WORKSHEET: IDEAL GASES

6 *Use of the Data Booklet is relevant to this question.*

The gas laws can be summarised in the ideal gas equation.

$$pV = nRT$$

0.56 g of ethene gas is contained in a vessel at a pressure of 102 kPa and a temperature of 30 °C.

What is the volume of the vessel?

A 49 cm^3 **B** 494 cm^3 **C** 48 900 cm^3 **D** 494 000 cm^3

s/12/qp11

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6 *Use of the Data Booklet is relevant to this question.*

The gas laws can be summarised in the ideal gas equation.

$$pV = nRT$$

0.96 g of oxygen gas is contained in a glass vessel of volume 7000 cm^3 at a temperature of 30 °C.

What is the pressure in the vessel?

A 1.1 kPa **B** 2.1 kPa **C** 10.8 kPa **D** 21.6 kPa

s/12/qp12

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9 *Use of the Data Booklet is relevant to this question.*

In an experiment using a gas syringe, 0.10 g of a gas is found to occupy 83.1 cm^3, measured at standard pressure (1.0×10^5 Pa) and 27 °C.

What is the relative molecular mass of the gas?

A $\dfrac{0.10 \times 8.31 \times 27}{1.0 \times 10^5 \times 83.1}$

B $\dfrac{0.10 \times 8.31 \times 300}{1.0 \times 10^5 \times 83.1}$

C $\dfrac{0.10 \times 8.31 \times 27}{1.0 \times 10^5 \times 83.1 \times 10^{-6}}$

D $\dfrac{0.10 \times 8.31 \times 300}{1.0 \times 10^5 \times 83.1 \times 10^{-6}}$

w/03/qp1

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8 *Use of the Data Booklet is relevant to this question.*

Which expression gives the pressure exerted by 1.6×10^{-3} mol of N_2 in a container of volume $3.0\,dm^3$ at 273 °C?

A $\dfrac{1.6 \times 10^{-3} \times 8.31 \times 273}{3.0 \times 10^{-6}}$ Pa

B $\dfrac{1.6 \times 10^{-3} \times 8.31 \times (273 + 273)}{3.0 \times 10^{-6}}$ Pa

C $\dfrac{1.6 \times 10^{-3} \times 8.31 \times 273}{3.0 \times 10^{-3}}$ Pa

D $\dfrac{1.6 \times 10^{-3} \times 8.31 \times (273 + 273)}{3.0 \times 10^{-3}}$ Pa

w/04/qp1

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6 The density of ice is $1.00\,g\,cm^{-3}$.

What is the volume of steam produced when $1.00\,cm^3$ of ice is heated to 323 °C (596 K) at a pressure of one atmosphere (101 kPa)?

[1 mol of a gas occupies $24.0\,dm^3$ at 25 °C (298 K) and one atmosphere.]

A $0.267\,dm^3$ **B** $1.33\,dm^3$ **C** $2.67\,dm^3$ **D** $48.0\,dm^3$

s/08/qp1

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7 Flask X contains $5\,dm^3$ of helium at 12 kPa pressure and flask Y contains $10\,dm^3$ of neon at 6 kPa pressure.

If the flasks are connected at constant temperature, what is the final pressure?

A 8 kPa **B** 9 kPa **C** 10 kPa **D** 11 kPa

w/10/qp12

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6 *Use of the Data Booklet is relevant to this question.*

The volume of a sample of ammonia is measured at a temperature of 60 °C and a pressure of 103 kPa. The volume measured is 5.37×10^{-3} m^3.

What is the mass of the sample of ammonia, given to two significant figures?

A 0.00019 g **B** 0.0034 g **C** 0.19 g **D** 3.4 g

w/12/qp11

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3 *Use of the Data Booklet is relevant to this question.*

The volume of a sample of ammonia was measured at a temperature of 40 °C and a pressure of 95 kPa. The volume measured was 4.32×10^{-5} m^3.

What is the mass of the sample of ammonia?

A 2.7×10^{-5} g **B** 2.1×10^{-4} g **C** 2.7×10^{-2} g **D** 2.1×10^{-1} g

w/12/qp13

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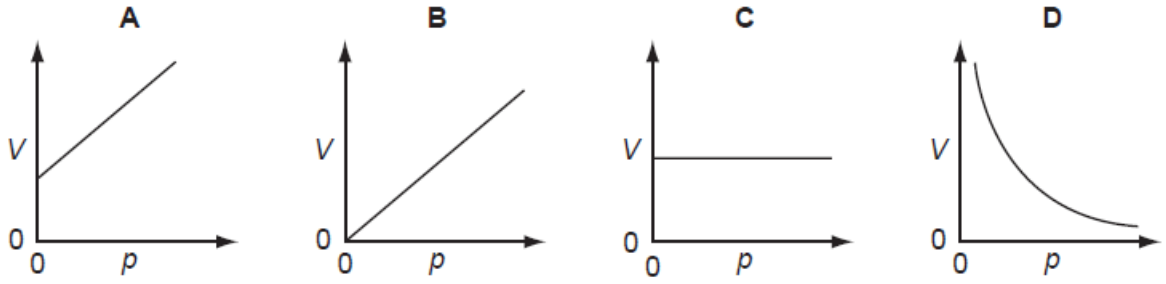
1 Which diagram shows the correct graph of V against p for a fixed mass of an ideal gas at constant temperature?



w/12/qp13

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33 Which are assumptions of the kinetic theory of gases and hence of the ideal gas equation, $PV = nRT$?

