

Unit 1 Calculations

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- 1 In which of the following pairs of gases contain the same number of oxygen atoms?
- 2 A pencil lead contains 3.01×10^{22} of carbon atoms. What is the mass of the pencil lead if 50% of the lead is made from carbon?
- 3 How many litres of carbon dioxide could theoretically be produced when 6 litres of carbon monoxide is mixed with 2 litres of oxygen?
- 4 Taking the molar volume of hydrogen as $24 \text{ litres mol}^{-1}$. How many litres of hydrogen are produced when 2g of calcium is reacted with excess water?
- 5 How many moles of nitrogen are there in 1.5 mol of nitrogen dioxide?
- 6 Sulphur exists as S_8 molecules. How many of these S_8 molecules are there in 1.6g of sulphur?
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1 In which of the following pairs of gases contain the same number of oxygen atoms?

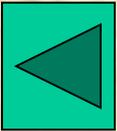
- a. 2 mol of oxygen and 2 mol of carbon monoxide.
- b. 3 mol of oxygen and 1.5 mol carbon dioxide.
- c. 1 mol of oxygen and 2 mol of carbon dioxide.
- d. 1 mol of oxygen and 1 mol of carbon dioxide.



a hint!!!!

1st hint

A mole of an element has 6.02×10^{23} atoms.



2nd hint

O_2 has 2 O atoms and CO_2 has 2 O atoms and 1 C atom



In which of the following pairs do gases contain the same number of oxygen atoms?

Correct because.....

1 mol of oxygen and 1 mol of carbon dioxide.

1 mol of oxygen = O_2

1 mol of O atoms = 6.02×10^{23} atoms

So O_2 has $6.02 \times 10^{23} \times 2$ atoms

1 mol of carbon dioxide, CO_2

1 mol of CO_2 molecules = 6.02×10^{23} molecules

So there are 1 mol of C atoms and 2 mol of O atoms



2 A pencil lead contains 3.01×10^{22} of carbon atoms.
What is the mass of the pencil lead if 50% of the lead is made from carbon.

a. 0.5g

b. 0.6 g

c. 1.2 g

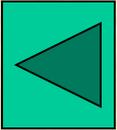
d. 2.5 g



a hint!!!!

1st hint

One mole has 6.02×10^{23} particles.



2nd hint

How many moles of carbon are there in the pencil?



A pencil lead contains 3.01×10^{22} of carbon atoms.
What is the mass of the pencil lead if 50% of the lead is made from carbon. **Correct** because....

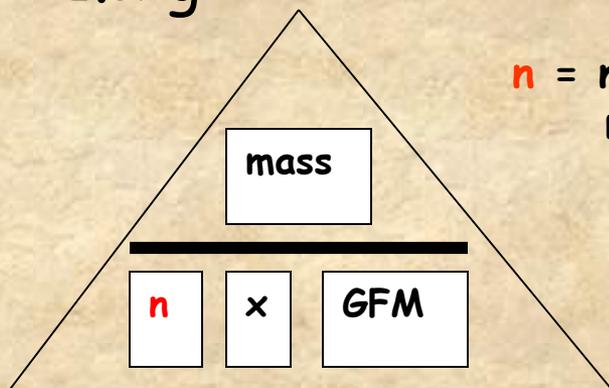
$$1 \text{ mol of C atoms} = 6.02 \times 10^{23} \text{ atoms}$$

So 3.01×10^{22} of carbon atoms would contain

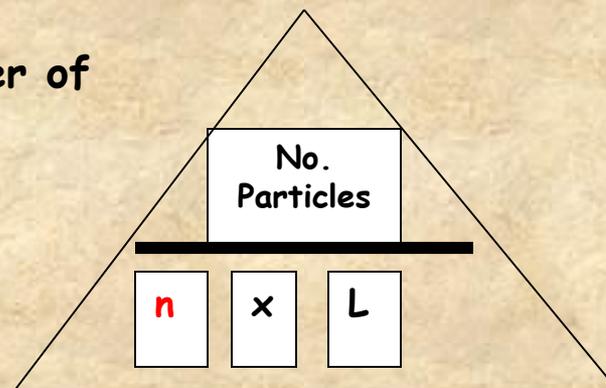
$$\frac{3.01 \times 10^{22}}{6.02 \times 10^{23}} \text{ mol} = 5 \times 10^{-2} \text{ mol}$$

