Mole Lab

Introduction to The Mole Concept

Introduction

Although technically not a laboratory experiment, this activity certainly helps to drive home the main idea behind the mole concept—that chemists can count out infinitesimally small particles by weighing.

Concepts

- Avogadro's number
- Chemical formulas
- Molar mass or molecular weight

Materials (for each lab station, two or three lab pairs can work at each station)

Aluminum foil

Ammonium sulfate, $(NH_4)_2SO_4$, 100 g

Sodium chloride, NaCl, 500 g

Water, distilled, 500 mL

Beakers, 600-mL or cut off 2-L soda bottles, 3 labeled

Cups, blue, clear, and red plastic, 2–3 of each

Pipets, Beral-type, 2–3

Spoons, plastic, 4–6

Balance, electronic, 0.01-g precision (if only triple beam balances are available, it is best if there is one for each lab pair)

Materials (for the instructor's station, preferably near the center of the room)

Copper sheet, 12 pieces*

Balance, electronic, 0.01-g precision

Cups, blue, clear, and red plastic, 1 each

Scoring Standard Table

**See the* Preparation *section below for sizes of copper pieces.*

Safety Precautions

Ammonium sulfate is slightly toxic by ingestion. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Wash hands thoroughly with soap and water before leaving the laboratory. Follow all laboratory safety guidelines. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

Preparation

1. Label three 600-mL beakers "NaCl," "water," and "ammonium sulfate" and add to each the corresponding substance. *Note:* Do not write the chemical formula for ammonium sulfate on the beaker; students must determine this.
2. Place 2–3 spoons in each beaker containing a solid substance.
3. Place 2–3 pipets in the beaker of water.
4. Cut twelve pieces of copper sheet according to Table 1 and label with the corresponding numbers 1–12. *Note:* The copper pieces can have any weights you want them to. Using the weights given in the table allows you to use the Scoring Standard table as is. If you use other weights, just modify column C in the table accordingly, as shown in Figure 1 on page 2

Cu Piece	Mass (g)
#1	4.22
#2	4.78
#3	4.98
#4	5.13
#5	5.44
#6	5.97
#7	6.09
#8	6.55
#9	6.79
#10	7.13
#11	7.65
#12	7.88

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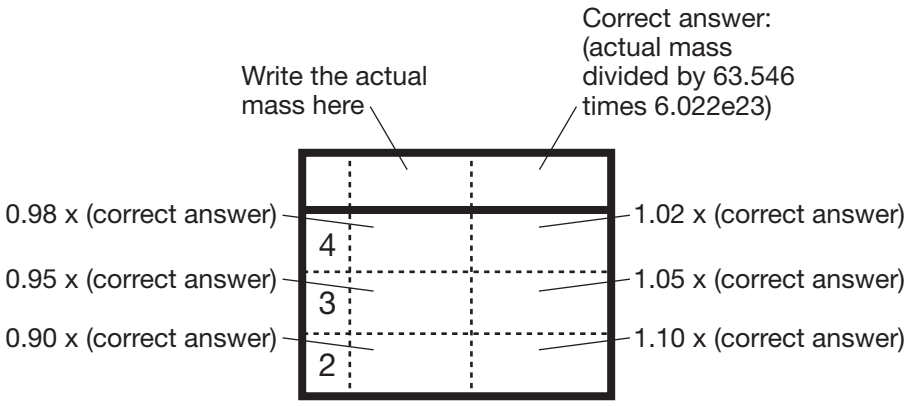

Figure 1.

Procedure

1. After some coverage of the mole concept, hand out the half sheets included. You should give each pair a different number. *Note:* If the class has more than 25 students, then repeats will occur.
2. Tell the students they will get graded on how accurately (and precisely) they complete each task.
3. As groups complete their tasks, they bring them up to you for quick scoring.
4. For tasks A, B, and E, this involves your weighing the sample they bring up to you and seeing where the mass falls on the Scoring Standard Table (See the *Tips* section for examples of how to use the table). The simplest way of doing this is to place a clean dry plastic cup that matches the color of the cup they are bringing up to you on the scale and taring it. Then pour the contents of their cup into the one on the scale. The mass shown will be the mass of just the substance, not the cup.
5. After circling the score on their half-sheet, you can then pour the substance back into their cup and instruct them to recycle it back into the large container at their lab station.
6. For task C, students will get their copper sample from you, and then bring it back with their answer. Use the Scoring Standard Table to see where their answer falls and circle their score on their half-sheet.
7. For task D, use the same procedure as step 4, without a cup. Simply weigh their piece of aluminum on your scale and mark their score.
8. When students complete all five tasks, they simply turn in their sheets.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. All materials may be stored for future use (do not return chemicals to original containers unless they are dedicated for this activity). Ammonium sulfate and sodium chloride may be disposed of as solid waste according to Flinn Suggested Disposal Method #26a.

