VIDYA BHAWAN BALIKA VIDYA PITH

शक्तिउत्थानआश्रमलखीसरायबिहार

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10. Find the angle between the x-axis and the line joining the points (3, –1) and (4, –2).

Solution:

The Slope of the line joining the points (3, -1) and (4, -2) is given by

$m = (y_2 − y_1)/(x_2 − x_1)$ where, $x \neq x_1$

$m = (-2 −(-1))/(4-3)$

$= (-2+1)/(4-3)$

$= -1/1$

$= -1$

The angle of inclination of line joining the points (3, -1) and (4, -2) is given by

$\tan θ = -1$

$θ = (90° + 45°) = 135°$

∴ The angle between the x-axis and the line joining the points (3, –1) and (4, –2) is 135°.

11. The slope of a line is double of the slope of another line. If tangent of the angle between them is 1/3, find the slopes of the lines.

Solution:

Let us consider 'm_1' and 'm' be the slope of the two given lines such that $m_1 = 2m$

We know that if θ is the angle between the lines l1 and l2 with slope m_1 and m_2, then

$$\tan\theta = \left|\frac{(m_2 - m_1)}{(1 + m_1 m_2)}\right|$$

Given here that the tangent of the angle between the two lines is 1/3

So,

$$\frac{1}{3} = \left|\frac{m-2m}{1+2m \times m}\right| = \left|\frac{-m}{1+2m^2}\right|$$

$$\frac{1}{3} = \frac{m}{1+2m^2}$$

Now, case 1:

$$\frac{1}{3} = \frac{-m}{1+2m^2}$$

$1+2m^2 = -3m$

$2m^2 + 1 + 3m = 0$

$2m(m+1) + 1(m+1) = 0$

$(2m+1)(m+1) = 0$

m = -1 or -1/2

If m = -1, then the slope of the lines are -1 and -2

If m = -1/2, then the slope of the lines are -1/2 and -1

Case 2:

$$\frac{1}{3} = \frac{-m}{1+2m^2}$$

$2m^2 - 3m + 1 = 0$

$2m^2 - 2m - m + 1 = 0$

$2m(m-1) - 1(m-1) = 0$

m = 1 or 1/2

If m = 1, then the slope of the lines are 1 and 2

If m = 1/2, then the slope of the lines are 1/2 and 1

∴ The slope of the lines are [-1 and -2] or [-1/2 and -1] or [1 and 2] or [1/2 and 1]

12. A line passes through (x_1, y_1) and (h, k). If slope of the line is m, show that k − y_1 = m (h − x_1).

Solution:

Given: the slope of the line is 'm'

The slope of the line passing through (x_1, y_1) and (h, k) is $(k - y_1)/(h - x_1)$

So,

$(k - y_1)/(h - x_1)$ = m

$(k - y_1)$ = m $(h - x_1)$

Hence proved.

13. If three points (h, 0), (a, b) and (0, k) lie on a line, show that a/h + b/k = 1

Solution:

Let us consider if the given points A (h, 0), B (a, b) and C (0, k) lie on a line

Then, slope of AB = slope of BC

$(b - 0)/(a - h) = (k - b)/(0 - a)$

let us simplify we get,

-ab = (k-b) (a-h)

-ab = ka- kh –ab +bh

ka +bh = kh

Divide both the sides by kh we get,

ka/kh + bh/kh = kh/kh

a/h + b/k = 1

Hence proved.

14. Consider the following population and year graph (Fig 10.10), find the slope of the line AB and using it, find what will be the population in the year 2010?