Q1. In an experiment to measure the temperature of the flame of a Bunsen burner, a lump of copper of mass 0.12 kg is heated in the flame for several minutes. The copper is then transferred quickly to a beaker, of negligible heat capacity, containing 0.45 kg of water, and the temperature rise of the water measured.

Specific heat capacity of water = 4200 J kg^{-1} K^{-1}
Specific heat capacity of copper = 390 J kg^{-1} K^{-1}

(a) (i) The temperature of the water rises from 15ºC to 35ºC. Calculate the thermal energy gained by the water.

thermal energy gained = ...

(ii) Calculate the temperature reached by the copper in the flame. Assume no heat is lost when the copper is transferred.

temperature = ...

(4)

(b) When the lump of copper entered the water, some of the water was turned to steam.

(i) The specific latent heat of vaporisation of steam is 2.25 MJ kg^{-1}. What further measurement would need to be made to calculate the energy used to produce this steam?

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(ii) Without further calculation, describe how this further measurement should be used to obtain a more accurate value of the flame temperature.

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(3)
(Total 7 marks)

Q2. An electrical heater is placed in an insulated container holding 100 g of ice at a temperature of –14 °C. The heater supplies energy at a rate of 98 joules per second.

(a) After an interval of 30 s, all the ice has reached a temperature of 0 °C. Calculate the specific heat capacity of ice.

answer = ...J $kg^{-1}K^{-1}$

(2)

(b) Show that the final temperature of the water formed when the heater is left on for a further 500 s is about 40 °C.

specific heat capacity of water = 4200 J $kg^{-1}K^{-1}$

specific latent heat of fusion of water = 3.3×10^5 J $kg^{\ 1}$

(3)

(c) The whole procedure is repeated in an uninsulated container in a room at a temperature of 25 °C.

State and explain whether the final temperature of the water formed would be higher or lower than that calculated in part (b).

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(2)
(Total 7 marks)

Q3. The pressure inside a bicycle tyre of volume 1.90×10^{-3} m^3 is 3.20×10^5 Pa when the temperature is 285 K.

(i) Calculate the number of moles of air in the tyre.

answer = ... mol

(1)

(ii) After the bicycle has been ridden the temperature of the air in the tyre is 295 K. Calculate the new pressure in the tyre assuming the volume is unchanged. Give your answer to an appropriate number of significant figures.

answer = ... Pa

(3)

(b) Describe **one** way in which the motion of the molecules of air inside the bicycle tyre is similar and **one** way in which it is different at the two temperatures.

similar ....

....

different ....

....

(2)

(Total 6 mark)

Q4. (a) (i) One of the assumptions of the kinetic theory of gases is that molecules make *elastic collisions.* State what is meant by an elastic collision.

....

....

(ii) State **two** more assumptions that are made in the kinetic theory of gases.

....

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....

(3)

(b) One mole of hydrogen at a temperature of 420 K is mixed with one mole of oxygen at 320 K. After a short period of time the mixture is in *thermal equilibrium*.

(i) Explain what happens as the two gases approach and then reach thermal equilibrium.

....

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(ii) Calculate the average kinetic energy of the hydrogen molecules before they are mixed with the oxygen molecules.

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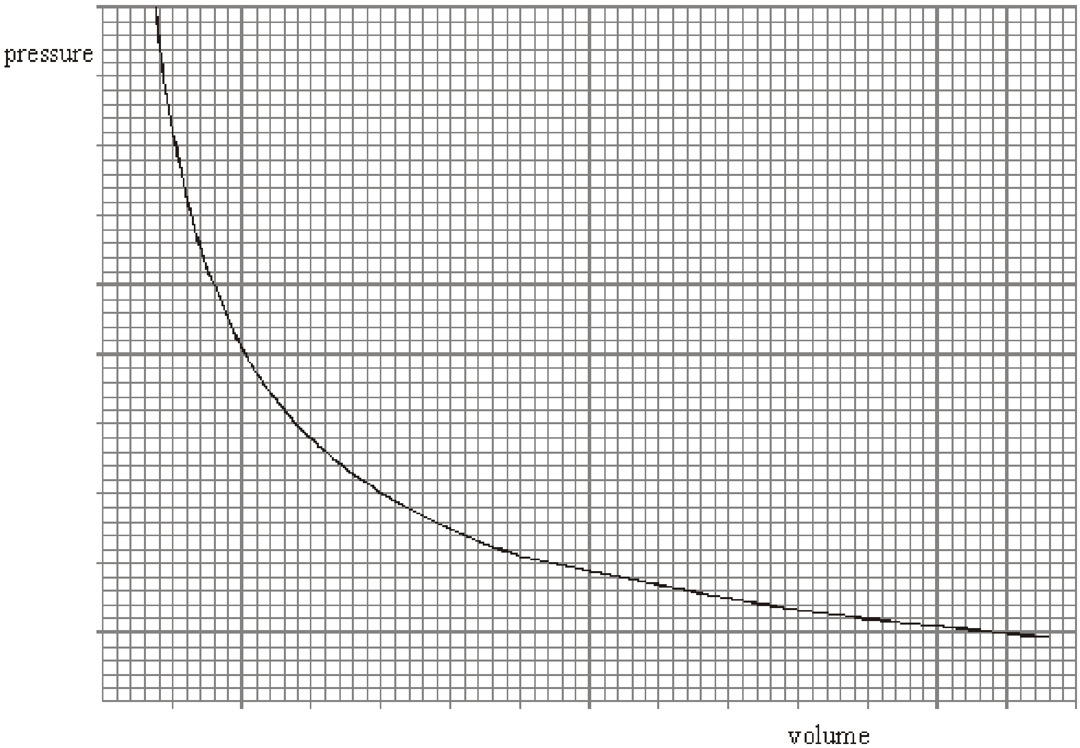
(4)
(Total 7 marks)

