

# Linear equations, inequalities, sets and functions, quadratics, and logarithms

## 1 Simplify expressions

Simplify the following expressions as much as possible:

a.  $(-x^4y^2)^2$

b.  $9(3^0)$

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

d.  $\frac{x^4}{x^3}$

e.  $(-2)^{7-4}$

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

g.  $y^7y^6y^5y^4$

h.  $\frac{2a/7b}{11b/5a}$

i.  $(z^2)^4$

## 2 Simplify a (more complex) expression

Simplify the following expression:

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

## 3 Graph sketching

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

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

Sketch the graphs of:

1.  $y = f(x)$

2.  $y = g(x)$

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

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

## 4 Root finding

Find the roots (solutions) to the following quadratic equations.

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

a.  $9x^2 - 3x - 12 = 0$

b.  $x^2 - 2x - 16 = 0$

c.  $6x^2 - 6x - 6 = 0$

## 5 Systems of linear equations

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

a. Two unknowns

$$3x - 2y = 18$$

$$5x + 10y = -10$$

b. Three unknowns

$$5x - 2y + 3z = 20$$

$$2x - 4y - 3z = -9$$

$$x + 6y - 8z = 21$$

c. An animal shelter has a total of 350 animals comprised of cats, dogs, and rabbits. If the number of rabbits is 5 less than one-half the number of cats, and there are 20 more cats than dogs, how many of each animal are at the shelter?

## 6 Work with sets

Using the sets

$$A = \{2, 3, 7, 9, 13\}$$

$$B = \{x : 4 \leq x \leq 8 \text{ and } x \text{ is an integer}\}$$

$$C = \{x : 2 < x < 25 \text{ and } x \text{ is prime}\}$$

$$D = \{1, 4, 9, 16, 25, \dots\}$$

identify the following:

1.  $A \cup B$

2.  $(A \cup B) \cap C$

3.  $C \cap D$

## 7 Simplify logarithms

Express each of the following as a single logarithm:

a.  $\log(x) + \log(y) - \log(z)$

b.  $2\log(x) + 1$

c.  $\log(x) - 2$