1(a)

Given, the light should be ON if it goes below 20 Lux (at dusk).

20 lux = 2V

0 lux = 1V

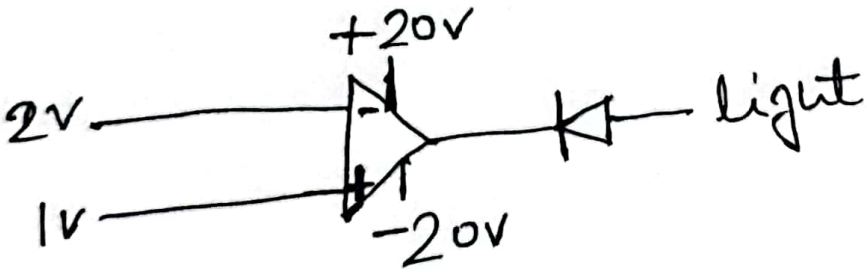
80 lux = 3V

$V_+ < 2V$

$V_+ = 1V$

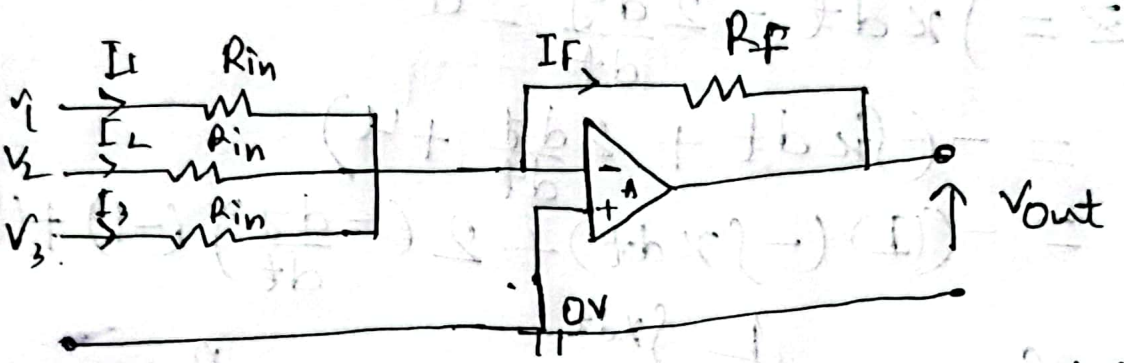
$V_- > 2V$

$V_- = 2V$



1(b)

It is an inverting adder.



$V_1 = 1V$, $V_2 = 2V$ and $V_3 = 1.5V$

Let, $R_{in} = R_f = 10\,k\Omega$

$$V_0 = -\left(\frac{R_f}{R_{in}} V_1 + \frac{R_f}{R_{in}} V_2 + \frac{R_f}{R_{in}} V_3\right)$$

$$= -\left(\frac{10}{10} \times 1 + \frac{10}{10} \times 2 + \frac{10}{10} 1.5\right)$$