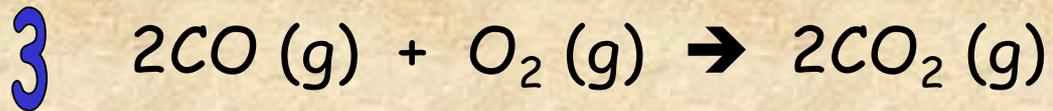
$$\text{Mass} = 5 \times 10^{-2} \times 12 = 6.0 \times 10^{-1} \text{ g} = 50\% \text{ of the lead}$$

$$\text{Ans.} = 1.2 \text{ g}$$



n = number of moles





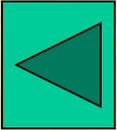
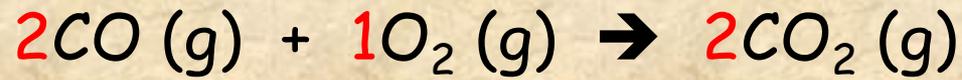
How many litres of carbon dioxide could theoretically be produced when 6 litres of carbon monoxide is mixed with 2 litres of oxygen?

- a. 8 litres
- b. 12 litres
- c. 3 litres
- d. 4 litres



a hint!!!!

1st hint



2nd hint

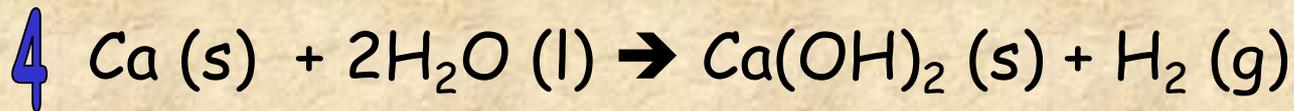
Gases react in simple volume ratios.



How many litres of carbon dioxide could theoretically be produced when 6 litres of carbon monoxide is mixed with 2 litres of oxygen?

Correct because...





Taking the molar volume of hydrogen as 24 litres mol⁻¹.
How many litres of hydrogen are produced when 2g of calcium is reacted with excess water?

- a. 1.2 litres
- b. 48 litres
- c. 12 litres
- d. 480 litres



a hint!!!!

1st hint

24 litres is 1 mol of H₂ , What about Ca?

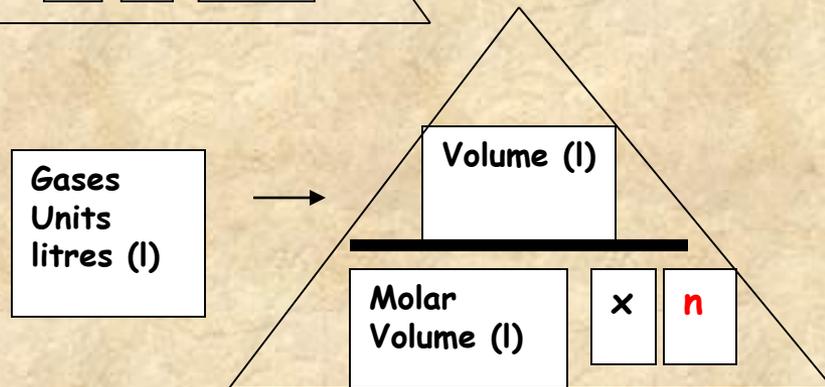
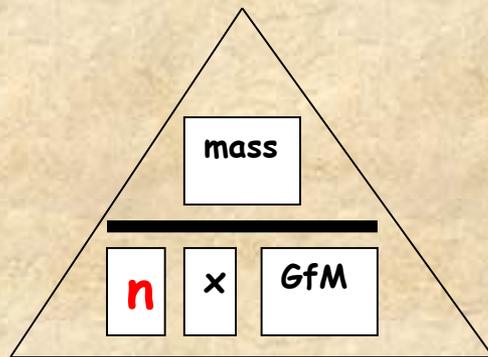


2nd hint



Taking the molar volume of hydrogen as 24 litres mol⁻¹.
How many litres of hydrogen is produced when 2g of calcium is reacted with excess water?

Correct because.....



$$2 \text{ g of Ca} = \frac{2}{40} = 0.05 \text{ mol}$$

So 0.05 mol of H₂ made.

$$\text{So vol} = 24 \times 0.05$$

Ans: = 1.2 litres



5 How many moles of nitrogen are there in 1.5 mol of nitrogen dioxide?

a. 0.15 mol

b. 0.5 mol

c. 1.5 mol

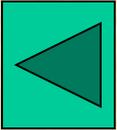
d. 4.5 mol



a hint!!!!

1st hint

The formula for nitrogen dioxide is NO_2



2nd hint

How many moles of nitrogen are in 1 mole of nitrogen gas?



How many moles of nitrogen are there in 1.5 mol of nitrogen dioxide?

Correct because.....

