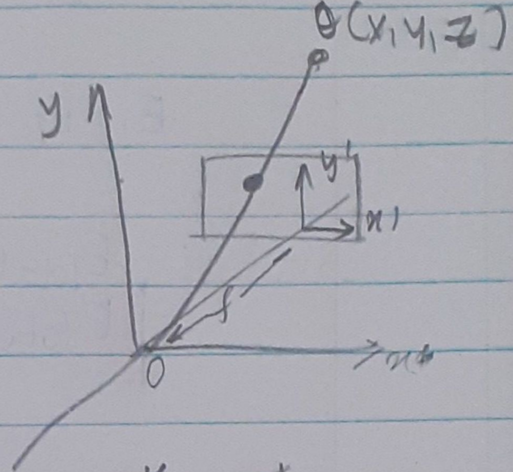
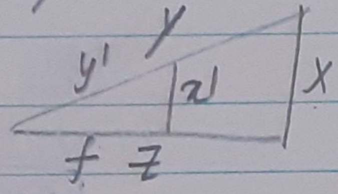
COMPUTER VISION
ASSIGNMENT-1

P1. a) $(x, y, 3) = (1, -3, 2) = (X, Y, Z)$



$\therefore\ x' = \frac{X}{Z} * f$

$= \frac{1}{2} * 28$



$x' = 14mm$

$y' = \frac{-3}{2} \times 28$

$y' = 42mm$ $\therefore\ \underline{(x', y') = (14, 42)mm}$.

b) $(X, Y, Z) = (2, -6, 4)$

$x' = \frac{2}{4} \times 28 = 14mm$

$y' = \frac{-6}{4} \times 28 = 42mm$ $\underline{(x', y') = (14, 42)mm}$

c) $(X, Y, Z) = (-1, 2, 7)$

$x' = \frac{-1}{7} \times 28 = -4mm$

$y' = \frac{2}{7} \times 28 = +8mm$ $\underline{(x', y') = (-4, 8)mm}$.

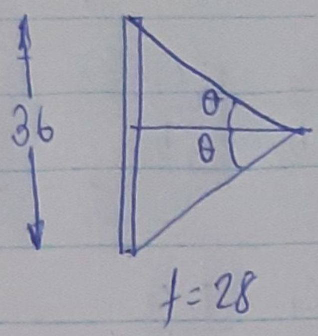
d) $(X, Y, Z) = (0, 0, 7)$

$x' = \frac{0}{7} \times 28 = 0$ $y' = \frac{0}{7} \times 28 = \underline{(x', y') = (0, 0)}$

e)

$$\theta = \tan^{-1}\left(\frac{36/2}{28}\right)$$

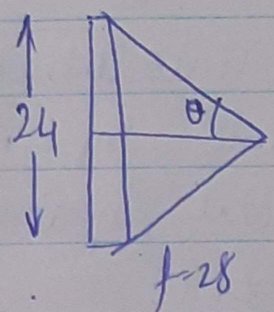
$$\theta = 32.73$$



$$2\theta = 32.73 \times 2$$

$\boxed{2\theta = 65.4^\circ}$ horizontal field.

f) $\theta = \tan^{-1}(12/28)$



$$\theta = 23.19$$

$\boxed{2\theta = 46.38^\circ}$ vertical field.

P2) $a_1 x + b_1 y + c_1 = 0$
$a_2 x + b_2 y + c_2 = 0$

Using Cramer's rule

$$\frac{x}{b_1 c_2 - b_2 c_1} = \frac{-y}{a_1 c_2 - a_2 c_1} = \frac{1}{a_1 b_2 - a_2 b_1}$$

$$\therefore x = \frac{b_1 c_2 - b_2 c_1}{a_1 b_2 - a_2 b_1}$$

$$y = \frac{a_2 c_1 - a_1 c_2}{a_1 b_2 - a_2 b_1}$$

$a_2 = 5 \quad b_2 = 6 \quad c_2 = 7$
$a_1 = 2 \quad b_1 = 3 \quad c_1 = 4$

b) $x = \dfrac{b_1c_2 - b_2c_1}{a_1b_2 - a_2b_1} = \dfrac{3\times7 - 6\times4}{2\times6 - 5\times3} = \dfrac{21-24}{12-15} = 1$

$y = \dfrac{a_2c_1 - a_1c_2}{a_1b_2 - a_2b_1} = \dfrac{5\times4 - 2\times7}{2\times6 - 5\times3} = \dfrac{20-14}{12-15} = -2$

