

# Section 7.4 Notes

## Nonlinear System of Equations and Inequalities

### 1 Systems of Nonlinear Equations

#### Introduction

- A *system of nonlinear equations* is any system where one or more of the equations is not linear.

For example,

$$3x - y = 2$$

$$4x^2 + y = 7$$

- To solve these systems, we go back to using either substitution or elimination.
- With systems of nonlinear equations, you could have *any* number of solutions - 0, 1, 2, 3, etc. or infinitely many. It all depends on what shapes the graphs have and how they intersect.

### 2 Substitution

#### Examples

1.

$$x^2 + y = -3$$

$$x - y = 5$$

$(2, -3)$  and  $(1, -4)$

2.

$$x + y = 4$$

$$xy = 3$$

$(1, 3)$  and  $(3, 1)$

3.

$$x^2 + 4y^2 = 20$$

$$xy = 4$$

$(2, 2)$ ,  $(-2, -2)$ ,  $(4, 1)$ ,  $(-4, -1)$

### 3 Elimination

#### Examples

1.

$$\begin{aligned}x^2 - y^2 &= 2 \\ 2x^2 - y^2 &= 4x - 1\end{aligned}$$

$$(3, -\sqrt{7}) \text{ and } (3, \sqrt{7})$$

2.

$$\begin{aligned}2xy + 3y^2 &= 7 \\ 3xy - 2y^2 &= 4\end{aligned}$$

$$(2, 1), (-2, -1)$$

### 4 Systems of Inequalities

#### Definitions

- A *system of inequalities* a list of inequalities
- The *solution* to a system of inequalities consists of region(s) of space which, when you plug in points from that region, make all the inequalities true.

#### Method

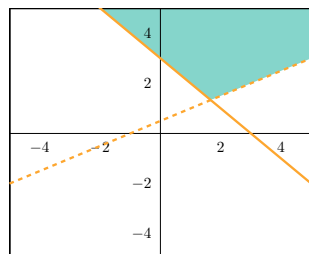
1. Graph each inequality as if it were an equation, except:
  - If the inequality is  $\leq, \geq$ , then use a solid line.
  - If the inequality is  $<, >$ , then use a dashed/dotted line.
2. Use one or more test points to determine which regions get shaded.

#### Examples

Graph the solution.

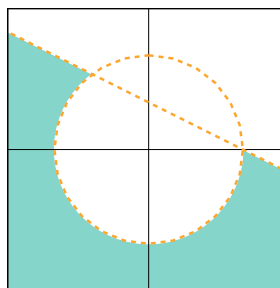
1.

$$\begin{aligned}x + y &\geq 3 \\ x - 2y &< -1\end{aligned}$$



2.

$$\begin{aligned}x^2 + y^2 &> 4 \\ x + 2y &< 2\end{aligned}$$



3.

$$x^2 + y^2 \leq 25$$

$$9y \geq 4x^2$$

