S.t.p (standard temperature and pressure) and r.t.p (room temperature and pressure)

GASES
It is not convenient to weigh gases. They are normally measured by volumes.

Avogadros law
Equal moles of any gase, under the same conditions of temperature and pressure occupy equal volumes.

a. At s.t.p. 1 mole of any gas occupy 22.4dm^3 or 22400cm^3. This volume is called the **molar volume at s.t.p**.
b. At r.t.p. 1 mole of any gas occupy 24dm^3 or 24000cm^3. This volume is called the **molar volume at r.t.p**.

Example1
Calculate the mass of magnesium required to produce 2.24 litres of hydrogen at s.t.p on the reaction with dilute sulphuric acid
[Mg = 24, molar volume at s.t.p = 22.4L]

Solution: $Mg(s) + H_2SO_4(aq) \rightarrow MgSO4(aq) + H_2(g)$

1 mole of Mg produce 1 mole of H_2

1 mole of Mg produced 22.4L of H_2
But 1 mole of mg weigh 24g

22.4L of H_2 require 24g of Mg
2.24L of H_2 require$\frac{2.24 \ x \ 24}{22.4} = 2.4g \ of \ Mg$

Example 2
Magnesium reacts with chlorine when heated, according to the equation
$Mg(s) + Cl_2(g) \rightarrow Mg\ Cl_2\ (s)$

Calculate the volume of chlorine that will react completely with 0.6g of magnesium.
(1 mole of gas at stp = 22.4 dm^3, Mg = 24)

Solution
From equation
24g of Mg react with 22.4dm^3 of chlorine
∴ 0.6g of Mg react with $\frac{0.6 \ x \ 22.4}{24} = 0.56dm^3$ of chlorine

Example3

Ammonia is oxidised by copper II oxide according to the equation

$2NH_3(g) + 3CuO(s) \rightarrow 3Cu(s) + 3H_2O(l) + N_2(g)$

What volume of ammonia gas will be oxidised by 6.0g of copper II oxide at s.t.p? (Cu = 64, O = 16, Molar volume of gas at s.t.p = 22.4l)

Solution

Formula mass of CuO = 64 + 16 = 80g

(3 x 80)g of CuO require (2 x 22.4) l of ammonia

6.0g of CuO require $\frac{2\ x22.4\ x\ 6.0}{2\ x\ 80} = 1,12l\ of\ ammonia$

Example 4

Calculate the molar masses of the following gas at s.t.p?

(One mole of a gas occupies 22.4dm^3 at s.t.p.

(a) 0.8g of gas X occupies 560cm3 (s.t.p)

Solution

560cm^3 weigh 0.8g

1mole or 22400cm^3 weigh $\frac{0.8\ x\ 22400}{560}$ =32g

∴ formula mass of X = 32 (remember formula mass has no units)

(b) 1.12dm^3 of gas y measured at s.t.p weighted 1.5g

Solution

1.12 dm^3 weigh 1.5g

1mole or 22.4 dm^3 weigh $\frac{01,5\ \ 22.4}{1.12}$ =30g

∴ formula mass of Y = 30

Exercise

1 Calcium carbide reacts with water to produce a gas according to the following equation

$CaC_2(s) + H_2O(l) \longrightarrow Ca(OH)_2g + C_2H_2\ (g)$

The volume of a gas produced at s.t.p when 6.4g of calcium carbide reacts completely with water is (Ca = 40, C =12)

A. $\frac{6.4\ x\ 64}{31}$ B. $\frac{22.4}{64\ x\ 6.4}$ C. 64 x 6.4 x 22.4 D. $\frac{6.4\ x\ 22.4}{64}$

2 Copper carbonate when heated in air decompose according to the following equation

$CuCO_3(s) \xrightarrow{heat} CuO(s) + CO_2(g)$

What volume of carbon dioxide is produced at s.t.p when 0.5 mole of copper (II) oxide is formed? (Cu = 64, O = 16, C = 12)

