Topic covered:
- Mole Concept (Session - 1) - JEE

Worksheet

1. Calculate the number of NO₂ molecules in 4 moles of a pure sample of NO₂ molecules.
   a. \(6.022 \times 10^{23}\)  
   b. \(24.088 \times 10^{23}\)  
   c. \(2.408 \times 10^{23}\)  
   d. \(12.044 \times 10^{23}\)

2. Calculate the number of formula units of Na₂SO₄ in 4/9 millimoles of a pure sample of Na₂SO₄.
   a. \(24.088 \times 10^{23}\)  
   b. \(2.41 \times 10^{20}\)  
   c. \(2.68 \times 10^{20}\)  
   d. \(2.68 \times 10^{23}\)

3. Calculate the number of formula units of CuSO₄.₅H₂O present in \(10^{-13}\) moles of pure CuSO₄.₅H₂O.
   a. \(6.022 \times 10^{10}\)  
   b. \(6.022 \times 10^{13}\)  
   c. \(6.022 \times 10^{12}\)  
   d. \(6.022 \times 10^{9}\)

4. Find the number of moles of NO₂ molecules in a sample containing \(3.011 \times 10^{23}\) molecules of NO₂.
   a. 0.05 moles  
   b. 0.5 moles  
   c. 2 moles  
   d. 0.25 moles

5. Find the number of moles of HNO₃ molecules in a sample containing \(10^6\) molecules of HNO₃.
   a. \(2.66 \times 10^{-18}\) moles  
   b. \(2.66 \times 10^{-20}\) moles  
   c. \(1.66 \times 10^{-20}\) moles  
   d. \(1.66 \times 10^{-18}\) moles

6. Find the number of millimoles of KOH in a sample containing 30 KOH molecules.
   a. \(4.98 \times 10^{-23}\)  
   b. \(0.498 \times 10^{-23}\)  
   c. \(4.98 \times 10^{23}\)  
   d. \(4.98 \times 10^{-20}\)

7. Find the total number of oxygen atoms in 200 formula units of Na₂SO₄.
   a. 800  
   b. 600  
   c. 1200  
   d. 1600

8. Find the total number of oxygen atoms in \(3 \times 10^3\) formula units of \([\text{Ni(H}_2\text{O)}_6]\)Cl₂.
   a. \(6 \times 10^3\)  
   b. \(18 \times 10^3\)  
   c. \(24 \times 10^3\)  
   d. \(0.6 \times 10^3\)
9. If we have a pure CH₃OH sample and it contains a total of 6000 hydrogen atoms, then find the number of CH₃OH molecules present in the sample.
   a. 1200  
   b. 1000  
   c. 1500  
   d. 800

10. We have a pure H₂SO₄ sample and it contains a total of 1120 hydrogen atoms. Find the number of H₂SO₄ molecules present in the sample.
   a. 560  
   b. 2240  
   c. 1120  
   d. 1000

11. If we have a FeSO₄.7H₂O sample and it contains a total of 2233 oxygen atoms, then find the number of formula units of FeSO₄.7H₂O present in the sample.
   a. 210  
   b. 203  
   c. 103  
   d. 233

12. Find the number of O-atoms in 2/3 moles of NO₂.
   a. 4.014 × 10²³  
   b. 4.014 × 10²⁰  
   c. 8.029 × 10²³  
   d. 8.029 × 10²⁰

13. How many C-atoms are present in 2.6 micromoles of C₆H₁₂O₆?
   a. 3.13 × 10¹⁶  
   b. 6.26 × 10¹⁶  
   c. 1.56 × 10¹⁶  
   d. 9.39 × 10¹⁶

14. How many O-atoms are present in 3/8 millimoles of [Co(H₂O)₄Cl₂]Cl?
   a. 9.033 × 10²⁴  
   b. 2.26 × 10²⁴  
   c. 9.033 × 10²⁰  
   d. 2.26 × 10²⁰

15. Find the number of moles of N₂O₅ in a pure sample that contains 1 nanomole of O-atoms.
   a. 2 × 10⁻¹⁰ moles  
   b. 0.2 × 10⁻¹⁰ moles  
   c. 4 × 10⁻¹⁰ moles  
   d. 0.4 × 10⁻¹⁰ moles

16. Find the number of moles of CuSO₄.5H₂O in a pure sample that contains 0.045 moles of O-atoms.
   a. 0.5 moles  
   b. 0.005 moles  
   c. 50 moles  
   d. 5 moles

