TERM 4 GASES REVISION SHEET

1. A syringe contains 80 mL of oxygen gas at 100 kPa. It is compressed to a volume of 15 mL at a constant temperature. What is the new gas pressure in atmospheres?

2. Use the kinetic theory of gases to explain the following observation.
"*A balloon left in a locked car on a hot day will expand and possibly explode*."

3. The gas used in disposable lighters is butane (C_4H_{10}). The mass of a full lighter was found to be 20.69g and the mass of the empty lighter was 15.91g.
(a) What volume of butane gas is released from the above lighter at SLC?
(b) The balanced equation for the complete combustion of butane is:

$$2C_4H_{10(g)} + 13\ O_{2(g)} \rightarrow 8\ CO_{2(g)} + 10\ H_2O_{(g)}$$

If 3L of butane is completely combusted, how much water vapour will be produced?

4. Real gases show deviations from the behaviour predicted by the ideal gas equation. Explain why real gases vary from ideal behaviour when subjected to high pressure.

5. Calculate the mass of chlorine in 150L of the gas at 23^{o}C and 130 kPa.

6. An <u>ideal</u> gas has a volume of 22.4 litres at STP. This can easily be calculated from the ideal gas equation. Gases such as H_2 and He will also have a volume of 22.4 L at STP, however other gases can deviate from ideal gas behaviour even at STP.
The molar volume of several gases is provided in TABLE 213. Explain why

Table 213: MOLAR VOLUME OF GASES

GAS	Molar Volume at STP
CH_4 - Methane	22.37 L
CO_2 – Carbon Dioxide	22.26 L
NH_3 - Ammonia	22.06 L

- **each gas not only differs from ideal gas behaviour but also why the molar volume of each gas differs from the other two.**
- **Under what conditions would you expect each of the gases listed in the table to approach ideal gas behaviour. Your answer should highlight differences in the gases listed.**

7. Use your understanding of gas behaviour and/or gas relationships to FULLY explain the following situation - your understanding should demonstrate your knowledge of gas laws and/or the kinetic theory of gases:

(a) Joe decides to prepare some carbon dioxide by heating solid calcium carbonate. He places the calcium carbonate in a test tube and heats it over a Bunsen burner, having first placed a rubber stopper in the test tube, so that the carbon dioxide cannot escape. After a short time, the test tube shatters and glass flies across the room.

8. During respiration in animals, glucose ($C_6H_{12}O_{6(aq)}$) reacts completely with oxygen gas, ($O_{2(g)}$) in cells to produce both Carbon Dioxide ($CO_{2(g)}$) and water.

$$C_6H_{12}O_{6\,(aq)} + 6\,O_{2\,(g)} \rightarrow 6\,CO_{2\,(g)} + 6\,H_2O_{\,(g)} \quad \Delta H = -2939\ kJ/mol$$

Young active males belong to the group of people who require the largest amounts of energy per day. A active 16 year old boy (Henry) may 700g of glucose to fuel the metabolic processes occurring in his body. As Henry respired and produced his energy, gaseous carbon dioxide would have been produced and breathed out via the lungs. Assuming that all the CO_2 is exhaled via the lungs, what total volume of CO_2 would have been breathed out during the day. Assume Henry has a normal body temperature of 37^oC and that the partial pressure caused by the exhaled CO_2 in the lungs is 0.05 atmospheres.

9. Carbon Dioxide Gas (CO_2) can be produced by the reaction between Hydrochloric Acid (HCl) and Calcium carbonate (CO_3). In order to collect an exact amount of CO_2, HCl will be used as the limiting reagent in the reaction and Calcium Carbonate will be used in excess. The carbon dioxide will be collected by the displacement of water in a gas collecting jar. (It is fairly insoluble in water).

(a) Draw a labelled diagram of how you would set up the equipment to perform the above experiment.