A. 112.0L B. 44.0L C. 22.4L D. 11.2L

3 Methane burns in oxygen according to the following equation

$CH_4\ (g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$

If 10cm^3 of methane and 20cm3 of oxygen are mixed and exploded, the final products cooled to room temperature, the final volume is

A. 10cm^3 B. 15cm^3 C. 25cm^3 D. 30cm^3

4 Which of the following gases does not react with water?

A. Ammonia B. Chlorine C. carbon monoxide D. sulphur dioxide

5 Steam reacts with methane according to the following equation

$CH_4(g) + 2H_2O(l) \longrightarrow 2H_2(g) + CO_2(g)$

What volume of a gas will remain when 30cm^3 of methane is reacted with 20cm^3 of steam?

A. 20cm^3 B. 50cm^3 C. 70cm^3 D. 80cm^3

6. Ammonia is oxidized by copper oxide according to the equation

$2NH_3(g) + 3CuO(s) \rightarrow 3Cu(s) + 3H_2O(l) + N_2(g)$

The volume of ammonia oxidised by 6.0g of copper oxide s.t.p is?

(one mole gas occupies 22.4dm3 at s.t.p)

A. $\frac{80}{6} x \frac{3}{2} x\ 22400$ B. $\frac{80}{6} x \frac{2}{3} x\ 22400$

C. $\frac{6}{80} x \frac{3}{2} x\ 22400$ D. $\frac{6}{80} x \frac{2}{3} x\ 22400$

7 What volume of ammonia at s.t.p will be produced when 15cm^3 of nitrogen react completely with hydrogen according to the following equation?

$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$Type equation here.

A. 7.5cm3 B. 15cm^3 C. 30cm^3 D. 45cm^3

8. Zinc reacts with hydrochloric acid according to the following equation

$Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$

The volume of hydrogen liberated at s.t.p when 13.0g of zinc reacts with the acid is (Zn = 65, H = 1, O = 16)

A. $\frac{65\ x\ 13}{22.4}$ B. $\frac{13\ x\ 22.4}{65}$ C. $\frac{13}{65\ x\ 22.4}$ D. $\frac{65\ x\ 22.4}{13}$

9. Propene burns in oxygen according to equation

$2C_3H_6(g) + 9O_2(g) \longrightarrow 6CO_2(g) + 6H_2O(g)$

When 2.1g of propene is completely burnt in oxygen, the volume carbon dioxide produced at room temperature is

A. 1.2dm^3 B. 2.4dm^3 C. 3.6dm^3 D. 4.8dm^3

10 Magnesium reacts with chlorine according to the following equation

$Mg(s) + 2HCl(g) \longrightarrow MgCl^2(s) + H^2(g)$

The volume of chlorine in litres, at s.t.p that react completely with 0.6g of magnesium is (1 mole of a gas occupies 22.4dm^3 at s.t.p, Mg = 24)

A. $\frac{0.6\ x\ 22.4}{24}$ B. $\frac{0.6\ x\ 22.4}{24\ x\ 2}$ C. $\frac{0.6\ x\ 24}{22.4}$ D. $\frac{0.6\ x\ 22.4}{22.4\ x\ 2}$

11 80cm^3 of hydrogen and 80cm^3 of oxygen are allowed to react. What volume of gas remains unreacted?

A. 40cm^3 B. 80cm^3 C. 120cm^3 D. 160cm^3

12 Zinc reacts with hydrochloric acid according to the following equation

$Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$

The volume of hydrogen liberated at s.t.p when 13.0g of zinc reacts with the acid is (Zn = 65, H = 1, O = 16)

A. 2.24dm^3 B. 4.48cm^3 C. 22.4dm^3 D. 11.2dm^3

13 Nitrogen monoxide reacts with oxygen according to the following equation

$2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$

What volume of oxygen would react with 200cm^3 of oxygen monoxide?

