

**Problem 1** (1 point). Solve  $2^{x^2-5} = 2^{x+2}$ .

*Solution.* Since the bases are the same, it suffices to solve  $x^2 - 5 = x + 2$ . This equation is equivalent to

$$x^2 - x - 7 = 0,$$

whose roots are

$$x = \frac{1 \pm \sqrt{29}}{2}.$$

□

**Problem 2** (2 points). Solve  $3^{x^2-5} = 27^{x+2}$ .

*Solution.*  $27 = 3^3$ , so the above equation is equivalent to

$$3^{x^2-5} = 3^{3x+6}.$$

It suffices to solve  $x^2 - 5 = 3x + 6$ , which is equivalent to

$$x^2 - 3x - 11 = 0.$$

The roots are

$$x = \frac{3 \pm \sqrt{53}}{2}.$$

□

**Problem 3** (2 points). Solve  $2^{x^2-5} = 8^{x+2}$ .

*Solution.*  $27 = 2^3$ , so the above equation is equivalent to

$$2^{x^2-5} = 2^{3x+6}.$$

It suffices to solve  $x^2 - 5 = 3x + 6$ , which is equivalent to

$$x^2 - 3x - 11 = 0.$$

The roots are

$$x = \frac{3 \pm \sqrt{53}}{2}.$$

□

**Problem 4** (3 points). Solve  $4^{x^2-5} = 8^{x+2}$ .

*Solution.*  $4 = 2^2$  and  $8 = 2^3$ , and so the above equation is equivalent to

$$2^{2x^2-10} = 2^{3x+6}.$$

It suffices to solve  $2x^2 - 10 = 3x + 6$ , which is equivalent to

$$2x^2 - 3x - 16 = 0.$$

The roots are

$$x = \frac{3 \pm \sqrt{137}}{4}.$$

□