Tips

- The purpose in giving each lab group a different sheet is so that each group will have to do the work for themselves—no copying off of what some other group did.
- The lab may run much more smoothly and cause much less anxiety if the students are told they can have one free "re-do." If not, some groups become frozen into inactivity! You may wish to offer them a chance to make it up after school, but they will have to start all over with a completely new and different lab sheet.
- The different cup colors allow for ease of identification and prevent contamination.
- For tasks A, B, and E, some groups may forget to account for the mass of the cup

	1.51	88.24
4	86.48	90.01
3	83.83	92.66
2	79.42	97.07

Figure 2.

when they weigh out their sample. They are usually quick to figure this out when they see what you are doing! If, for example, group 3 comes to you with their clear cup containing their weighed-out sample of salt (task A), and you find it weighs 88.62 g, then this would earn them a top score of "4" since it falls in the top range (see Figure 2). A group that is way off and brings up only 76.53 g of NaCl (perhaps because they did not account for the cup) will end up with a low score of "1" since 76.53 falls outside of the lowest range on the table.

- A scoring example for task C is if group 8 comes to you with "6.48×10^{22}" written on their sheet, this would fall in the "3" range on the scoring standard (see Figure 3).

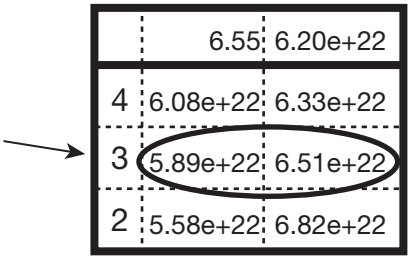

Figure 3.

Discussion

Consider the following example. Sarah is a bright student who is well-versed in the computational technique of dimensional analysis (AKA factor label). Ask her how much 4.23×10^{23} atoms of iron would weigh, and she will quickly and correctly set it up as 4.23×10^{23} atoms × (1 mole/6.022×10^{23} atoms) x (55.847 g/1 mole) and solve to get 39.2 g. Now ask her to bring you 4.23×10^{23} atoms of iron, and Sarah says, "Huh? How do I do that?" That simple connection from the pen-and-paper "answer" to the physical manifestation of that answer, from what's on the page to what goes in the beaker, is a connection with which many students struggle, yet it is an important connection for them to be able to make. It keeps the concepts relevant and real. And to spend the time to measure out 39.2 g of iron, to associate it with the calculations performed, to contemplate that therein lie 4.23×10^{23} atoms of iron, more than could ever be counted, yet still just shy of that quantity called the "mole"—this is time well spent!

The quick scoring method provides a good opportunity to chat with the students as they come up. "So, Molly, how many moles of salt have you brought me?" (Molly answers, "*3.06*") "And how do you know that?" ("*Because we weighed it out*").... "How many molecules of water are in this cup, Peter?" ("*2.93×10^{23}*") "And what is water's formula?" ("*H_2O*.") "So, how many oxygen atoms would there be in there?" ("Hmmm").... And for a group bringing up an answer of "*6.48*" for task C, neglecting to include the "... × 10^{22}" in their answer, hold up the returned piece of copper. "So, Tim, how many copper atoms is this made up of?" ("*6.48*.") "Hmmm, they must be pretty big atoms...why can't we see them?" ("*Oh, wait a second...*")

On the final task, the most common mistake is that students forget to balance the charges on the compound. They write down "*NH_4*" for ammonium, then "*SO_4*" for sulfate, but then they just leave it as "*NH_4SO_4*" instead of the correct $(NH_4)_2SO_4$. This obviously throws off their answer considerably. Still, it is important for them to tie together what they learned previously—writing correct names and formulas—with this new concept of moles and molecular weights.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Evidence, models, and explanation
Constancy, change, and measurement
Content Standards: Grades 5–8
Content Standard B: Physical Science, properties and changes of properties in matter
Content Standard G: History and Nature of Science, nature of science
Content Standards: Grades 9–12
Content Standard B: Physical Science, structure of atoms, structure and properties of matter
Content Standard G: History and Nature of Science, nature of scientific knowledge

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Mole Lab* activity, presented by Bob Becker, is available in *Introduction to The Mole Concept*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Mole Lab* are available from Flinn Scientific, Inc.