A. 100cm^3 B. 200cm^3 C. 300cm^3 D. 400cm^3

14 Sulphuric acid reacts with zinc according to the following equation

$Zn(s) + H_2SO_4(aq) \longrightarrow ZnSO4(aq) + H_2(g)$

The number of moles of zinc that will react with excess sulphuric acid to produce 60cm^3 of hydrogen at room temperature is

(one mole of a gas at r.t.p is 24dm^3)

A. 0.0025 B. 0.005 C. 0.025 D. 0.05

15 Calcium carbonate reacts dilute hydrochloric acid according to the following equation

$CaCO_3 (s) + 2HCl(aq) \rightarrow CaCl_2(s) + CO_2(g) + H_2O(l)$

What volume of carbon dioxide would be evolved at s.t.p when 1g of calcium carbonate is reacted with excess hydrochloric acid?

(Ca= 40, H=1, Cl = 35.5, O = 16, one mole of a gas occupies 22.4dm^3 at s.t.p)

A. 2240cm^3 B. 224cm^3 C. 112cm^3 D.448cm^3

16 Carbon dioxide is produced from sodium hydrogen carbonate according to the following equation

$2NaHCO_3 (s) \xrightarrow{heat} Na_2CO_3 (s) + CO_2(g) + H_2O(l)$

The volume in litres of carbon dioxide evolved at s.t.p when 21.0g of sodium hydrogen carbonate is heat is

($NaHCO_3$ = 84, 1 mole of a gas at s.t.p occupies 22.4dm^3)

A. $\left(\frac{21}{168}\ x\ \frac{1}{2}\ x\ 22.4l\right)$ B. $\left(\frac{168}{21}\ x\ 2\ x\ \frac{1}{22.4}l\right)$

C. $\frac{21}{84}.\left(x\ \frac{1}{2}\ x\ 22.4l\right)$ D. $\left(\frac{84}{21}\ x\ 2\ x\ \frac{1}{22.4}l\right)$

17 Calculate the relative molecular mass of gas P, if 8.4dm^3 of the gas at s.t.p has a mass of 0.93g (1 mole of a gas at s.t.p occupies 22.4dm^3)

A. $\left(\frac{0.93\ x 22.4}{8.4}\right)$ B. $\left(\frac{8.4\ x 22.4}{0.93}\right)$ C. $\left(\frac{0.93\ x 8.4}{22.4}\right)$ D. $\left(\frac{0.93}{8.4\ x\ 22.4}\right)$

18 When 2.5g of a solid is heated, 560 cm^3 of a gas was produced at s.t.p and a residue of 1.4g was left. The molecular mass of the gas is

(1 mole of a gas at s.t.p is 22400cm^3).

A. $\left(\frac{22400\ x\ 2.5}{560}\ cm^3\right)$ B. $\left(\frac{22400\ x\ 1.4}{560}\ cm^3\right)$

C. $\left(\frac{22400\ x\ 1.1}{560}\ cm^3\right)$ D. $\left(\frac{22400}{560}\ cm^3\right)$

19 What mass of ethane gas (C_2H_6) Mr =30 will occupy the same volume as 8g of methane (CH_4) Mr = 16 at s.t.p?

(molar gas volume at s.t.p = 22.4dm^3)

A. $\frac{16}{30}\ x\ 8$ B. $\frac{8}{16}\ x\ 30$ C. $\frac{16}{8}\ x\ 30$ D. $\frac{8}{30}\ x\ 16$

20 The mass of 560cm^3 of a gas X is 1.10g at s.t.p. the relative formula mass of the gas is (Molar gas volume at s.t.p = 22400 cm^3)

A. $\frac{22400}{1.1}\ x\ 560$ B. $\frac{1.1}{560}\ x\ 22400$ C. $\frac{1.1}{22400}\ x\ 560$ D. $\frac{560}{1.1}\ x\ 22400$

21 Ammonia is oxidized by copper oxide according to the equation

$2NH_3(g) + 3CuO(s) \rightarrow 3Cu(s) + 3H_2O(l) + N_2(g)$

The volume of ammonia oxidised by 6.0g of copper oxide s.t.p is?

