

Exercise walk-through

Undecidable Problems ■ 3.18

eXercise

You must be able to

- explain how a **decidable** 可判定 problem has an algorithm that always gives a correct yes-or-no answer
- explain how an **undecidable** 不可判定 problem has no algorithm that solves every case
- describe the difference between undecidable and merely **inefficient** 低效
- recognize undecidability as a **limit** on computation

Method — Decidable vs undecidable

- A **decidable** problem has an algorithm that **always** gives a correct yes-or-no answer.
- An **undecidable** problem has **no** algorithm that solves **every** case correctly.

Method — Undecidable is not just slow

Undecidability is stronger than inefficiency: an inefficient problem can still be solved (given enough time), but an undecidable one **cannot** be solved for all cases at all.

Method — A limit on computation

Undecidability shows there are things computers simply **cannot** do.

Practice 2.1 ■ 1 mark

Define a decidable problem.

Solution 2.1

Method: Decidable vs undecidable

Worked steps

a problem with an algorithm that always gives a correct yes-or-no answer **B1**.

Practice 2.2 ■ 1 mark

Define an undecidable problem.

Solution 2.2

Worked steps

a problem for which no algorithm can solve every case correctly **B1**.

Practice 2.3 ■ 1 mark

State the difference between an undecidable problem and a merely inefficient one.

Solution 2.3

Method: Undecidable is not just slow

Worked steps

an inefficient problem can still be solved (just slowly); an undecidable one cannot be solved for all cases at all **B1**.

Exam-style 3.1 ■ 1 mark

A decidable problem has an algorithm that

- A** always gives a correct yes-or-no answer
- B** never finishes
- C** gives a random answer
- D** is simply slow

Solution 3.1

Method: Decidable vs undecidable

A always gives a correct yes-or-no answer



B never finishes

C gives a random answer

D is simply slow

Worked steps

A.

Exam-style 3.2 ■ 1 mark

An undecidable problem

- A** can always be solved slowly
- B** has no algorithm that solves every case correctly
- C** is a syntax error
- D** is a data type

Solution 3.2

- A** can always be solved slowly
- B** has no algorithm that solves every case correctly 
- C** is a syntax error
- D** is a data type

Worked steps

B.

Exam-style 3.3 ■ 1 mark

A problem has no algorithm that can correctly answer it in **all** cases.

- (a) Name this kind of problem.
- (b) State whether this is the same as being slow.
- (c) State what it shows about computation.

Solution 3.3

Worked steps

(a) an undecidable problem **B1**. (b) no **B1**. (c) that there are limits to what computers can do **B1**.