

Gases worksheet 4

Question 3

- 3.1 A fixed mass of gas occupies a volume of $1,5 \text{ cm}^3$ in a gas syringe at 20°C . The volume of the syringe is now increased to 2 cm^3 .

- 3.1.1 How does the average speed of the molecules in syringe now compare with the average speed when the volume was $1,5 \text{ cm}^3$?

Write down only INCREASE, DECREASE OR REMAINS THE SAME.

(1)

- 3.1.2 How will the pressure exerted by the gas now be affected? Write down only INCREASE OR DECREASE.

(1)

- 3.1.3 Name the law that explains this change in pressure.

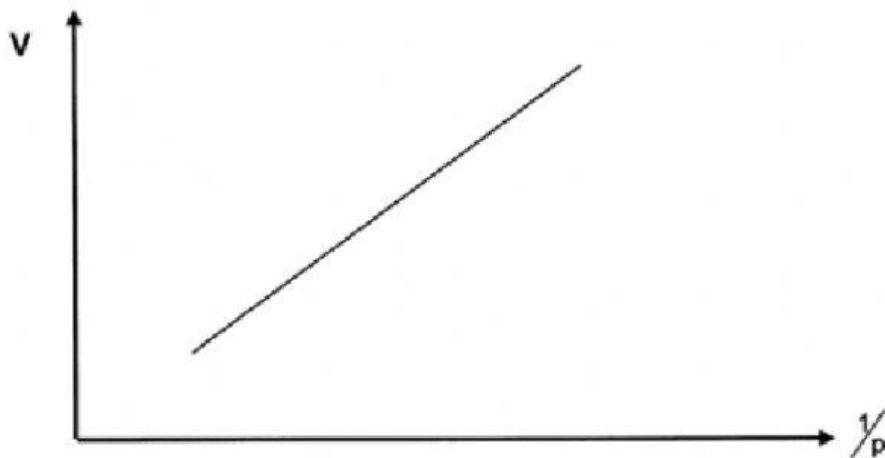
(1)

Questions dealing with gradients of graphs

Something to remember: if the question asks you to calculate the gradient, what does the gradient represent?

Well it depends on what is on your x and y axis.

