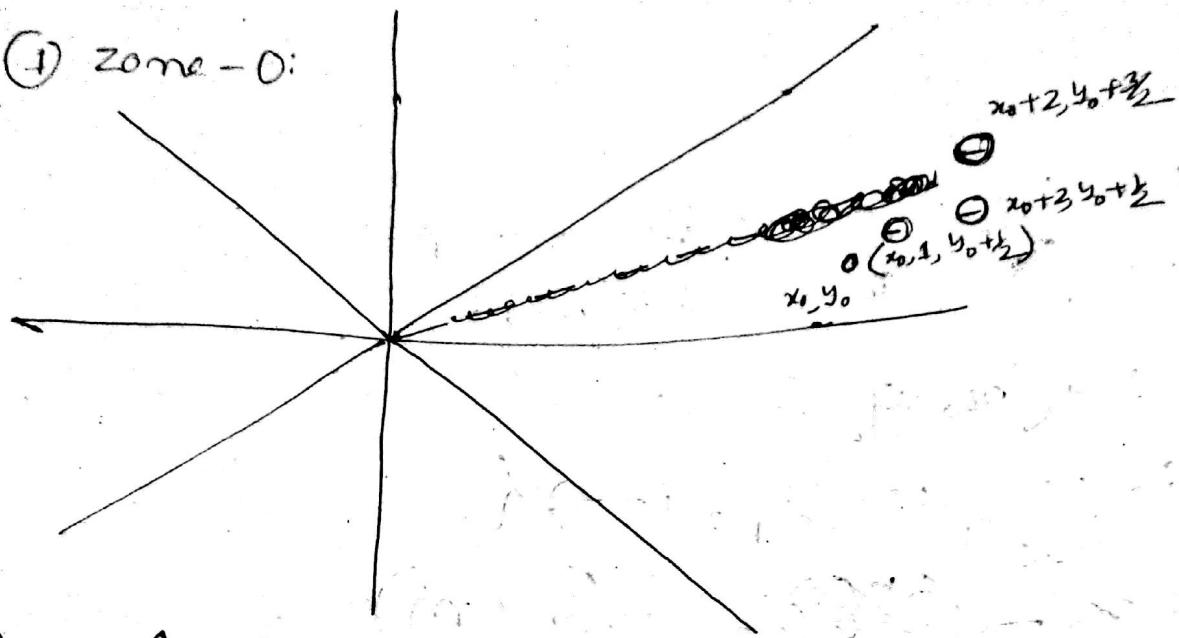


mid point Line drawing

① zone-0:



$$So, Ax + By + C = 0$$

$$\Rightarrow dy \propto x + (-dx)y + C = 0$$

so, midpoint + M(x₀+1, y₀+1/2)

M₁ (x₀+2, y₀+1/2)

M₂ (x₀+2, y₀+3/2)

$$f(M) = A(x_0+1) + B(y_0+1/2) + C$$

$$\Rightarrow d = A + \frac{B}{2} = dy - \frac{dx}{2} =$$

$$f(M_1) = A(x_0+2) + B(y_0+1/2) + C$$

$$= 2A + \frac{B}{2} = 2dy - \frac{dx}{2}$$

$$\begin{aligned}
 f(M_2) &= A(x_0 + 2) + C(y_0 + \frac{3}{2}) + D \\
 &= 2A + \frac{3B}{2} \\
 &= 2dy - \frac{3dx}{2}
 \end{aligned}$$

