Application of Clickers in a Small Inorganic Chemistry Lecture Class

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Order of the Presentation

- ***Original Goals of the Project***
- ***Description of the Setting***
- ***Various Teaching Methods Applied with "Clickers"***
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- ***Student Evaluation Information***
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Original Goals of the Project

- ***Does clicker use help students better learn Inorganic Chemistry?***
- ***Is there a method which might be better to apply?***
- ***Are there any particular differences between the small classroom and the large classroom?***

Description of the Setting

- ***CHE 410 Inorganic Chemistry -- lecture (no lab)***
- ***12 Chemistry Majors, 1 Chemistry Minor, 1 Health Science Studies Student***
- ***Turning Technologies Response Ware -- students used laptops or phones with internet to answer questions***

Various Teaching Methods Applied with "Clickers"

- ***peer instruction (2 or 3 students)***
- ***group discussion (classroom discussion)***
- ***simple poll, contingency teaching***

Sample Questions

- ***The following slides show some of the questions used in the course.***
- ***Questions were used as preview, review, or both.***
- ***Some of the questions appeared on the mid-term and/or final exam.***

Q5: A first approximation of the energy of electrons was developed by

1) ***Bohr and Rydberg;***
2) ***deBroglie and Schr***ödinger***;***
3) ***Gerlach and Stern;***
4) ***Heisenberg and Pauli.***

Q10: The maximum number of electrons that could have $m_s = +½$ in N is:

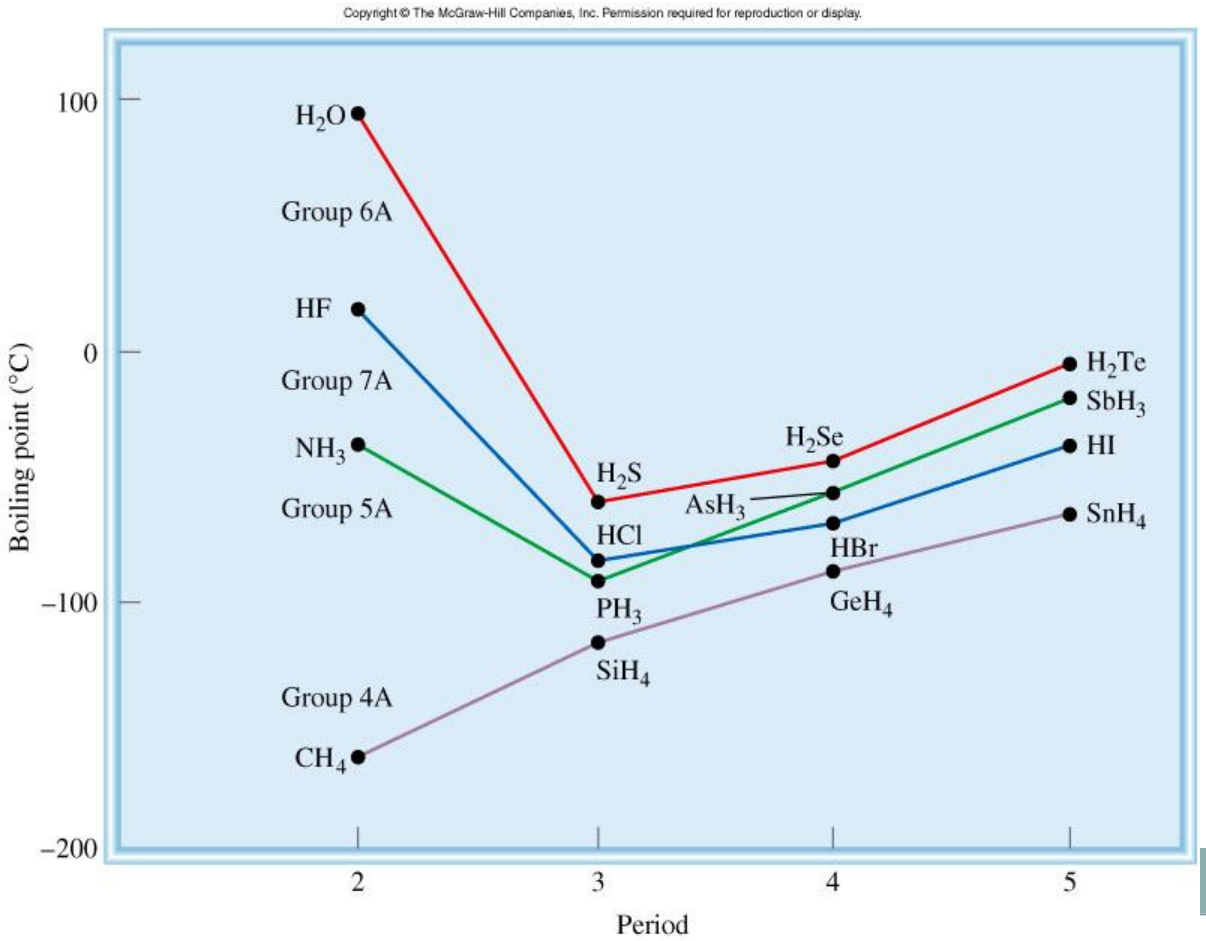
Q6: The boiling points of the compounds increase in the order:

1) $CaF_2 < CO_2 < SF_2$;
2) $CaF_2 < SF_2 < CO_2$;
3) $CO_2 < CaF_2 < SF_2$;
4) $CO_2 < SF_2 < CaF_2$;
5) $SF_2 < CaF_2 < CO_2$;
6) $SF_2 < CO_2 < CaF_2$.

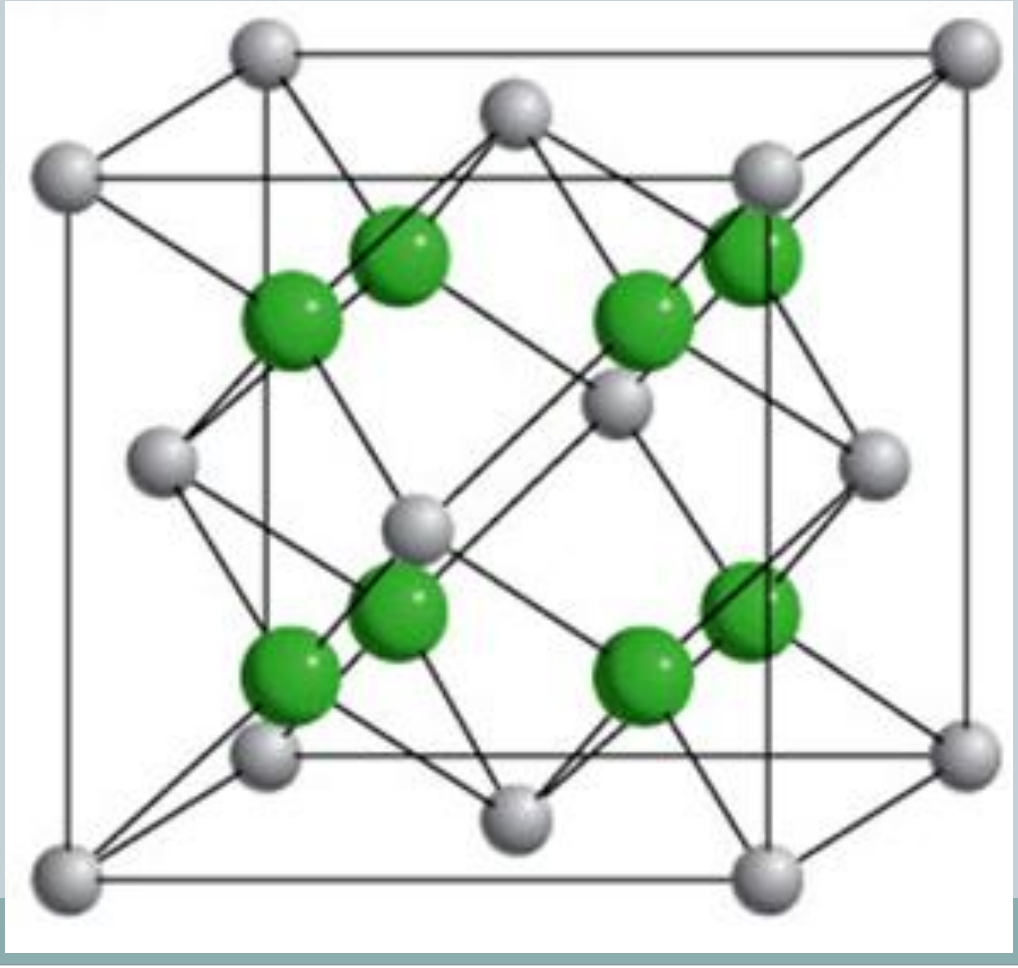
Q7: There is some evidence of hydrogen bonding in H_2S and HCl.

A. **True**

B. **False**



How many atoms are in the cubic lattice unit cell below?