17. Find the number of moles of BaCl₂.2H₂O in a pure sample that contains 3/8 kilomoles of oxygen atoms.

18. Find the total number of moles of electrons present in 24.088 × 10²³ SO₂ molecules.
   a. 132 moles  
   b. 128 moles  
   c. 232 moles  
   d. 328 moles
19. Find the total number of moles of electrons present in $6.022 \times 10^{18}$ H$_3$PO$_4$ molecules.
   a. 0.5 moles   b. 0.05 moles   c. 0.005 moles   d. 0.0005 moles

20. Find the total number of moles of electrons present in $12.044 \times 10^{14}$ PO$_4^{3-}$ ions.

21. If we have a pure Na$_2$SO$_4$ sample that contains a total of 7 billion electrons, then find the number of moles of Na$_2$SO$_4$ present in the sample.
   a. $1.66 \times 10^{-16}$ moles   b. $1.66 \times 10^{-14}$ moles   c. $3.66 \times 10^{-16}$ moles   d. $3.66 \times 10^{-14}$ mole

22. If we have a pure Ca(NO$_3$)$_2$ sample that contains a total of 1.64 kilomoles of electrons then find the number of moles of Ca(NO$_3$)$_2$ present in the sample.
   a. 10 moles   b. 20 moles   c. 30 moles   d. 40 moles

23. If we have a pure MgCO$_3$ sample that contains a total of 1.26 millimoles of electrons, find the number of moles of MgCO$_3$ present in the sample.

24. Find the total number of electrons present in 40 millimoles of BaSO$_4$. (atomic number of Ba=56)
   a. $2.89 \times 10^{24}$   b. $3.89 \times 10^{24}$   c. $2.51 \times 10^{24}$   d. $3.51 \times 10^{24}$

25. If we have a pure Na$_2$CO$_3$ sample that contains a total of $7.8286 \times 10^{24}$ electrons, then find the number of moles of Na$_2$CO$_3$ present in the sample.
   a. 0.5 moles   b. 0.3 moles   c. 0.7 moles   d. 0.25 moles
## Answer Key

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1. (b)
We know,
1 mole of NO₂ = 6.022 × 10²³ NO₂ molecules
So, 4 moles of NO₂ = 6.022 × 10²³ × 4 molecules = 24.088 × 10²³ NO₂ molecules

2. (c)
We know,
1 mole of Na₂SO₄ = 6.022 × 10²³ formula units of Na₂SO₄
So, 1 millimole of Na₂SO₄ = 6.022 × 10²⁰ formula units of Na₂SO₄
Therefore 4/9 millimoles of Na₂SO₄
= 6.022 × 10²⁰ × \(\frac{4}{9}\) formula units = 2.68 × 10²⁰ formula units of Na₂SO₄

3. (a)
We know,
1 mole of CuSO₄.5H₂O = 6.022 × 10²³ formula units of CuSO₄.5H₂O
So, 10⁻¹³ moles of pure CuSO₄.5H₂O
= 6.022 × 10²³ × 10⁻¹³ formula units = 6.022 × 10¹⁰ formula units of CuSO₄.5H₂O

4. (b)
We know,
6.022 × 10²³ molecules of NO₂ = 1 mole of NO₂
So, 3.011 × 10²³ molecules of NO₂
= \(\frac{3.011 \times 10²³}{6.022 \times 10²³}\) moles = 0.5 moles of NO₂

5. (d)
We know,
6.022 × 10²³ molecules of HNO₃ = 1 mole of HNO₃
So, 10⁶ molecules of HNO₃ = \(\frac{10⁶}{6.022 \times 10²³}\) moles = 1.66 × 10⁻¹⁸ moles of HNO₃

6. (d)
We know,
6.022 × 10²³ molecules of KOH = 1 mole of KOH
So, 30 molecules of KOH = \(\frac{30}{6.022 \times 10²³}\) mole of KOH
= \(\frac{30}{6.022 \times 10²³}\) × 10³ millimoles of KOH = 4.98 × 10⁻²⁰ millimoles of KOH
7. (a) 
Number of O-atoms in one formula unit of Na$_2$SO$_4$ = 4  
So, number of O-atoms in 200 formula unit of Na$_2$SO$_4$ = 200 × 4 = 800

8. (b) 
Number of O-atoms in one formula unit of [Ni(H$_2$O)$_6$]Cl$_2$ = 6  
So, number of O-atoms in 3 × 10$^3$ formula units of [Ni(H$_2$O)$_6$]Cl$_2$ = 6 × 3 × 10$^3$  
= 18 × 10$^3$

