Chemistry **[33 marks]**

Name: …….. **Prep School: ……**

1.

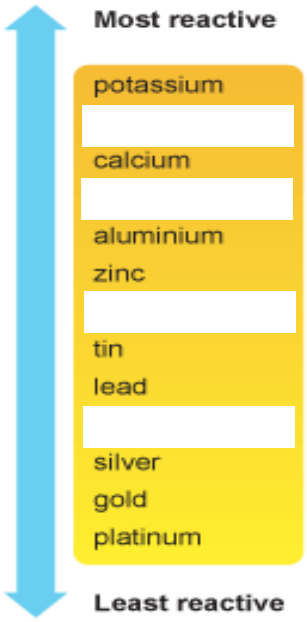


Fig. 1

a. Fig. 1 is a reactivity series of metals. Insert the missing elements from the list below:

Copper Magnesium Sodium Iron

[3]

b. Carbon is used to displace iron and zinc from their oxides, but cannot be used for aluminium. Put an **arrow** on *Fig.1* to show where carbon should be in this series.

[1]

c. Copper oxide will neutralise an acid when heated. What is the name of a substance that neutralises an acid, but does not dissolve in water?

……

[1]

d. What gas is made when hydrochloric acid reacts with limestone?

……

[1]

e. Complete the following word equation:

Acid + Alkali → ……..…… + ……

[2]

Question 1 total marks [8]

2.



Fig.2

Fig. 2 shows an oxygen candle. These are used in emergency situations to provide oxygen for people to breathe when other systems fail and are used in spacecraft. Oxygen candles work by the thermal decomposition of an oxygen-rich substance to produce oxygen and another product. Lithium perchlorate is often used as it gives a very high quantity of oxygen for its weight and for its size.

$LiClO_4$	→	LiCl	+	… O_2
Lithium Perchlorate		Lithium Chloride		Oxygen

a. Put a number on the dotted line above to balance the equation for the thermal decomposition of lithium perchlorate.

[1]

b. Circle the **one** word below that best describes lithium perchlorate.

Exothermic Atomic Compound Element

Mixture Liquid Molecular

[1]

c. What is the test and outcome for oxygen gas?

……

[2]

d. How many atoms of oxygen are there in $LiClO_4$?

……..

[1]

- Lithium perchlorate has a density of 2.42g / cm^3.
- 60.2% of its mass is oxygen.
- Liquid oxygen has density of 1.14g / cm^3.

e. Calculate whether lithium perchlorate has a greater mass of oxygen per cm^3 than liquid oxygen.

…….

[2]

Sodium perchlorate is cheaper than lithium perchlorate and decomposes in exactly the same way, but only has an oxygen density of 52.2% by mass. Sodium perchlorate is normally used in oxygen candles in mines.

f. Why do they use the more expensive candles in spacecraft?

……..

……..

[2]

g. Which metal is more reactive, sodium or lithium?

……..

[1]

h. Iron is also a metal. List one difference in **chemical properties** and one difference in **physical properties** between sodium and iron.

Chemical difference: ……...

Physical difference: ……

[2]

Chlorine gas can form as a by-product of the thermal decomposition in oxygen candles. Oxygen candles also contain a small amount of barium peroxide. Barium peroxide scavenges any chlorine gas that is made forming solid barium chloride and oxygen.

BaO_2	+	Cl_2	→	$BaCl_2$	+	O_2
Barium Peroxide		Chlorine		Barium Chloride		Oxygen

i. Why is it essential that any chlorine gas made be scavenged?

……..

[1]

Fig. 3 below is a graph showing the rate of production of oxygen by a commercially available sodium perchlorate oxygen candle.