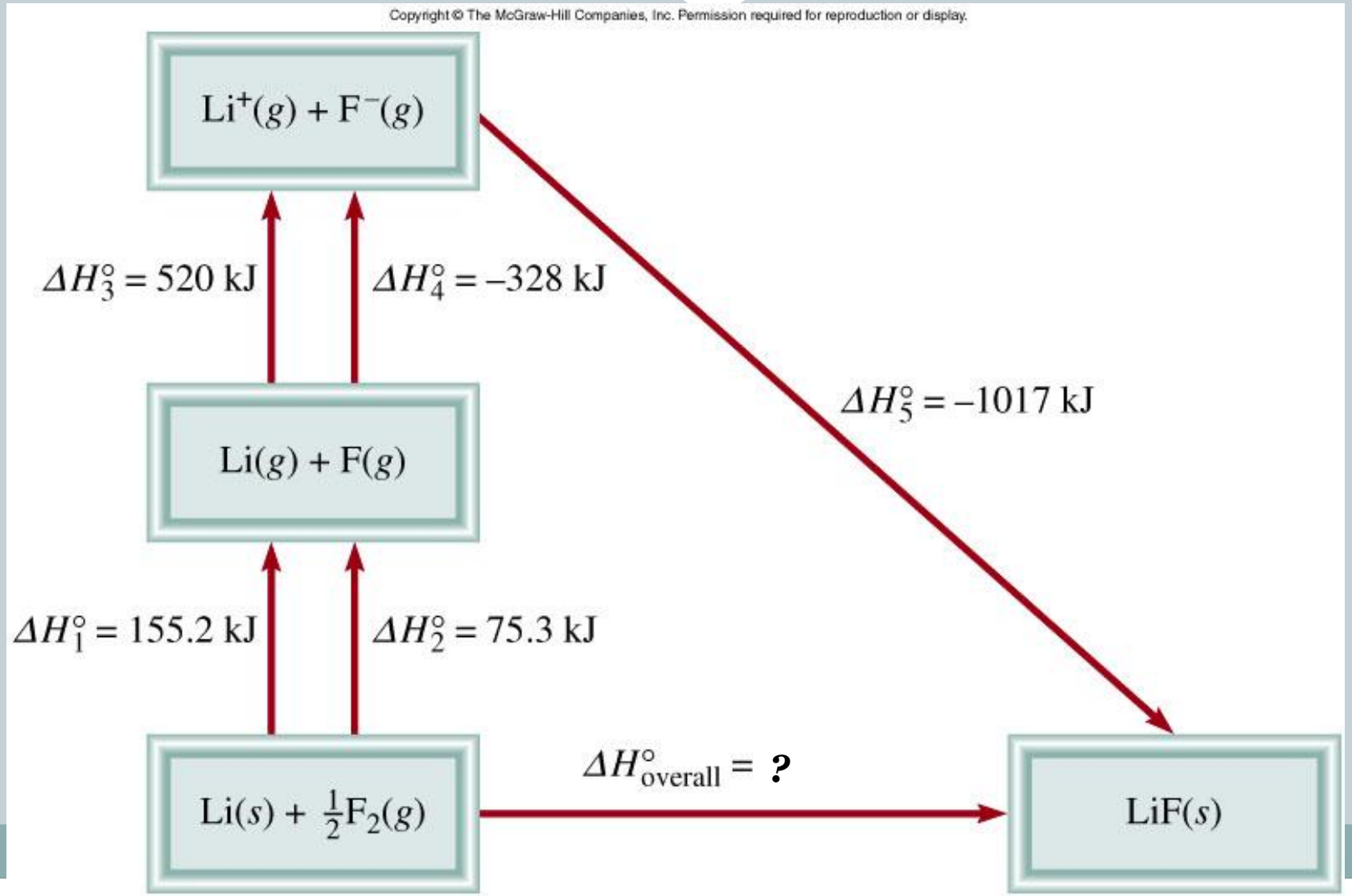
Ligands are

1) anions
2) cations
3) neutral molecules
4) both (1) and (2)
5) both (1) and (3)
6) both (2) and (3)
7) (1), (2), and (3)

Which of the following is an example of an Arrhenius acid?