Q5. The graph shows how the pressure of an ideal gas varies with its volume when the mass and temperature of the gas are constant.



(a) On the same axes, sketch **two** additional curves **A** and **B**, if the following changes are made.

(i) The same mass of gas at a lower constant temperature (label this **A**).

(ii) A greater mass of gas at the original constant temperature (label this **B**).

(2)

(b) A cylinder of volume 0.20 m^3 contains an ideal gas at a pressure of 130 kPa and a temperature of 290 K. Calculate

(i) the amount of gas, in moles, in the cylinder,

....

....

....

(ii) the average kinetic energy of a molecule of gas in the cylinder,

....

(iii) the average kinetic energy of the molecules in the cylinder.

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....

(5)
(Total 7 marks)

Q6. (a) (i) Write down the equation of state for *n* moles of an ideal gas.

....

(ii) The molecular kinetic theory leads to the derivation of the equation

$pV = \frac{1}{3} Nm\overline{c^2}$,

where the symbols have their usual meaning.

State **three** assumptions that are made in this derivation.

....

....

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....

(4)

(b) Calculate the average kinetic energy of a gas molecule of an ideal gas at a temperature of 20 °C.

....

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(3)

(c) Two different gases at the same temperature have molecules with different mean square speeds.
Explain why this is possible.

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....

(2)
(Total 9 marks)

Q7. (a) The air in a room of volume 27.0 m^3 is at a temperature of 22 °C and a pressure of 105 kPa.

Calculate

(i) the temperature, in K, of the air,

....

(ii) the number of moles of air in the room,

....

....

....

(iii) the number of gas molecules in the room.

....

....

(5)

(b) The temperature of an ideal gas in a sealed container falls. State, with a reason, what happens to the

(i) mean square speed of the gas molecules,

....

....

....

(ii) pressure of the gas.

....

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....

....

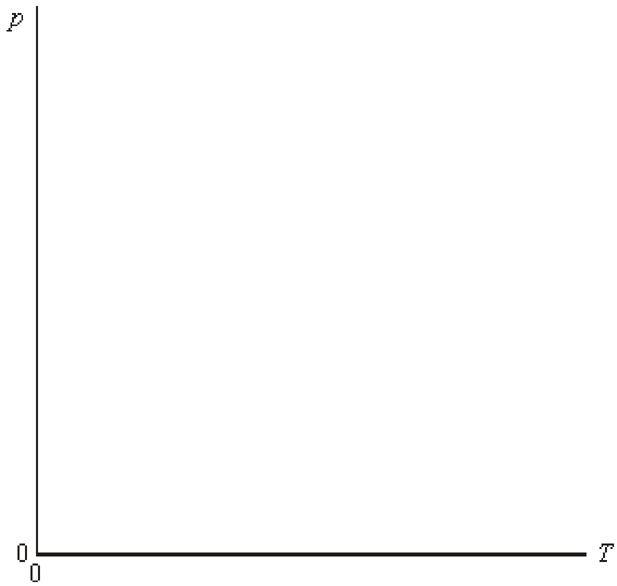
(4)
(Total 9 marks)

Q8. (a) State the equation of state for an ideal gas.

....

(1)

(b) A fixed mass of an ideal gas is heated while its volume is kept constant. Sketch a graph on the axes below to show how the pressure, *p*, of the gas varies with the absolute temperature, *T*, of the gas.



(2)

(c) Explain in terms of molecular motion, why the pressure of the gas in part (b) varies with the absolute temperature.

You may be awarded marks for the quality of written communication in your answer.

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(4)

(d) Calculate the average kinetic energy of the gas molecules at a temperature of 300 K.

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(2)
(Total 9 marks)

Q9. (a) A cylinder of fixed volume contains 15 mol of an ideal gas at a pressure of 500 kPa and a temperature of 290 K.

(i) Show that the volume of the cylinder is 7.2×10^{-2} m^3**.**

....

....

(ii) Calculate the average kinetic energy of a gas molecule in the cylinder.