(one mole gas occupies 22.4dm_3 at s.t.p)

A. $\frac{80}{6}\ x\ \frac{3}{2}\ x\ 22400$ B. $\frac{80}{6}\ x\ \frac{2}{3}\ x\ 22400$

C. $\frac{6}{80}\ x\ \frac{3}{2}\ x\ 22400$ D. $\frac{6}{80}\ x\ \frac{2}{3}\ x\ 22400$

22 Calcium hydrogen carbonate when heated decompose according to the equation

$Ca(HCO_3)_2 \rightarrow CaO(s) + CO_2(g) + H_2O(l)$

The volume of carbon dioxide evolved at s.t.p when27g of hydrogen carbonate is heated is (H = 1, C =12, Ca = 40, O = 16, 1 mole of a gas occupies 22.4dm^3 at s.t.p)

A. 27 x 22.4 B. $\frac{162}{27\ x\ 22.4}$ C. $\frac{2\ x\ 27\ x\ 22.4}{162}$ D. $\frac{162}{2\ x\ 27\ x\ 22.4}$

23 Methane burns in oxygen according to the equation

$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(g)$

The volume of methane that remains unburnt when 50cm^3 of methane is reacted with 40cm^3 of oxygen is

A. 10cm^3 B. 20cm^3 C. 30cm^3 D. 45cm^3

24 Hydrogen chloride reacts with ammonia according to the following equation

$NH_3(g) + HCl(g) \longrightarrow NH_4Cl(g)$

The mass of ammonium chloride formed when excess ammonia is reacted with 0.56dm^3 of hydrogen chloride at s.t.p is (N = 14, H = 1, Cl = 35.5)

A. $\frac{0.56 \, x \, 22.4}{53.5}$ B. $\frac{53.5 \, x \, 0.56}{22.4}$ C. $\frac{0.56 \, x \, 50.5}{50.5}$ D. $\frac{0.56 \, x \, 50.5}{22.4}$

25 Copper (II) oxide reacts with hydrogen according to the equation

$CuO(s) + H_2(g) \longrightarrow Cu(s) + H_2O(l)$

The volume of hydrogen in litres, required to react completely with 16,0g of copper (II) at s.t.p is (Cu = 64, O =16, one mole of a gas occupies 22.4l at s.t.p)

A. 1.1.2 B. 2.24 C. 4.48 D. 11.20

26 Hydrogen burns in oxygen according to the following equation

$2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$

The mass of steam formed when 100cm^3 of hydrogen is burnt in excess oxygen is at s.t.p is (H =1, O =16, one mole of a gas occupies 22.4l at s.t.p)

A. 0.04g B. 0.08g C. 0.12g D. 0.16g

27 Propane burns in oxygen according to equation

$C_3H_8\ (g) + 5O_2\ (g) \longrightarrow 3CO_2(g) + 4H_2O(g)$

When 10l of propene is completely burnt in oxygen, the volume of oxygen used at room temperature is

A. 5l B. 10l C. 15l D. 50l

28 Glucose burn in oxygen according to the following equation

$C_6H_{12}O_6(s) + 6O_2(g) \longrightarrow 6CO_2(g) + 6H_2O(l)$ + energy

The volume of oxygen at s.t.p that is required to produce 150g of carbon dioxide is (H = 1, C = 12, O = 16, 1 mole of a gas at s.t.p occupies 22.4dm^3)

A. $\frac{150 \, x \, 22.4 \, cm^3}{44}$ B. $\frac{50 \, x \, 22.5}{44 \, x \, 6}$ C. $\frac{44}{150 \, x \, 22.4}$ D. $\frac{44 \, x \, 6}{150 \, x \, 22.4}$