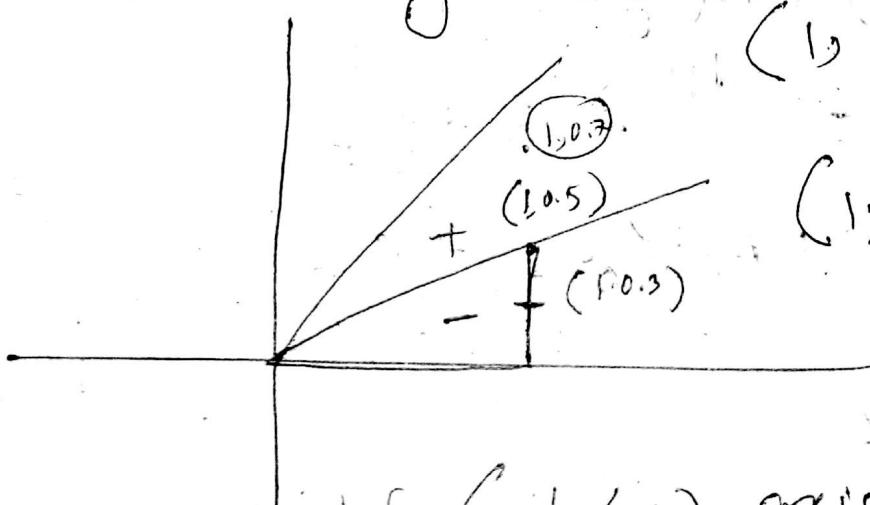
No, axis does change

$$\begin{aligned}
 f(M_1) - f(M) &= 2dy - \frac{dx}{2} - dy + \frac{dx}{2} \\
 \Rightarrow dE &= dy
 \end{aligned}$$

~~if~~ diagonal does change

$$\begin{aligned}
 f(M_2) - f(M) &= 2dy - \frac{3dx}{2} - dy + \frac{dx}{2} \\
 \Rightarrow dNE &= dy - \frac{2dx}{2} \\
 &= dy - dx
 \end{aligned}$$

now taking a mid line

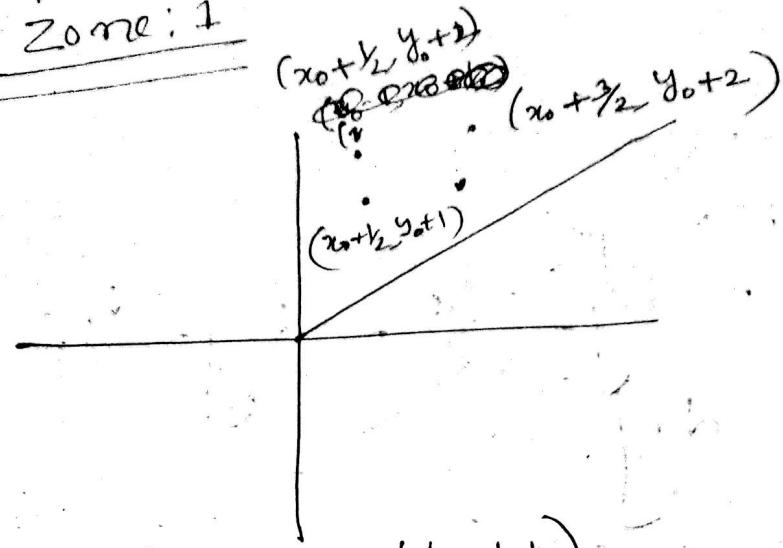


$$\begin{aligned}
 (1, 0.3) \rightarrow f(M) &= 0.3 - 0.5 \\
 &\equiv -0.2 \leftarrow D \\
 (1, 0.7) \rightarrow f(M) &= 0.7 - \frac{1}{2} \\
 &\equiv 0.7 - 0.5 \\
 &= 0.2 \rightarrow D
 \end{aligned}$$