....

....

(4)

(b) A quantity of gas is removed from the cylinder and the pressure of the remaining gas falls to 420 kPa. If the temperature of the gas is unchanged, calculate the amount, in mol, of gas remaining in the cylinder.

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(2)

(c) Explain in terms of the kinetic theory why the pressure of the gas in the cylinder falls when gas is removed from the cylinder.

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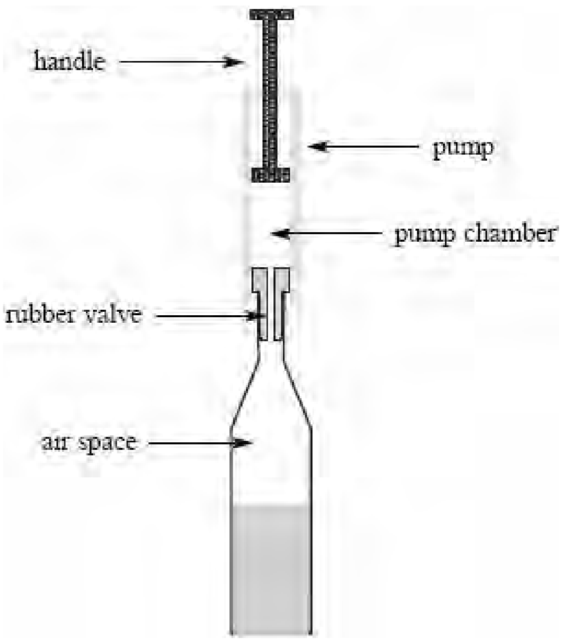
(4)
(Total 10 marks)

Q10. Some liquids in open bottles deteriorate exposure to air. The diagram below shows one device used to reduce this deterioration. It consists of a rubber valve that is inserted into the neck of the bottle together with a pump that is used to remove some of the air in the bottle through this rubber valve. On an up-stroke of the pump, air enters the pump chamber from the bottle. On the down-stroke, the rubber valve closes and the air in the chamber is expelled to the atmosphere through another valve (not shown) in the handle.



(a) There is 3.5×10^{-4} m^3 of air space in the bottle and the volume of the pump chamber changes from zero at the beginning of the up-stroke to 6.5×10^{-4} m^3 at the end of the up-stroke. The initial pressure of the air in the bottle is that of the atmosphere with a value of 99 kPa.

Assuming the process is at constant temperature, calculate the pressure in the bottle after one up-stroke of the pump.

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....

(3)

(b) Calculate the number of molecules of air originally in the air space in the bottle at a temperature of 18 °C.

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....

....

(3)

(c) Explain how the kinetic theory of an ideal gas predicts the existence of a gas pressure inside the bottle. Go on to explain why this pressure decreases when some of the air is removed from the bottle.

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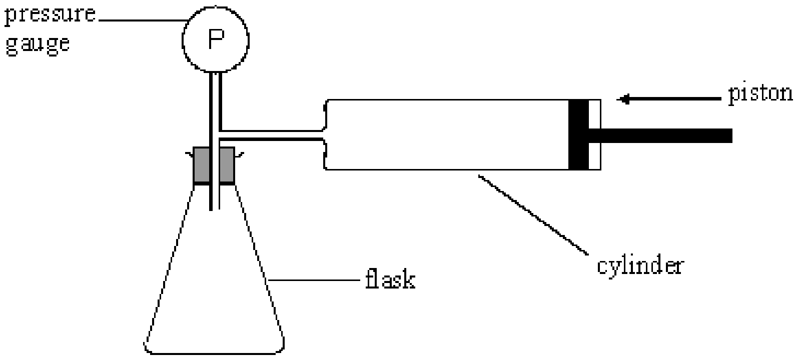
(5)
(Total 11 marks)

Q11. The diagram shows an arrangement that is used to measure the density of a powder. The air in the cylinder is forced into the flask and the air pressure is measured, by the pressure gauge P, before and after the change. The test is then repeated with the powder present in the flask. In both tests, the initial pressure in the flask is the same.



(a) (i) Explain why, after compression of the air the pressure in the flask is greater when the powder is present than when it is not present.

You may be awarded marks for the quality of written communication in your answer.

....

....

....

....

(ii) Calculate the pressure in the flask, after compression at constant temperature, when no powder was present. Assume that the volume of the tubes and pressure gauge is negligible.

volume of the empty flask = 2.50×10^{-4} m^3
volume of the cylinder = 1.00×10^{-4} m^3
initial pressure of the air in the flask and cylinder = 100 kPa.

....

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....

....

(6)

(b) To test the apparatus, 0.13 kg of powder of density 2700 kg m^{-3} was placed in the flask before compression.

(i) Calculate the volume of this amount of powder.

....

....

....

(ii) The pressure of the air in the flask increased to 150 kPa when the test was carried out with this amount of powder in the flask. By carrying out an appropriate calculation, justify whether or not the test was successful.