Example 1



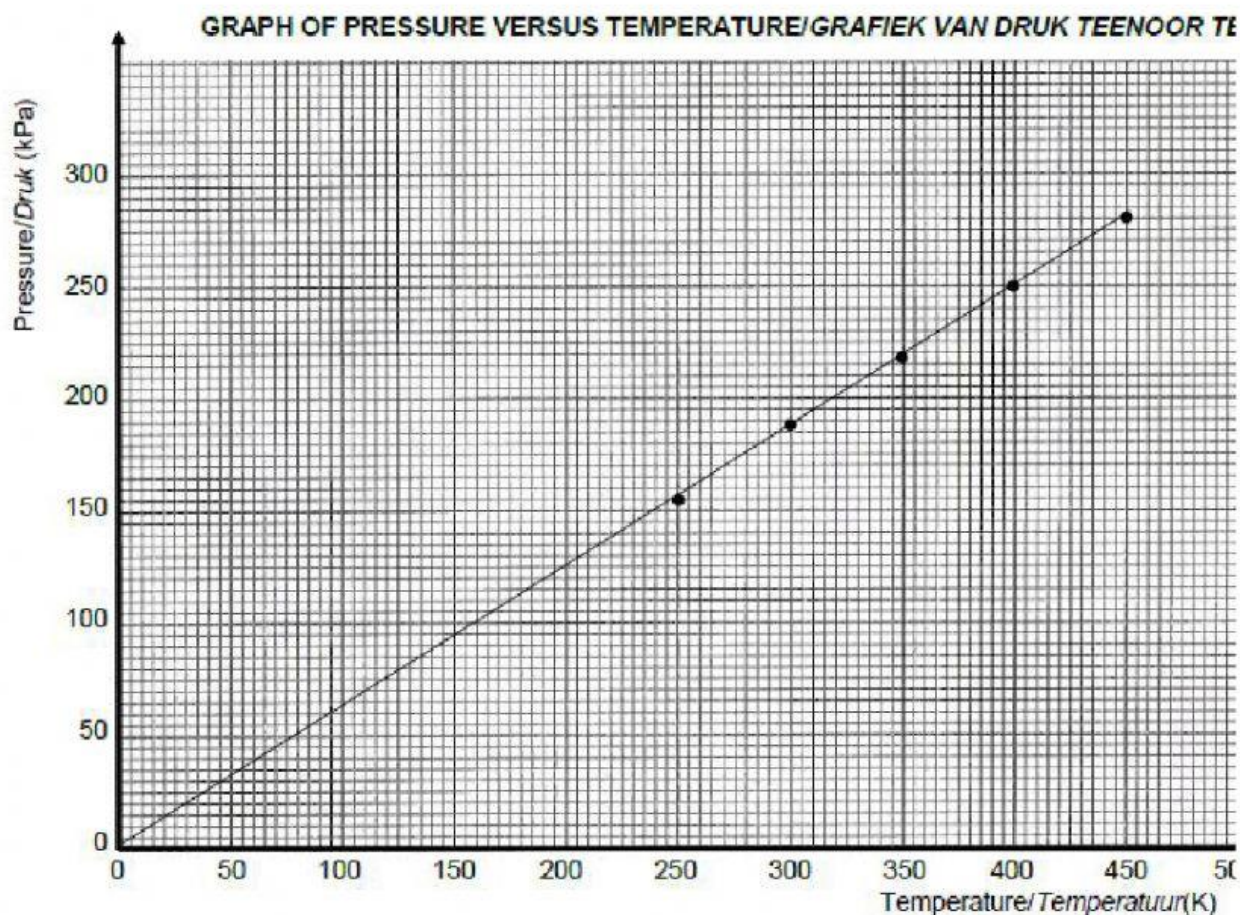
$$\text{Gradient} = \frac{\Delta V}{\frac{\Delta 1}{p}}$$

$$\begin{aligned}\text{Or simplified: gradient} &= \Delta V \div \Delta (1/p) \\ &= \Delta V \times p/1 \\ &= V.p\end{aligned}$$

Keep, change and flip

Thus the gradient represent = $V.p$ if they ask

Example 2



$$\text{Gradient} = \frac{\Delta P}{T}$$

If they ask you to use this gradient to calculate the volume:

Firstly, manipulate the formula to get $P \div T$

$$pV = nRT$$

$$\frac{\Delta P \cdot V}{T} = n \cdot R$$

Then divide both sides by V

$$\text{Thus } \frac{p}{T} = \frac{nR}{V}$$

Thus the gradient also equal to $= \frac{nR}{V}$,

Which seems very random, but they could then ask you to calculate Volume for example.

Let's do this for the graph above:

Example

Calculate the volume of 2 moles of the gas represented on the graph.