$(x, y) = (1, -2)$

c) i) For 2 lines to be prallel we need to make sure $m_1 = m_2$ where m_1 & m_2 are slops of the Equation

$y = mx + c$

$y = -\dfrac{a_1}{b_1}x - \dfrac{c_1}{b_1}$

$y = -\dfrac{a_2}{b_2}x - \dfrac{c_2}{b_2}$

$\therefore \dfrac{a_1}{b_1} = \dfrac{a_2}{b_2}$ //

ii) And they shouldn't have the same intersection point

$c_1 \neq c_2$

$\therefore \dfrac{c_1}{b_1} \neq \dfrac{c_2}{b_2}$.

P3) a) Using the Taylor series Expression up to 2^{nd} order

$$f(x) = f(x_0) + f'(x_0)(x - x_0) + \frac{1}{2} f''(x_0)(x - x_0)^2$$

b) $f(x) = 4 + 3x + 2\sin(x)$

$$= 4 + 3x_0 + 2\sin x_0 + (3 + 2\cos x_0)(x - x_0) + \frac{1}{2}\{(x - x_0)^2(-2\sin x_0)\}$$

$$= 4 + \cancel{3x_0} + 2\sin x_0 + 3x - \cancel{3x_0} + 2x\cos x_0 - 2x_0\cos x_0$$
$$+ \frac{1}{2}\{-x^2\sin x_0 - x_0^2\sin x_0 + 2xx_0\sin x_0\}$$

$$= 4 + 3x + 2\sin x_0 + 2x\cos x_0 - 2x_0\cos x_0$$
$$+ \frac{1}{2}\{-x^2\sin x_0 - x^2\sin x_0 + 2xx_0\sin x_0\}$$

c) $$f(x,y) = f(a,b) + f_x(a,b)(x-a) + f_y(a,b)(y-b)$$
$$+ \frac{f_{xx}(a,b)}{2}(x-a)^2 + f_{xy}(a,b)(x-a)(y-b)$$
$$+ \frac{f_{yy}(a,b)}{2}(y-b)^2$$

