#422265

Calculate the molar mass of the following :

(i) H_2O

(ii) CO_2

(iii) CH_4

Solution

(i) Molar mass of water $(H_2O) = 2 \times \text{atomic mass of hydrogen } + \text{atomic mass of oxygen}$

$\text{Molar mass of water} = 2(1\,g/mol) + 16\,g/mol = 18\,g/mol$

(ii) Molar mas of $CO_2 = \text{atomic mass of C} + 2 \times \text{atomic mass of oxygen}$

$\text{Molar mass of } CO_2 = 12\,g/mol + 2(16\,g/mol) = 44\,g/mol$

(iii) Molar mass of methane $= \text{atomic mass of carbon} + 4\text{atomic mass of hydrogen}$

$\text{Molar mass of methane} = 12\,g/mol + 4(1\,g/mol) = 16\,g/mol$

#422266

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Solution

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#422268

Calculate the molar mass of the following :

CH_4

Solution

$\text{Molar mass of methane} = \text{atomic mass of carbon} + 4 \text{ atomic mass of hydrogen}$

$\text{Molar mass of methane} = 12\,g/mol + 4(1\,g/mol) = 16\,g/mol$

#422296

Calculate the atomic mass (average) of chlorine using the following data :

	% Natural Abundance	Molar Mass
^{35}Cl	75.77	34.9689
^{37}Cl	24.23	36.9659

Solution

Average atomic mass of chlorine $= \dfrac{75.77 \times 34.9689 + 24.23 \times 36.9659}{100} = 35.45$ g/mol.

#422301

If 3 moles of ethane (C_2H_6) are given, calculate the following:

(i) Number of moles of carbon atoms.

(ii) Number of moles of hydrogen atoms.

(iii) Number of molecules of ethane.

Solution

1 mole of ethane (C_2H_6) has 2 moles of carbon and 6 moles of hydrogen.

We are given 3 moles of ethane.

(i) Number of moles of carbon atoms $= 3 \times 2 = 6$

(ii) Number of moles of hydrogen atoms $= 3 \times 6 = 18$

(iii) Number of molecules of ethane $= 3 \times 6.023 \times 10^{23} = 1.8069 \times 10^{24}$

#422394

Which one of the following will have largest number of atoms ?

(i) 1 g Au (s)

(ii) 1 g Na (s)

(iii) 1 g Li (s)

(iv) 1 g of Cl_2 (g)

Solution

The number of atoms is directly proportional to the number of moles and is inversely proportional to the molar mass. The molar masses of Au, Na, Li and Cl_2 are 197 g/mol , 23 g/mol, 7 g/mol and 71 g/mol respectively.

Since the molar mass of Li is minimum, it will have a maximum number of atoms.

#422435

Use the data given in the following table to calculate the molar mass of naturally occurring argon isotopes:

Isotope	Isotopic molar mass	Abundance
^{36}Ar	$35.96755\ g\ mol^{-1}$	0.337%
^{38}Ar	$37.96272\ g\ mol^{-1}$	0.063%
^{40}Ar	$39.9624\ g\ mol^{-1}$	99.600%

Solution

The average atomic mass of argon is $\dfrac{35.96755(0.337)+37.96275(0.063)+39.9624(99.60)}{100}=39.94$ g/mol.

#422440

Calculate the number of atoms in each of the following.

(i) 52 moles of Ar

(ii) 52 u of He

(iii) 52 g of He.

Solution

(i) The number of atoms present in 52 mol of Ar are $52\times 6.023\times 10^{23}=3.13\times 10^{25}$atoms.

(ii) 52 u of He will contain $\dfrac{52}{4}=13$ atoms.

(iii) 52 g of He will contain $\dfrac{52}{4}\times 6.023\times 10^{23}=7.82\times 10^{24}$atoms.

#422613

Calculate the mass and charge of one mole of electrons.

Solution

Mass of one mole of electrons is $9.11\times 10^{-31}\times 6.023\times 10^{23}=5.486\times 10^{-7}$kg.

Charge of 1 mole of electrons is $1.602\times 10^{-19}\times 6.023\times 10^{23}=9.647\times 10^{4}C$

#422622

Find (a) the total number and (b) the total mass of neutrons in 7 mg of ^{14}C.

(Assume that mass of a neutron =$1.675\times 10^{-27}kg$)

Solution

Number of neutrons is equal to the difference in the mass number and atomic number.