$$\text{Gradient} = \frac{\Delta P}{T}$$

$$= \frac{(250 \times 1000) - 0}{400 - 0}$$

$$= 625$$

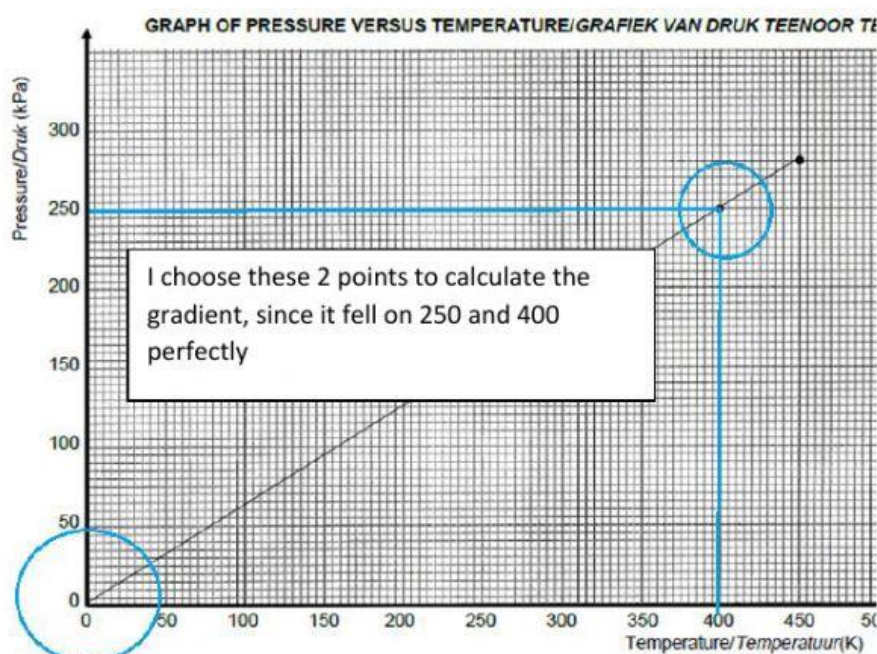
$$\frac{p}{T} = \frac{nR}{V}$$

$$625 = \frac{2(8,31)}{V}$$

$$625V = 16,62$$

$$V = 0,03 \text{ m}^3$$

Pressure needs to be in Pa

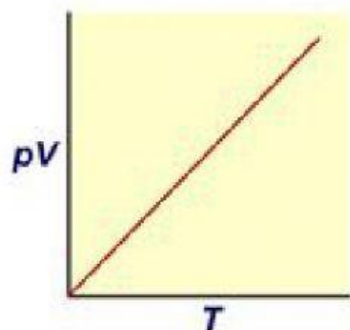


Then you can substitute into this formula and manipulate to get V by itself.

Example 3

pV/T graph: calculating number of moles

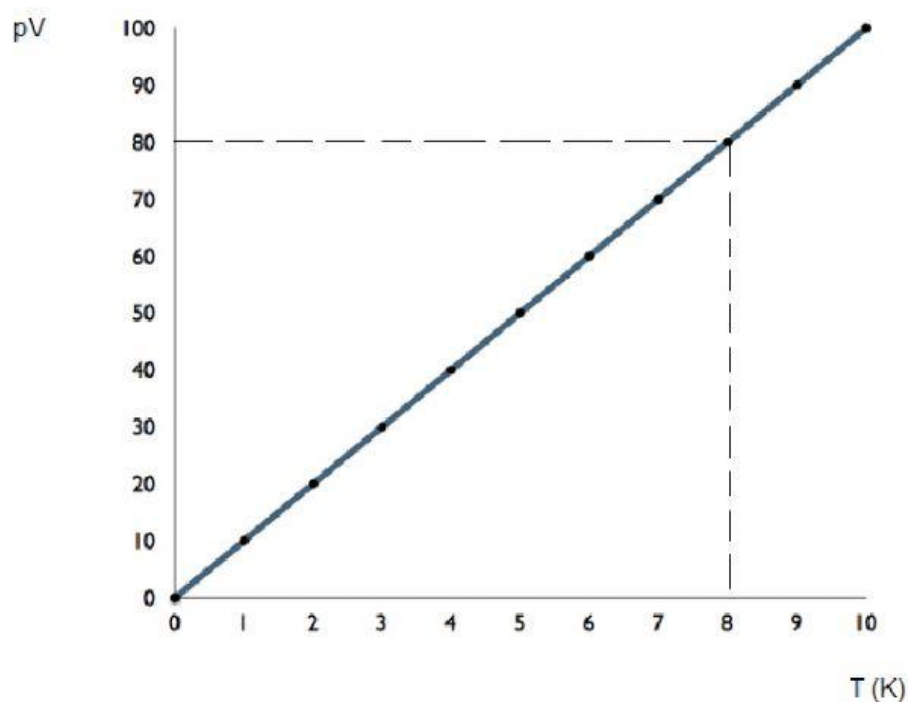
Plotting a graph of pV against T for an ideal gas:



$$pV = nRT, \text{ so } pV/T = nR$$

Therefore the gradient of the graph is equal to nR .