so, if ($d < 0$) axis does change
 $d = d + dE, x++$

else $d = d + dNE, x++, y++$

~~poisson~~
Zone: 1



$$M(x_0 + \frac{1}{2}, y_0 + 1)$$

$$M_1(x_0 + \frac{1}{2}, y_0 + 2)$$

$$M_2(x_0 + \frac{3}{2}, y_0 + 2)$$

$$f(M) = A(x_0 + \frac{1}{2}) + B(y_0 + 1) + C$$

$$\Rightarrow d = \frac{A}{2} + B = \frac{dy}{2} - dx$$

$$f(M_1) = A(x_0 + \frac{1}{2}) + B(y_0 + 2) + C$$

$$= \frac{A}{2} + 2B = \frac{dy}{2} - 2dx$$

$$f(M_2) = A(x_0 + \frac{3}{2}) + B(y_0 + 2) + C$$

$$= \frac{3A}{2} + 2B$$

$$= \frac{3dy}{2} - 2dx$$

~~diagonal~~ axis change

$$f(M_1) - f(M) = \frac{dy}{2} - 2dx - \frac{dy}{2} + dx$$

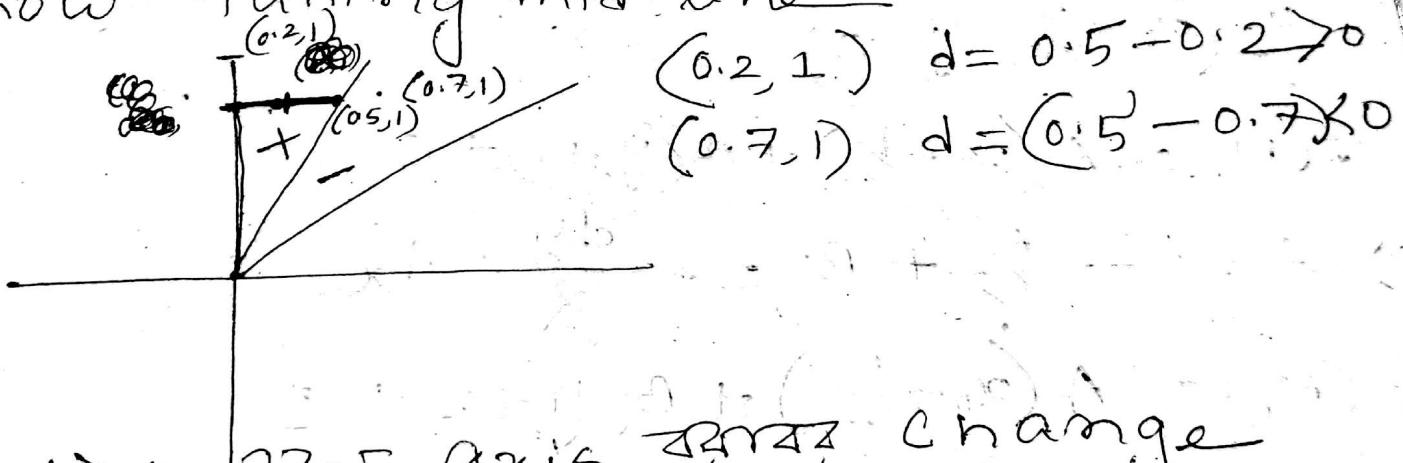
$$\Rightarrow dE = -dx$$

~~perp~~ diagonal axis change,

$$f(M_2) - f(M) = \frac{3dy}{2} - 2dx - \frac{dy}{2} + dx$$