29 On heating sodium nitrate produces sodium nitrite and oxygen according to the following equation

$2NaNO_3\ (s) \longrightarrow 2NO_2(s) + O_2(g)$

The mass of sodium nitrite formed when 480cm^3 of oxygen was evolved at room temperature. (Na = 23, N = 14, O = 16, 1 mole of a gas occupies 24dm^3 at s.t.p)

A. 1.38g B. 2.76g C. 5.52g D. 0.114g

30. When 3.0g of X was heated, 210cm3 of a gas was evolved at s.t.p and 2.4g of solid remained. The relative molecular mass of the gas is [1 mole of a gas at s.t.p occupies 22.4dm^3 at s.t.p]

A. $\frac{0.6 \, x \, 22400}{210}$ B. $\frac{3 \, x \, 22400}{210}$ C. $\frac{2.4 \, 22400}{210}$ D. $\frac{5.4 \, x \, 22400}{210}$

31 Calcium carbonate decompose according to the equation

$CaCO_3\ (s) \longrightarrow CaO(s) + CO_2(g)$

The maximum volume of carbon dioxide produced at s.t.p when 100g of calcium carbonate is heated is (Ca =4=, O = 16, 1 mole of a gas occupies 22.4dm^3 at s.t.p.)

A. $\frac{10 \, x \, 22.4}{100} dm^3$ B. $\frac{10 \, x \, 100}{22.4} dm^3$ C. $\frac{22.4}{10 \, x \, 100} dm^3$ D. $\frac{100}{10 \, x \, 22.4} dm^3$

32 Methane burns in oxygen according to the following equation

$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$
The volume of carbon dioxide produced when 20cm^3 of methane is burnt in 40cm^3 of oxygen is
A. 10cm^3 B. 20cm^3 C. 40cm^3 D. 60cm^3

33 Propane burns in air according to the following equation
$C_3H_8 (g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)$
Which of the following is the volume of air required for complete combustion of 60cm^3 of propane?
(The percentage of oxygen in air is 21%)
A. $\frac{5\ x\ 100}{24}cm^3$ B. $\frac{21\ x\ 5\ x\ 60}{100}cm^3$ C. $\frac{5\ x\ 60\ x\ 100}{21}$ $D.\frac{100\ 60}{5\ x\ 21}cm^3$

Commented [S1]:
Commented [S2R1]:
Commented [S3R1]:
Commented [S4R1]:

In each of the questions 34 to 35 one or more of the answers given may be correct. Read each question carefully and then indicate the correct answer according to the following

A. If 1, 2, 3, only are correct
B. If 1 and 3 only are correct
C. If 2 and 4 only are correct
D. If 4 only is correct

34. Which of the following contains the same volume as 8.0g of oxygen at s.t.p?
1. 17.0g of ammonia
2. 22.0g of carbon dioxide
3. 2.0g of hydrogen
4. 7g of nitrogen

35. Which one of the following contains the same number of moles as 2.4dm^3 of hydrogen gas at room temperature?
(1mole of a gas occupies 24dm^3 at room temperature)
1. 17g of ammonia
2. 1.7g of ammonia
3. 35.5g of chlorine
4. 3.55g of chlorine

show clear working

36 Sulphuric acid reacts with potassium hydrogen carbonate according to the equation
$H_2SO_4(aq) + 2KHCO_3 (aq) \longrightarrow K_2SO_4(aq) + CO_2(g) + H_2O(l)$
Calculate the volume of carbon dioxide produced at s.t.p when 20cm3 of 0.5M sulphuric acid is reacted with excess potassium hydrogen carbonate

37 Sulphur dioxide combine with air to form sulphur trioxide according to the equation
$2SO_2(g) + O_2(g) \longrightarrow 2SO_3(g)$
Calculate the volume of sulphur trioxide that would be formed when 20cm^3 of sulphur dioxide was reacted with 100cm^3 of oxygen.