Because R is a constant, the number of moles can be calculated from the gradient.



Firstly, what would the gradient of this graph represent?

$$pV = nRT$$

manipulate the formula so that $pV \div T$ is on one side of the equation

$$\frac{pV}{T} = n.R$$

Thus the gradient equals to $n.R$

Since you always have the value of R, you can use the gradient and calculate the

Use the graph and determine the number of moles of gas from the graph

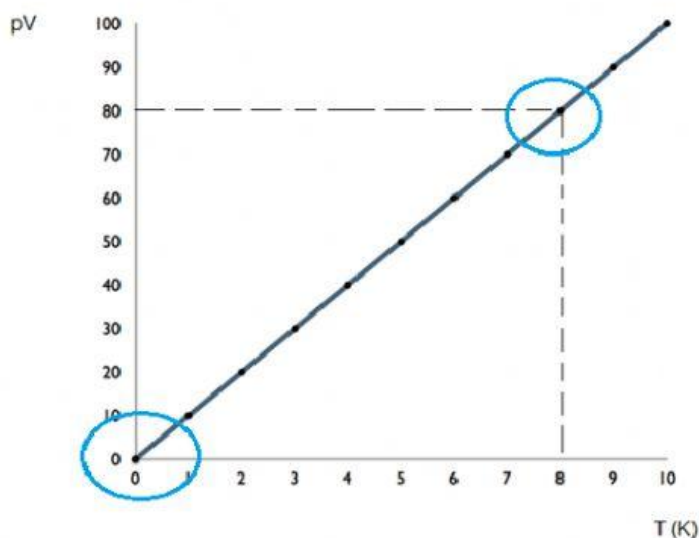
$$\frac{pV}{T} = n.R$$

$$\frac{80-0}{8-0} = n.R$$

$$10 = n.R$$

$$10 = n(8,31)$$

$$n = 1,2 \text{ mol}$$



Determine what the unit for the gradient would be

The unit for the gradient would be J.K⁻¹

Why?

The unit for pV equals to Joules, why?

Pressure = Force per unit area = N/m²

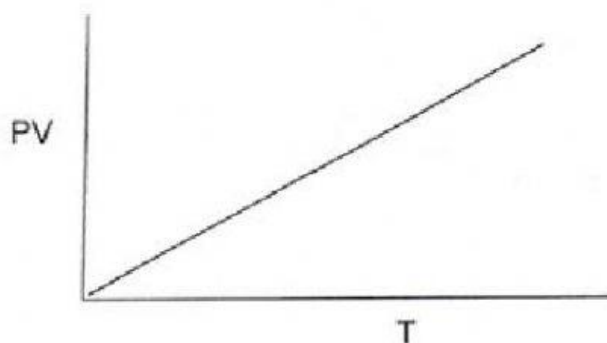
Pressure x Volume = N/m² x m³ = N m

Force x distance (N m) = Energy (Joules)

Therefore Pressure x Volume is in unit of Joules

Exam question

A diatomic gas was studied at various temperatures and pressures. The following graph was obtained from results of the study.



Assume that this gas is an ideal gas.

- 1.1 State the conditions under which real gases deviate from ideal gas behaviour.

(2)

High pressure

Low pressure

Low temperature

High temperature

- 1.2 Determine the gradient of this graph, if the gas occupied $3,36\text{dm}^3$ of STP.

Gradient =

(2 decimal places)

{Don't leave any spaces
between answer values
and units}

STP – standard temp and
pressure

$$T = 0^{\circ}\text{C} + 273$$

$$= 273\text{K}$$

$$P = 1 \text{ atm } (101,325\text{kPa})$$

- 1.3 0,384 g of a gas occupied a volume of 200cm^3 at a pressure of 149,58 kPa and temperature of 27°C . Identify this gas. Show clearly how you arrived at this answer.