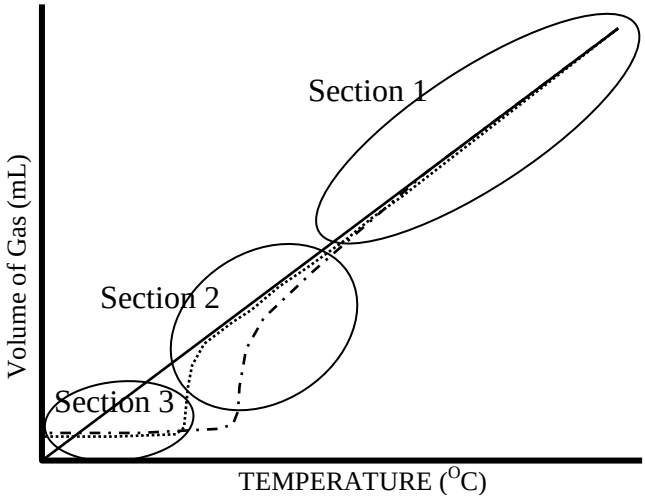
(b) Explain <u>how</u> you would calculate how many moles of CO_2 you have <u>collected</u>, AND how how would prove it was Carbon dioxide and not another gas.

(You do not have to do the actual calculation – just go through the process of how you would do it).

10. The gas used in disposable lighters is butane (C_4H_{10}). The mass of a full lighter before it was used was found to be 17.2g and, at the end of its use the empty lighter was 12.5g. Assuming that all the Butane gas was burnt when it was released - to produce carbon dioxide and water vapour – what volume of carbon dioxide would have been produced at 25^0C and 101.3 kPa?

11. The graph shows the behaviour of gases at various temperatures. A syringe was filled with each of the gases and the volume of the syringe measured at various temperatures.

Three gases – H_2 and CO and an "ideal" gas are shown on this graph. The gases are not identified by a key however.



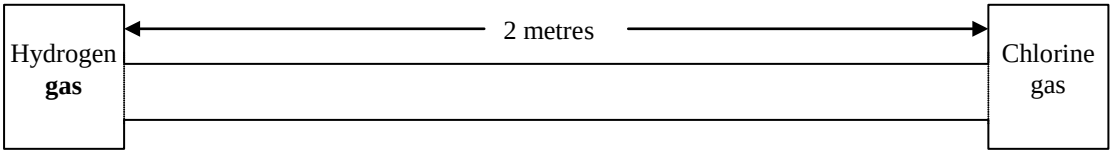
(A) Label each line with its correct gas and provide an explanation for your choices. Each explanation should clearly show

- your understanding of gas laws and/or real and ideal gas behaviour
- A logical justification for each decision explaining which sections of the graph allowed you to identify the gases.

(B) One section of the graph was most useful in identifying the gases. Explain which section this was and explain why it was the most useful section.

(C) Redraw the data as a pressure versus temperature graph for all three graphs.

12. When hydrogen and chlorine gas mix they form droplets of HCl. If one end of a long tube is placed in a sample of Hydrogen gas and the other end placed in a sample of chlorine gas, Hydrogen chlorine droplets will form in the tube at some point along its length. If the tube is two metres in length, where exactly will you observe droplets in the tube?



13. The following reaction takes place in a sealed 40 litre container at a temperature of 120 ^{0}C.

$$4\ NH_{3(g)} + 5\ O_{2(g)} \rightarrow 4\ NO_{(g)} + 6\ H_2O_{(g)}$$

(a) when 34 g of NH_3 reacts with 96 g of O_2, what is the patrial pressure of NO in the container?

(b) What is the total pressure in the container?

14. Use table 1 to 4 on the following pages to answer the following questions.

(a) 20g of oxygen gas is released 100 m below the surface of the water. What volume would it be?

(b) A 10 litre hydrogen balloon is released from the ground. It rises to a height 5km above sea level. What would its final volume be?

