16. Thermodynamics

Starter Quiz · 课前小测

A-Level Physics Name: _____ Score: _____

1. Internal energy is the sum of which energies?

   ☐ the random kinetic energy of the molecules

   ☐ the potential energy between the molecules

   ☐ the bulk kinetic energy of the whole object

   ☐ the weight of the object

   Tick every correct option.

2. The work done by a gas expanding at constant pressure is:

   ☐ $p\,\Delta V$

   ☐ $\dfrac{p}{\Delta V}$

   ☐ pV^2

   ☐ $\dfrac{\Delta V}{p}$

3. A moving train's bulk kinetic energy counts as part of its internal energy.

   ☐ True ☐ False

4. When a gas expands, it does work on its surroundings.

   ☐ True ☐ False

5. Internal energy depends only on the state of the system, not on the path taken to reach it.

   ☐ True ☐ False

6. The first law of thermodynamics: $\Delta U = q +$ _____.

   _____

7. For an ideal gas, the internal energy is:

   ☐ $\frac{3}{2}nRT$

   ☐ pV exactly

   ☐ $mc\Delta T$

   ☐ $\frac{1}{2}mv^2$

8. 100 J of heat is added to a gas while 30 J of work is done **on** it. What is the rise in internal energy?

   _____ J

9. For an ideal gas, if the absolute temperature doubles, the internal energy multiplies by:

   _____

10. In an isothermal change of an ideal gas, the internal energy does not change.

    ☐ True ☐ False

A-Level Physics

1. **the random kinetic energy of the molecules; the potential energy between the molecules**

   Internal energy = random molecular KE + intermolecular PE. The object's overall motion (bulk KE) is separate.

2. $p\,\Delta V$

   Force = pA, distance = Δx, so work = $pA\Delta x = p\,\Delta V$.

3. **False**

   No — internal energy is the energy of the *random* molecular motion, not the whole object moving along.

4. **True**

   Yes — it pushes the piston/atmosphere outward. So the work done *on* the gas is negative.

5. **True**

   Yes — U is a function of state (T, p, V, amount); two routes to the same state give the same U.

6. **W**

   $\Delta U = q + W$, where W is the work done **on** the gas and q is the heat added.

7. $\frac{3}{2}nRT$

   No intermolecular PE, so U is all kinetic: $U = \frac{3}{2}NkT = \frac{3}{2}nRT$.

8. **130 J**

   $\Delta U = q + W = 100 + 30 = 130$ J.

9. **2**

   $U = \frac{3}{2}nRT \propto T$, so doubling T doubles U.

10. **True**

    For an ideal gas $U \propto T$, so constant T means $\Delta U = 0$ (and then $q = -W$).