d) $f(x,y) = 4 + 3x_0y_0 + 2\sin(y_0) = 4$

$f_x(x,y) = 3y_0 = 0$

$f_{xx}(x,y) = 0$

$f_{xy}(x,y) = 3$

$f_y(x,y) = 3x_0 + 2\cos y_0 = 2$

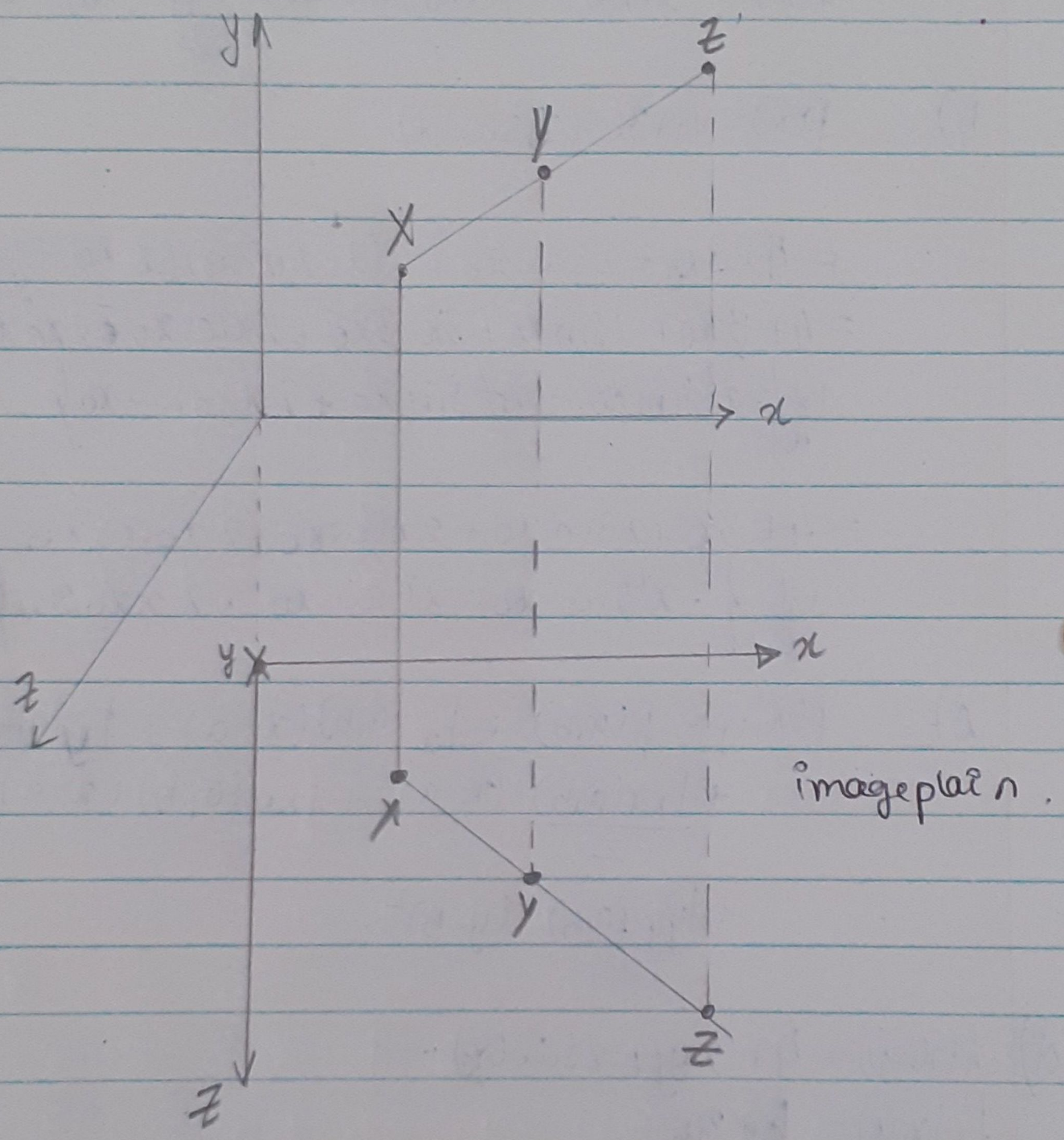
$f_{yy}(x,y) = -2\sin y_0 = 0$

$\therefore$ $f(a,b) + 3y_0(x-a) + (3x_0 + 2\cos y_0)(y-b) + \frac{1}{2}\{0\}$

$+ 3(x-a)(y-b) + \frac{1}{2}\{-2\sin y_0(y-b)^2\}$

$a=0$
$b=0$ $f(x,y) = 4 + 2y + 3xy.$

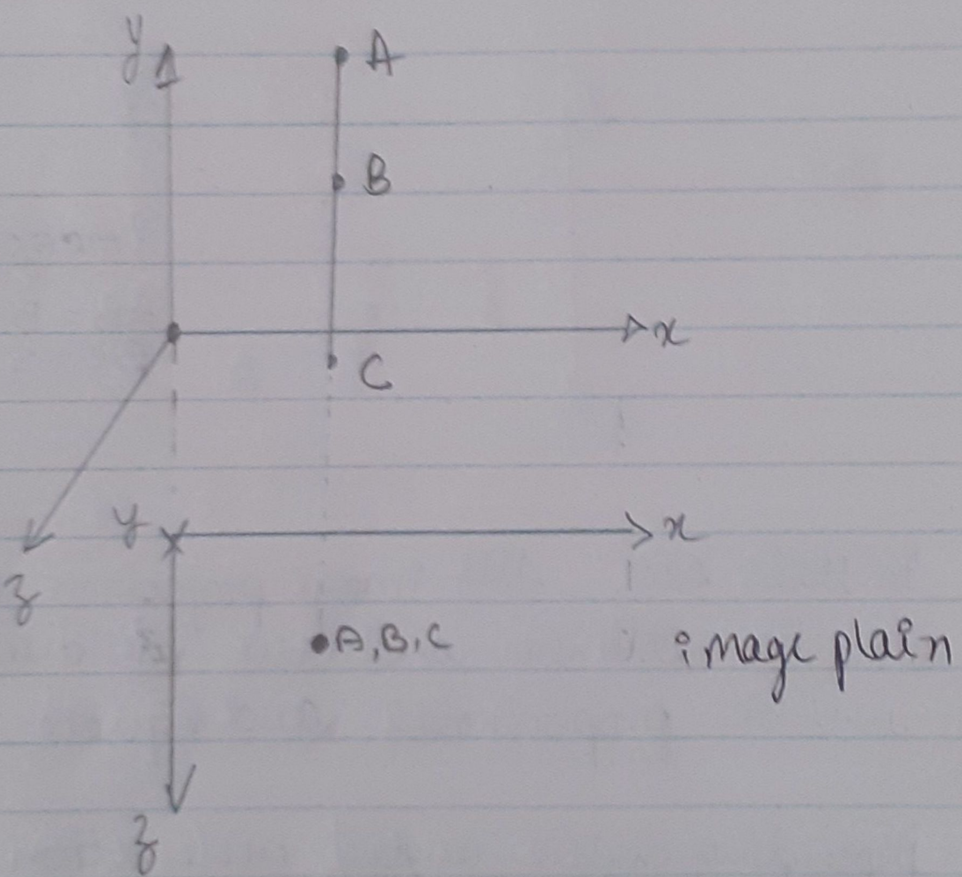
P4) a) Considering a 3D scene with X, Y, Z being the co-ordinates of the objects in space.