15. A chemist was asked to investigate a set of dodgy cigarette lighters imported from New Zealand. In order to identify the gas the chemist first weighed the lighter – its mass was 11.62g. The chemist then released some of this gas into an otherwise empty bag. The volume of the bag increased from zero to 4.2 litres. The pressure was measured at 121.3 kPa at a temperature of 16 degrees Celsius. When the lighter was re-weighed it had a mass of 8.78 grams.

(a) What safety risks are posed by the method above? How would you ensure that this experiment was performed safely?

(b) Calculate the Molar Mass of the Gas.

(c) Was the gas in the lighter "dodgy"? Gases in lighter should belong to the alkanes series of gases. Alkanes all contain only Carbon and Hydrogen and the generic formula for alkanes is C_xH_{2x+2}.

Numerical answers:

1. 533.3kPa, 5.26 atm
3. (a) 2.01 litres (b) 11 g or 15 l
5. 563 g
8. 11,900 L
10. 7.72 L
12. Cl_2 = 28.7 cm; H_2 = 171.3 cm
13. a) 162 kPa b) 447 kPa
14. a) 1.4 L b) 16.9 L
15. b) 13.4g c) dodgy, too low, H_2/He contaminant

TABLE 1
Average Temperature Readings at Various Altitudes

Altitude (km)	Temp (°C)	Altitude (km)	Temp (°C)
0	15	52	-2
5	-18	55	-7
10	-49	60	-17
12	-56	65	-33
20	-56	70	-54
25	-51	75	-65
30	-46	80	-79
35	-37	84	-86
40	-22	92	-86
45	-8	95	-81
48	-2	100	-72

TABLE 2: Temperature variation with ocean

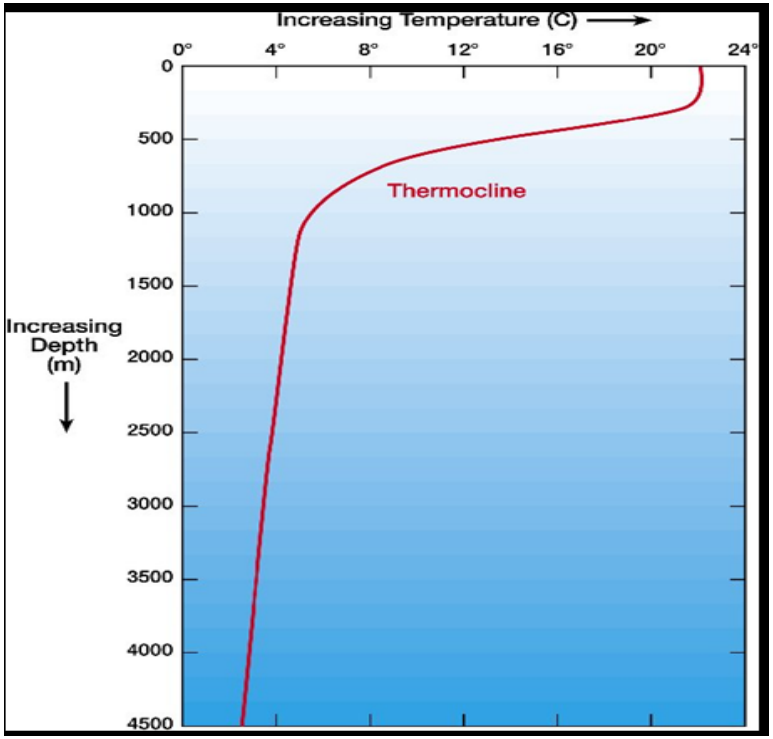


TABLE 3: Pressure variation with ocean depth

WATER PRESSURES			
BARS	Ocean depth in m	ATMOSPHERES	P.S.I
0.1	1	0.1	1.42
1	10	0.97	14.22
2	20	1.94	28.44
3	30	2.91	42.66
4	40	3.88	56.88
5	50	4.85	71.10

TABLE 4: Elevation and Atmospheric Pressure