$$= -(1+2+1.5)$$

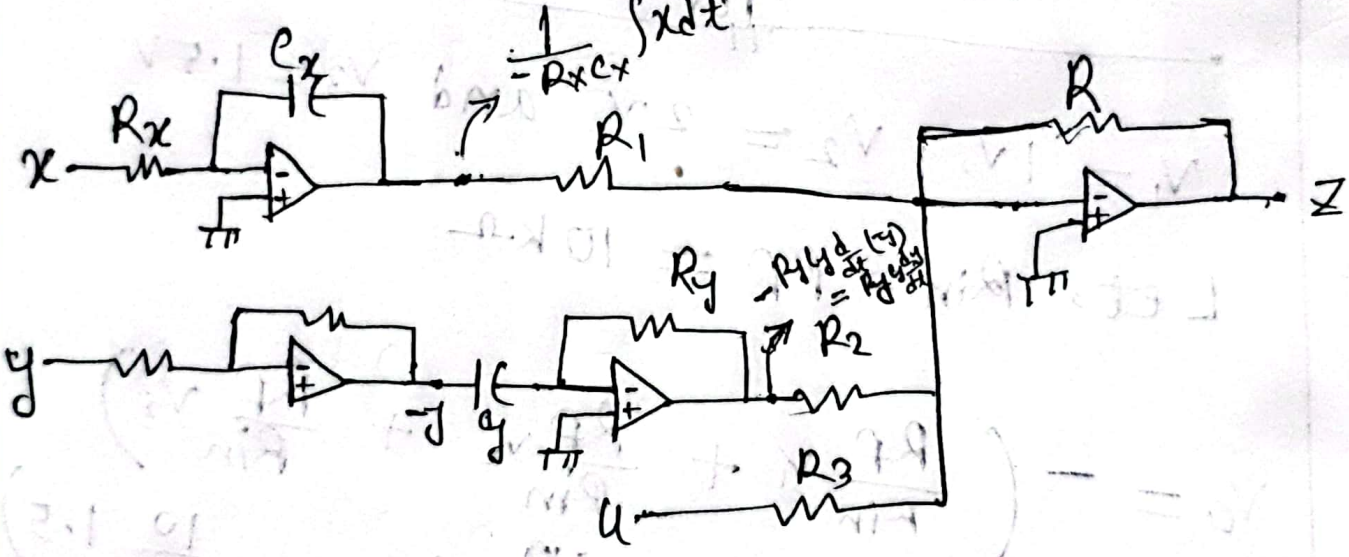
$$= -4.5\,V$$

1(c)

(i) $z = \int x\,dt - 2\frac{dy}{dt} - u$

$= -\left(-\int x\,dt + 2\frac{dy}{dt} + u\right)$

$= -\left((1)\left(-\int x\,dt\right) + 2\left(-\frac{dy}{dt}\right)(-1) + (1)(u)\right)$



Here,

$\frac{-1}{R_x C_x} = -1$

Let, $C_x = 47\,\mu F$

$\therefore R_x = 21.2766\,k\Omega$

Again, $-R_y C_y = -1$

Let, $C_y = 47\,\mu F$

$\therefore R_y = 21.2766\,k\Omega$

Again, $\frac{R}{R_1} = 1$, $\frac{R}{R_2} = 2$, $\frac{R}{R_3} = 1$.