38 Copper carbonate reacts dilute hydrochloric acid according to the following equation
$CuCO_3 (s) + 2HCl(aq) \longrightarrow CuCl_2(s) + CO_2(g) + H_2O(l)$
What volume of carbon dioxide would be evolved at s.t.p when 6.2g of copper (II) carbonate is reacted with excess hydrochloric acid?
(Cu= 64, H=1, Cl = 35.5, O = 16, one mole of a gas occupies 22.4dm^3 at s.t.p)

39 Hydrogen chloride gas reacts with silver nitrate according to the equation
$HCl(g) + AgNO_3(aq) \longrightarrow AgCl(s) + HNO_3(aq)$

Calculate the mass of silver chloride produced when 1.2dm^3 of hydrogen chloride gas is bubbled through silver nitrate at room temperature.
(Ag= 108, H=1, Cl = 35.5, O = 16, N = 14 one mole of a gas occupies 22.4dm^3 at s.t.p)

40 Nitrogen reacts with hydrogen to form ammonia according to the following equation
$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$
Calculate the volume of ammonia produced at s.t.p when 18.5 g of hydrogen gas reacted with excess nitrogen
[H = 1, N = 14, 1 mole of a gas occupies 22.4dm^3 at s.t.p)

41. Potassium chlorate (V) decompose according to the following equation
$2KClO_3 \longrightarrow 2KCl\ (s) + 3O_2(g)$
Calculate the volume of oxygen at room temperature when 16 g of potassium chlorate (V) is heated
(K =39. O = 1, Cl = 35.5, 1 mole of a gas at r.t.p 24dm^3)

42 Sulphur dioxide can be prepared by roasting zinc sulphide according to the following equation
$2ZnS(s) + 3O_2(g) \longrightarrow 2ZnO(s) + 2SO_2(g)$
Calculate the volume of sulphur dioxide evolved at room temperature when 9.7g of zinc sulphide is reacted with excess oxygen
(Zn = 65, S = 32, O = 16 , 1mole of a gas occupies 24dm^3 at room temperature)