$$= dy - dx$$

now taking mid line

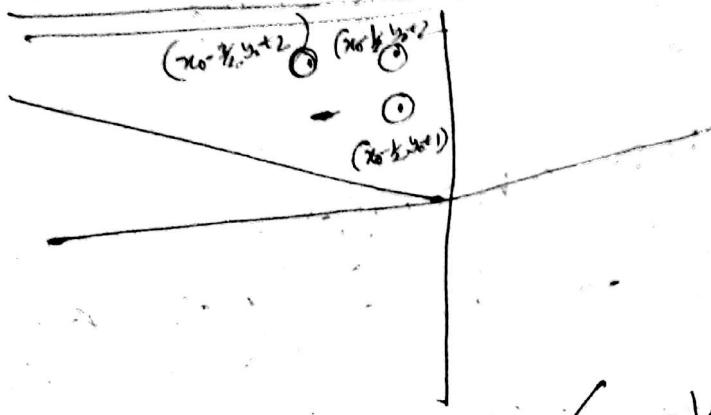


so, $d > 0$ 2nd axis change
 $d = d + dE$, $y++$

$d < 0$ 2nd diagonal axis change

$$d = d + dNE, y++ x++$$

for zone 2



$$M(x_0 - \frac{1}{2}, y_0 + 1) \quad M_1(x_0 - \frac{1}{2}, y_0 + 2)$$

$$M_2(x_0 - \frac{3}{2}, y_0 + 2)$$

$$f(M) = A(x_0 - \frac{1}{2}) + B(y_0 + 1) + C$$

$$\Rightarrow d = -\frac{A}{2} + B = -\frac{dy}{2} - dx$$

$$f(M_1) = A(x_0 - \frac{1}{2}) + B(y_0 + 2) + C$$

$$= -\frac{A}{2} + 2B = +\frac{dy}{2} - 2dx$$

$$f(M_2) = A(x_0 - \frac{3}{2}) + B(y_0 + 2) + C$$

$$= -\frac{3A}{2} + 2B$$

$$= -\frac{3dy}{2} - 2dx$$

axis error change

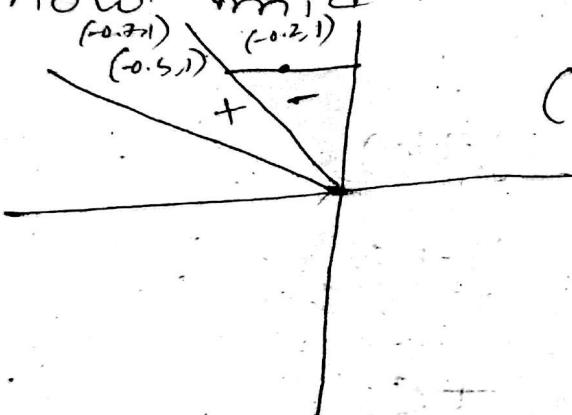
$$f(M_1) - f(M) = -\frac{dy}{2} - 2dx + \frac{dy}{2} + dx$$