Catalog No.	Description
A0168	Ammonium Sulfate, 500 g
S0064	Sodium Chloride, 2 kg
W0001	Water, Distilled, 1 Gallon
C0080	Copper, Sheet, #30 Gauge, 12'' × 12''
AP8949	Scissors, Heavy-Duty
OB2141	Flinn Scientific Electronic Balance, 0.01-g

Consult the Flinn Scientific website for current prices.

Mole Lab Worksheet

GROUP #1 (20 pts) Names: _____ _____

Do each of the following tasks, showing your results to the instructor as you complete them. Your grade for each will be based on the accuracy with which you complete the tasks.

	within 2%	within 5%	within 10%	you tried
A. Measure out 1.25 moles of salt (NaCl) into a clear, dry cup.	4	3	2	1
Show work:				
B. Put 4.52×10^{24} molecules of water into a red, dry cup.	4	3	2	1
Show work:				
C. Obtain a sample of copper metal (#1) from your instructor and determine how many atoms it contains. Write your answer here:_____ then show it to the instructor and return the sample.	4	3	2	1
Show work:				
D. Hand your instructor 6.13×10^{22} atoms of aluminum.	4	3	2	1
Show work:				
E. Measure out 0.0485 moles of ammonium sulfate into a blue, dry cup.	4	3	2	1
Show work:				

Mole Lab Worksheet

GROUP #2 (20 pts) Names: _____ _____

Do each of the following tasks, showing your results to the instructor as you complete them. Your grade for each will be based on the accuracy with which you complete the tasks.

	within 2%	within 5%	within 10%	you tried
A. Measure out 1.35 moles of salt (NaCl) into a clear, dry cup.	4	3	2	1
Show work:				
B. Put 4.32×10^{24} molecules of water into a red, dry cup.	4	3	2	1
Show work:				
C. Obtain a sample of copper metal (#2) from your instructor and determine how many atoms it contains. Write your answer here:_____ then show it to the instructor and return the sample.	4	3	2	1
Show work:				
D. Hand your instructor 6.69×10^{22} atoms of aluminum.	4	3	2	1
Show work:				
E. Measure out 0.0472 moles of ammonium sulfate into a blue, dry cup.	4	3	2	1
Show work:				

Mole Lab Worksheet

GROUP #3 (20 pts) Names: _____ _____

Do each of the following tasks, showing your results to the instructor as you complete them. Your grade for each will be based on the accuracy with which you complete the tasks.

	within 2%	within 5%	within 10%	you tried
A. Measure out 1.51 moles of salt (NaCl) into a clear, dry cup.	4	3	2	1
Show work:				
B. Put 4.12×10^{24} molecules of water into a red, dry cup.	4	3	2	1
Show work:				
C. Obtain a sample of copper metal (#3) from your instructor and determine how many atoms it contains. Write your answer here:_____ then show it to the instructor and return the sample.	4	3	2	1
Show work:				
D. Hand your instructor 6.86×10^{22} atoms of aluminum.	4	3	2	1
Show work:				
E. Measure out 0.0468 moles of ammonium sulfate into a blue, dry cup.	4	3	2	1
Show work:	Show work:			

Mole Lab Worksheet

GROUP #4 (20 pts) Names: _____ _____

Do each of the following tasks, showing your results to the instructor as you complete them. Your grade for each will be based on the accuracy with which you complete the tasks.

	within 2%	within 5%	within 10%	you tried
A. Measure out 1.65 moles of salt (NaCl) into a clear, dry cup.	4	3	2	1
Show work:				
B. Put 3.93×10^{24} molecules of water into a red, dry cup.	4	3	2	1
Show work:				
C. Obtain a sample of copper metal (#4) from your instructor and determine how many atoms it contains. Write your answer here:_____ then show it to the instructor and return the sample.	4	3	2	1
Show work:				
D. Hand your instructor 7.02×10^{22} atoms of aluminum.	4	3	2	1
Show work:				
E. Measure out 0.0459 moles of ammonium sulfate into a blue, dry cup.	4	3	2	1
Show work:				

Mole Lab Worksheet

GROUP #5 (20 pts) Names: _____ _____

Do each of the following tasks, showing your results to the instructor as you complete them. Your grade for each will be based on the accuracy with which you complete the tasks.

