15. Ideal gases

Starter Quiz · 课前小测

A-Level Physics Name: _____ Score: _____

1. One mole of a substance contains:

   ☐ 6.02×10^{23} particles

   ☐ 1000 particles

   ☐ 6.02×10^{-23} particles

   ☐ exactly 1 particle

2. The equation of state of an ideal gas is:

   ☐ $pV = nRT$

   ☐ $pV = nRT^2$

   ☐ $\dfrac{p}{V} = nRT$

   ☐ $pVT = nR$

3. Select **all** the assumptions of the kinetic theory of an ideal gas.

   ☐ molecules are in continuous random motion

   ☐ the molecules' own volume is negligible

   ☐ collisions are elastic

   ☐ molecules attract each other strongly at all times

   Tick every correct option.

4. The mole is one of the SI base units.

   ☐ True ☐ False

5. You may use temperature in °C in the ideal gas equation.

   ☐ True ☐ False

6. A gas exerts pressure on its container because the molecules:

   ☐ collide with the walls

   ☐ attract the walls

   ☐ slowly expand

   ☐ lose energy over time

7. A sample contains 3.01×10^{23} molecules. How many moles is this?

   _____ mol

8. At constant temperature, a gas at 100 kPa is squeezed to half its volume. What is the new pressure?

   _____ kPa

9. The r.m.s. speed is the square root of the _____ speed.

   _____

10. The molar mass is the mass of:

    ☐ one mole of the substance

    ☐ one single particle

    ☐ one kilogram of it

    ☐ 6.02 particles

15. Ideal gases

Answers · 答案

A-Level Physics

1. **6.02×10^{23} particles**

   A mole always contains the Avogadro number, $N_A = 6.02 \times 10^{23}$, of particles.

2. **$pV = nRT$**

   $pV = nRT$ (moles) or $pV = NkT$ (molecules) — with T in kelvin.

3. **molecules are in continuous random motion; the molecules' own volume is negligible; collisions are elastic**

   Forces between molecules are ignored *except* during (elastic) collisions — they do not attract strongly at all times.

4. **True**

   Yes — amount of substance (mole) is a base quantity, alongside the kilogram, metre, second, ampere and kelvin.

5. **False**

   No — $pV \propto T$ only with T in kelvin. Convert °C to K first.

6. **collide with the walls**

   Each collision pushes on the wall; the combined effect of countless collisions is the pressure.

7. **0.5 mol**

   $n = \dfrac{N}{N_A} = \dfrac{3.01 \times 10^{23}}{6.02 \times 10^{23}} = 0.50$ mol.

8. **200 kPa**

   Boyle: pV is constant, so halving V doubles $p \rightarrow 200$ kPa.

9. **mean-square**

   Take the mean of the squared speeds, then square-root it: $c_{\text{r.m.s.}} = \sqrt{\langle c^2 \rangle}$.

10. **one mole of the substance**

    Molar mass is the mass per mole; dividing it by N_A gives the mass of one particle.