Let, $R = 10k\Omega$

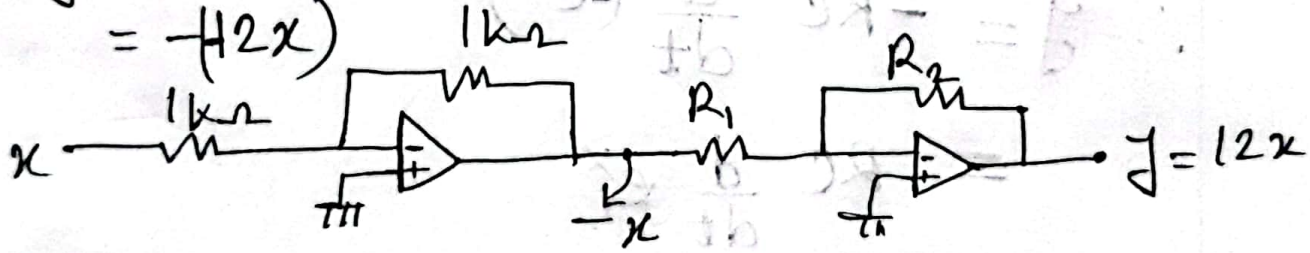
$\therefore R_1 = 10k\Omega$

$R_2 = 5k\Omega$

$R_3 = 10k\Omega$

(ii) $y = 12x$

$= -(-12x)$

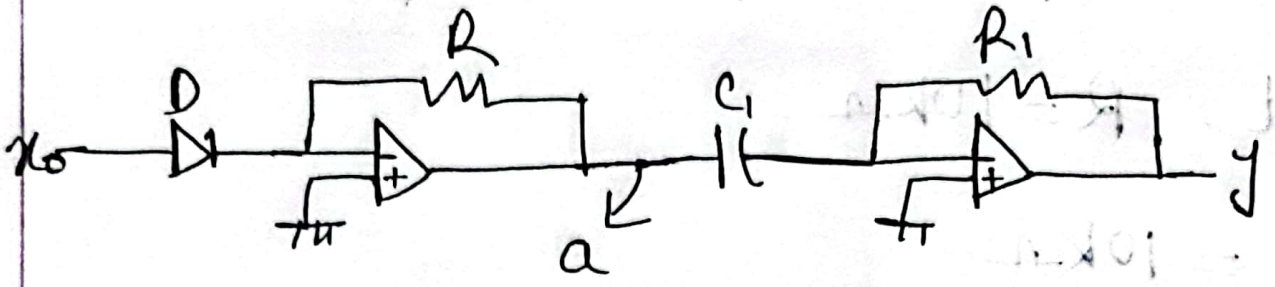


here, $-\frac{R_2}{R_1} = -12$

Let, $R_1 = 1k\Omega$

$\therefore R_2 = 12k\Omega$.

1(d)



Given, $I_S R = 1$ and $V_T = 1$

$$a = -I_S R \exp\left(\frac{x}{V_T}\right)$$

$$\Rightarrow a = -\exp(x)$$

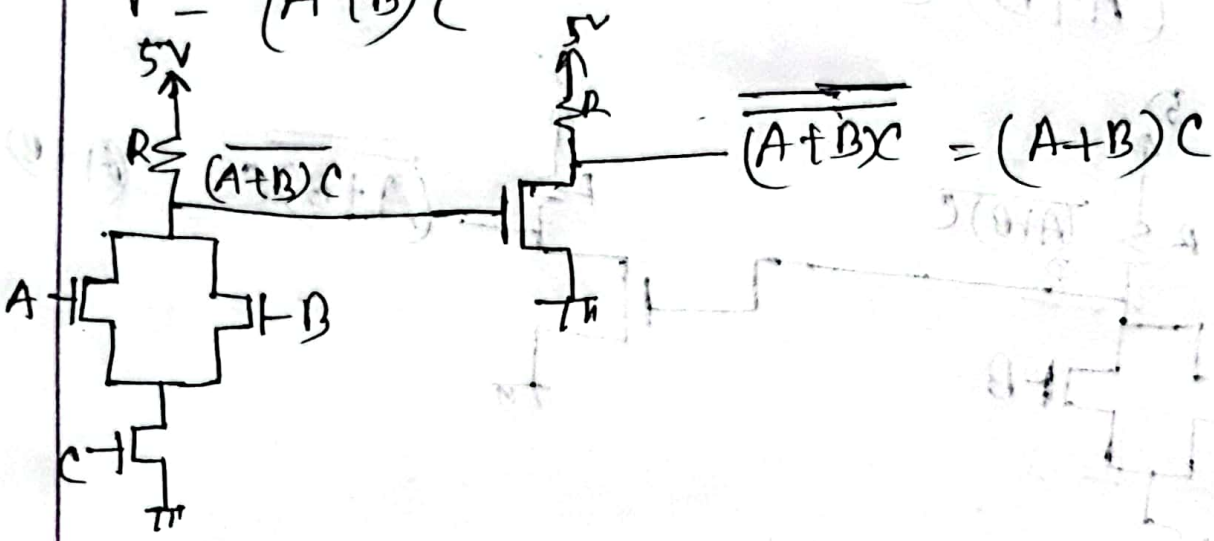
$$\therefore y = -RC \frac{d}{dt}(-e^x)$$