Answers

		Working
1.	D	Formula mass of CaC_2 = 40 + 12x 2 = 64 64g produce 22,4 dm^3 of gas 6.4g produce $\frac{6.4 \, x \, 22.4}{64}$
2.	D	1mole of $CuCO_2$ produce 22.4dm^3 0.5mole produce $\frac{22.4 \, x \, 0.5}{1} = 11.2L$
3.		10cm^3 of methane react with 20cm^3 of oxygen to produce 10cm^3 of CO_2
4.	C	
5.	A	(2 x 22400) cm^3 of steam reacts with 22400 cm^3 of methane ∴ 20cm^3 of steam react with $\frac{20 \, x \, 22400}{2 \, x \, 22400} = 10cm^3$ The volume of methane that did not react = 30 – 20 =20cm^3
6.	D	Formula mass of copper oxide, CuO = 64 + 16 = 80 (3 x 80)g of CuO react with (2 x 22400) cm^3 ∴ 6g of CuO will oxidise $\frac{2 \, x \, 22400 \, x \, 6}{3 \, x \, 80} \, cm^3$
7.	C	1cm^3 of N_2 form 2cm^3 of ammonia ∴ 15cm^3 of N_2 form $\frac{2 \, x \, 15}{1} = 30cm^3$
8.	B	65g of zinc liberate 22.4dm^3 of hydrogen 13g of zinc liberate $\frac{13 \, x \, 22.4}{65} cm^3$
9.	C	Formula mass of propane 3 x 12 + 6 x 1 = 42 42 x 2g of propane produce (6 x 24) dm^3 2.1g of propane produces $\frac{6 \, x \, 24x \, 2.1}{42 \, x \, 2} = 3.6dm^3$
10.	A	24g of magnesium produce 22.4dm^3 0.6g of magnesium produce $\frac{0.6 \, x \, 22.4}{24}$$dm^3$
11.	A	Reaction equation $2H_2(g) + O_2(g) \longrightarrow 2H\,O(l)$ 2 x 22400 cm^3 of oxygen react with 22400 cm^3 of oxygen 80cm^3 of hydrogen react with $\frac{80 \, x \, 22400}{2 \, x \, 22400} = 40cm^3$ Unreacted oxygen = 80 – 40 = 40 cm^3
12.	B	65g of produces 22.4dm3 of hydrogen 13g of zinc produce $\frac{22.4 \, x \, 13}{65} = 4.48dm^3$
13	A	(2 x 22400) cm^3 of nitrogen monoxide react with 22400cm^3 of oxygen 200cm^3 of nitrogen monoxide will react with $\frac{\cancel{22400} \, x \, 200}{2 \, x \, \cancel{22400}} = 100cm^3$
14	A	24000cm^3 of hydrogen require 1mole of zinc 60cm^3 of hydrogen require $\frac{60 \, x \, 1}{24000}$ = 0.0025moles of Zn
15	B	Formula mass of $CaCO_3$ = 40 + 12 + 16 x3 = 100 100g of $CaCO_3$ produce 22400cm^3 of carbon dioxide 1g of $CaCO_3$ produce $\frac{1 \, x \, 22400}{100} = 224 \, cm^3$
16	C	(2 x 84) g of $NaHCO_3$ produce 22.4l of carbon dioxide 21 g of $NaHCO_3$ produce $\frac{21 \, x \, 22.4}{2 \, x \, 84}$
17	A	8.4dm^3 of P weigh 0.93g 22.4dm^3 (or 1 mole of a gas at s.t.p) will weigh $\frac{22.4 \, x \, 0.93}{8.4} g$

18 C Mass of the gas = 2.5 – 1.5 = 1.1g
560 cm^3 of P weigh 1.1g
22400 cm^3 (or 1 mole of a gas at s.t.p) will weigh $\frac{22400 \ x\ 1.1}{560} g$

19 C Equal moles of a gas occupy the same volume at the same temperature
Therefore, 16g of CH_4 occupy the same volume as 30g of C_2H_6
8g of CH_4 occupies $\frac{30\ x\ 16}{8}$

20 B 560 cm^3 of P weigh 1.10g
22400m^3 (or 1 mole of a gas at s.t.p) will weigh $\frac{22400\ x\ 1.10}{560} g$

21 D Formula mass of copper oxide, CuO = 64 + 16 = 80
(3 x 80)g of CuO react with (2 x 22400) cm^3
∴ 6g of CuO will oxidise $\frac{2\ x\ 22400\ x\ 6}{3\ x\ 80}\ cm^3$

22 C Formula mass of $Ca(HCO_3)_2$ = 40 + 2 (1 + 12 + 16 x 3) = 162
162g od $Ca(HCO_3)_2$ produce 22.4dm^3
27g of $Ca(HCO_3)_2$ produce $\frac{27\ 22.4}{12}\ dm^3$

23 C 2 mole of oxygen react with 1mole of methane
Since moles are directly proportion to volumes of gases
40 cm^3 of oxygen react with $\frac{1\ x\ 40}{2}\ 20cm^3$
Volume of unreacted methane = 50 – 20 = 30cm^3

24 B Formula mass of NH4Cl = 14 + 1 x4 + 35.5 = 53.5g
22.4dm^3 of ammonia form 53.5g of NH4Cl
0.56gdm^3 of ammonia form $\frac{0.56\ x\ 53.5}{22.4} g$

25 C Formula mass of CuO = 64 + 16 = 80g
80g of CuO is reduce by 22.4l of hydrogen
16.0g of CuO is reduce by $\frac{22.4\ x\ 16}{80} = 4.48dm^3$

