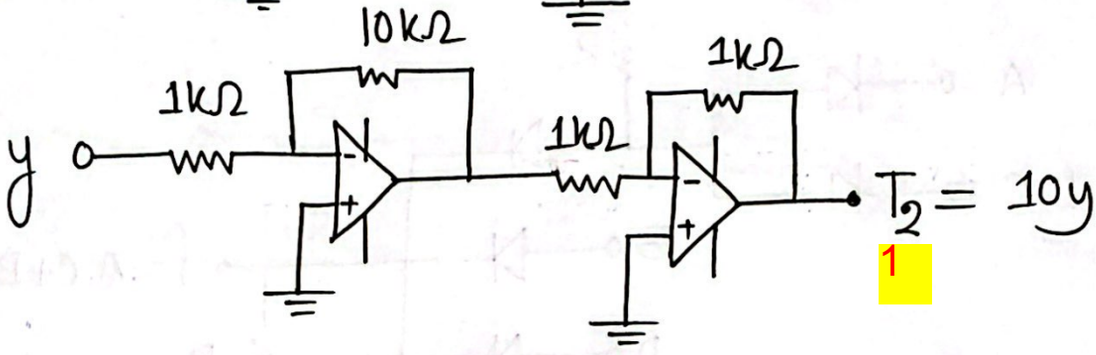
you can give 0.5 out of 1 if they can identify the OR gate / the AND gate but the function is not fully correct.

Q3

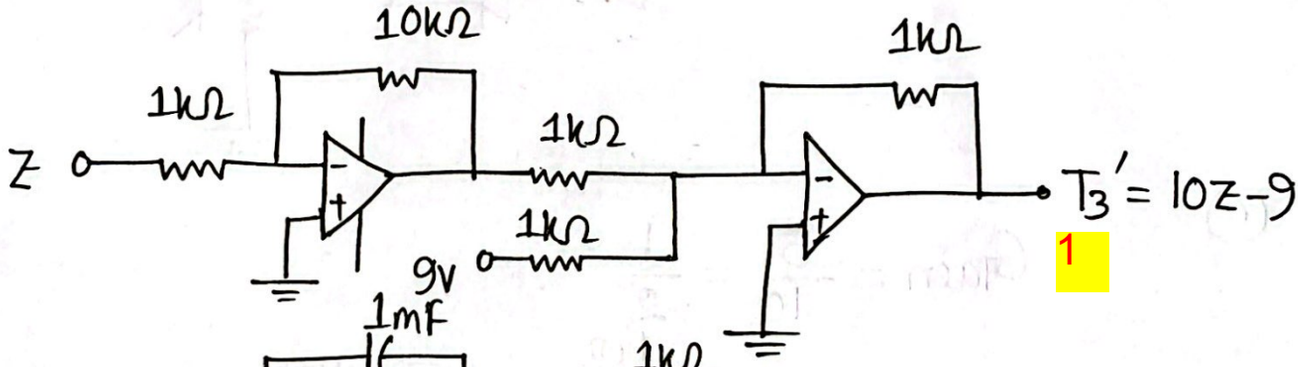
(a) $f = \frac{d^2x}{dt^2} + 10y + \int \underbrace{(10z-9)}_{T_3'} dt$