It is equal to $14-6=8$

(a) The number of neutrons present in 7 mg of C-14 is $\dfrac{6.023\times 10^{23}\times 8}{14}\times 7\times 10^{10-3}=2.4088\times 10^{21}$neutrons.

(b) Total mass of neutrons in 7 mg of C-14 is $2.4088\times 10^{21}\times 1.675\times 10^{-27}4.035\times 10^{-6}$ kg.

#422626

Find (a) the total number and (b) the total mass of protons in 34 mg of NH_3 at STP.

Will the answer change if the temperature and pressure are changed ?

Solution

(a)Number of protons present in 1 molecule of ammonia $= 7 + 3 = 10$

Number of molecules present in 34 mg of ammonia is $\dfrac{6.023 \times 10^{23} \times 34 \times 10^{-3}}{17} = 1.2044 \times 10^{21}$.

Total number of protons present in 34mg of ammonia$= 10 \times 1.2044 \times 10^{21} = 1.2044 \times 10^{22}$

(b) Total mass of protons present in 34 mg of ammonia at STP is $1.6726 \times 10^{-27} \times 1.204 \times 10^{22} = 2.0138 \times 10^{-5}$kg.

When temperature and pressure is changed, there is no difference in the answer.

#422979

Calculate the total number of electrons present in 1.4 g of dinitrogen gas.

Solution

1.4 g of nitrogen corresponds to $\dfrac{1.4}{28} = 0.05$ moles.

0.05 moles of nitrogen corresponds to $0.05 \times 6.023 \times 10^{23} = 3.011 \times 10^{22}$molecules.

One molecule of nitrogen contains 14 electrons.

1.4 g of nitrogen will contain $3.011 \times 10^{22} \times 14 = 5.2154 \times 10^{23}$electrons.

#422980

How much time would it take to distribute one Avogadro number of wheat grains, if 10^{10} grains are distributed each second?

Solution

Avogadro's number is 6.023×10^{23}.

The time required to distribute 6.023×10^{23} grains is $\dfrac{6.023 \times 10^{23}}{1 \times 10^{10}} sec = 6.023 \times 10^{13}$ seconds.

Convert unit of time from seconds to years.

$\dfrac{6.023 \times 10^{13}}{3600 \times 24 \times 365} = 1.9096 \times 10^{6}$years.

Note: 1 year is equal to $3600 \times 24 \times 365$seconds.

#464386

When 3.0 g of carbon is burnt in 8.00 g oxygen, 11.00 g of carbon dioxide is produced. What mass of carbon dioxide will be formed when 3.00 g of carbon is burnt in 50.00 g of oxygen? Which law of chemical combination will govern your answer?

Solution

$C + O_2 \rightarrow CO_2$

3 g 8 g 11 g

Total mass of reactants = mass of carbon + mass of oxygen = 3 g+8 g=11 g

Total mass of reactants = Total mass of products

Hence, the law of conservation of mass is proved.

Further, it also shows carbon dioxide contains carbon and oxygen in a fixed ratio by mass, which is 3:8.

Thus it also proves the law of constant proportions. 3 g of carbon must also combine with 8 g of oxygen only. This mean that (50-8)=42 of oxygen will remain unreacted.

#464387

Write the chemical formula of the following.

(a) Magnesium chloride

(b) Calcium oxide

(c) Copper nitrate

(d) Aluminium chloride

(e) Calcium carbonate

Solution

Chemical formula of the following is as follows:

(a) Magnesium chloride = $MgCl_2$

(b) Calcium oxide = CaO

(c) Copper nitrate = $Cu(NO_3)_2$

(d) Aluminium chloride = $AlCl_3$

(e) Calcium carbonate = $CaCO_3$

#464391

Calculate the molar mass of the following substances.

(a) Ethyne, C_2H_2

(b) Sulphur molecule, S_8

(c) Phosphorus molecule, P_4(Atomic mass of phosporus $= 31$)

(d) Hydrochloric acid, HCl

(e) Nitric acid, HNO_3

Solution

(a) Ethyne (C_2H_2)=$2 \times Mass\ of\ C\ atom + 2 \times Mass\ of\ H\ atom = 2 \times 12 + 2 \times 1 = 24 + 2 = 26\ g$

(b) Sulphur dioxide (S_8)=$8 \times Mass\ of\ sulphur\ atom = 8 \times 32 = 256\ g$

(c) $P_4 = 4 \times Mass\ of\ P\ atom = 4 \times 31 = 124\ g$

(d) $HCl = 1 \times Mass\ of\ H\ atom + 1 \times Mass\ of\ Cl\ atom = 1 + 35.5 = 36.5\ g$

(e) $HNO_3 = 1 \times Mass\ of\ H\ atom + 1 \times Mass\ of\ N\ atom + 3 \times Mass\ of\ O\ atom$

$= 1 \times 1 + 1 \times 14 + 3 \times 16 = 63\ g$

#464395

What is the mass of-

(a) 1 mole of nitrogen atoms?

