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. A two-mark definition of an ideal gas needs which elements? Select **all** that apply.

   ☐ it obeys pV proportional to T (or pV = nRT)

   ☐ T is the thermodynamic temperature

   ☐ this holds at all values of p, V and T

   ☐ the gas is monatomic

   Tick every correct option.

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. The equation of state of an ideal gas is:

   ☐ $pV = nRT$

   ☐ $pV = nRT^2$

   ☐ $\frac{p}{V} = nRT$

   ☐ $pVT = nR$

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

   ☐ True ☐ False

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

   _____

10. How many atoms are there in one mole of oxygen gas, O2?

    ☐ 1.20 x 10^24, twice the Avogadro constant

    ☐ 6.02 x 10^23

    ☐ 3.01 x 10^23

    ☐ it depends on the pressure

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. **it obeys pV proportional to T (or pV = nRT); T is the thermodynamic temperature; this holds at all values of p, V and T**

   The relationship alone earns one mark; "at all values" earns the second. Being monatomic is not part of the definition.

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. **$pV = nRT$**

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

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. **False**

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

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. **1.20 x 10^24, twice the Avogadro constant**

    One mole is 6.02 x 10^23 molecules, and each O2 molecule holds two atoms. Saying which particle you are counting is worth a mark on its own.