$$= RC \frac{d}{dt} e^x$$

Answer To The Question No! 2

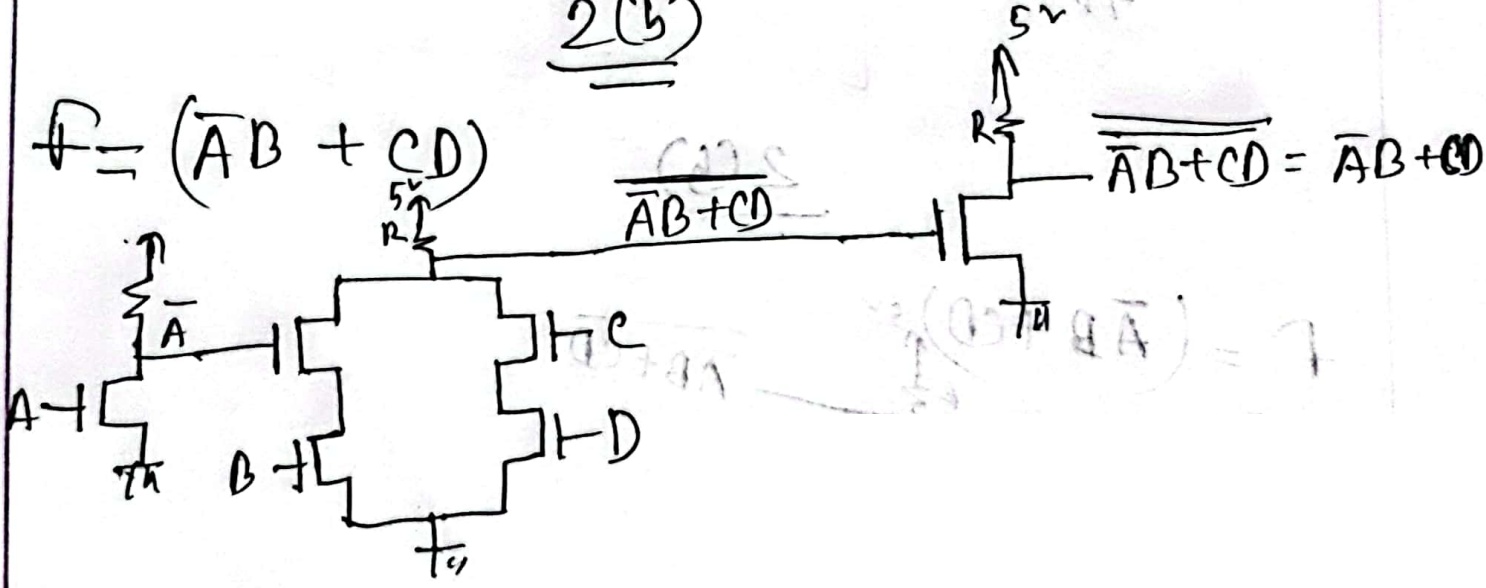
2(a)

$f = (A+B)C$



2(b)

$f = (\bar{A}B + CD)$

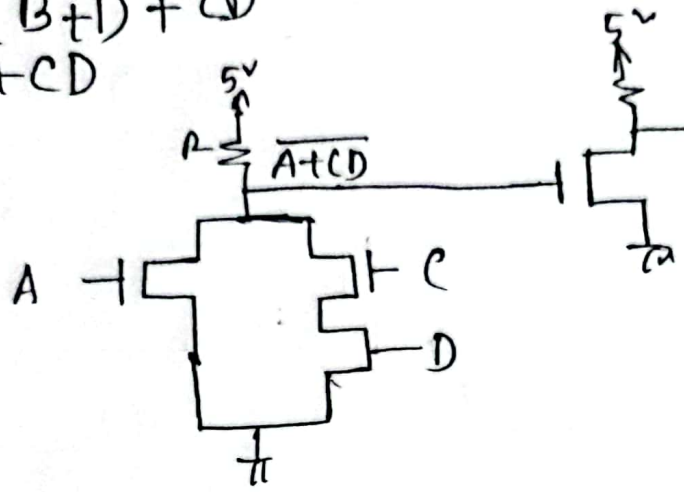


2(c)

$f = AB + A + CD$ (with simplification)

$= A(B+1) + CD$

$= A + CD$



$f = AB + A + CD$ (without simplification)