	within 2%	within 5%	within 10%	you tried
A. Measure out 1.81 moles of salt (NaCl) into a clear, dry cup.	4	3	2	1
Show work:				
B. Put 3.76×10^{24} molecules of water into a red, dry cup.	4	3	2	1
Show work:				
C. Obtain a sample of copper metal (#5) from your instructor and determine how many atoms it contains. Write your answer here:_____ then show it to the instructor and return the sample.	4	3	2	1
Show work:				
D. Hand your instructor 7.25×10^{22} atoms of aluminum.	4	3	2	1
Show work:				
E. Measure out 0.0447 moles of ammonium sulfate into a blue, dry cup.	4	3	2	1
Show work:				

Mole Lab Worksheet

GROUP #6 (20 pts) Names: _____ _____

Do each of the following tasks, showing your results to the instructor as you complete them. Your grade for each will be based on the accuracy with which you complete the tasks.

	within 2%	within 5%	within 10%	you tried
A. Measure out 1.95 moles of salt (NaCl) into a clear, dry cup.	4	3	2	1
Show work:				
B. Put 3.61×10^{24} molecules of water into a red, dry cup.	4	3	2	1
Show work:				
C. Obtain a sample of copper metal (#6) from your instructor and determine how many atoms it contains. Write your answer here:_____ then show it to the instructor and return the sample.	4	3	2	1
Show work:				
D. Hand your instructor 7.39×10^{22} atoms of aluminum.	4	3	2	1
Show work:				
E. Measure out 0.0437 moles of ammonium sulfate into a blue, dry cup.	4	3	2	1
Show work:				

Mole Lab Worksheet

GROUP #7 (20 pts) Names: _____ _____

Do each of the following tasks, showing your results to the instructor as you complete them. Your grade for each will be based on the accuracy with which you complete the tasks.

	within 2%	within 5%	within 10%	you tried
A. Measure out 2.15 moles of salt (NaCl) into a clear, dry cup.	4	3	2	1
Show work:				
B. Put 3.48×10^{24} molecules of water into a red, dry cup.	4	3	2	1
Show work:				
C. Obtain a sample of copper metal (#7) from your instructor and determine how many atoms it contains. Write your answer here:_____ then show it to the instructor and return the sample.	4	3	2	1
Show work:				
D. Hand your instructor 7.63×10^{22} atoms of aluminum.	4	3	2	1
Show work:				
E. Measure out 0.0425 moles of ammonium sulfate into a blue, dry cup.				
Show work:				

Mole Lab Worksheet

GROUP #8 (20 pts) Names: _____ _____

Do each of the following tasks, showing your results to the instructor as you complete them. Your grade for each will be based on the accuracy with which you complete the tasks.

	within 2%	within 5%	within 10%	you tried
A. Measure out 2.35 moles of salt (NaCl) into a clear, dry cup.	4	3	2	1
Show work:				
B. Put 3.38×10^{24} molecules of water into a red, dry cup.	4	3	2	1
Show work:				
C. Obtain a sample of copper metal (#8) from your instructor and determine how many atoms it contains. Write your answer here:_____ then show it to the instructor and return the sample.	4	3	2	1
Show work:				
D. Hand your instructor 7.91×10^{22} atoms of aluminum.	4	3	2	1
Show work:				
E. Measure out 0.0414 moles of ammonium sulfate into a blue, dry cup.	4	3	2	1
Show work:				

Mole Lab Worksheet

GROUP #9 (20 pts) Names: _____ _____

Do each of the following tasks, showing your results to the instructor as you complete them. Your grade for each will be based on the accuracy with which you complete the tasks.

	within 2%	within 5%	within 10%	you tried
A. Measure out 2.55 moles of salt (NaCl) into a clear, dry cup.	4	3	2	1
Show work:				
B. Put 3.25×10^{24} molecules of water into a red, dry cup.	4	3	2	1
Show work:				
C. Obtain a sample of copper metal (#9) from your instructor and determine how many atoms it contains. Write your answer here:_____ then show it to the instructor and return the sample.	4	3	2	1
Show work:				
D. Hand your instructor 8.32×10^{22} atoms of aluminum.	4	3	2	1
Show work:				
E. Measure out 0.0409 moles of ammonium sulfate into a blue, dry cup.	4	3	2	1
Show work:				

Mole Lab Worksheet

GROUP #10 (20 pts) Names: _____ _____

Do each of the following tasks, showing your results to the instructor as you complete them. Your grade for each will be based on the accuracy with which you complete the tasks.