$$\Rightarrow dE = -dx$$

diagonal zeros change,

$$f(M_2) - f(M) = -\frac{3dy}{2} - 2dx + \frac{dy + dx}{2}$$
$$= -dy - dx$$

* now mid line $(-0.2, 1)$ $d = -0.5 + 0.2 < 0$



$$(-0.7, 1), d = -0.5 + 0.7 > 0$$

so, if ($d < 0$) \rightarrow axis zeros change

$$d = d + dE \quad \cancel{y++},$$

else $d = d + dNE$

$$y++ \quad \cancel{x-} \quad \cancel{y-} \quad \cancel{x+}$$

$$x- \quad \cancel{y-} \quad \cancel{x+} \quad \cancel{y+}$$

$$x- \quad y- \quad \cancel{x+} \quad \cancel{y+}$$

and zeros change

else $d = d + dNE$

for zone 3

$(x_0 - 2, y_0 + \frac{3}{2})$

$(x_0 - 2, y_0 + \frac{1}{2})$

$M(x_0 - 1, y_0 + \frac{1}{2})$

$M_1(x_0 - 2, y_0 + \frac{1}{2})$

$M_2(x_0 - 2, y_0 + \frac{3}{2})$

$$f(M) = A(x_0 - 1) + B(y_0 + \frac{1}{2}) + C$$

$$\Rightarrow dE = -A + \frac{B}{2} = -dy - \frac{dx}{2}$$

$$f(M_1) = A(x_0 - 2) + B(y_0 + \frac{1}{2}) + C$$

$$= -2A + \frac{B}{2} = -2dy - \frac{dx}{2}$$

$$f(M_2) = A(x_0 - 2) + B(y_0 + \frac{3}{2}) + C$$

$$= -2A + \frac{3B}{2} = -2dy - \frac{3dx}{2}$$

so, axis is ~~axis~~ change

$$f(M_1) - f(M) = -2dy - \frac{dx}{2} + dy + \frac{dx}{2}$$

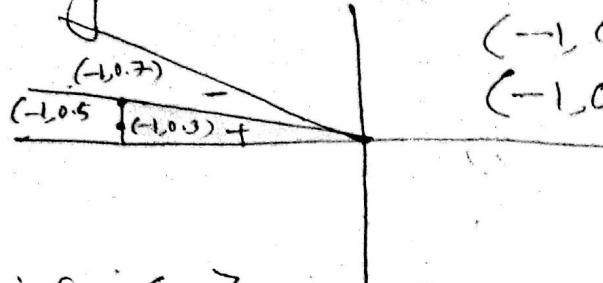
$$\Rightarrow dE = -dy$$

Taking $\frac{dx}{2}$

$$f(M_2) - f(M) = -2dy - \frac{3dx}{2} + dy + \frac{dx}{2}$$

$$\Rightarrow dNE = -dy - dx$$

taking mid line



$$(-1, 0.3) \quad d = -0.3 + 0.3 > 0$$

$$(-1, 0.7) \quad d = -0.7 + 0.3 < 0$$

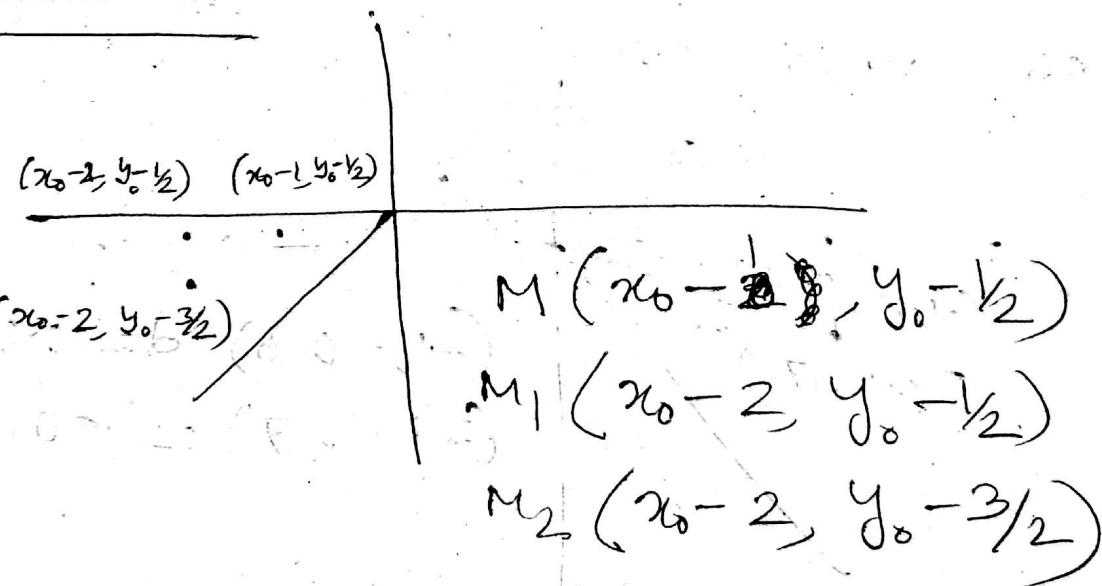
so, if $(d \neq 0)$ then axis area change

