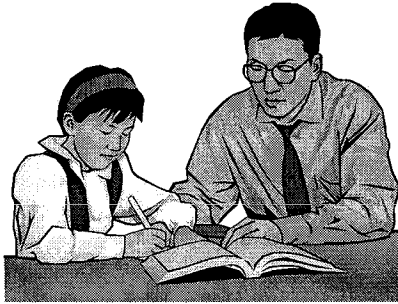# CENTRE OF EXCELLENCE

# IN

# MATHS TUITION

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# YEAR 11 – MATHEMATICS

# LESSON & TUTORIAL - 6
# TOPIC : REGIONS &
# INEQUALITIES

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## 6. Regions and inequalities :

### 6.1 Equations :

An equation or expression such as $y = 2x + 5$, represents a straight line.

### Example :

Fill in the table of values and sketch the line $y = 2x + 5$

| x | -1 | 0 | 1 |
|---|----|---|---|
| y |    |   |   |

### 6.2 Inequations :

An inequation such as $y \leq 2x + 5$ represents all points on a half-plane either above or below the line $y = 2x + 5$. Test this with a well chosen point. Sketch this region on the previous example.

### Example :

Sketch the region represented by

(1) $y < x + 1$

(2) $y \leq x^2$

(3) $x^2 + y^2 \leq 4$

(4) $y < \sqrt{4 - x^2}$

(5) $x \leq \sqrt{1 - y^2}$

(6) $y \leq x + 1 \cap x + y \leq 1 \cap y \geq 0$

### 6.3 Locus :

Locus is the set of points that satisfies a set of rules and is in the form of an equation e.g. $y = x + 1$ or $y = x^2$.

These equations are sometimes referred to as **"Cartesian equations".**

### Examples :

Sketch the locus of a point $P(x, y)$ that :

(1) is always two units from the $y$-axis.

$$\boxed{x = \pm 2}$$

(2) is always three units from the $x$-axis.

$$\boxed{y = \pm 3}$$

(3) is always one unit from the origin.

$$\boxed{x^2 + y^2 = 1}$$

(4) is always two units from the point (1,2).

$$\boxed{(x-1)^2 + (y-2)^2 = 4}$$

**Exercises :**

Sketch the regions given by these inequalities:

(1) $x + y \geq 2$

(2) $y < 2x - 1$

(3) $y - x^2 > 0$

(4) $x^2 + y^2 \leq 9$

(5) $x^2 + y^2 > 1$

(6) $y < \sqrt{9 - x^2}$

(7) Sketch the locus of $P(x, y)$ that is

(a) 2 units from the $x$–axis

(b) 3 units from the $y$–axis

(c)  2 units from the origin.

(e) 2 units from the line joining the points (-1,2) and (1,-2).

(d)  3 units from the point  (-1,-1)

## PAST EXAMINATION QUESTIONS

### HSC 2003

(3)

(c)   Shade the region in the Cartesian plane for which the inequalities $\qquad$ **3**
$y < x - 2$, $y \geq 0$ and $x \geq 6$ hold simultaneously.

### SBHS 2004 (Prelim)

(4) (g) Sketch the region in the number plane which satisfies both the inequalities

$$y \leq \sqrt{16 - x^2} \text{ and } x - y \geq 4 .$$

**A.M.P 2001 (Prelim)**

(6) (b) (i)  Shade the region bounded by the inequations

$$y \geq 0, \; x + y < 1 \text{ and } y < 4x + 6$$

neatly on the same number plane.

**SBHS 2000 (Prelim)**

(3) (a) (i)  Find the points of intersection of the line $y = 4 - x$ and the circle $x^2 + y^2 = 16$.

$$\boxed{(0,4) \text{ and } (4,0)}$$

(ii) Hence sketch the region where $y \geq 4 - x$ and $x^2 + y^2 < 16$ hold simultaneously.

**A.R.C. 2000 (Prelim)**

(8) (b) The locus of point $P(x, y)$ has equation $x^2 + y^2 - 6x + 2y + 6 = 0$.

     (i)     Describe its shape.
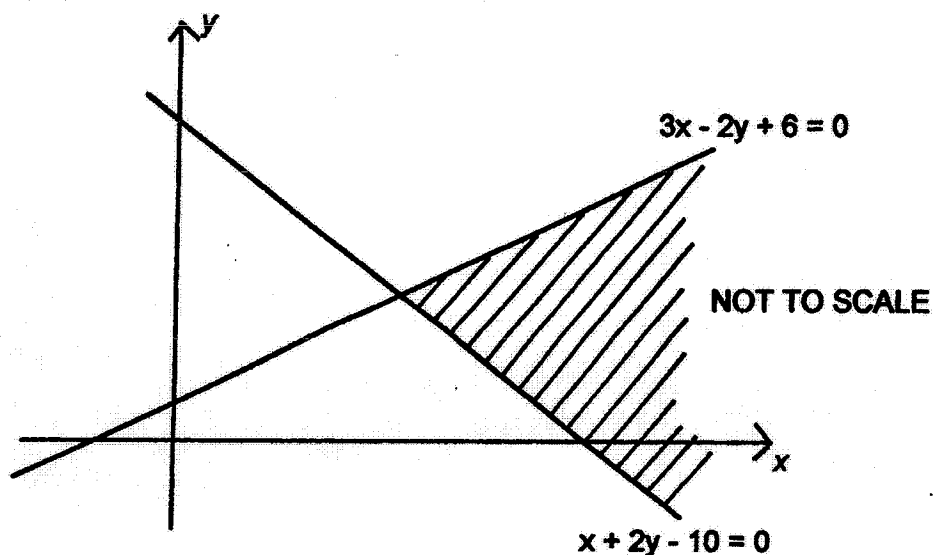
     (ii)     List all its features.

> Circle with centre $(3, -1)$ and radius 2 units.

**NSWIS '99 (Prelim)**
(4)

    (c)     The diagram below shows the graphs $3x - 2y + 6 = 0$ and $x + 2y - 10 = 0$.     **2**



State the pair of inequalities which define the shaded region.

**NSWIS '98 (Prelim)**

(4) (b)  Sketch the region given by the following inequalities　　　　**3**

$$x + y - 2 > 0, \ y \le x^2, \ x \ge 0, \ y \ge 0.$$

**NSWIS '97 (Prelim)**

(1) (d) (i) Sketch the lines $x - y - 1 = 0$ and $3x + y - 6 = 0$ on the same set of axes.　**3**

(ii) Shade on your sketch the region which is satisfied by the inequalities

$$x - y - 1 \ge 0, \ 3x + y - 6 \le 0 \ \text{and} \ y \ge 0.$$