# Edexcel Physics A-Level

## Topic 9.2 - Gas Laws

### Flashcards

# How is the motion of gas molecules described?

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Gas molecules move with Brownian motion, which is the random motion of molecules caused by collisions with larger particles.

# How does a gas exert a force on its container?

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- The molecules collide with the walls of their container.
  - Collisions cause a change in momentum.
  - A change in momentum produces a force equal to the rate of change of momentum.

# What does Boyle's Law state?

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When a gas is at a constant temperature, pressure and volume are inversely proportional to each other.

# Explain Boyle's Law.

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- When the volume of a gas increases, the space between molecules increases and so the time between collisions is larger.
- This causes the rate of collisions and so the rate of change of momentum to decrease.
- This means the force exerted is lower, causing a decrease in pressure.

# What does Charles' Law state?

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When a gas is at a constant pressure, the volume is directly proportional to the absolute temperature.

# Explain Charles' Law.

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- As temperature increases, the average kinetic energy of the molecules increases.
- Pressure is constant so the force and so also the rate of change of momentum, must remain constant.
- To achieve this, the volume increases so the faster speed of the molecules is compensated by there being larger gaps between them.

# What does the Pressure Law state?

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When a gas has a fixed volume, pressure is directly proportional to the absolute temperature.

# Explain the Pressure Law.

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- As temperature increases, the average kinetic energy, and so the speed of the molecules also increases.
- This increases the rate of collisions, and so produces a larger rate of change of momentum.
- This leads to a greater force exerted and so an increase in pressure.

# In kinetic theory, what is assumed about the gases involved?

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- The gas contains a large number of molecules.
- The molecules are identical to each other.
- All collisions between molecules and the walls of their container are perfectly elastic.
- The time taken for collisions is negligible compared to the time between collisions.
- There are no intermolecular forces between molecules.
- Molecules are in constant random motion.
- The gas particles obey Newton's Laws of motion.

# What follows all the assumptions made in kinetic theory?

What follows all the assumptions made in kinetic theory?

Ideal gases.

State the relationship between volume and pressure for a given quantity of gas at a fixed temperature.

State the relationship between volume and pressure for a given quantity of gas at a fixed temperature.

Pressure is inversely proportional to volume.

$$P = k/V$$

State the relationship between volume and temperature for a given quantity of gas at a fixed pressure.

State the relationship between volume and temperature for a given quantity of gas at a fixed pressure.

Volume is directly proportional to temperature.

$$V = kT$$

State the relationship between pressure and temperature for a given quantity of gas with a fixed volume.

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Pressure is directly proportional to temperature.

$$P = kT$$

Combine the relationships between pressure, volume and temperature into a single expression, with a constant.

Combine the relationships between pressure, volume and temperature into a single expression, with a constant.

$$\frac{pV}{T} = \text{constant}$$

# State the ideal gas equation.

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$$pV = NkT$$

# What does ‘k’ represent in the ideal gas equation?

# What does ‘k’ represent in the ideal gas equation?

The Boltzmann Constant

(= $1.38 \times 10^{-23} JK^{-1}$)

# What does ‘N’ represent in the ideal gas equation?

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The number of **molecules**.

# How do you convert between the number of moles and number of molecules in a sample?

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Multiply the number of moles by the Avogadro constant.

State three ideal gas assumptions about the motion of the particles in an ideal gas.

State three ideal gas assumptions about the motion of the particles in an ideal gas.

1. The particles obey Newton's Laws of motion
2. They travel in straight lines
3. They are in random motion

What assumption is made about the forces between molecules in an ideal gas?

What assumption is made about the forces between molecules in an ideal gas?

There are no intermolecular forces acting between collisions.

# What can be said about the internal energy of an ideal gas?

# What can be said about the internal energy of an ideal gas?

There are no intermolecular forces and so there is no potential energy. This means the internal energy is entirely kinetic energy.

Describe the collisions between the molecules in an ideal gas.

Describe the collisions between the molecules in an ideal gas.

The collisions between molecules and between molecules and the container are elastic.

What assumptions are made about the size of the molecules in an ideal gas?

# What assumptions are made about the size of the molecules in an ideal gas?

1. The volume of the molecules is negligible in comparison to the volume of the container
2. All the molecules are identical

State the equation linking the pressure and volume of a gas to the speed of its molecules.

State the equation linking the pressure and volume of a gas to the speed of its molecules.

$$pV = \frac{1}{3} Nm\langle c^2 \rangle$$

# What is Wien's Law?

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Peak Wavelength x Temperature = $2.898 \times 10^{3}$

$$\lambda_{max} T = 2.898 \times 10^{3}$$

Peak wavelength is the wavelength at which the emitted radiation is most intense ie. there is a peak on the black body radiation curve

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The peak wavelength is the wavelength at which the emitted radiation is most intense ie. there is a peak on the black body radiation curve.

# What is the Stefan-Boltzmann law equation?

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$$L=\sigma AT^4$$

L is power output (W), σ is the Stefan-Boltzmann constant, A is the surface area of the black body ($m^2$) and T is the temperature (K)

What equation can be used to calculate the kinetic energy of a molecule from its temperature?

What equation can be used to calculate the kinetic energy of a molecule from its temperature?

$$KE=3/2kT$$

K is the boltzmann constant and T is the temperature (K)