Graphing Solution Region of Inequalities

The solution region of an inequality consists of all points (*a, b*) such that when $x = a$, and $y = b$, all inequalities are true.

Example

Check to see if given points are in the solution region of a system of inequalities.

1. Graph the solution region of a system of inequalities:
$$x + 2y \leq 1$$
$$x^2 + y \geq 4$$

2. Which of the following points are within the solution region?
(-1.6, 1.8), (-2, -5), (2.8, -1.4), (-8,4)

Before Starting There may be differences in the results of calculations and graph plotting depending on the setting. Return all settings to the default value and delete all data.

Step & Key Operation	Display	Notes
1-1 Rewrite the inequalities so that the left-hand side is *y*.		$x + 2y \leq 1 \rightarrow y \leq \frac{1-x}{2}$ $x^2 + y \geq 4 \rightarrow y \geq 4 - x^2$

1-2 Enter $y = \frac{1-x}{2}$ for Y1 and $y = 4 - x^2$ for Y2.

| Y= | a/b | 1 | — | X/θ/T/*n* |

| ▼ | 2 | ENTER | 4 | — | X/θ/T/*n* | x^2 |

```
Y1= 1-X
    ───
     2
Y2=4-X²
Y3=
Y4=
Y5=
```

1-3 Set the shade and view the solution region.

2nd F DRAW G 1

2nd F VARS A ENTER A 2 ▶

2nd F VARS ENTER 1

GRAPH

```
Set shade
    Y2 < Y < Y1
       < Y <
       < Y <
       < Y <
       < Y <
```

$Y2 \leq y \leq Y1$

- -
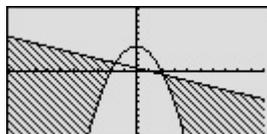
2-1 Set the display area (window) to : $-9 < x < 3$, $-6 < y < 5$.

WINDOW (-) 9 ENTER 3 ENTER

ENTER (-) 6 ENTER 5 ENTER

```
Window (Rect)
 Xmin=-9
 Xmax=3
 Xscl=1
 Ymin=-6
 Ymax=5
 Yscl=1
```
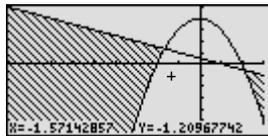
SHARP

Step & Key Operation	_Display_	_Notes_

2-2 Use the cursor to check the position of each point. (Zoom in as necessary).

GRAPH ▶ or ◀ or ▲ or ▼
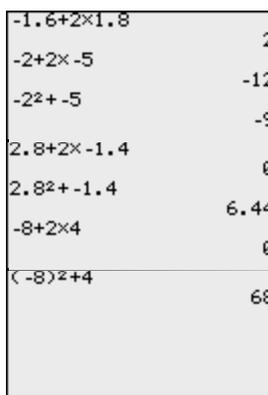

X=-1.57142857   Y=-1.20967742

Points in the solution region are (2.8, -1.4) and (-8, 4). Points outside the solution region are (-1.6, 1.8) and (-2, -5).

2-3 Substitute points and confirm whether they are in the solution region.

⊞⊟⊠⊞ (-) 1 · 6 +

2 × 1 · 8 • • •

(Continuing key operations omitted.)

```
-1.6+2×1.8
                    2
-2+2×-5
                   -12
-2²+-5
                    -9
2.8+2×-1.4
                    0
2.8²+-1.4
                  6.44
-8+2×4
                    0
(-8)²+4
                   68
```

• (-1.6, 1.8): -1.6 + 2 × 1.8 = 2
→ This does not materialize.
• (-2, -5): -2 + 2 × (-5) = -12
            $(-2)^2$ + (-5) = -1
→ This does not materialize.
• (2.8, -1.4): 2.8 + 2 × (-1.4) = 0
            $(2.8)^2$ + (-1.4) = 6.44
→ This materializes.
• (-8, 4): -8 + 2 × 4 = 0
            $(-8)^2$ + 4 = 68
→ This materializes.

Graphical solution methods not only offer instructive visualization of the solution process, but they can be applied to inequalities that are often very difficult to solve algebraically. The EL-9900 allows the solution region to be indicated visually using the Shading feature. Also, the free-moving tracer or Zoom-in feature will allow the details to be checked visually.

SHARP