Essential Pre-Uni Physics G1.1

GCSE A Level

Give your answer to 3 significant figures. Remember that $0\,^{\circ}\mathrm{C} = 273\,\mathrm{K}$ (no $^{\circ}$ in K).

Convert $23\,^{\circ}\mathrm{C}$ into K.

Gas Laws, Density and Kinetic Energy 32.8

A Level

Within a gas mixture at equilibrium, the mean kinetic energy of each type of molecule is the same. This is because the temperature is uniform. In a mixture of helium ($m = 4.00\,\mathrm{u}$) and nitrogen ($m = 28.0\,\mathrm{u}$),

Part A Which molecules move faster

state which molecules move faster.

- Nitrogen
- Helium

Part B Ratio

calculate the ratio $\overline{c^2_{\text{helium}}} \,/\, \overline{c^2_{\text{nitrogen}}}$.

Essential Pre-Uni Physics G2.6

A Level

Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

Don't forget that one mole of gas contains 6.02×10^{23} molecules, and that the mass of this amount is called the 'molar mass'.

A tyre contains $800\,\mathrm{cm}^3$ of air at a pressure of about $5.0 \times 10^5\,\mathrm{Pa}$ at $9\,^\circ\mathrm{C}$. After a cycle ride, the volume is $760\,\mathrm{cm}^3$, the temperature is now $25\,^\circ\mathrm{C}$, and the pressure is $4.0 \times 10^5\,\mathrm{Pa}$. What percentage of the gas molecules have leaked out?

Gas Laws, Density and Kinetic Energy 32.6

A Level

Calculate the mean kinetic energy of molecules in a gas at $15\,^{\circ}\mathrm{C}$.

Essential Pre-Uni Physics G2.5

GCSE A Level

Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

Don't forget that one mole of gas contains 6.02×10^{23} molecules, and that the mass of this amount is called the 'molar mass'.

A tyre contains $800\,\mathrm{cm}^3$ of air at a pressure of about $5.0 \times 10^5\,\mathrm{Pa}$ at $9.0\,^\circ\mathrm{C}$. After a cycle ride, the volume is $810\,\mathrm{cm}^3$ and the temperature is now $25\,^\circ\mathrm{C}$. Assuming that none of the gas has leaked, what is the new pressure?

Essential Pre-Uni Physics G2.1

A Level

Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

Don't forget that one mole of gas contains 6.02×10^{23} molecules, and that the mass of this amount is called the 'molar mass'.

What is the volume of a mole of gas at atmospheric pressure ($1.01 \times 10^5\,\mathrm{Pa}$) and at $20\,^\circ\mathrm{C}$? Give your answer to two significant figures.

Gas Laws, Density and Kinetic Energy 32.2

A Level

Element	Molar mass / $\mathrm{g\,mol^{-1}}$
H	1
S	32
O	16

What is the density of a sulfuric acid gas cloud on Venus if the temperature is $467\,^{\circ}\mathrm{C}$ and the pressure is $9308\,\mathrm{kPa}$? The chemical formula for sulfuric acid is $\mathrm{H_2SO_4}$.

Essential Pre-Uni Physics G2.3

A Level

Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

Don't forget that one mole of gas contains 6.02×10^{23} molecules, and that the mass of this amount is called the 'molar mass'.

How many molecules of gas do you need in a $100\,\mathrm{cm}^3$ cylinder to exert a pressure of $1.0 \times 10^8\,\mathrm{Pa}$ at a temperature of $800\,^\circ\mathrm{C}$? Give your answer to 2 significant figures.

Essential Pre-Uni Physics G2.2

A Level

Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

Don't forget that one mole of gas contains 6.02×10^{23} molecules, and that the mass of this amount is called the 'molar mass'.

Calculate the density of nitrogen gas at atmospheric pressure and at $20\,^{\circ}\mathrm{C}$ if the molar mass of nitrogen is $0.028\,\mathrm{kg}$.

Gas Laws, Density and Kinetic Energy 32.1

A Level

Quantities:

P pressure $\left(\mathrm{N\,m^{-2}}\right)$
V volume of a gas $\left(\mathrm{m^3}\right)$
T temperature $\left(\mathrm{K}\right)$
m mass of particle $\left(\mathrm{kg}\right)$
ρ density of a gas $\left(\mathrm{kg\,m^{-3}}\right)$
M_M molar mass $\left(\mathrm{kg\,mol^{-1}}\right)$

n number of moles of gas $\left(\mathrm{mol}\right)$
M total mass of gas $\left(\mathrm{kg}\right)$
N number of particles in a gas
$\overline{c^2}$ mean-square speed $\left(\mathrm{m^2\,s^{-2}}\right)$
m_u molecular mass $\left(\mathrm{u}\right)$
$\overline{K}$ mean molecule kinetic energy $\left(\mathrm{J}\right)$

Equations:

$$PV = nRT \qquad n = \frac{M}{M_\mathrm{M}} \qquad PV = \frac{Nm\overline{c^2}}{3} \qquad n = \frac{N}{N_\mathrm{A}} \qquad \rho = \frac{M}{V}$$

$$PV = Nk_\mathrm{B}T \qquad \overline{K} = \tfrac{1}{2}m\overline{c^2} \qquad m_u = \frac{m}{1.66 \times 10^{-27}\,\mathrm{kg}}$$

Use the equations above to derive expressions for:

Part A P using M, M_M, V, R, T

P in terms of M, M_M, V, R and T.

The following symbols may be useful: `M, M_M, P, R, T, V`

Part B ρ using M_M, P, R, T

ρ in terms of M_M, P, R and T.

The following symbols may be useful: `M_M, P, R, T, rho`

Part C ρ using m, P, k_B, T

ρ in terms of m, P, k_B and T.

The following symbols may be useful: `P, T, k_B, m, rho`

Part D ρ using P, $\overline{c^2}$

ρ in terms of P and $\overline{c^2}$ *(written as c^2 in the editor)*.

The following symbols may be useful: `P, c^2, rho`

Part E $\overline{K}$ using k_B, T

$\overline{K}$ *(written as K in the editor)* in terms of k_B and T.

The following symbols may be useful: `K, T, k_B`
