Fundamentals of Chemistry

Important Problems Practice

1. What is the mass of 5 moles of ice?

SOLUTION

Given no. of mole of ice =5 moles

Molecular mass of ice (H_2O)= (2×1)+(1×16)=2+16

Molecular mass of ice =18 amu

Number of moles = Mass in gram ÷ Molecular mass

Rearranging the formula

Mass in gram =number of moles × Molecular mass

Mass of ice in grams = 5 × 18 = 90 grams

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2. During thunder storms, oxygen is transformed to ozone O_3. Determine the mass of ozone if a storm produces 9.05 moles of ozone.

Ozone is a molecular substance. Determine its molar mass and use it to convert moles to mass in grams.

9.05 moles of O_3 —→? g of O_3

Solution:

1 mole of O_3 = 16 x 3 = 48 g

1 mole of O_3 = 48 g

So, 9.05 moles of O3 = 48 g x 9.05

= 434.4g of O_3

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3. When methane is burned, carbon dioxide is produced. How much CO_2 is created when 0.25 moles of CO_2 are produced?

SOLUTION

Molar mass of CO_2 = 12 + 16 x 2 = 44g

1 mole of CO_2 = 44g of CO_2

So, 0.25 moles of CO_2 = 44 x 0.25 = 11g of CO_2

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4. Calculate the moles of each of the following

A. Balloon filled with 5g of hydrogen

B. A block of ice that has mass of 100g

SOLUTION

a) Molar mass of H_2 = 1.008 x 2 = 2.016g

1 mole of H_2 = 2.016g

So, 2.016g of H_2 = 1 mole of H_2

1g of H_2= 1/2.016 moles of H_2

5 gram of H_2 =1÷2.016×5

5 gram of H_2 = 2.48 Moles of H_2

b) 1 Mole Of H_2O =2×1.008+16

1 Mole of H_2O =2.016+16

1Mole of H_2O=18.016g

so

1 gram of H_2O = 1÷18.016 moles

100 Gram of H_2O= 1÷18.016×100 moles

100 grams of H_2O=5.55 Moles of H_2O

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5. Zn is a metal used to prevent corrosion by galvanizing steel. How many atoms are in 1.25 moles of zinc?

SOLUTION

1 mole of Zn contains = 23 6.022 x 10^{23} atoms

1.25 moles of Zn contains = 6.022 x 10^{23} x 1.25 = 7.53 x 10^{23} Zn atoms

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6. Methane is one of the principal constituents of natural gas. Determine how many moles are in 0.5 moles of a pure methane sample.

SOLUTION

1 mole of CH4 contains = 6.022 x 10^{23} molecules

So, 0.5 moles of CH4 will contain = 6.022 x 10^{23} x 0.5 = 3.011 x 10^{23} molecules

7. Titanium is a metal that is used in rockets. Calculate the number of moles in a sample containing 3.011×10^{23}atoms

SOLUTION

6.022×10^{23} atoms = 1 mole

3.011×10^{23}Atoms →? mole

6.022×10^{23} atoms = 1 mole of Ti

1 Ti atom =$1\div6.022\times10^{23}$ moles of Ti

3.011×10^{23} Ti atoms = $1 \div (6.022\times10^{23}) \times 3.011\times10^{23}$ moles of Ti

=0.5 moles of Ti

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8. Determine the number of moles in 60 grams of carbon dioxide.

SOLUTION

Mass of CO_2 =60 g

The molar mass of CO_2= 12g+2(16)g

=12g+32g

=44g/mol

Number of moles of CO_2=Mass in grams ÷ molar mass

Number of moles of CO_2=60/44

=1.364 moles

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9. How many moles of hydrogen are there in 8.9×10^{23} hydrogen atoms

SOLUTION

Number of atoms of hydrogen $=8.9\times10^{23}$

Avagadro number = $N_A=6.023\times10^{23}$

Number of moles of hydrogen =Number of atoms or molecules /Avogadro number

Number of moles of hydrogen $=8.9\times10^{23} \div 6.023\times10^{23}$

=1.48 moles

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10. Determine the molar masses of water, sodium, nitrogen, and sucrose

SOLUTION

a) Molecular mass of H_2O

= 1 X 2 + 16 = 18

Therefore, mass of 1 mole of water = 18 g

b) 1 mole of sodium (Na) = 23g

c) Nitrogen occurs as diatomic molecules.

Molecular mass of nitrogen (N_2)= 14 x 2

= 28amu

Therefore, mass of 1 mole of N_2 = 28 g

d) Molecular mass of $C_{12}H_{22}O_{11}$

= 12x12 + 1x22 + 16x11

= 144 + 22 + 176

Therefore, mass of 1 mole of sucrose = 342g

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11. Calculate the number of moles of butane (C_4H_{10}) in 151g of butane?

SOLUTION

Mass= 151 g

Molecular mass of butane= (12×4) + (1×10) = 58amu

Number of moles = Mass ÷ Molecular mass

Number of moles =151÷58

Number of moles = 2.63 moles

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12. Calculate the mass of 6.68 $\times 10^{23}$molecules of PCl_3

SOLUTION

Number of molecules =6.68 $\times 10^{23}$molecules

Avogadro number= 6.023×10^{23}

Molecular mass of PCl_3= (1×30.97)+(3×35.5)

Molecular mass of PCl_3=30.97+106.5=137.47 amu

First Calculating moles

Number of moles = Number of molecules/ Avogadro number

Number of moles =6.68 $\times 10^{23}$molecules $\div 6.023 \times 10^{23}$

Number of moles =1.10 mol

Mass in gram =Number of moles × molecular mass

Mass in gram =1.10×137.47

Mass in gram =151.62g

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13. Determine the number of molecules in 6.50 moles of CH_4

SOLUTION

Number of moles = 6.5 moles

Avogadro number =6.023×10^{23}

Number of moles = Number of molecule / Avogadro's number

Number of molecules= No of moles × Avogadro's number

Number of molecules =$6.50 \times 6.023 \times 10^{23}$

Number of molecules =39.14×10^{23}

Number of molecules =3.914×10^{24}

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