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(5)
(Total 11 marks)

Q12.

Figure 1

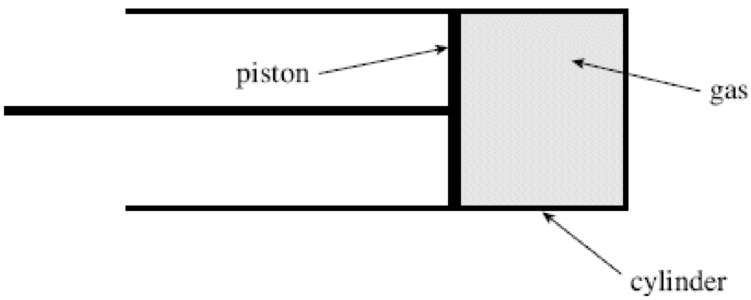
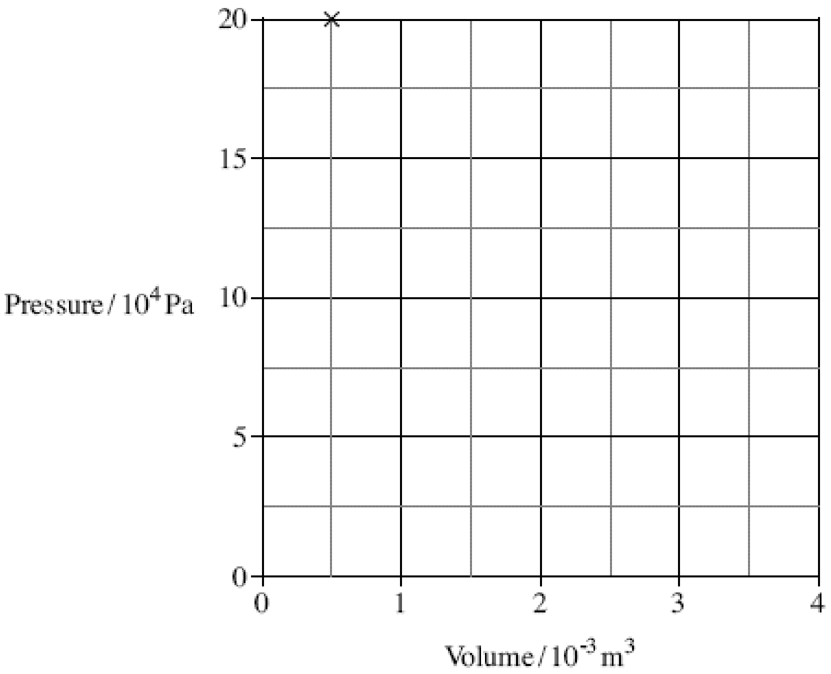


Figure 1 shows a cylinder, fitted with a gas-tight piston, containing an ideal gas at a constant temperature of 290 K. When the pressure, p, in the cylinder is 20×10^4 Pa the volume, V, is 0.5×10^{-3} m^3.

Figure 2 shows this data plotted.

Figure 2



(a) By plotting two or three additional points draw a graph, on the axes given in **Figure 2**, to show the relationship between pressure and volume as the piston is slowly pulled out. The temperature of the gas remains constant.

(3)

(b) (i) Calculate the number of gas molecules in the cylinder.

answer = ... molecules

(2)

(ii) Calculate the total kinetic energy of the gas molecules.

answer = ... J

(3)

(c) State **four** assumptions made in the molecular kinetic theory model of an ideal gas.

(i) ....

....

(ii) ....

....

(iii) ....

....