1 Molecules move without interacting with one another except for collisions.

2 Intermolecular forces are negligible.

3 Intermolecular distances are much greater than the molecular size.

w/11/qp12

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9 The use of sucrose in food processing depends in part on osmotic pressure, symbol Π.

In dilute solution, Π varies with concentration in a similar way to gas behaviour. The equation $\Pi V = nRT$ can be used, where n is the number of moles of solute molecules contained in volume V at temperature T. The number of moles of solvent molecules should be ignored.

Under aqueous acidic conditions sucrose is hydrolysed.

$$\underset{\text{sucrose}}{C_{12}H_{22}O_{11}} + H_2O \rightarrow \underset{\text{glucose}}{CH_2OH(CHOH)_4CHO} + \underset{\text{fructose}}{CH_2OH(CHOH)_3COCH_2OH}$$

What can be deduced from this hydrolysis equation?

	the osmotic pressure	glucose and fructose are
A	decreases	optical isomers
B	decreases	structural isomers
C	increases	optical isomers
D	increases	structural isomers

w/11/qp12

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5 At room temperature and pressure chlorine does not behave as an ideal gas.

At which temperature and pressure would the behaviour of chlorine become more ideal?

	pressure /kPa	temperature /K
A	50	200
B	50	400
C	200	200
D	200	400

w/11/qp11

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7 Which of the following would behave most like an ideal gas at room temperature?

A carbon dioxide

B helium

C hydrogen

D nitrogen

w/08/qp1

31 What are assumptions of the kinetic theory of gases and hence of the ideal gas equation, $PV = nRT$?

1 Molecules move without interacting with one another except for collisions.

2 Intermolecular forces are negligible.

3 Intermolecular distances are much greater than the molecular size.

w/07/qp1

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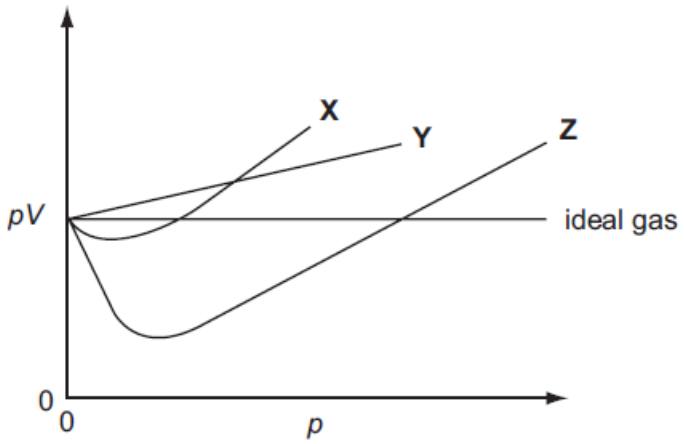
6 For an ideal gas, the plot of pV against p is a straight line. For a real gas, such a plot shows a deviation from ideal behaviour. The plots of pV against p for three real gases are shown below.

The gases represented are ammonia, hydrogen and nitrogen.



What are the identities of the gases **X**, **Y** and **Z**?

	X	Y	Z
A	ammonia	nitrogen	hydrogen
B	hydrogen	nitrogen	ammonia
C	nitrogen	ammonia	hydrogen
D	nitrogen	hydrogen	ammonia

w/06/qp1

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5 Which gas is likely to deviate most from ideal gas behaviour?

A HCl **B** He **C** CH_4 **D** N_2

w/05/qp1

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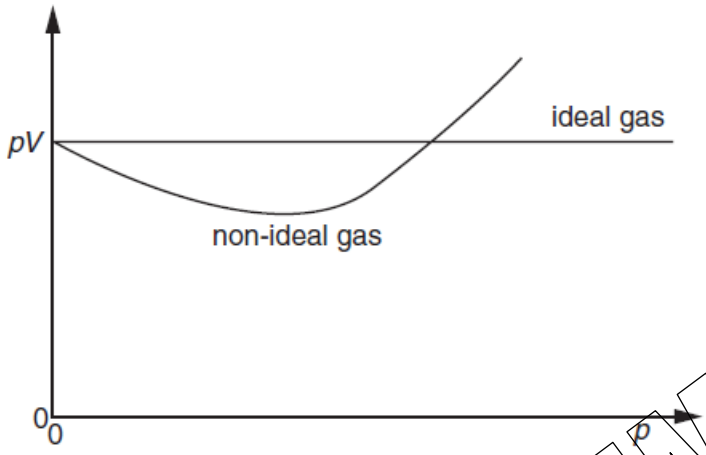
10 The value of pV is plotted against p for two gases, an ideal gas and a non-ideal gas, where p is the pressure and V is the volume of the gas.