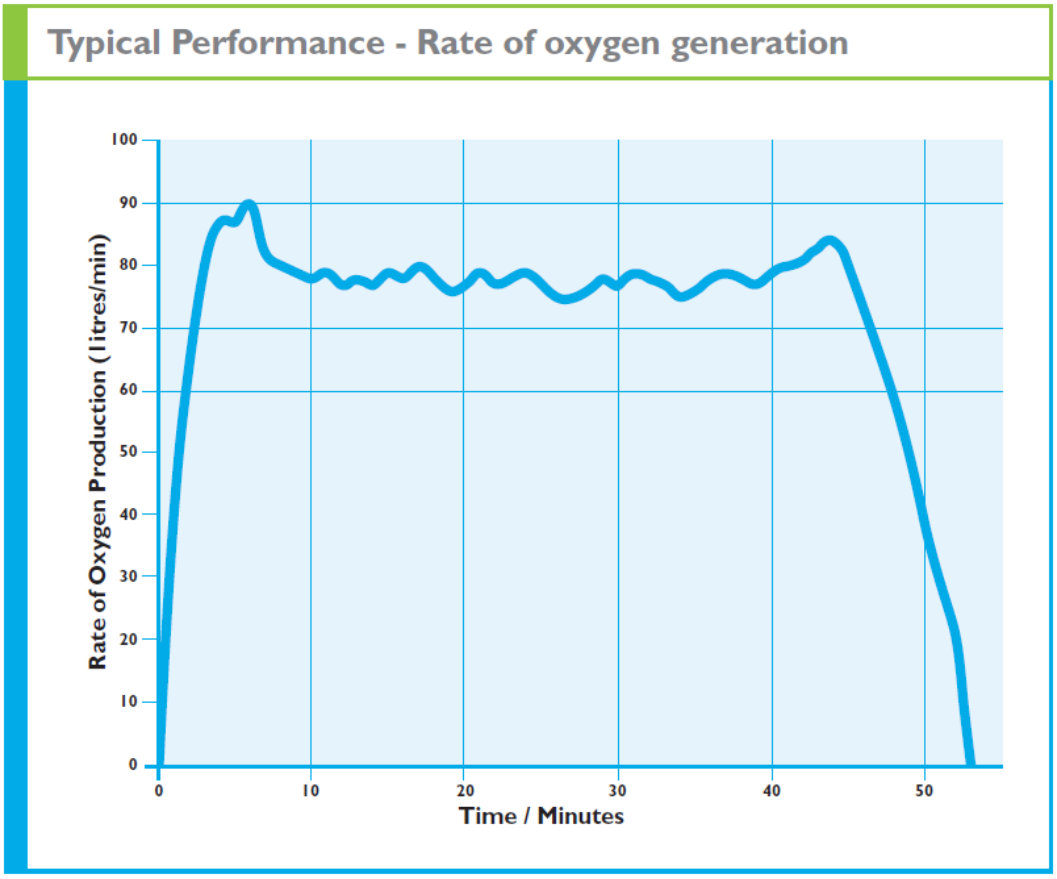


Fig. 3

j. After ten minutes the rate of production has stabilised. Approximately how many litres of oxygen are being produced per minute once the rate has stabilised?

……..

[1]

k. At what time is the rate of oxygen production the greatest?

……..

[1]

l. Describe what happens to the rate of production of oxygen after 44 minutes.

……

……

[2]

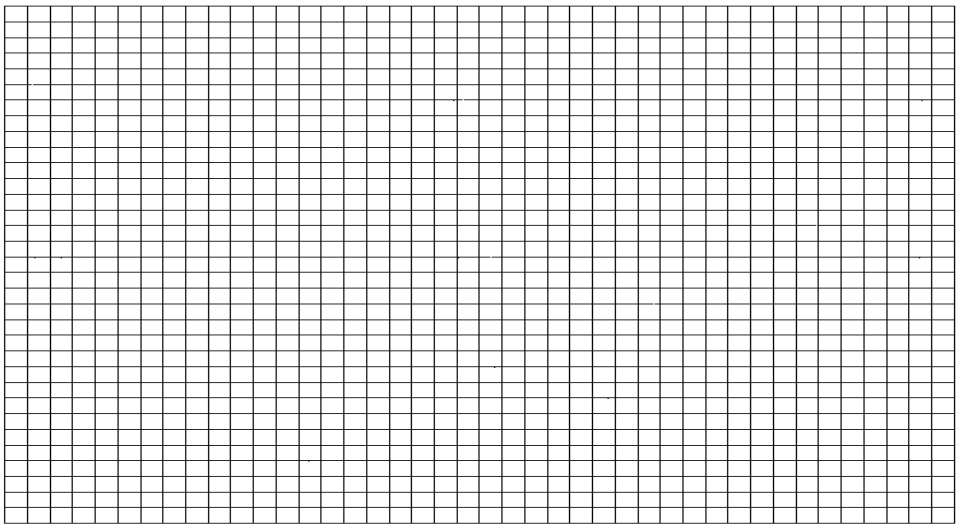
m. Circle the value in litres that best approximates the **total** volume of oxygen produced by the candle after an hour.

53 91 0 60

370 7200 3700

[2]

n. Sketch a graph below to show how the mass changes with time for a 3kg sodium perchlorate oxygen candle. Approximately 50% of the starting mass is oxygen.



[2]

o. When humans respire they produce carbon dioxide. This gas can dissolve in water in the atmosphere and lead to what type of pollution?

……

[1]

p. Roughly what percentage of the air is oxygen?

……..

[1]

q. Describe the differences in **movement** and **separation** of oxygen molecules when in the gas phase as compared to the liquid phase.

Movement: ……..

Separation: ……..

[2]

Question 2 total marks [25]