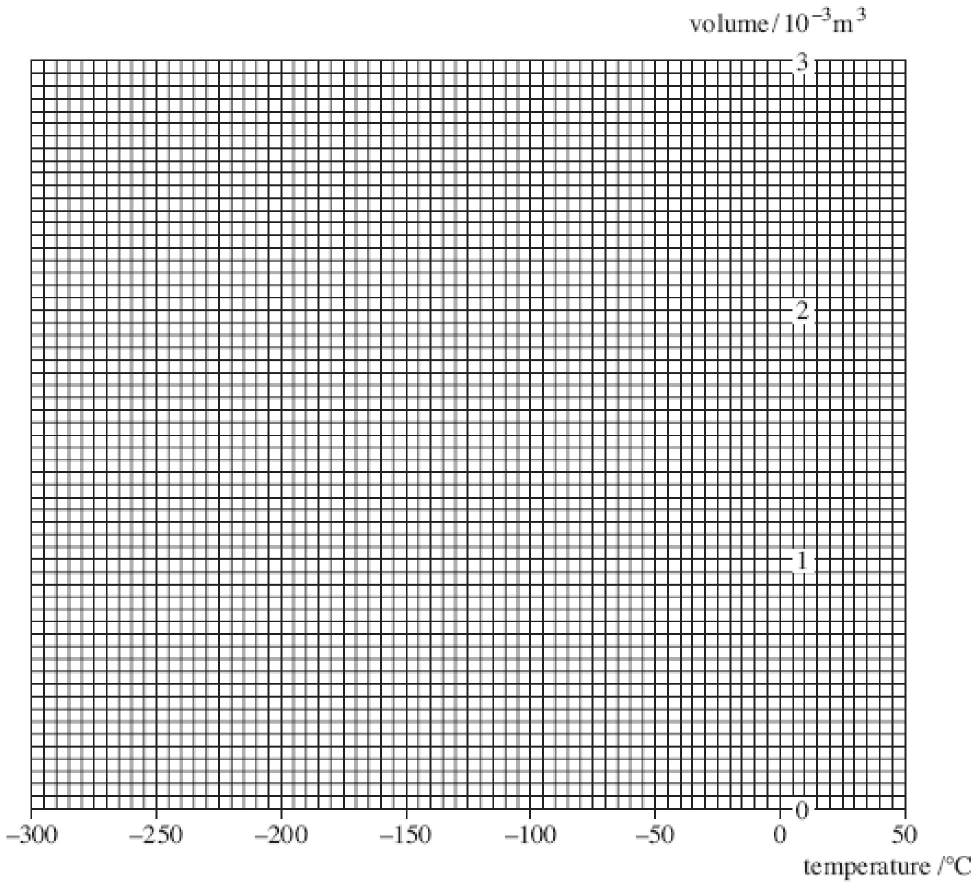
(iv) ....

....

(4)
(Total 12 marks)

Q13. A fixed mass of ideal gas at a low temperature is trapped in a container at constant pressure. The gas is then heated and the volume of the container changes so that the pressure stays at 1.00×10^5 Pa. When the gas reaches a temperature of 0 °C the volume is 2.20×10^{-3} m^3.

(a) Draw a graph on the axes below to show how the volume of the gas varies with temperature in °C.



(2)

(b) Calculate the number of moles of gas present in the container.

answer = ...moles

(2)

(c) Calculate the average kinetic energy of a molecule when this gas is at a temperature of 50.0 °C. Give your answer to an appropriate number of significant figures.

answer = ...J

(3)

(d) Calculate the total internal energy of the gas at a temperature of 50.0 °C.

answer = ...J

(1)

(e) By considering the motion of the molecules explain how a gas exerts a pressure and why the volume of the container must change if the pressure is to remain constant as the temperature increases.

The quality of your written communication will be assessed in this question.

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(6)
(Total 14 marks)

M1. (a) (i) thermal energy gained by water = 0.45 × 4200 × (35 – 15)
= 3.78×10^4 J **(1)**

(ii) (thermal energy loss by copper = thermal energy gained by water gives)

$0.12 \times 390 \times \Delta T = 3.78 \times 10^4$ **(1)**

$\Delta T = \frac{3.78 \times 10^4}{0.12 \times 390} = 808$ K

flame temperature (= 808 + 35ºC) = 843ºC or 1116 K **(1)**

3

(b) (i) measure the total mass of the water, beaker and iron lump (to find the mass of water lost) **(1)**

mass of water lost due to conversion to steam,
m = mass measured in (b) (i) - initial mass of water, beaker and iron **(1)**

add the thermal energy due to steam produced, *mL*, to the thermal energy gained by the water **(1)**

calculated flame temperature would be greater **(1)**

4

[7]

M2. (a) (use of $\Delta Q = m\,c\,\Delta T$)

$30 \times 98 = 0.100 \times c \times 14$ ✓

$c = 2100$ (J kg^{-1} K^{-1}) ✓

2

(b) (use of $\Delta Q = m\,l + m\,c\,\Delta T$)

$500 \times 98 = 0.100 \times 3.3 \times 10^5$ ✓ $+ 0.100 \times 4200 \times \Delta T$ ✓

(ΔT = 38 °C)

T = 38°C ✓

3

(c) the temperature would be higher ✓

as the ice/water spends more time below 25°C

or heat travels in the direction from hot to cold

or ice/water first gains heat then loses heat

any **one** line ✓

2

[7]

M3. (a) (i) $n = PV/RT = 3.2 \times 10^5 \times 1.9 \times 10^{-3}/8.31 \times 285$

$n = 0.26$ mol ✓ (0.257 mol)

1

(ii) $P_2 = \frac{T_2}{T_1} \times P_1 = \frac{295}{285} \times 3.20 \times 10^5$ ✓

3.31×10^5 Pa ✓(allow $3.30\text{-}3.35 \times 10^5$ Pa)

3 sig figs ✓sig fig mark stands alone even with incorrect answer

3

(b) similar -(rapid) **random** motion

- range of speeds

different - **mean** kinetic energy

- root **mean** square speed

- **frequency** of collisions

2

[6]

