



The Mole



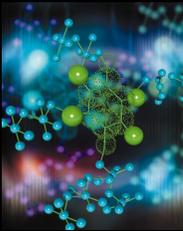

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Molecules Are Too Small To See

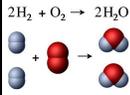
We must “deduce” number of molecules involved in reactions


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Reactions occur at the particulate level:

$$2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$$


Molecules “collide” to form new products
(Collision Theory)



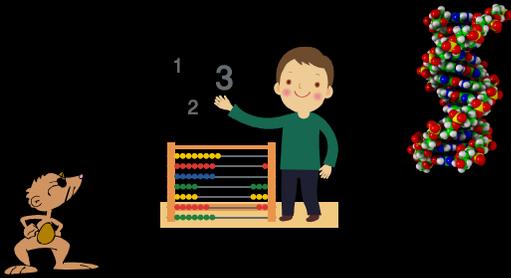
Need way to determine number of reacting atoms



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The Mole is a Chemist's Way of Counting Atoms & Molecules



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The Mole

Mole always contains the same number of formula units:
 6.02×10^{23} (Avogadro's Number)

- 1 mol element = 6.02×10^{23} atoms
- 1 mol diatomic element = 6.02×10^{23} molecules
- 1 mol molecular compound = 6.02×10^{23} molecules
- 1 mol ionic compound = 6.02×10^{23} formula units



So, the "per" expressions:

- 1 mol = 6.02×10^{23} atoms
- 1 mol = 6.02×10^{23} molecules
- 1 mol = 6.02×10^{23} formula units



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Each Element Has A Different Atomic Mass

Periodic Table

1	2	10	16	17	18
1	2	10	16	17	18
3	4	5	6	7	8
9	10	11	12	13	14
15	16	17	18	19	20
21	22	23	24	25	26
27	28	29	30	31	32
33	34	35	36	37	38
39	40	41	42	43	44
45	46	47	48	49	50
51	52	53	54	55	56
57	58	59	60	61	62
63	64	65	66	67	68
69	70	71	72	73	74
75	76	77	78	79	80
81	82	83	84	85	86
87	88	89	90	91	92
93	94	95	96	97	98
99	100	101	102	103	104
105	106	107	108	109	110
111	112	113	114	115	116
117	118	119	120	121	122
123	124	125	126	127	128
129	130	131	132	133	134
135	136	137	138	139	140
141	142	143	144	145	146
147	148	149	150	151	152
153	154	155	156	157	158
159	160	161	162	163	164
165	166	167	168	169	170
171	172	173	174	175	176
177	178	179	180	181	182
183	184	185	186	187	188
189	190	191	192	193	194
195	196	197	198	199	200
201	202	203	204	205	206
207	208	209	210	211	212
213	214	215	216	217	218
219	220	221	222	223	224
225	226	227	228	229	230
231	232	233	234	235	236
237	238	239	240	241	242
243	244	245	246	247	248
249	250	251	252	253	254
255	256	257	258	259	260
261	262	263	264	265	266
267	268	269	270	271	272
273	274	275	276	277	278
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597	598	599	600	601	602
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615	616	617	618	619	620
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861	862	863	864	865	866
867	868	869	870	871	872
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957	958	959	960	961	962
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975	976	977	978	979	980
981	982	983	984	985	986
987	988	989	990	991	992
993	994	995	996	997	998
999	1000	1001	1002	1003	1004
1005	1006	1007	1008	1009	1010
1011	1012	1013	1014	1015	1016
1017	1018	1019	1020	1021	1022
1023	1024	1025	1026	1027	1028
1029	1030	1031	1032	1033	1034
1035	1036	1037	1038	1039	1040
1041	1042	1043	1044	1045	1046
1047	1048	1049	1050	1051	1052
1053	1054	1055	1056	1057	1058
1059	1060	1061	1062	1063	1064
1065	1066	1067	1068	1069	1070
1071	1072	1073	1074	1075	1076
1077	1078	1079	1080	1081	1082
1083	1084	1085	1086	1087	1088
1089	1090	1091	1092	1093	1094
1095	1096	1097	1098	1099	1100
1101	1102	1103	1104	1105	1106

Let's Study the Mole, People







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The Mole Lab






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Today's Lab

- Work In Pairs
- See Video on The Mole
- Identify Unknown Elements
- Determine Moles and Formula Units for Ionic Compounds
- Determine Moles and Molecules for Molecular Compound



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Element Identification

Select 3 Element Vials (with different colored dots)

Each vial marked with:

Label (Letter of the Unknown)

Weight of empty vial and cap

Weigh each vial

Mass of unknown vial – mass written on vial = mass unknown

Determine Atomic Mass of the unknown (grams / mole)

mass (grams) unknown / 0.100 mole = unknown atomic mass

Identify Unknown Element

Find element on the periodic table with unknown's atomic mass

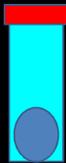


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Weighing By Difference



Container
Plus
Sample
Weight



Container
Weight



Sample
Weight



Technique gives best weight of sample
(no mechanical loss while weighing)

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Moles and Formula Units



Weigh each vial

Mass of sample vial – mass written on vial = mass sample

Determine moles of the sample (grams / mole)

mass (grams) $\times \frac{1 \text{ mole}}{\text{formula mass (g)}} = \# \text{ Moles}$

Identify Number of Formula Units

$\# \text{ moles} \times 6.02 \times 10^{23} \frac{\text{formula units}}{\text{mole}} = \# \text{ Formula Units}$

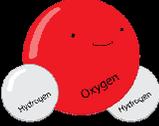


Each group determines both NaCl and KNO₃

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Moles and Number of molecules

Measure mass of 40.0 mL of deionized water
 Tare balance with 50 mL grad cylinder; fill to 40.0 mL
 Measure mass
 Determine moles of the sample (grams / mole)

$$\text{mass (grams)} \times \frac{1 \text{ mole}}{\text{molecular mass (g)}} = \# \text{ Moles sample}$$

Identify Number of Formula Units (Molecules)

$$\# \text{ moles} \times \frac{6.02 \times 10^{23} \text{ molecules}}{\text{mole}} = \# \text{ Molecules in sample}$$


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Results
 Fill in tables with calculated values
Conclusion
Questions
 Proper units and sig figs



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Let's Boldly Go Explore Today's Lab




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