Firstly, convert all the values into the correct SI units

{leave no spaces between values and units}

$p =$ {in decimal notation – not scientific notation}

$V =$ {5 decimal places and in decimal notation}

$T =$

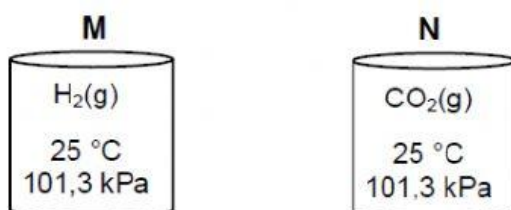
Answer for the mole(n) =

Final answer for M =

Thus the gas is (just state the element symbol) =

Multiple choice questions

1. Two identical containers, **M** and **N**, are shown below. Container **M** contains $\text{H}_2(\text{g})$ and container **N** contains $\text{CO}_2(\text{g})$. Both gases are at a temperature of 25°C and a pressure of 101,3 kPa.



Consider the following statements:

- (i) The average kinetic energy of the molecules is the same in both containers.
- (ii) Container **M** contains more gas molecules than container **N**.
- (iii) The mass of the gas in container **N** is greater than the mass of the gas in container **M**.

Which of the above statements is/are CORRECT?

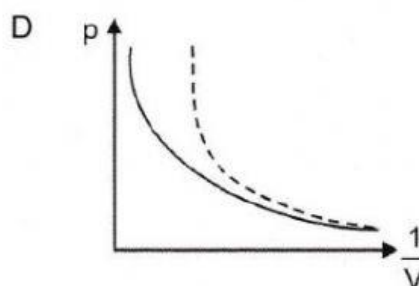
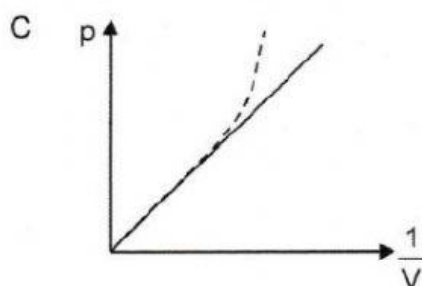
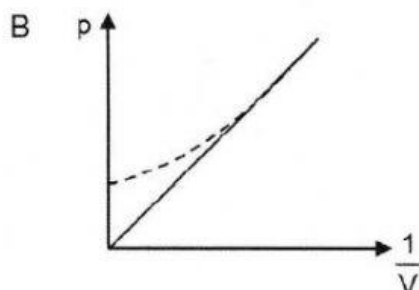
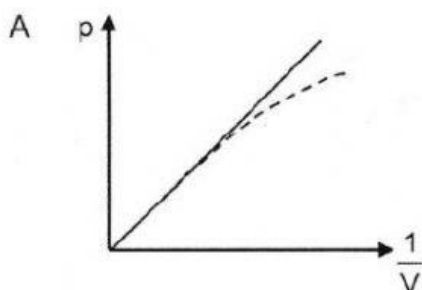
- A (i) only
- B (iii) only
- C (i) and (ii) only
- D (i) and (iii) only

2. The volume of a gas at a certain temperature and pressure is V .

If the temperature is doubled and the pressure is halved, the volume of the gas will be ...

- A $4V$
- B $2V$
- C V
- D $\frac{1}{2}V$

3. In which ONE of the following graphs does the dotted line CORRECTLY represent the deviation of a real gas from ideal gas behaviour?



4. A gas of volume V is at a temperature T_1 and pressure P_1 in a gas syringe. If the pressure on the gas is doubled and the temperature halved, then the volume that the gas will occupy is ...

- A $\frac{1}{4}V$
- B $\frac{1}{2}V$
- C V
- D $2V$