M4. (a) (i) a collision in which kinetic energy is conserved **(1)**

(ii) molecules of a gas are identical
[or all molecules have the same mass] **(1)**
molecules exert no forces on each other except during impact **(1)**
motion of molecules is random
[or molecules move in random directions] **(1)**

volume of molecules is negligible (compared to volume of container)
[or very small compared to volume of container or point particles] **(1)**
time of collision is negligible (compared to time between collisions) **(1)**
Newton's laws apply **(1)**
large number of particles **(1)** (any two)

3

(b) (i) the hot gas cools and cooler gas heats up
until they are at same temperature
hydrogen molecules transfer energy to oxygen molecules
until **average k.e.** is the same
(any two **(1)** **(1)**)

(ii) (use of $E_k = \frac{3}{2}kT$ gives) $E_k = \frac{3}{2} \times 1.38 \times 10^{-23} \times 420$ **(1)**

$= 8.7 \times 10^{-21}$ J (8.69×10^{-21} J)

4

[7]

M5. (a) (i) curve A below original, curve B above original **(1)**

(ii) both curves correct shape **(1)**

2

(b) (i) (use of $pV = nRT$ gives) $130 \times 10^3 \times 0.20 = n \times 8.31 \times 290$ **(1)**

$n = 11$ (mol) **(1)** (10.8 mol)

(ii) (use of $E_k = \frac{3}{2}kT$ gives) $E_k = \frac{3}{2} \times 1.38 \times 10^{-23} \times 290$ **(1)**

$= 6.0 \times 10^{-21}$ J **(1)**

(iii) (no. of molecules) $N = 6.02 \times 10^{23} \times 10.8$ (= 6.5×10^{24})
total k.e. = $6.5 \times 10^{24} \times 6.0 \times 10^{-21} = 3.9 \times 10^4$ J **(1)**
(allow C.E. for value of n and E_k from (i) and (ii))

(use of n = 11 (mol) gives total k.e. = 3.9 (7) × 10^4 J)

5

[7]

M6. (a) (i) $pV = nRT$ **(1)**

(ii) all particles identical or have same mass **(1)**
collisions of gas molecules are elastic **(1)**
inter molecular forces are negligible (except during collisions) **(1)**
volume of molecules is negligible (compared to volume of container) **(1)**
time of collisions is negligible **(1)**
motion of molecules is random **(1)**
large number of molecules present
(therefore statistical analysis applies) **(1)**
monamatic gas **(1)**
Newtonian mechanics applies **(1)**

max 4

(b) $E_k = \frac{3RT}{2N_A}$ or $\frac{3}{2}kT$ **(1)**

$= \frac{3 \times 8.31 \times 293}{2 \times 6.02 \times 10^{23}}$ **(1)**

$= 6.1 \times 10^{-21}$ J **(1)** (6.07×10^{-21} J)

3

(c) masses are different **(1)**
hence because E_k is the same,
mean square speeds must be different **(1)**

2

[9]

M7. (a) (i) T (=273 + 22) = 295 (K) **(1)**

(ii) $pV = nRT$ **(1)**
$105 \times 10^3 \times 27 = n \times 8.31 \times 295$ **(1)**
n = 1160 (moles) **(1)** **(**1156 moles)
(allow C.E. for T (in K) from (i)

(iii) $N = 1156 \times 6.02 \times 10^{23} = 7.0 \times 10^{26}$ **(1)** (6.96×10^{26})

5

(b) (i) decreases **(1)**

because temperature depends on mean square speed (or $\overline{c^2}$)
[or depends on mean E_k] **(1)**

(ii) decreases **(1)**
as number of collisions (per second) falls **(1)**
rate of change of momentum decreases **(1)**

[or if using $pV = nRT$
decreases **(1)**
as V constant **(1)**
as n constant **(1)**]

[or if using $p = 1/3\rho\overline{c^2}$
decrease **(1)**
as ρ is constant **(1)**

as $\overline{c^2}$ is constant **(1)**]

max 4

[9]

M8. (a) $pV = nRT$ **(1)**

1

(b) graph to show:
straight line **(1)**
through the origin **(1)**

2

(c) **average kinetic** energy or speed of the molecules increases
with temperature **(1)**
more collisions occur (more frequently) **(1)**
[or more particles hit (per second)]
(average) change in momentum (during a collision) is greater **(1)**
rate of change of momentum is greater **(1)**
(hence) force/pressure (during collision) is greater **(1)**

max 4
QWC 1

(d) average $E_k = \frac{3}{2}kT$ **(1)**

$= 1.5 \times 1.38 \times 10^{-23} \times 300 = 6.2$**(1)** $\times 10^{-21}$ J **(1)**

[or use energy per mole = $\frac{3}{2}RT = \frac{3}{2} \times 8.31 \times 300$

$= 3.74 \times 10^{3}$ J mol^{-1}]

2

[9]

M9. (a) (i) $p\,V = nR\,T$ **(1)**

$V =$ **(1)** (gives $V = 7.2 \times 10^{-2}$m^3)