	within 2%	within 5%	within 10%	you tried
A. Measure out 2.75 moles of salt (NaCl) into a clear, dry cup.	4	3	2	1
Show work:				
B. Put 3.16×10^{24} molecules of water into a red, dry cup.	4	3	2	1
Show work:				
C. Obtain a sample of copper metal (#10) from your instructor and determine how many atoms it contains. Write your answer here:_____ then show it to the instructor and return the sample.	4	3	2	1
Show work:				
D. Hand your instructor 8.60×10^{22} atoms of aluminum.	4	3	2	1
Show work:				
E. Measure out 0.0395 moles of ammonium sulfate into a blue, dry cup.	4	3	2	1
Show work:				

Mole Lab Worksheet

GROUP #11 (20 pts) Names: _____ _____

Do each of the following tasks, showing your results to the instructor as you complete them. Your grade for each will be based on the accuracy with which you complete the tasks.

	within 2%	within 5%	within 10%	you tried
A. Measure out 2.87 moles of salt (NaCl) into a clear, dry cup.	4	3	2	1
Show work:				
B. Put 3.04×10^{24} molecules of water into a red, dry cup.	4	3	2	1
Show work:				
C. Obtain a sample of copper metal (#11) from your instructor and determine how many atoms it contains. Write your answer here:_____ then show it to the instructor and return the sample.	4	3	2	1
Show work:				
D. Hand your instructor 9.23×10^{22} atoms of aluminum.	4	3	2	1
Show work:				
E. Measure out 0.0388 moles of ammonium sulfate into a blue, dry cup.	4	3	2	1
Show work:				

Mole Lab Worksheet

GROUP #12 (20 pts) Names: _____ _____

Do each of the following tasks, showing your results to the instructor as you complete them. Your grade for each will be based on the accuracy with which you complete the tasks.

	within 2%	within 5%	within 10%	you tried
A. Measure out 3.06 moles of salt (NaCl) into a clear, dry cup.	4	3	2	1
Show work:				
B. Put 2.93×10^{24} molecules of water into a red, dry cup.	4	3	2	1
Show work:				
C. Obtain a sample of copper metal (#12) from your instructor and determine how many atoms it contains. Write your answer here:_____ then show it to the instructor and return the sample.	4	3	2	1
Show work:				
D. Hand your instructor 9.67×10^{22} atoms of aluminum.	4	3	2	1
Show work:				
E. Measure out 0.0374 moles of ammonium sulfate into a blue, dry cup.	4	3	2	1
Show work:				

