A-LEVEL PHYSICS • HOLIDAY HOMEWORK 假期作业

16 Work and the first law – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
work	功			
first law of thermodynamics	热力学第一定律			

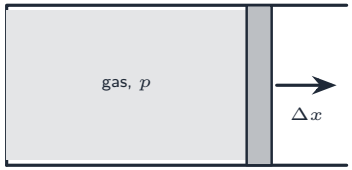
Recall

Internal energy can change when heat is added, or when **work** 功 is done on or by the gas.

New ideas

Read these first. Each idea has a short worked example. Then do the Practice.

1 Work done by a gas

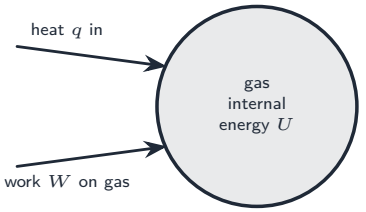


$W = p\,\Delta V$

When a gas expands against an outside pressure p by a small volume ΔV, it does work $W = p\,\Delta V$ on the surroundings.

Worked example. A gas at $p = 1.0 \times 10^5$ Pa expands by $\Delta V = 2.0 \times 10^{-3}$ m^3: $W = p\,\Delta V = (1.0 \times 10^5)(2.0 \times 10^{-3}) = 200$ J of work done on the surroundings.

2 The first law



$\Delta U = q + W$

The **first law of thermodynamics** 热力学第一定律: $\Delta U = q + W$ — the change in internal energy equals the heat added plus the work done *on* the gas.

Worked example. 100 J of heat is added to a gas while it pushes a piston out, doing 30 J of work on the surroundings. Work done *on* the gas is $W = -30$ J, so $\Delta U = q + W = 100 + (-30) = 70$ J.

Watch out: in $\Delta U = q + W$, the symbol W is the work done *on* the gas. If the gas expands (doing work on the surroundings), W is *negative*.

Practice

Try these in order.

16.1 Write the work done when a gas changes volume at constant pressure. [1]

16.2 When a gas *expands*, does it do work on the surroundings or have work done on it? [1]

16.3 Write the *first law of thermodynamics*. [1]

16.4 Heat $q = 50$ J is added and $W = 20$ J of work is done on a gas. Find ΔU. [1]

16.5 A gas at 2.0×10^5 Pa expands by 1.5×10^{-3} m^3. Find the work it does on the surroundings ($W = p\Delta V$). [2]

16.6 80 J of heat is added to a gas while it does 50 J of work on the surroundings. Find the change in internal energy, and explain the signs. [2]

16.7 Challenge. A gas is compressed quickly, so fast that no heat escapes ($q = 0$). Explain what happens to its internal energy and temperature. [2]