(ii) (use of $E_k = \frac{3}{2}kT$ gives) $E_k = \frac{3}{2} \times 1.38 \times 10^{-23} \times 290$ **(1)**

$= 6.0 \times 10^{-21}$ (J) **(1)**

4

(b) (use of $pV = nRT$ gives) $n = \frac{420 \times 10^{3} \times 7.2 \times 10^{-2}}{8.31 \times 290}$ **(1)**
[or use $p \propto n$]

$n = 13$ moles **(1)** (12.5 moles)

2

(c) pressure is due to molecular bombardment [or moving molecules] **(1)**
when gas is removed there are fewer molecules in the cylinder
[or density decreases] **(1)**

(rate of) bombardment decreases **(1)**
molecules exert forces on wall **(1)**

$\overline{c^2}$ is constant **(1)**

[or $pV = \frac{1}{3} Nm (c^2)$ **(1)**

V and *m* constant **(1)**

(c^2) constant since *T* constant **(1)**

$p \propto N$ **(1)**]

[or $p = \frac{1}{3}$ p(c^2) **(1)**

explanation of ρ decreasing **(1)**

(c^2) constant since *T* constant **(1)**

p (c^2) ρ **(1)**]

max 4

[10]

M10. (a) use *of* pV = constant or $p_1V_1 = p_2V_2$ **(1)**

$p = 99 \times 3.50/4.15$ **(1)**

= 83.5 kPa **(1)**

3

(b) no. of moles = 99 [× 10] × 3.5 × 10^{-4}/8.31 × **291 (1)**

= 1.4(3) × 10^{-2} moles **(1)**

no. of molecules (= 1.4(3) × 10^{-2} × 6.02 × 10^{-23})

= 8.6(1) × 10^{-21} **(1)**

3

(c) molecules/particles have momentum **(1)**

momentum change at wall **(1)**

momentum change at wall/collision at wall leads to force **(1)**
[allow impulse arguments]

less air so fewer molecules **(1)**

so change in momentum per second/rate of change is less
[*or* per unit per time] **(1)**

pressure is proportional to number of molecules (per unit volume) **(1)**

max 5

[11]

M11. (a) (i) volume of air is less with the powder present **(1)**
pressure α 1/volume so pressure is greater **(1)**

QWC 2

(ii) initial volume = 3.5×10^{-4} (m^3)
final volume = 2.5×10^{-4} (m^3)

final pressure = $\frac{100 \times 10^3 \times 3.5 \times 10^{-4}}{2.5 \times 10^{-4}}$ **(1)**

= 140×10^3 Pa **(1)**

[alternative: no.of moles (n) (= $\frac{P_0 V_0}{RT_0}$)

= $\frac{1.0 \times 10^5 \times 3.5 \times 10^{-4}}{RT_0}$ **(1)** **(1)**

final pressure = $\frac{nRT_0}{V_1}$ = $\frac{1.0 \times 10^5 \times 3.5 \times 10^{-4}}{2.5 \times 10^{-4}}$ **(1)**

= 140 kPa **(1)**

6

(b) (i) volume of powder = $\left(\frac{\text{mass}}{\text{density}} = \frac{0.13}{2700}\right) = 4.8 \times 10^{-5}$ m^3

(ii) assuming powder volume as in (b)(i),

initial volume = $(3.5 - 0.48) \times 10^{4}$ (m^3) **(1)**

final volume = $(2.5 - 0.48) \times 10^{-4}$ (m^3) **(1)**

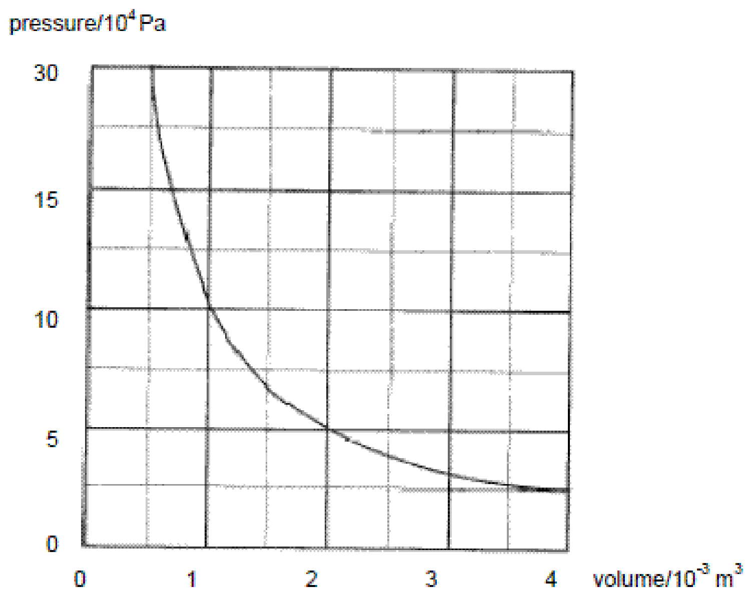
final pressure = $\frac{100 \times 10^3 \times 3}{2}$ = 150×10^3 Pa **(1)**

test successful as calculated final pressure = measured final pressure **(1)**

5

[11]

