

# Linear equations, inequalities, sets and functions, quadratics

## Simplify expressions

1. Simplify the following expressions as much as possible:<sup>1</sup>

a.  $(-x^2y^3)^3$

b.  $9(3^0)$

c.  $(3^2a^2)^2(6a^4)$

d.  $\left(\frac{x^3}{x^4}\right)^3$

e.  $(-2)^{(4-9)}$

f.  $\left(\frac{1}{27b^4}\right)^{1/3}$

g.  $y^5y^6y^5y^2$

h.  $\frac{13a/7b}{13b/2a}$

## Simplify a (more complex) expression

2. Simplify the following expression:<sup>2</sup>

$$(a+b)^2 + (a-b)^2 + 2(a+b)(a-b) - 3a^2$$

## Graph sketching

3. Let the functions  $f(x)$  and  $g(x)$  be defined for all  $x \in \mathbb{R}$  by

$$f(x) = \begin{cases} |x-2| & \text{if } x < 1 \\ 1 & \text{if } x \geq 1 \end{cases}, \quad g(x) = \begin{cases} x^3 & \text{if } x < 2 \\ 4 & \text{if } x \geq 2 \end{cases}$$

Sketch the graphs of:<sup>3</sup>

1.  $y = f(x)$

2.  $y = g(x)$

3.  $y = f(g(x))$

4.  $y = g(f(x))$

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<sup>1</sup>inspired by Gill 1.1

<sup>2</sup>inspired by Gill 1.2

<sup>3</sup>inspired by Pemberton and Rau problem 3-1

## Root finding

4. Find the roots (solutions) to the following quadratic equations.<sup>4</sup>

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

- a.  $9x^2 - 3x - 12 = 0$
- b.  $x^2 - 2x - 16 = 0$
- c.  $6x^2 - 6x - 6 = 0$

## Systems of linear equations

5. Solve the following systems of equations for their unknown values. If there is no solution, indicate as such.

- a. Two unknowns<sup>5</sup>

$$\begin{aligned} 3x - 2y &= 17 \\ 5x - 10y &= -10 \end{aligned}$$

- b. Three unknowns<sup>6</sup>

$$\begin{aligned} 5x - 2y + 3z &= 9 \\ 2x - 4y - 3z &= -9 \\ x + 6y - 8z &= 24 \end{aligned}$$

- c. An animal shelter has a total of 124 animals comprised of cats, dogs, and rabbits. If the number of rabbits is 4 less than twice the number of dogs, and there are 76 more cats than dogs, how many of each animal are at the shelter?<sup>7</sup>

## Work with sets

6. Using the sets

$$\begin{aligned} A &= \{2, 3, 7, 9, 12, 13\} \\ B &= \{x : 6 \leq x \leq 12 \text{ and } x \text{ is an even integer}\} \\ C &= \{x : 2 < x < 25 \text{ and } x \text{ is prime}\} \\ D &= \{1, 4, 9, 16, 25, \dots\} \end{aligned}$$

identify the following:<sup>8</sup>

- 1.  $A \cup B$
- 2.  $(A \cup B) \cap C$
- 3.  $C \cap D$

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<sup>4</sup>Gill 1.25

<sup>5</sup>inspired by OpenStax Algebra ex 7.1.12

<sup>6</sup>inspired by OpenStax Algebra ex 7.2.12

<sup>7</sup>inspired by OpenStax Algebra 7.2.54

<sup>8</sup>inspired by Grimmer HW1.1

## AI and Resources statement

- Please list (in detail) all resources you used for this assignment. If you worked with people, list them here as well. It is not enough to say that you used a resource for help, you need to be specific on the link and *how* it was helpful. W/R/T gen AI tools (including GPT, etc. ) you cannot use them to do work on your behalf – you cannot put in any of the questions, etc. You can ask for help on logic / sample problems. If you do use GPT or other AI tools, you need to provide a link to your chat transcript. Any suspected academic integrity violations will be immediately reported.