NO_2 contains 1 mol of N atoms and 2 mol of oxygen atoms

So 1.5 mol of NO_2 contains

1.5×1 mol of N atoms and 1.5×2 mol of oxygen atoms

Ans: = 1.5 mol



6 Sulphur exists as S_8 molecules. How many of these S_8 are there in 1.6g of sulphur?

a. 3.01×10^{22}

b. 1.6×10^{23}

c. 3.76×10^{21}

d. 5.0×10^{21}



a hint!!!!

1st hint

How many atoms of S are there in 1.6g of S?



2nd hint

How many atoms of S are there in a molecule of S?



Sulphur exists as S_8 molecules. How many types of these molecules are there in 1.6g of sulphur?

Correct because.....

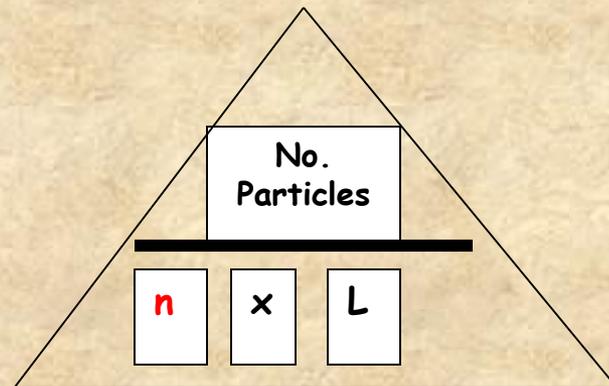
$$1.6 \text{ g of } S = \frac{1.6}{32} \text{ mol of } S = 0.05 \text{ mol}$$

Since 1 mol = 6.02×10^{23} atoms

$$0.05 \text{ mol has } 6.02 \times 10^{23} \times 0.05 \text{ atoms} = 3.01 \times 10^{22}$$

Since there are 8 atoms in every S_8 molecules

$$\text{Ans: } 3.01 \times 10^{22} / 8 = 3.76 \times 10^{21} \text{ molecules}$$



7 A mixture of calcium chloride and calcium nitrate contain 5 mol of calcium and 2 mol of nitrate ions. How many moles of chloride ions are present?

a. 3 mol

b. 4 mol

c. 6 mol

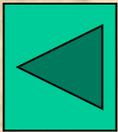
d. 8 mol



a hint!!!!

1st hint

The chemical formula for $\text{Ca}(\text{NO}_3)_2$, what is the ratio of Ca to NO_3 ions?



2nd hint

CaCl_2 has a ratio of 1 Ca: 2 Cl



A mixture of calcium chloride and calcium nitrate contain 5 mol of calcium and 2 mol of nitrate ions. How many moles of chloride ions are present?

Correct because....

Calcium chloride CaCl_2 contains 1 mol Ca and 2 mol Chloride ions

Calcium nitrate $\text{Ca}(\text{NO}_3)_2$ contains 1 mol Ca and 2 mol nitrate ions

So 2 mol of nitrate ions combine with 1 mol of Ca ions, leaving 4 mol of Ca ions to combine with Chloride ions.

Ans: 8 mol of Chloride ions combine with 4 mol of Ca ions



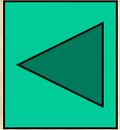
8 The Avogadro Constant is the same as the number of?

- a. Electrons in 1 g of carbon
- b. Ions in 40 g calcium carbonate
- c. Protons in 4 g of helium
- d. Molecules in 28 g of nitrogen



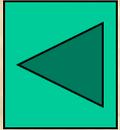
a hint!!!!

How many electrons does carbon have?, so how many electrons would a mole of carbon have?



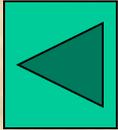
a hint!!!!

Helium has a mass number of 4 and an atomic number of (proton number) 2.



a hint!!!!

CaCO_3 contains Ca^{2+} and CO_3^{2-} ions i.e. 2 ions per formula unit.



The Avogadro Constant is the same as the number of?

Correct because.....

• 1 g of carbon would be $\frac{1}{12}$ mol = 0.083 mol
each C has 6 electrons
so $6 \times 0.083 = 0.498$ mol

• Ions in 40 g calcium carbonate, $\text{Ca}^{2+}\text{CO}_3^{2-}$
1 mol of $\text{CaCO}_3 = 100\text{g}$, $40\text{g} = \frac{40}{100} = 0.4$ mol
So 0.4×2 ions = 0.8 mol

• Protons in 4 g of helium, = $\frac{4}{2}$ mol = 1 mol so 2 mol protons

• Molecules in 28 g of nitrogen (N_2) = $\frac{28}{28} = 1.0$ mol

