

A-Level Physics

Name: _____ Score: _____

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:

- ☐ $pVT = nR$
- ☐ $pV = nRT$
- ☐ $\frac{p}{V} = nRT$
- ☐ $pV = nRT^2$

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

- ☐ attract the walls
- ☐ collide with 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 $^{\circ}\text{C}$ 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

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. **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**

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

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. 1.20×10^{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.