9. (c) 
From the molecular formula of CH$_3$OH,  
1 mole CH$_3$OH contains 4 moles of H atoms  
So, we can say that 4 moles of H-atoms are present in 1 mole of CH$_3$OH.  
Again, 6.022 × 10$^{23}$ H-atoms = 1 mole of H-atoms  
Therefore, 6000 H-atoms = $\frac{6000}{6.022 \times 10^{23}}$ moles of H-atoms  
Hence number of CH$_3$OH molecules present in the sample  
= $\frac{6000}{6.022 \times 10^{23}} \times \frac{1}{4} \times 6.022 \times 10^{23}$ = 1500

10. (a) 
From the molecular formula of H$_2$SO$_4$,  
1 mole of H$_2$SO$_4$ contains 2 moles of H atoms  
So, 2 moles of H-atoms are present in 1 mole of H$_2$SO$_4$  
Again, 6.022 × 10$^{23}$ H-atoms = 1 mole of H-atoms  
Therefore, 1120 H-atoms = $\frac{1120}{6.022 \times 10^{23}}$ moles of H-atoms  
Hence, number of H$_2$SO$_4$ molecules present in the sample  
= $\frac{1120}{6.022 \times 10^{23}} \times \frac{1}{2} \times 6.022 \times 10^{23}$ = 560

11. (b) 
From the molecular formula of FeSO$_4$.7H$_2$O,  
1 mole of FeSO$_4$.7H$_2$O contains 11 moles of O-atoms  
So, 11 moles of O-atoms are present in 1 mole of FeSO$_4$.7H$_2$O  
Again, 6.022 × 10$^{23}$ O-atoms = 1 mole of O-atoms  
Therefore, 2233 O-atoms = $\frac{2233}{6.022 \times 10^{23}}$ moles of O-atoms  
Hence, number of formula units of FeSO$_4$.7H$_2$O present in the sample:  
= $\frac{2233}{6.022 \times 10^{23}} \times \frac{1}{11} \times 6.022 \times 10^{23}$ = 203
12. (c)
From the molecular formula of NO$_2$,
1 mole of NO$_2$ molecules contains 2 moles of O-atoms
So, 2/3 moles of NO$_2$ molecules contain 4/3 moles of O atoms
Again, 1 mole of O-atoms = $6.022 \times 10^{23}$ O-atoms
Therefore, 4/3 moles of O-atoms = $\frac{4}{3} \times 6.022 \times 10^{23} = 8.029 \times 10^{23}$ O-atoms

13. (d)
From the formula of C$_6$H$_{12}$O$_6$,
1 mole of C$_6$H$_{12}$O$_6$ molecules contains 6 moles of C atoms.
So, 2.6 micromoles of C$_6$H$_{12}$O$_6$ molecules contain 2.6 $\times$ 6 = 15.6 micromoles of C-atoms
Again, 1 mole of C-atoms = $6.022 \times 10^{23}$ C-atoms
Therefore, 15.6 micromoles of C-atoms = $15.6 \times 10^{-6} \times 6.022 \times 10^{23}$ C-atoms
= 9.39 $\times$ 10$^{16}$ C-atoms

14. (c)
From the formula of [Co(H$_2$O)$_4$Cl$_2$]Cl,
1 mole of [Co(H$_2$O)$_4$Cl$_2$]Cl formula unit contains 4 moles of O-atoms
So, 3/8 millimoles of [Co(H$_2$O)$_4$Cl$_2$]Cl contain $\frac{3}{8} \times 4 = \frac{3}{2}$ millimoles of O-atom
Again, 1 mole of O-atoms = $6.022 \times 10^{23}$ O-atoms
Therefore, $\frac{3}{2}$ millimoles of O-atoms = $\frac{3}{2} \times 10^{-3} \times 6.022 \times 10^{23}$ O-atoms
= 9.033 $\times$ 10$^{20}$ O-atoms

15. (a)
From the molecular formula of N$_2$O$_5$,
5 moles of O-atoms are contained in 1 mole of N$_2$O$_5$
So, 1 nanomole of O-atoms will be contained in
= $\frac{1}{5} \times 10^{-9}$ moles of N$_2$O$_5$
= $2 \times 10^{-10}$ moles of N$_2$O$_5$
16. (b)
From the molecular formula unit of CuSO$_4$.5H$_2$O,
9 moles of O-atoms are contained in 1 mole of CuSO$_4$.5H$_2$O
So, 0.045 moles of O-atoms will be contained in
\[\frac{1}{9} \times 0.045 \text{ moles} = 0.005 \text{ moles of CuSO}_4.5\text{H}_2\text{O}\]

17. (187.50 mol)
From the molecular formula unit of BaCl$_2$.2H$_2$O,
2 moles of O-atoms are contained in 1 mole of BaCl$_2$.2H$_2$O
So, \(\frac{3}{8}\) kilomoles of O-atoms will be contained in
\[\frac{1}{2} \times \frac{3}{8} \times 1000 \text{ moles of BaCl}_2.2\text{H}_2\text{O} = 187.50 \text{ moles of BaCl}_2.2\text{H}_2\text{O}\]