$$d = d + dE, x--$$

else $d = d + dNE$

$$x--, y++$$

for zone 4



$$f(M) = A(x_0-1) + B(y_0-1/2) + C$$

$$\Rightarrow d = -A - \frac{B}{2} = -dy + \frac{dx}{2}$$

$$f(M_1) = A(x_0-2) + B(y_0-1/2) + C$$

$$= -2A - \frac{B}{2} = -2dy + \frac{dx}{2}$$

$$f(M_2) = A(x_0 - 2) + B(y_0 - \frac{3}{2}) + C$$

$$= -2A - \frac{3B}{2}$$

$$= -2dy + \frac{3dx}{2}$$

so, axis ~~area~~ change $\frac{dx}{2} + dy - \frac{dx}{2}$

$$f(M_1) - f(M) = -2dy + \frac{dx}{2} + dy - \frac{dx}{2}$$

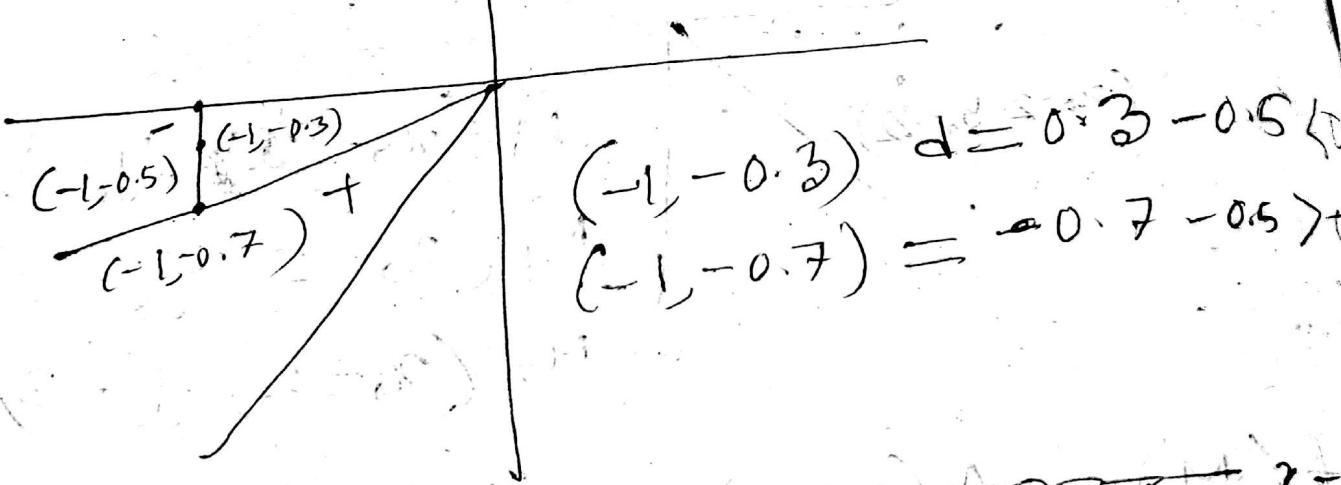
$$\Rightarrow dE = -dy$$

diagonal ~~area~~ change $\frac{3dx}{2} + dy - \frac{dx}{2}$

$$f(M_2) - f(M) = -2dy + \frac{3dx}{2} + dy - \frac{dx}{2}$$

$$\Rightarrow dNE = \cancel{\frac{3dx}{2}} - \cancel{dy}$$

now mid line



if $(d < 0)$ change axis ~~area~~ $d = d + dE$

~~else~~ else

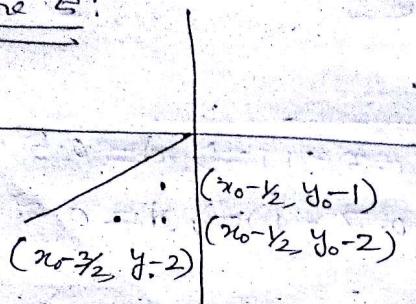
$$d = d + dNE$$

$x--$

$y--$



for zone 5:



$$M(x_0 - 1/2, y_0 - 1) \quad M_1(x_0 - 1/2, y_0 - 2) \quad M_2(x_0 + 3/2, y_0 - 2)$$