The points X, Y and Z in the x, y, z 3D plane are collinear then their projection on 2D plane with z, x co-ordinates are also collinear as shown in the above figure

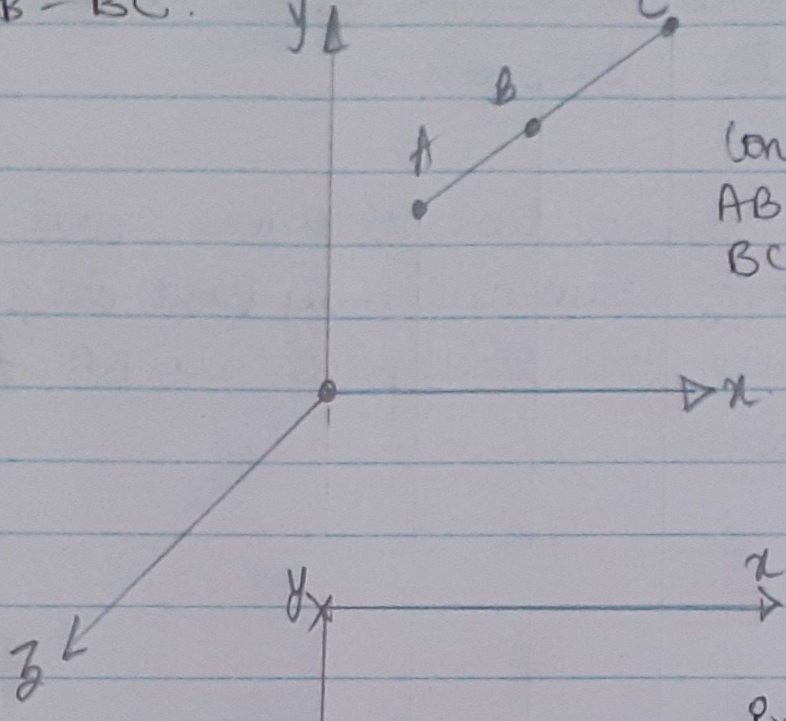
6b) There are cases in 2D plain where the points are not collinear even when they are collinear in 3D plain.

Let us assume that there are 3 point with fixed x, z values and only varies in z. When we see these point in 3D they are collinear.

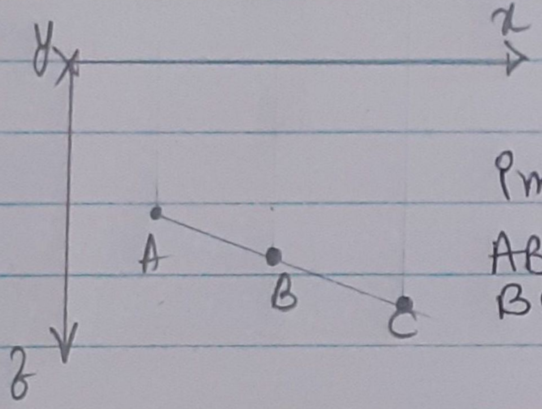


here we observe in the image plain the points dont seem to be collinear

P4 c) Let us consider a collinear point in 3D plain A, B & C and they are seperated with AB = BC.



Consider.
AB = 10cm
BC = 10cm.



Imageplan
AB = 5.5cm
BC = 5.5cm.

In this case the image projection will also be collinear and the distances will be proportional and Equale.

Depending on the angle of inclination the value is determined but the distan between AB and BC are Equale.

So YES the hypotisis that distan b/w AB & BC are same both in R^2 & R^3.