18. (b)
24.088 \times 10^{23} \text{ SO}_2 \text{ molecules} = \frac{24.088 \times 10^{23}}{6.022 \times 10^{23}} \text{ moles} = 4 \text{ moles of SO}_2
The number of electrons in one molecule of SO$_2$ = 16 + 8 \times 2 = 32 electrons
So, the number of moles of electrons in one mole of SO$_2$ = 32 moles
Therefore, total number of moles of electrons in 4 moles of SO$_2$ would be:
\[= 50 \times 10^{-5} \text{ moles} = 0.0005 \text{ moles}\]

19. (d)
6.022 \times 10^{18} \text{ H}_3\text{PO}_4 \text{ molecules} = \frac{6.022 \times 10^{18}}{6.022 \times 10^{23}} \text{ moles} = 10^{-5} \text{ moles H}_3\text{PO}_4
The number of electrons in one molecule of H$_3$PO$_4$ = 3 + 15 + 8 \times 4 = 50 electrons
So, the number of moles of electrons in one mole of H$_3$PO$_4$ = 50 moles
Therefore, the total number of moles of electrons in $10^{-5}$ moles of H$_3$PO$_4$ would be:
\[= 50 \times 10^{-5} \text{ moles} = 0.0005 \text{ moles}\]

20. ($10^{-7}$ mol)
We know,
12.044 \times 10^{14} \text{ PO}_4^{3-} \text{ ions} = \frac{12.044 \times 10^{14}}{6.022 \times 10^{23}} \text{ moles} = 2 \times 10^{-9} \text{ moles PO}_4^{3-} \text{ ions}
The number of electrons in one PO$_4^{3-}$ ion = 15 + 8 \times 4 + 3 = 50 electrons
So, the number of moles of electrons in one mole of PO$_4^{3-}$ ion = 50 moles
Therefore, the total number of moles of electrons in $2 \times 10^{-9}$ moles of PO$_4^{3-}$ ions:
\[= 50 \times 2 \times 10^{-9} \text{ moles} = 10^{-7} \text{ moles}\]
21. (a)

One molecule of Na₂SO₄ contains = (11 × 2 + 16 + 8 × 4) = 70 electrons
So, number of electrons in 1 mole of Na₂SO₄ = 70 × 6.022 × 10²³
Therefore 7 × 10⁹ electrons will be contained in
= \( \frac{7 \times 10^9}{70 \times 6.022 \times 10^{23}} \) moles of Na₂SO₄
= 1.66 × 10⁻¹⁶ moles of Na₂SO₄

22. (b)

One molecule of Ca(NO₃)₂ contains = (20 + 2 × 7 + 6 × 8) = 82 electrons
So, number of electrons in 1 mole of Ca(NO₃)₂ = 82 × 6.022 × 10²³
Therefore 1.64 kilomoles of electrons will be contained in
= \( \frac{1.64 \times 1000 \times 6.022 \times 10^{23}}{82 \times 6.022 \times 10^{23}} \) moles of Ca(NO₃)₂
= 20 moles of Ca(NO₃)₂

23. (3 × 10⁻⁵ mol)

One molecule of MgCO₃ contains = (12 + 6 + 8 × 3) = 42 electrons
So, number of electrons in 1 mole of MgCO₃ = 42 × 6.022 × 10²³
Therefore, 1.26 millimoles of electrons will contained in
= \( \frac{1.26 \times 10^{-3} \times 6.022 \times 10^{23}}{42 \times 6.022 \times 10^{23}} \) moles = 3 × 10⁻⁵ moles of MgCO₃

24. (c)

The total number of electrons present in one molecule of BaSO₄ = 56 + 16 + 32 = 104
Therefore, total number of electrons present in one mole of BaSO₄ = 104 × 6.022 × 10²³
Hence, total number of electrons present in 40 millimoles of BaSO₄
= 104 × 6.022 × 10²³ × 40 × 10⁻³ = 2.51 × 10²⁴

25. (d)

Total number of electrons present in one molecule of Na₂CO₃ = 11 × 2 + 6 + 3 × 8 = 52
So, 52 × 6.022 × 10²³ electrons are present in 1 mole of Na₂CO₃
Therefore, 7.8286 × 10²⁴ electrons will be present in
= \( \frac{7.8286 \times 10^{24}}{52 \times 6.022 \times 10^{23}} \) moles of Na₂CO₃
= 0.25 moles of Na₂CO₃