Mole Lab Scoring Standard Table

		A			B			C			D			E	
		1.25	73.05		4.52	135.22		4.22	3.99e+22		6.13	2.75		0.0485	6.41
1	4	71.59	74.51	4	132.52	137.9	4	3.91e+22	4.07e+22	4	2.69	2.80	4	6.28	6.54
	3	69.40	76.70	3	128.46	141.99	3	3.79e+22	4.19e+22	3	2.61	2.88	3	6.09	6.73
	2	65.75	80.36	2	121.70	148.75	2	3.59e+22	4.39e+22	2	2.47	3.02	2	5.77	7.05
		1.35	78.89		4.32	129.24		4.78	4.52e+22		6.69	3.00		0.0472	6.24
2	4	77.32	80.47	4	126.66	131.83	4	4.43e+22	4.62e+22	4	2.94	3.06	4	6.11	6.36
	3	74.95	82.84	3	122.78	135.70	3	4.30e+22	4.75e+22	3	2.85	3.15	3	5.93	6.55
	2	71.00	86.78	2	116.32	142.17	2	4.07e+22	4.98e+22	2	2.70	3.30	2	5.61	6.86
		1.51	88.24		4.12	123.26		4.98	4.71e+22		6.86	3.07		0.0468	6.18
3	4	86.48	90.01	4	120.79	125.72	4	4.6e+22	4.81e+22	4	3.01	3.13	4	6.06	6.31
	3	83.83	92.66	3	117.10	129.42	3	4.48e+22	4.95e+22	3	2.92	3.23	3	5.87	6.49
	2	79.42	97.07	2	110.93	135.58	2	4.24e+22	5.19e+22	2	2.77	3.38	2	5.57	6.80
		1.65	96.43		3.93	117.57		5.13	4.86e+22		7.02	3.15		0.0459	6.07
4	4	94.50	98.35	4	115.22	119.93	4	4.76e+22	4.95e+22	4	3.08	3.21	4	5.94	6.19
	3	91.60	101.25	3	111.70	123.45	3	4.61e+22	5.10e+22	3	2.99	3.30	3	5.76	6.37
	2	86.78	106.07	2	105.82	129.33	2	4.37e+22	5.34e+22	2	2.83	3.46	2	5.46	6.67
		1.81	105.78		3.76	112.489		5.44	5.15e+22		7.25	3.25		0.0447	5.91
5	4	103.66	107.89	4	110.24	114.74	4	5.05+22	5.25e+22	4	3.18	3.31	4	5.79	6.02
	3	100.49	111.07	3	106.86	118.11	3	4.89e+22	5.41e+22	3	3.09	3.41	3	5.61	6.20
	2	95.20	116.35	2	101.24	123.74	2	4.63e+22	5.67e+22	2	2.92	3.57	2	5.32	6.50
		1.95	113.96		3.61	108.00		5.97	5.65e+22		7.39	3.31		0.0437	5.7
6	4	111.68	16.24	4	105.84	110.16	4	5.54e+22	5.77e+22	4	3.24	3.38	4	5.66	5.89
	3	108.26	119.66	3	102.60	113.40	3	5.37e+22	5.94e+22	3	3.15	3.48	3	5.49	6.06
	2	102.56	125.35	2	97.20	118.80	2	5.09e+22	6.22e+22	2	2.98	3.64	2	5.20	6.35
		2.15	125.65		3.48	104.11		6.09	5.77e+22		7.63	3.42		0.0425	5.62
7	4	123.13	128.16	4	102.03	106.19	4	5.65e+22	5.88e+22	4	3.35	3.49	4	5.50	5.73
	3	119.36	131.93	3	98.91	109.32	3	5.48e+22	6.05e+22	3	3.25	3.59	3	5.34	5.90
	2	113.08	138.21	2	93.70	114.52	2	5.19e+22	6.34e+22	2	3.08	3.76	2	5.05	6.18
		2.35	137.33		3.38	101.12		6.55	6.20e+22		7.91	3.54		0.0414	5.47
8	4	134.59	140.08	4	99.10	103.14	4	6.08e+22	6.33e+22	4	3.47	3.61	4	5.36	5.58
	3	130.47	144.20	3	96.06	106.18	3	5.89e+22	6.51e+22	3	3.37	3.72	3	5.20	5.74
	2	123.60	151.07	2	91.01	111.23	2	5.58e+22	6.82e+22	2	3.19	3.90	2	4.92	6.02
		2.55	149.02		3.25	97.23		6.79	6.43e+22		8.32	3.73		0.0409	5.40
9	4	146.04	152.00	4	95.29	99.17	4	6.30e+22	6.56e+22	4	3.65	3.80	4	5.30	5.51
	3	141.57	156.47	3	92.37	102.09	3	6.11e+22	6.75e+22	3	3.54	3.91	3	5.13	5.67
	2	134.12	163.92	2	87.51	106.95	2	5.79e+22	7.07e+22	2	3.35	4.10	2	4.86	5.94
		2.75	160.71		3.16	94.54		7.13	6.75e+22		8.6	3.85		0.0395	5.22
10	4	157.50	163.92	4	92.65	96.43	4	6.62+22	6.89e+22	4	3.78	3.93	4	5.12	5.32
	3	152.67	168.75	3	89.81	99.26	3	6.41e+22	7.09e+22	3	3.66	4.05	3	4.96	5.48
	2	144.64	176.78	2	85.08	103.99	2	6.08e+22	7.43e+22	2	3.47	4.24	2	4.70	5.74
		2.87	167.72		3.04	90.95		7.65	7.24e+22		9.23	4.14		0.0388	5.13

11	4	164.37	171.08	4	89.13	92.77	4	7.10e+22	7.39e+22	4	4.05	4.22	4	5.02	5.23
	3	159.34	176.11	3	86.40	95.49	3	6.88e+22	7.61e+22	3	3.93	4.34	3	4.87	5.38
	2	150.95	184.50	2	81.85	100.04	2	6.52e+22	7.97e+22	2	3.72	4.55	2	4.61	5.64
		3.06	178.83		2.93	87.66		7.88	7.46e+22		9.67	4.33		0.0374	4.94
12	4	175.25	182.40	4	85.90	89.41	4	7.31e+22	7.61e+22	4	4.25	4.42	4	4.84	5.04
	3	169.89	187.77	3	83.27	92.04	3	7.09e+22	7.84e+22	3	4.12	4.55	3	4.69	5.19
	2	160.94	196.71	2	78.89	96.42	2	6.72e+22	8.21e+22	2	3.90	4.77	2	4.45	5.44