$$f(M) = A(x_0 - 1/2) + B(y_0 - 1) + C$$

$$= -A/2 - B = -\frac{dy}{2} + dx$$

$$f(M_1) = A(x_0 - 1/2) + B(y_0 - 2) + C$$

$$= -A/2 - 2B = -\frac{dy}{2} + 2dx$$

$$f(M_2) = A(x_0 + 3/2) + B(y_0 - 2) + C$$

$$= -3A/2 - 2B = -\frac{3dy}{2} + 2dx$$

so, ~~the~~ axis ~~area~~ change

$$f(M_1) - f(M) = -\frac{dy}{2} + 2dx + \frac{dy}{2} - dx$$

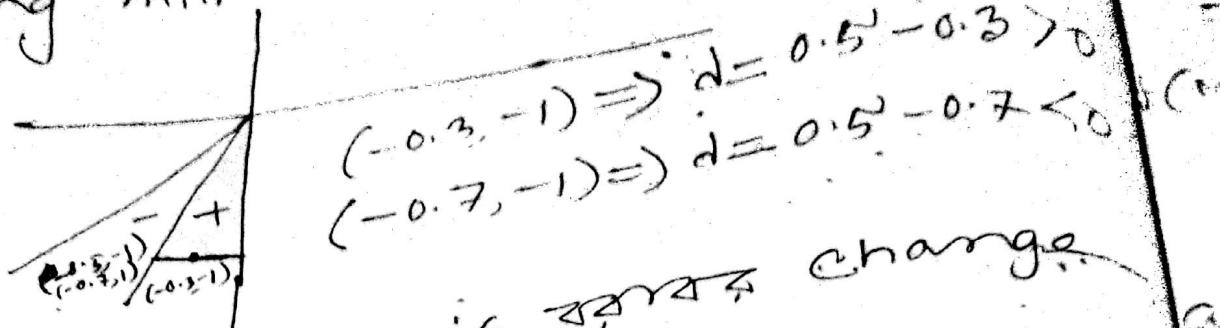
$$\Rightarrow dE = dx$$

diagonal ~~area~~ change

$$f(M_2) - f(M) = -\frac{3dy}{2} + 2dx + \frac{dy}{2} - dx$$

$$\Rightarrow dNE = -dy + dx$$

taking mid line



$$(-0.3, -1) \Rightarrow d = 0.5 - 0.3 > 0$$

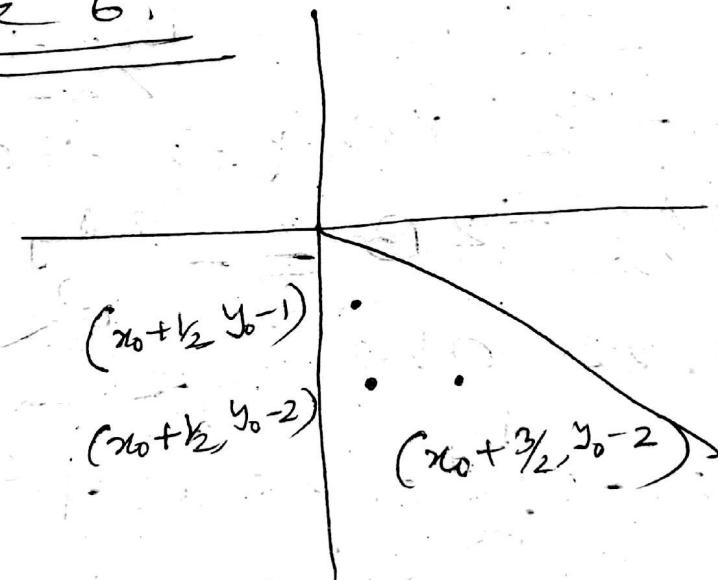
$$(-0.7, -1) \Rightarrow d = 0.5 - 0.7 < 0$$

so, $d > 0$ axis starts change
 ~~$y--$~~ $y--$

$$\text{else } d = d + dE$$

$$y--, x+-,$$

for zone 6:



$$M(x_0 + 1/2, y_0 - 1)$$

$$M_2(x_0 + 3/2, y_0 - 2)$$

$$M_1(x_0 + 1/2, y_0 - 2)$$

$$f(M) = A(x_0 + 1/2) + B(y_0 - 1) + C$$

$$= A/2 - B = \frac{dy}{2} + dx$$

$$(M_1) = A(x_0 + 1/2) + B(y_0 - 2) + C$$

$$= \frac{A}{2} - 2B = \frac{dy}{2} + 2dx$$

$$f(M_2) = A(x_0 + \frac{3}{2}) + B(y_0 - 2) + C$$

$$= -\frac{3A}{2} - 2B$$

$$= -\frac{3dy}{2} + 2dx$$

axis zeros change

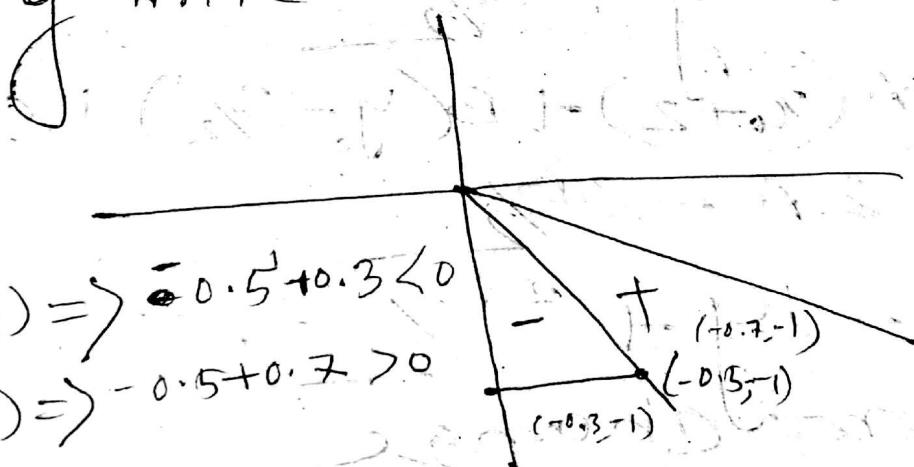
$$\textcircled{a} f(M_1) - f(M) = \frac{dy}{2} + 2dx - \frac{dy}{2} - dx$$