(b) 4 moles of aluminium atoms(Atomic mass of aluminium $= 27)$?

(c) 10 moles of sodium sulphite (Na_2SO_3)?

Solution

(a) 1 mole of nitrogen atoms=$1 \times mass\ of\ N = 1 \times 14 = 14\ g$

(b) 4 moles of aluminium atoms=$4 \times 27 = 108\ g$

(c) 10 moles of sodium sulphite(Na_2SO_3)=$10 \times Mass\ of\ Na_2SO_3$.

Mass of $Na_2SO_3 = 2 \times Mass\ of\ Na\ atom +_1 \times Mass\ of\ Satom + 3 \times Mass\ of\ O\ atom$

$= 2 \times 23 + 1 \times 32 + 3 \times 16 = 46 + 32 + 48 = 126\ g$

$\therefore 10\ moles\ of\ Na_2SO_3 = 10 \times 126 = 1260\ g$

#464396

Convert into mole.

(a) 12 g of oxygen gas

(b) 20 g of water

(c) 22 g of carbon dioxide.

Solution

(a) Molecular mass of oxygen in grams = 16 g of oxygen= one mole of oxygen gas

Thus, 12 g of oxygen$= \frac{1}{32} \times 12 = 0.375\ moles$

(b) Molecular mass of water (H_2O) in grams= 2+ 16=18 g=one mole of water

Thus, 20 g of water$= \frac{1}{18} \times 20 = 1.111\ moles$

(c) Molecular mass of carbon dioxide (CO_2) in grams$= 12 + 2 \times 16 = 44\ g =$one mole of carbon dioxide

Thus, 22 g of carbon dioxide $= \frac{1}{44} \times 22 = 0.5\ moles$

#464398

What is the mass of:

(a) 0.2 mole of oxygen atoms?

(b) 0.5 mole of water molecules?

Solution

(a) The mass of 1 mole of oxygen atoms = 16 g

Thus, the mass of 0.2 mole of oxygen atoms = 16 × 0.2 = 3.2 g

(b) The mass of 1 mole of water molecules = 18 g

Thus, the mass of 0.5 mole of water molecules = 18 × 0.5 = 9.0 g

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#464400

Calculate the number of molecules of sulphur(S_8) present in 16g of solid sulphur.

Solution

Moles of S_8=$\frac{16}{256} = \frac{1}{16}$

number of molecules=$\frac{N_A}{16} = \frac{6.023\times10^{23}}{16} = 3.76 \times 10^{22}$

#464401

Calculate the number of aluminium ions present in 0.051g of aluminium oxide.

Solution

The mass of an ion is the same as that of an atom of the same element. Atomic mass of $Al = 27\ u$

Moles of Al_2O_3=$\frac{0.051}{102}$

Number of molecules of $Al_2O_3 = \frac{0.051}{102} \times 6.023 \times 10^{23} = 3 \times 10^{20}$

1 molecule of Al_2O_3 contains 2 aluminium ions

so, $3 \times 10^{20} contains\ 6 \times 10^{20}$ aluminium ions

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#464508

Define valency by taking examples of silicon and oxygen.

Solution

Valency is defined as the combining capacity of the element. It is determined by the number of valence shell electrons present in the atom. If the number of valence electrons is less than or equal to 4 so the valency is same as the number of electrons present. If the number of valence electrons are more than 4 then the valency is 8-(the number of valence shell electrons).

Silicon has atomic number 14. The electronic configuration of silicon is 2, 8, 4. The number of valence electrons is 4. So the valency is 4.

Oxygen has atomic number 8. The electronic configuration is 2, 6. The valency is (8-6)=2.

#464530

What are polyatomic ions? Give examples.

Solution

A poly atomic ion, also known as a molecular ion, is a charged chemical species(ion) composed of two or more atoms covalently bonded or of a metal complex that can be considered to be acting as a single unit.

Eg: SO_4^{2-}, CO_3^{2-}.