M12. (a)



3

curve with decreasing negative gradient that passes through the given point which does not touch the *x* axis **(1)**

designated points	
pressure/10^4 Pa	volume/10^{-3} m^3
10	1.0
5.0	2.0
4.0	2.5
2.5	4.0

(b) (i) $N = PV/kT = 5 \times 10^4 \times 2 \times 10^{-3}/1.38 \times 10^{-23} \times 290$ **(1)**

[or alternative use of $PV = nRT$
$5 \times 10^4 \times 2.0 \times 10^{-3}/8.31 \times 290 = 0.0415$ moles]
$= 2.50 \times 10^{22}$ molecules **(1)**

2

(ii) (mean) kinetic energy of a molecule

$= \frac{3}{2}kT = \frac{3}{2} \times 1.38 \times 10^{-23} \times 290$ **(1)** ($= 6.00 \times 10^{-21}$ J)
(total kinetic energy = mean kinetic energy × N)
$= 6.00 \times 10^{-21} \times 2.50 \times 10^{22}$ **(1)**

= 150 (J) **(1)**

3

(c) all molecules/atoms are identical

molecules/atoms are in random motion

Newtonian mechanics apply

gas contains a large number of molecules

the volume of gas molecules is negligible (compared to the volume occupied by the gas) or reference to point masses

no force act between molecules except during collisions or the speed/velocity is constant between collisions or motion is in a straight line between collisions

collisions are elastic or **kinetic** energy is conserved

and of negligible duration

any 4 ***(1)(1)(1)(1)***

max 4

[12]

M13. (a) graph passes through given point 2.2×10^{-3} m^3 at 0 °C straight line with positive gradient ✓

(straight) line to aim or pass through –273 °C at zero volume ✓

2

(b) (use of n = $P\,V/R\,T$)

$1.00 \times 10^5 \times 2.20 \times 10^{-3}/8.31 \times 273$ ✓

$n = 0.0970$ (moles) ✓

2

(c) (use of mean kinetic energy = 3/2 K T)

$= 3/2 \times 1.38 \times 10^{-23} \times 323$ ✓

6.69×10^{-21} (J) ✓ 3 sfs ✓

3

(d) total internal energy $= 6.69 \times 10^{-21} \times 0.0970 \times 6.02 \times 10^{23} = 390$ (J) ✓

1

(e) **The candidate's writing should be legible and the spelling, punctuation and grammar should be sufficiently accurate for the meaning to be clear.**

The candidate's answer will be assessed holistically. The answer will be assigned to one of three levels according to the following criteria.

High Level (Good to excellent): 5 or 6 marks

The information conveyed by the answer is clearly organised, logical and coherent, using appropriate specialist vocabulary correctly. The form and style of writing is appropriate to answer the question.

The candidate provides a comprehensive and coherent sequence of ideas linking the motion of molecules to the pressure they exert on a container. At least three of the first four points listed below must be given in a logical order. The description should also show awareness of how a balance is maintained between the increase in speed and shortening of the time interval between collisions with the wall to maintain a constant pressure.
To be in this band, reference must be made to force being the rate of change of momentum or how, in detail, the volume compensates for the increase in temperature.

Intermediate Level (Modest to adequate): 3 or 4 marks

The information conveyed by the answer may be less well organised and not fully coherent. There is less use of specialist vocabulary, or specialist vocabulary may be used incorrectly. The form and style of writing is less appropriate.

The candidate provides a comprehensive list of ideas linking the motion of molecules to the pressure they exert on a container. At least three of the first four points listed below are given. The candidate also knows than the mean square speed of molecules is proportional to temperature. Using this knowledge, an attempt is made to explain how the pressure is constant.

Low Level (Poor to limited): 1 or 2 marks

The information conveyed by the answer is poorly organised and may not be relevant or coherent. There is little correct use of specialist vocabulary. The form and style of writing may be only partly appropriate.

The candidate attempts the question and refers to at least two of the points listed below.

Incorrect, inappropriate of no response: 0 marks

No answer or answer refers to unrelated, incorrect or inappropriate physics.

Statements expected in a competent answer should include some of the following marking points.

molecules are in rapid random motion/many molecules are involved

molecules change their momentum or accelerate on collision with the walls

reference to Newton's 2^{nd} law either $F = ma$ or F = rate of change of momentum

reference to Newton's 3^{rd} law between molecule and wall

relate pressure to force $P = F/A$

mean square speed of molecules is proportional to temperature

as temperature increases so does change of momentum or change in velocity

compensated for by longer time between collisions as the temperature increases

as the volume increases the surface area increases which reduces the pressure

max 6

[14]