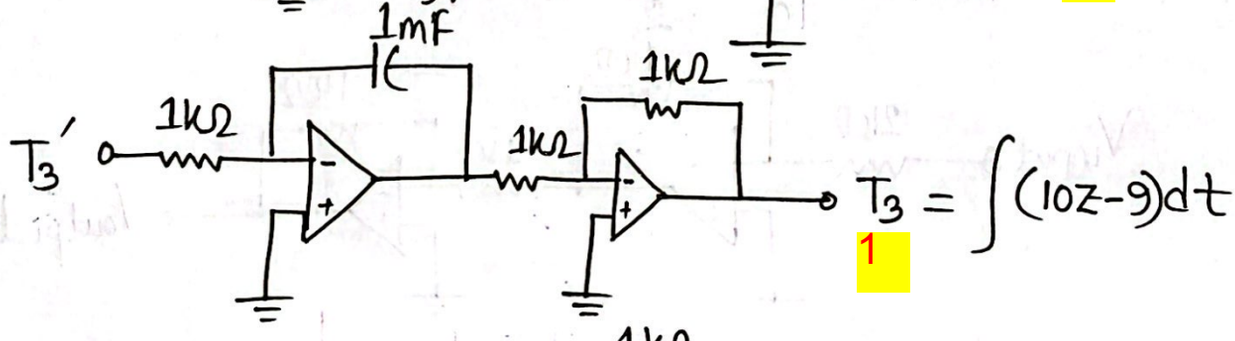
1



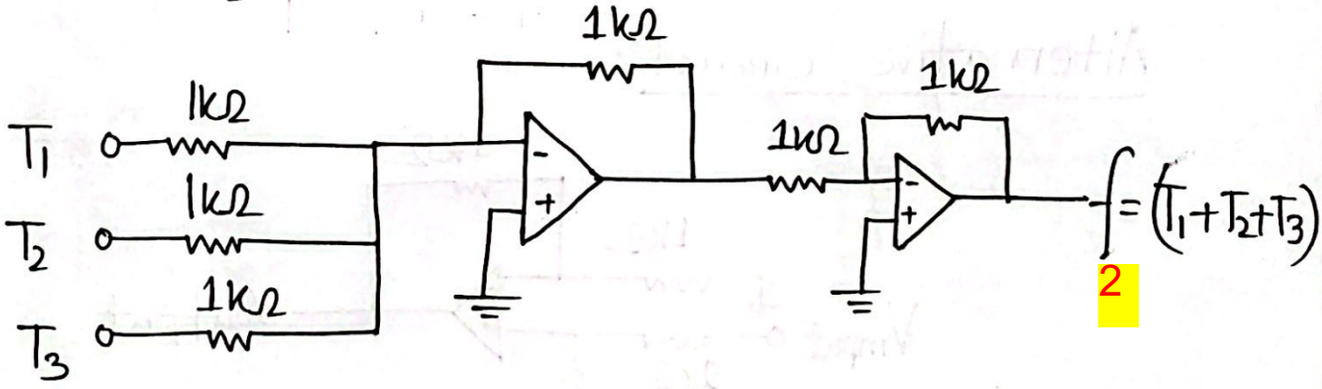
1



1



1

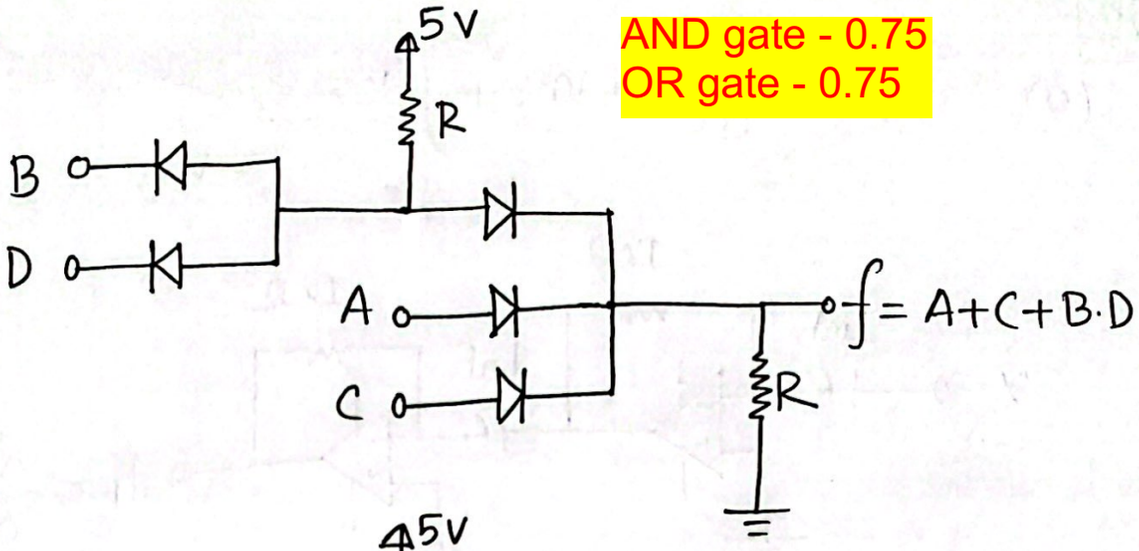


2

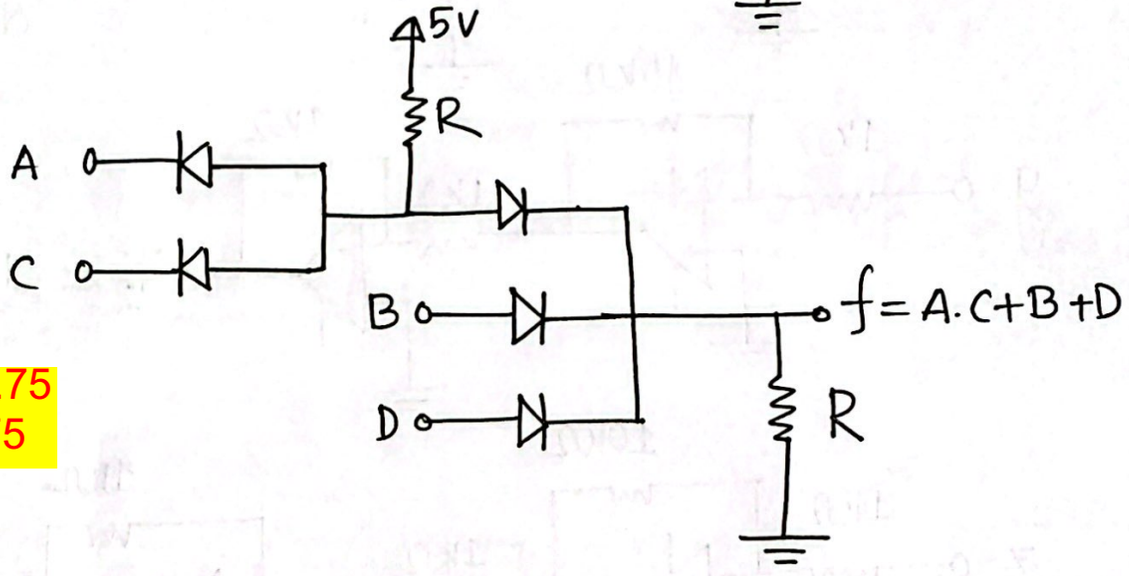
