1. One mole of a substance contains:

   ☐ 1000 particles

   ☐ 6.02×10^{-23} 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.

   ☐ the gas is monatomic

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

   ☐ T is the thermodynamic temperature

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

   Tick every correct option.

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

   ☐ the molecules' own volume is negligible

   ☐ molecules are in continuous random motion

   ☐ molecules attract each other strongly at all times

   ☐ collisions are elastic

   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:

   ☐ $pVT = nR$

   ☐ $pV = nRT$

   ☐ $\dfrac{p}{V} = nRT$

   ☐ $pV = nRT^2$

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

   ☐ attract the walls

   ☐ collide with the walls

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   ☐ 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, O_2?

    ☐ 3.01×10^{23}

    ☐ 6.02×10^{23}

    ☐ 1.20×10^{24}, twice the Avogadro constant

    ☐ it depends on the pressure

1. 6.02×10^{23} **particles**

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

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

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

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

   $n = \dfrac{N}{N_\mathrm{A}} = \dfrac{3.01 \times 10^{23}}{6.02 \times 10^{23}} = 0.50$ 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: $c_\mathrm{r.m.s.} = \sqrt{\langle c^2 \rangle}$.

10. 1.20×10^{24}**, twice the Avogadro constant**

    One mole is 6.02×10^{23} molecules, and each O_2 molecule holds two atoms. Saying which particle you are counting is worth a mark on its own.

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