Which of the following gases shows the greatest deviation from ideality?

A ammonia

B ethene

C methane

D nitrogen

w/03/qp1

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31 The gas laws can be summarised in the ideal gas equation.

$$pV = nRT$$

where each symbol has its usual meaning.

Which statements are correct?

1 One mole of an ideal gas occupies the same volume under the same conditions of temperature and pressure.

2 The density of an ideal gas at constant pressure is inversely proportional to the temperature, T.

3 The volume of a given mass of an ideal gas is doubled if its temperature is raised from 25 °C to 50 °C at constant pressure.

s/12/qp11

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8 Under which set of conditions is a gas most likely to behave ideally?

	temperature	pressure
A	high	high
B	high	low
C	low	high
D	low	low

s/12/qp11

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32 When a sample of a gas is compressed at constant temperature from 1500 kPa to 6000 kPa, its volume changes from 76.0 cm^3 to 20.5 cm^3.

Which statements are possible explanations for this behaviour?

1 The gas behaves non-ideally.

2 The gas partially liquefies.

3 Gas is adsorbed on to the vessel walls.

s/11/qp12

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33 Which equations apply to an ideal gas?
[p = pressure, V = volume, M = molar mass, ρ = density, c = concentration, R = gas constant, T = temperature]

1 $p = \frac{\rho RT}{M}$ **2** $pV = MRT$ **3** $pV = \frac{cRT}{M}$

s/11/qp12

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3 Which gas closely approaches ideal behaviour at room temperature and pressure?

A ammonia

B carbon dioxide

C helium

D oxygen

s/10/qp11

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32 An ideal gas obeys the gas laws under all conditions of temperature and pressure.

Which of the following are true for an ideal gas?

1 The molecules have negligible volume.

2 There are no forces of attraction between molecules.

3 The molecules have an average kinetic energy which is proportional to its absolute temperature.

s/09/qp1

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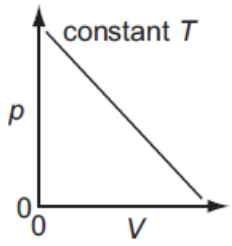
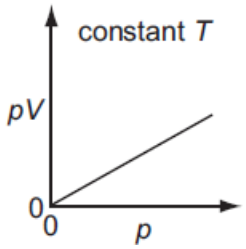
8 Which diagram correctly describes the behaviour of a fixed mass of an ideal gas? (*T* is measured in K.)

A



B



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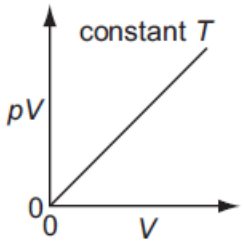
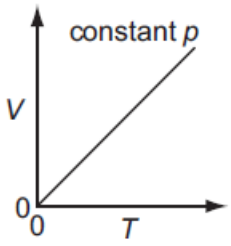


D



s/08/qp1

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6 Which of the following least resembles an ideal gas?

A ammonia

B helium

C hydrogen

D trichloromethane

s/06/qp1

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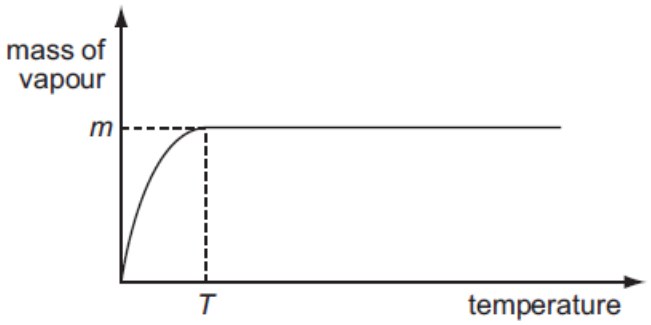
32 A quantity of solid *Y* was placed in a previously evacuated vessel and the apparatus was ther held at a series of different temperatures. At each temperature, the mass of *Y* in the vapour state was calculated from pressure measurements. The results are shown below.



What can be deduced from the diagram?

1 The mass of *Y* used in the experiment was *m*.

2 The pressure of the vapour was constant for all temperatures above temperature *T*.

3 Liquid appeared at temperature *T*.

s/05/qp1

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6 Measured values of the pressure, volume and temperature of a known mass of a gaseous compound are to be substituted into the equation

$$pV = nRT$$

in order to calculate the relative molecular mass, M_r, of the compound.

Which conditions of pressure and temperature would give the most accurate value of M_r?

	pressure	temperature
A	high	high
B	high	low
C	low	high
D	low	low

s/03/qp1