(b)

AND gate - 0.75
OR gate - 0.75

1.



2.

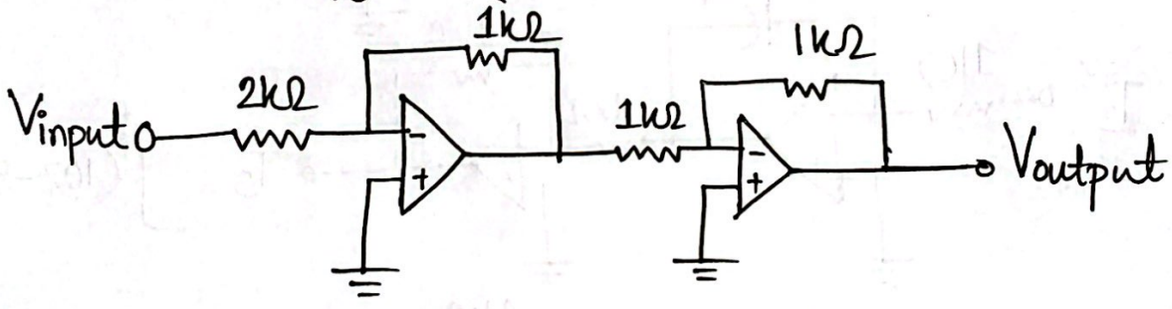


AND gate - 0.75
OR gate - 0.75

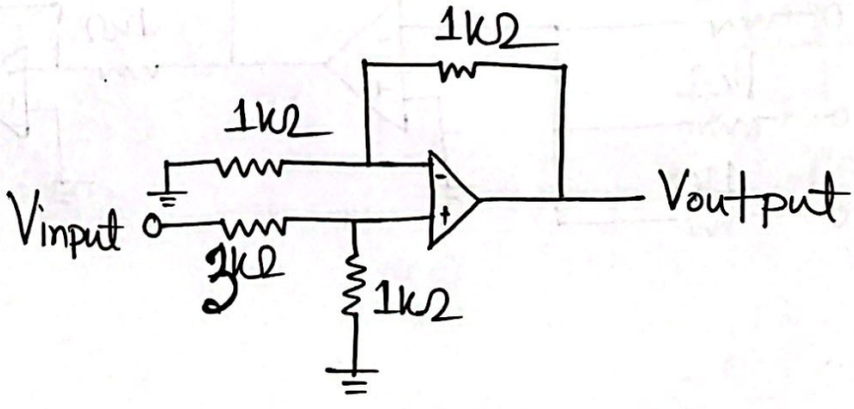
(c)