26 A Formula mass of H_2O of 1x2 + 16 = 18
22400 cm^3 of hydrogen produce $\frac{18}{2}\ g$ of H_2O
100cm^3 of hydrogen produce $\frac{18\ x\ 100}{22400\ x2} = 0.04g$

27 D 1mole propane react with 5mole of oxygen
10l of propane react with 5 x 10 = 50l of oxygen

28 A. Formula mass of CO_2 = 12 + 16 x 2 = 44g
6 x 44g of carbon dioxide require 6 x 22.4dm^3 of oxygen
150g of carbon dioxide require $\frac{\not{6}\ x\ 22.4\ x\ 150}{\not{6}\ x\ 44} = \frac{150\ x\ 22.4}{44}$

29 B Formula mass of $NaNO_2$ = 23 +14 + 16 x 2 = 69
24000 cm^3 of oxygen is produced with 2 x 69
480cm^3 of oxygen is produced with $\frac{2\ x\ 69\ x\ 480}{24000}$ = 2.76g

30 A Mass of a gas = 3.0 – 2.4 = 0.6g
210cm^3 contain 0.6g
24000cm^3 contain $\frac{0.6\ x\ 24000}{210}$

31 A Formula mass of $CaCO_3$ = 40 + 12 + 16 x 3 =100g
100g of $CaCO_3$ produce 24dm^3 of carbon dioxide
10cm^3 of $CaCO^3$ produce $\frac{24\ x\ 10}{100} dm^3$

32 B 1mole of methane produce 1 mole of CO_2 (g)

20cm^3 of methane produce same volume of 20cm^3 of CO_2

33 C 1 mole of propane react with 5 moles of oxygen

60cm^3 of propane react with (5 x 60) cm^3 of oxygen

But 21cm^3 of oxygen is found in 100cm^3 of air

∴ (5 x 60)cm^3 of oxygen are contained in $\frac{100 \times 5 \times 60}{21} cm^3$

34 D Remember oxygen and nitrogen are diatomic gases

35 C

36 Moles of sulphuric acid

1000cm^3 contain 0.5moles

20cm^3 contain $\frac{0.5 \times 20}{1000} = 0.01 moles$

1mole od H_2SO_4 produce 22.4dm^3 of carbon dioxide at s.t.p

0.01 mole of H_2SO_4 produce $\frac{22.4\ 0.01}{1} = 0.22 dm^3$

37 2mole of SO_2(g) produce 2 mole of SO_3

∴ 20cm^3 of SO_2 produce 20 cm^3 of SO_3

38 Formula mass of $CuCO_3$ = 64+ 12 + 16 x 3 = 124

124g of copper carbonate produce 22.4dm3

6.2g of copper carbonate produce $\frac{22.4 \times 6.2}{124} = 1.12 cm^3$

39 Formula mass of silver chloride, AgCl = 108 + 35.5 = 143.5

22.4dm^3 of HCl produce 143.5g of AgCl

1.2cm^3 of HCl produce $\frac{143.5 \times 1.2}{22.4} = 7.6875 g\ of\ silver\ chloride$

40. 3(1+1)g of hydrogen produce 2 x 22.4 dm^3 of ammonia

18.5g of hydrogen produce $\frac{2 \times 22.4 \times 18.5}{6} = 138.1 dm^3$

41. Formula mass of $KClO_3$ = 39 + 35.5 + 16 x 3 = 122.5

(122.5 x 2)g of $KClO_3$ produce 3 x 22.4 dm^3 of oxygen at s.t.p

16g of $KClO_3$ produce $\frac{3 \times 22.4 \times 16}{122.5 \times 2} = 4.4 dm^3$

42 Formula mass of ZnS = 65 +32 = 97g

97 x 2g of ZnS produce 2 x 24 dm^3 of SO_2

9.7g of ZnS produce $\frac{2 \times 24 \times 9.7}{97 \times 2} = 2.4 dm^3\ of\ SO_2$

End