

Exercise walk-through

Entropy and the Second Law of Thermodynamics ■ 9.6

eXercise

You must be able to

- describe **entropy** 熵 as a measure of disorder (the number of microstates)
- state the **second law of thermodynamics** 热力学第二定律: total entropy tends to increase
- explain why thermal energy flows spontaneously from hot to cold

Method — Entropy

Entropy measures **disorder** — the number of ways (microstates) the particles can be arranged. More disorder means higher entropy.

Method — The second law

The **total** entropy of an isolated system tends to **increase** over time.

Method — Direction of heat flow

Heat flows from hot to cold on its own because that **raises** the total entropy. The reverse (cold to hot) needs external work — that is what a refrigerator does.

Practice 2.1 ■ 1 mark

State what entropy measures.

Solution 2.1

Method: Entropy

Worked steps

the disorder of a system (the number of microstates) **B1**.

Practice 2.2 ■ 1 mark

State the second law of thermodynamics.

Solution 2.2

Worked steps

the total entropy of an isolated system tends to increase **B1**.

Practice 2.3 ■ 2 marks

Explain why heat does not flow from a cold object to a hot one on its own.

Solution 2.3

Method: Direction of heat flow

Worked steps

that would **decrease** the total entropy **B1**, which the second law forbids without external work being done **B1**.

Exam-style 3.1 ■ 1 mark

Entropy is a measure of a system's

A temperature

B energy

C disorder

D pressure

Solution 3.1

Method: The second law

A temperature

B energy

C disorder



D pressure

Worked steps

C.

Exam-style 3.2 ■ 1 mark

In an isolated system, the total entropy tends to

- A** decrease
- B** increase
- C** stay exactly constant
- D** fall to zero

Solution 3.2

Method: The second law

A decrease

B increase 

C stay exactly constant

D fall to zero

Worked steps

B.

Exam-style 3.3 ■ 1 mark

A block of ice melts in a warm room.

- (a) State whether the entropy of the water increases or decreases.
- (b) Explain your answer in terms of disorder.

Solution 3.3

Method: Entropy

Worked steps

(a) increases **B1**. (b) liquid water is more disordered than solid ice — its particles move more freely, so there are more microstates and higher entropy **B1** **B1**.