Gain Calculation - 1
Ckt Implementation - 1

$$\text{Gain} = \frac{5}{10} = \frac{1}{2}$$



Alternative circuit:-

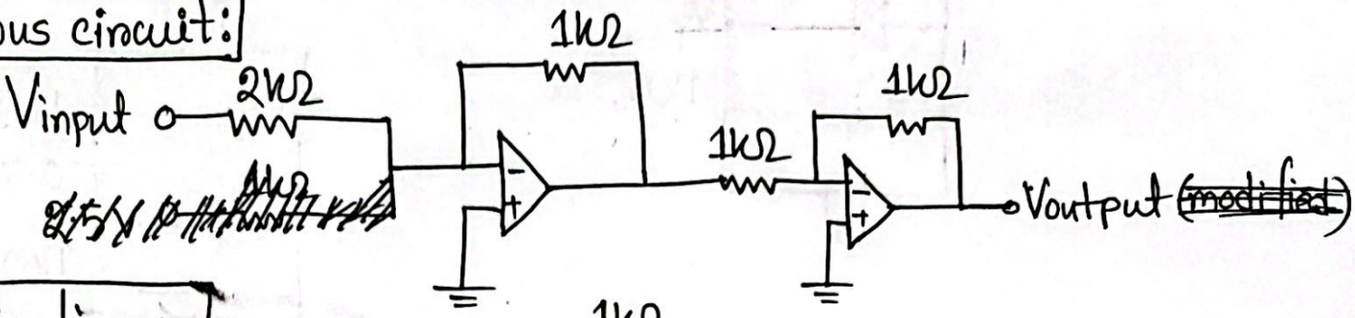


(d) $V_{output(modified)} = 2.5 + V_{output}$

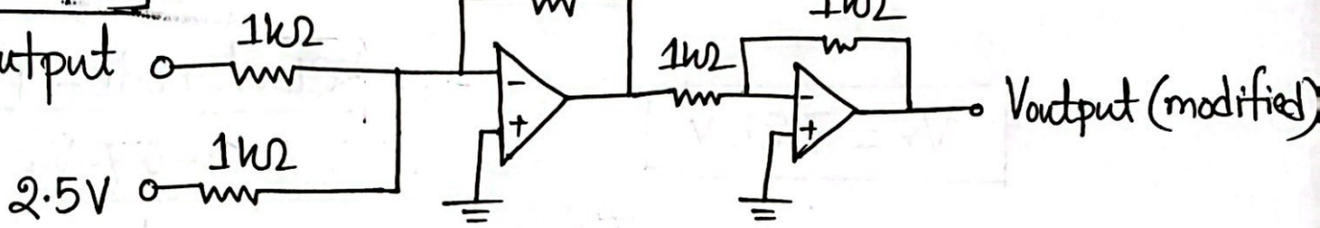
Equation Formulation - 1
Ckt Implementation - 1

A possible modification-

Previous circuit:



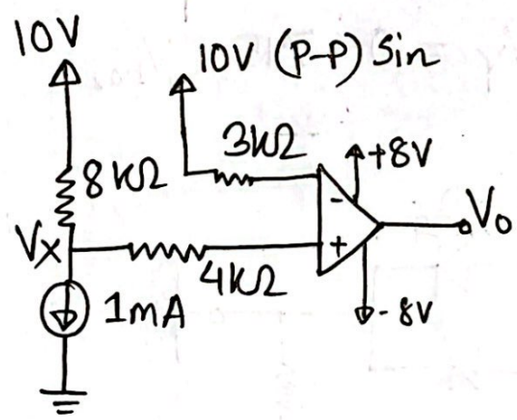
modifications:



Set 02

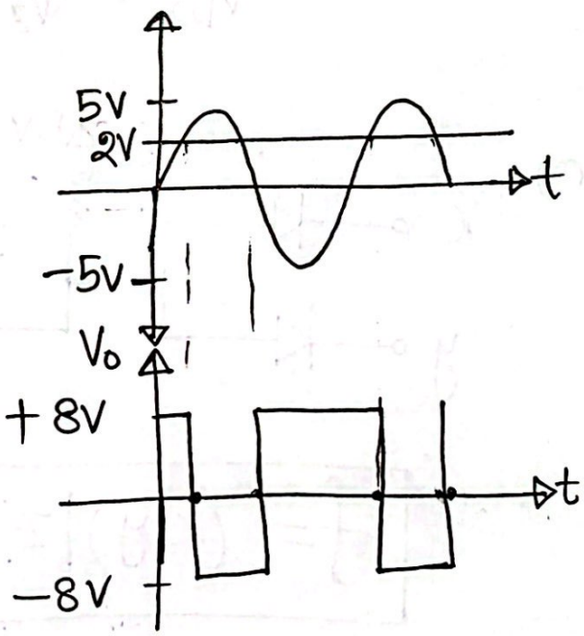
SET-02 Evaluation Rubric will be similar to the one found in SET-01

2. (a)

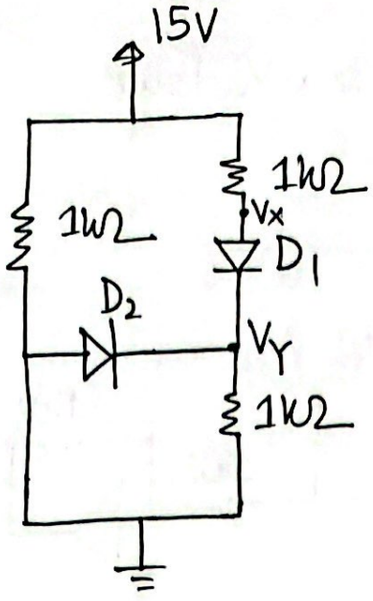


$$\frac{10 - V_x}{8} = 1$$

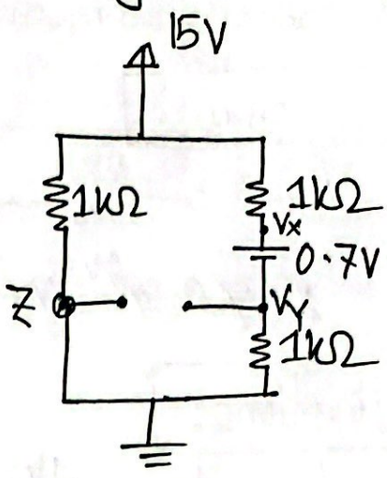
$$\Rightarrow \boxed{V_x = 2V}$$



(b)