$$\Rightarrow dE = dx$$

$$f(M_2) - f(M) = -\frac{3dy}{2} + 2dx = \frac{dy}{2} - dx$$

$$\Rightarrow dNE = dy + dx$$

taking mid line



$$(0.3, 1) \Rightarrow 0.5 + 0.3 > 0$$

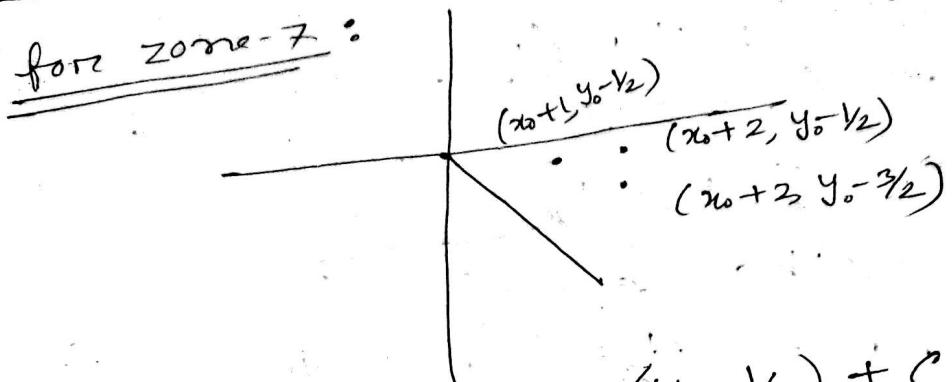
$$(-0.7, -1) \Rightarrow -0.5 + 0.7 > 0$$

so if $d(0)$ axis zeros change
 $d = d + dE, y -$

else $d = d + dNE$

$$y -, x ++$$

for zone-7:



$$f(M) = A(x_0 + 1) + B(y_0 - 1/2) + C$$

$$\Rightarrow d = A - \frac{B}{2} = dy + \frac{dx}{2}$$

$$f(M_1) = A(x_0 + 2) + B(y_0 - 1/2) + C$$

$$= 2A - \frac{B}{2}$$

$$= 2dy + \frac{3dx}{2}$$

$$f(M_2) = A(x_0 + 2) + B(y_0 - 3/2) + C$$

$$= 2A - \frac{3B}{2}$$

$$= 2dy + \frac{3dx}{2}$$

now, axis is ~~axis~~ change

$$f(M_1) - f(M) = 2dy + \frac{dx}{2} - dy - \frac{dy}{2}$$

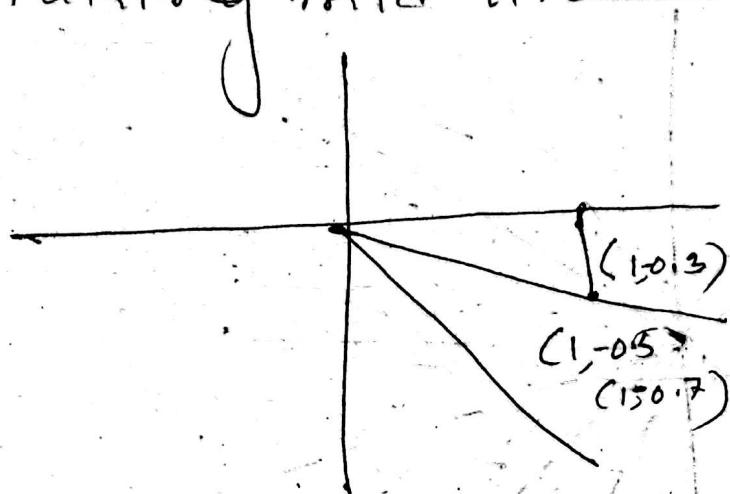
$$= dy$$

diagonal ~~axis~~ change

$$f(M_2) - f(M) = 2dy + \frac{3dx}{2} - dy - \frac{dx}{2}$$

$$= dy + dx$$

now taking mid line



$$(1, -0.3) \Rightarrow d = -0.3 + 0.5 > 0$$

$$(1, -0.7) \Rightarrow d = -0.7 + 0.5 < 0$$

if $(d < 0)$ then ~~Horizontal~~ axis change
 $d = d + dE, x++$

else $d = d + dNE, x++, y--$

~~summary~~

Summary:

