

Name Key

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Determine the Molar Mass of the following:

1. Gold = 197g/mol

2. Fluorine = 19g/mol

3. Carbon Dioxide = 44g/mol

4. Aluminum Oxide = 102g/mol

5. Magnesium Chloride = 95.2g/mol

6. Potassium Phosphate = 212.3g/mol

Convert the following Quantities into moles

7. 42g Gold $42g_{Au} \times \frac{1mol_{Au}}{197g} = 0.21mol_{Au}$

8. 63g Oxygen $63g_{O_2} \times \frac{1mol_{O_2}}{32g_{O_2}} = 2mol_{O_2}$

9. 232 grams sodium hydroxide $232g_{NaOH} \times \frac{1mol}{40g} = 5.8mol_{NaOH}$

10. 22g Copper (I) Sulfide $22g_{Cu_2S} \times \frac{1mol}{159.2g} = 0.14mol_{Cu_2S}$

Convert the following Quantities into grams

11. 3.3mol Potassium Sulfide $3.3mol \times \frac{110.3g}{1mol} = 364g_{K_2S}$

12. 12.4mol water $12.4mol \times \frac{18g}{1mol} = 223.2g_{H_2O}$

13. 4.5mol aluminum hydroxide $4.5mol_{Al(OH)_3} \times \frac{78g}{1mol} = 351g_{Al(OH)_3}$

Convert the following Quantities into atoms/molecules/units

14. 2.5g Nickel $2.5g Ni \times \frac{1 \text{ mole}}{58.7g} \times \frac{6.022 \times 10^{23}}{1 \text{ mol}} = 2.6 \times 10^{22}$

15. 23g Sodium Hydroxide $23g \times \frac{1 \text{ mol}}{40g} \times \frac{6.022 \times 10^{23} \text{ units}}{1 \text{ mol}} = 3.5 \times 10^{23} \text{ units}$

Convert the following into grams

16. 1 atom of silver $1 \text{ atom Ag} \times \frac{1 \text{ mole}}{6.022 \times 10^{23} \text{ atoms Ag}} \times \frac{107.8g}{1 \text{ mol Ag}} = 1.8 \times 10^{-22} g$

17. 7.78×10^{26} atoms of sulfur

Convert the following moles gases into Liters at (STP) $\rightarrow 22.4L / 1 \text{ mol}$

18. 5.4mol oxygen gas $5.4 \text{ mol O}_2 \times \frac{22.4L}{1 \text{ mol}} = 121L$

19. 3.20×10^{-2} mol CO₂ $.032 \text{ mol CO}_2 \times \frac{22.4L}{1 \text{ mol}} = 0.7168L$

20. 0.960 mol SO₃ $.960 \text{ mol SO}_3 \times \frac{22.4L}{1 \text{ mol}} = 21.504L$

21. 836g of CH₄ $836g \times \frac{1 \text{ mol}}{16g} = 52.25 \text{ mol} \times \frac{22.4L}{1 \text{ mol}} = 1171.5L$

Convert the following volumes of gases into Moles at STP

22. 89.6L Ne $89.6L Ne \times \frac{1 \text{ mol}}{22.4L} = 4 \text{ moles}$

23. 2.00×10^3 L C₂H₆ $2000L \times \frac{1 \text{ mol}}{22.4L} = 89.29 \text{ mol}$

24. 5.42L Fluorine $5.42L F_2 \times \frac{1 \text{ mol}}{22.4L} = .242 \text{ mol}$

25. How many grams of fluorine is that?

26. 3.24×10^{22} molecules of Neon $3.24 \times 10^{22} \text{ molecules} \times \frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ atoms}} = 0.054 \text{ mol} \times \frac{20g}{1 \text{ mol}} = 1.08g$

3.24×10^{22} atoms $\times \frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ atoms}} = 0.054 \text{ mol} \times \frac{22.4L}{1 \text{ mol}} = 1.21L$

$\frac{\text{Mass}}{\text{Volume}} = \text{g/L}$ for gases

ANY gas 1 mol = 22.4 L @ STP

What is the density of the following gases at STP in g/L

27. Nitrogen $\frac{28\text{g}}{1\text{mol}}$ or $\frac{28\text{g}_{\text{N}_2}}{1\text{mol}_{\text{N}_2}} \times \frac{1\text{mol}_{\text{N}_2}}{22.4\text{L}} = 1.25 \frac{\text{g}}{\text{L}}$

28. Argon $\frac{40\text{g}}{1\text{mol}}$

29. Carbon Dioxide $\frac{44\text{g}}{1\text{mol}} \times \frac{1\text{mol}}{22.4\text{L}} = 2 \frac{\text{g}}{\text{L}}$

Argon $\frac{40\text{g}}{1\text{mol}} \times \frac{1\text{mol}}{22.4\text{L}} = 1.8 \frac{\text{g}}{\text{L}}$

Determine the molarity (M) of the following solutions

$M = \frac{\text{mol solute}}{\text{L solution}}$

30. 3 moles of potassium hydroxide in a liter of solution.

$M = \frac{3\text{mol}}{1\text{L}} = 3\text{M KOH}$

31. 29 grams of sodium hydroxide in a liter of solution.

$\text{NaOH} = 40\text{g/mol}$ $\frac{29\text{g}}{40\text{g/mol}} = 0.725\text{mol}$ $M = \frac{0.725\text{mol}}{1\text{L}} = 0.725\text{M NaOH}$

32. 36 grams of calcium chloride in 792 mL of solution.

$\text{CaCl}_2 = 111\text{g/mol}$ $\frac{36\text{g}}{111\text{g/mol}} = 0.324\text{mol}$ $M = \frac{0.324\text{mol}}{0.792\text{L}} = 0.41\text{M CaCl}_2$

33. 3.2 kg of lithium chloride dissolved in 27,000 mL of solution

$\text{LiCl} = 42.4\text{g/mol}$ $\frac{3200\text{g}}{42.4\text{g/mol}} = 75.5\text{mol}$ $M = \frac{75.5\text{mol}}{27\text{L}} = 2.8\text{M LiCl}$

Determine the moles of solute in the following solutions

34. 72 mL of 0.35 M HCl $0.35\text{M} = \frac{0.35\text{mol}}{1\text{L}} \times 0.072\text{L} = 0.025\text{mol}$

35. 245 mL of 1.4 M NaOH $1.4\text{M} \times 0.245\text{L} = 0.343\text{mol}$

36. 45 g of NaOH is dissolved in 782 mL of solution. How many moles NaOH in 72 mL?

$45\text{g} \times \frac{1\text{mol}}{40\text{g}} = 1.125\text{mol} / 0.782\text{L} = 1.44\text{M}$ $1.44\text{M} \times 0.072\text{L} = 0.104\text{mol}$

Determine the moles of solute in the following solutions ($M_1V_1 = M_2V_2$)

37. You have 150 mL of 2M HCl. How much 1.5M solution can you make?

$150\text{mL} \times 2\text{M} = 1.5 V_2$ $V_2 = 200\text{mL}$

38. You need 500 mL of 3M NaOH and have unlimited 6M solution on stock. What volume of 6M solution do you need and how much water will you add to it?

$M_1V_1 = M_2V_2$ $6\text{M} \times V = 3\text{M} \times 500\text{mL}$ $V = 250\text{mL}$ stock and add 250 mL H₂O to it

39. You mix 50 mL of 2M HCl with 150 mL of 3M HCl. What is the final molarity of the solution (hint: $M_1V_1 + M_2V_2 = M_3V_3$)

$50\text{mL} \times 2\text{M} + 150\text{mL} \times 3\text{M} = M_3 V_3$ $V_3 = 50\text{mL} + 150\text{mL} = 200\text{mL}$
 $100 + 450 = 200M$
 $\frac{550}{200} = 2.75\text{M}$

Advanced Questions

40. How many atoms of hydrogen are there in 3.63 moles of water?
41. How many grams of KMnO_4 are needed to make 500.0 mL of a 0.200 M solution?
42. How many mL of solution will result when 15.0 g of H_2SO_4 is dissolved to make a 0.200 M solution?
43. If I were to give you one atom of gold for every second that has elapsed since the Dinosaur's went extinct 65 million years ago, what volume of gold would you have? Density of gold is 19.3g/cm^3

#40

$$3.63 \frac{\text{mol}}{\text{H}_2\text{O}} \times \frac{6.022 \times 10^{23} \frac{\text{units}}{\text{mol}}}{1 \frac{\text{mol}}{\text{H}_2\text{O}}} \times \frac{2 \text{H atoms}}{1 \text{unit}} = 4.37 \times 10^{24} \text{ atoms}_\text{H}$$

#41

$$M = \frac{\text{mol}}{\text{Liter}}$$

$$M = 0.200 \text{ M}$$

$$L = 0.5$$

$$\text{mol} = ?$$

$$\text{mol} = M \times L$$

$$\text{mol} = 0.2 \times 0.5 = 0.1 \text{ mol } \text{KMnO}_4$$

$$\text{MM}_{\text{KMnO}_4} = 158 \text{ g/mol}$$

$$0.1 \text{ mol } \text{KMnO}_4 \times \frac{158 \text{ g}}{1 \text{ mol}} = 15.8 \text{ g } \text{KMnO}_4$$

#42

$$\frac{15.0 \text{ g}}{158 \text{ g}} \text{H}_2\text{SO}_4$$

$$\text{MM}_{\text{H}_2\text{SO}_4} = 98.079 \frac{\text{g}}{\text{mol}}$$

$$M = 0.200$$

$$15.0 \text{ g } \text{H}_2\text{SO}_4 \times \frac{1 \text{ mol}}{98.1 \text{ g } \text{H}_2\text{SO}_4} = 0.153 \text{ mol}$$

$$M = \frac{\text{mol}}{L}$$

$$.200 = \frac{.153 \text{ mol}}{L}$$

$$L = .765 \text{ L} = 765 \text{ mL}$$

#43 See video