Assuming D_1 on ~~a~~ and D_2 off



KCL at node-Y

$$\frac{15-0.7-V_y}{1} = \frac{V_y-0}{1}$$

$$\Rightarrow \boxed{V_y = 7.15\ V}$$

$$\therefore \boxed{V_x = 7.85\ V}$$

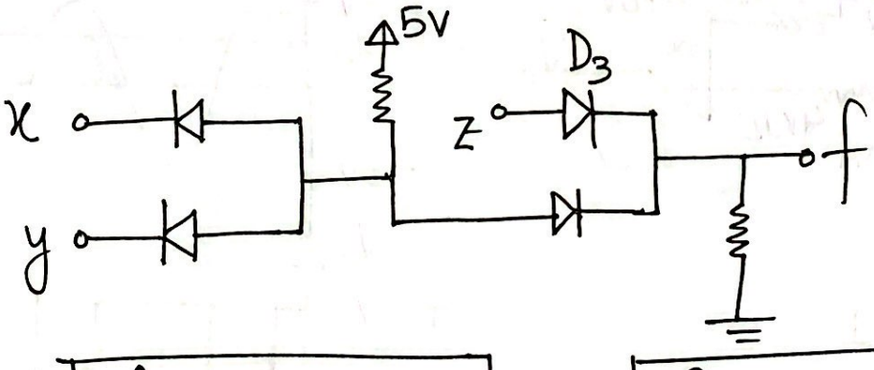
Assumption Validation:-

$$I_{D1} = \frac{15-7.15-0.7}{1} > 0$$

$$V_{D2} = V_Z - V_Y = 0 - 7.15 < V_{D02}$$

$$\boxed{I_{D1} = 7.15\,mA}$$
$$\boxed{I_{D2} = 0\,mA}$$

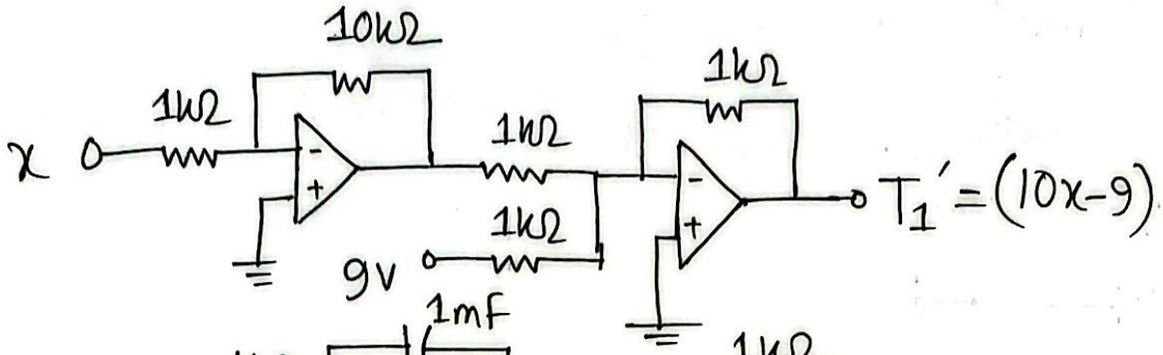
(c)

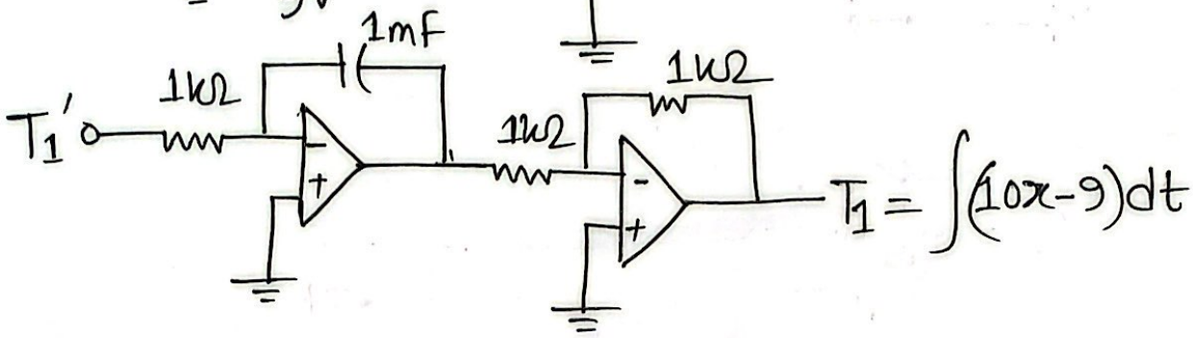


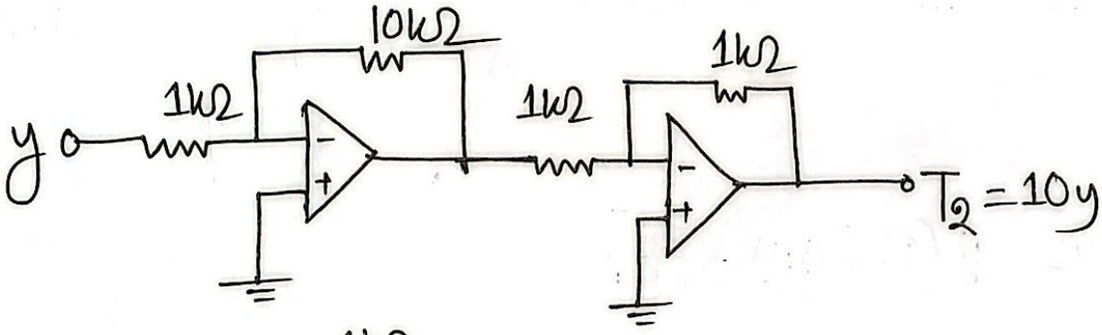
$$\boxed{f = (x \cdot y) | z} \quad \text{or} \quad \boxed{f = (x \cdot y) + z}$$

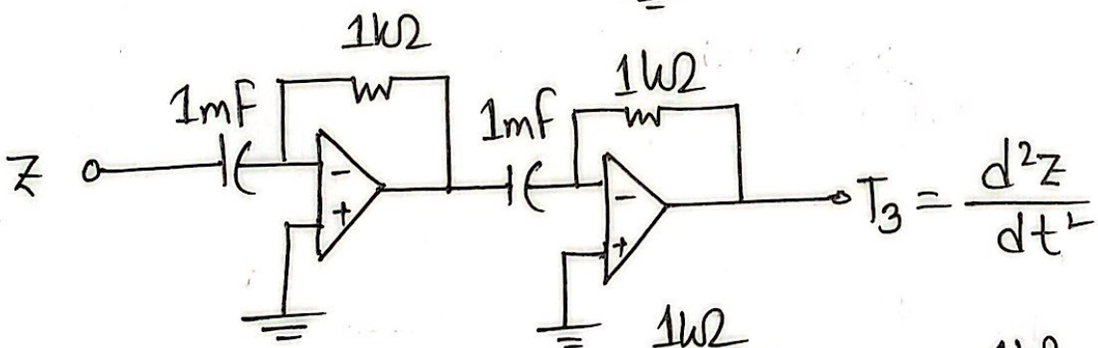
Q3

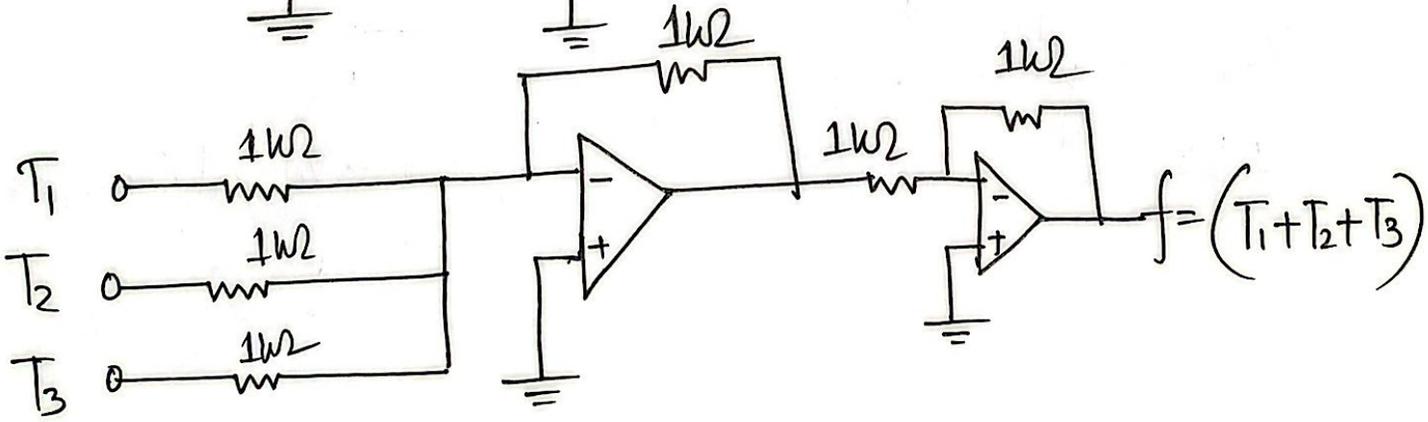
(a) $f = \int \underbrace{(10x-9)}_{T_1'} dt + 10y + \frac{d^2z}{dt^2}$





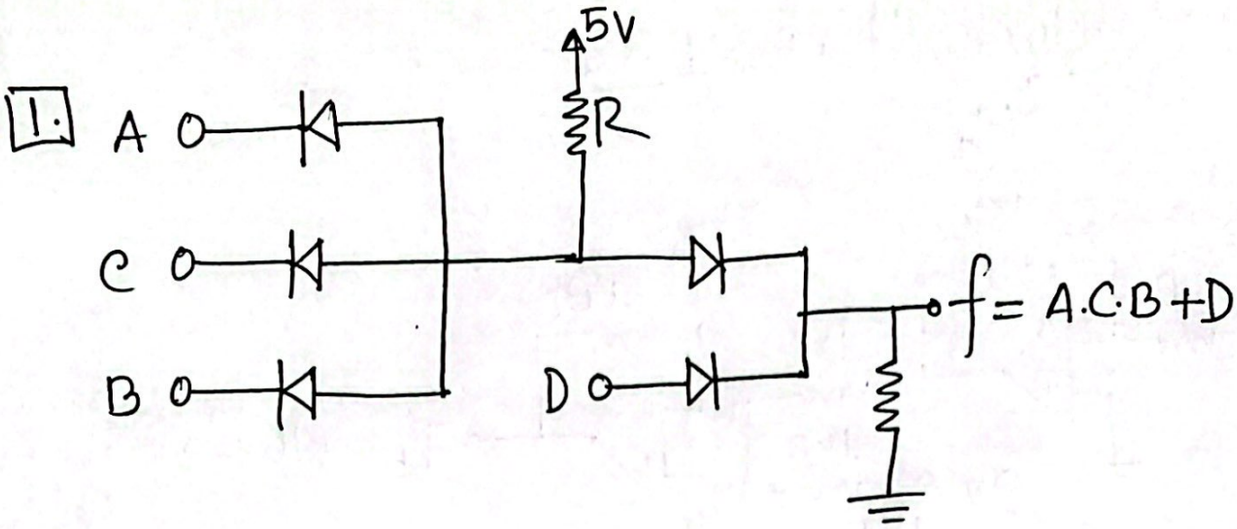




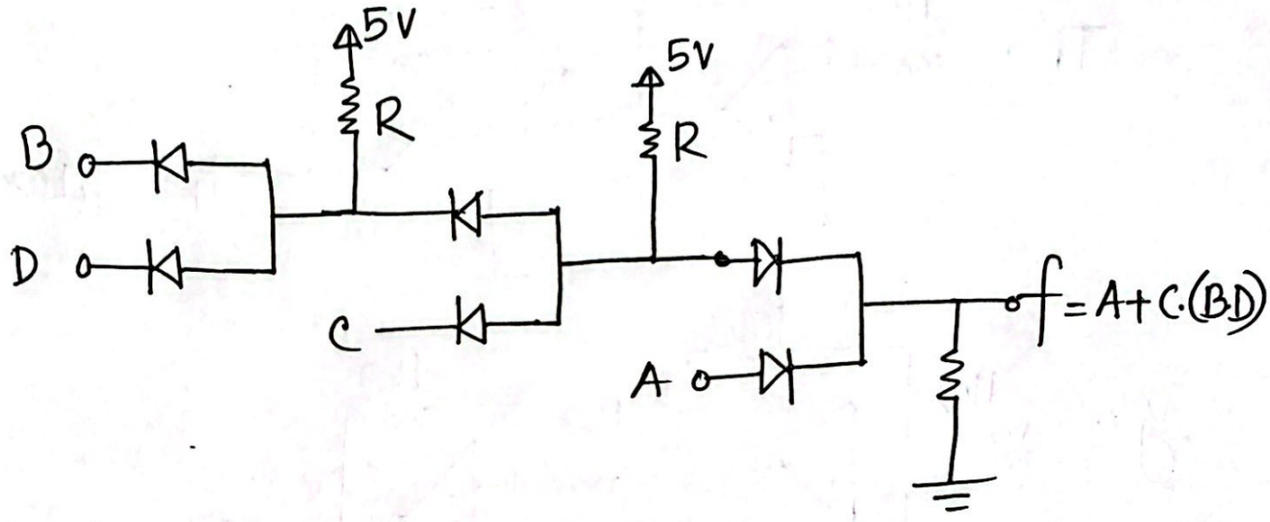


b)

1.



2.



(c) same as 3(c) [set 01]

(d) $V_{output\ (mod)} = -2.5 + V_{output}$.

modifications:-