1) ***HCl in acetic acid***
2) ***HCl in water***
3) ***both 1 & 2***
4) ***neither 1 nor 2***

Preview Question: Born-Haber Cycle: LiF



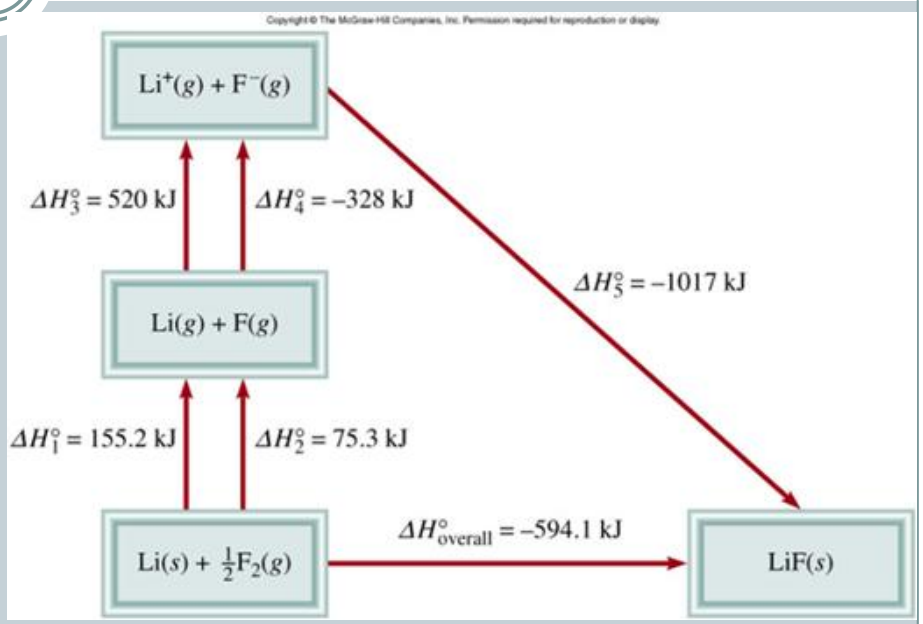
Final Exam Question (similar)

5. The lattice energy in LiF is

a. 1017 kJ

b 328 kJ

c. 594.1 kJ



Final Exam Question (new)

15. $CoCl_4^{2-}$ is tetrahedral. The number of unpaired electrons in the complex is

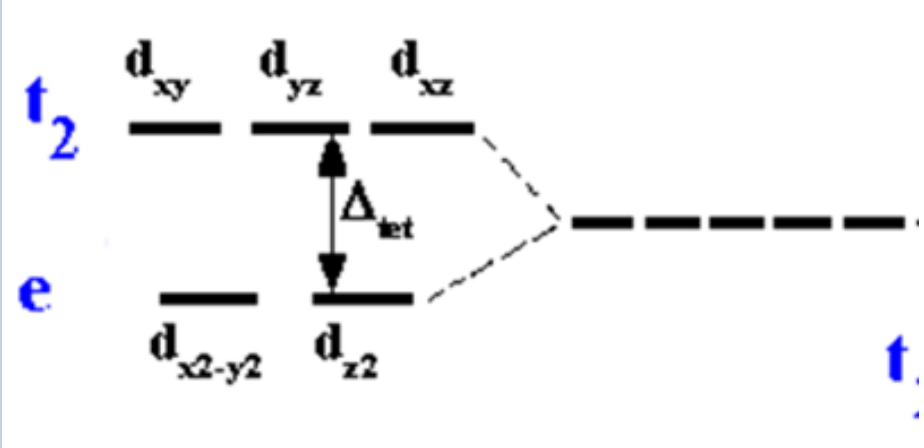
a. 0

b. 1

c. 2

d. 3

e. 7



Data on Classroom Responses: Mid-term Exam Results

N=	Question Type	Mean Score
9	Matched	0.7333
12	Similar	0.7389
4	New/control	0.7167

Data on Classroom Responses: Mid-term Exam to Final Exam

Retention rates – questions from midterm duplicated on final:

N=	Question type	Mean Score
5	Midterm	0.653333
5	Final	0.785714

Data on Classroom Responses: Final Exam Results

- ***Students achieved an 88.4% correct response rate for final exam questions with a similar in-class version.***
- ***Students achieved a 71.4% correct response rate for final exam questions that were new or were not taught with clickers.***
- ***Questions remain: How much is because it was familiar? How much is because it was "easier"? How much is because it was "recent"?***

Student Evaluation Information

- ***What is your general attitude towards the use of Audience Response Systems in this course?***
  - ***Pre-course Survey: 3.36 (out of 5) (neutral to somewhat positive)***
  - ***Post-course Survey: 3.00 (out of 5) (neutral)***

- ***Preferred Style of Teaching (only in Post-course Survey): Contingency Teaching (3.50) > Peer Instruction (3.29) > Group Discussion (3.00) (All are still neutral to***

More Student Evaluation Information

- ***What type of impact did Audience Response Systems have on your level of active engagement in a typical meeting of this course?***
  - ***4.29 (out of 5, where 1 was decreased involvement greatly, 5 was increased involvement greatly)***
- ***To what extent did you find Audience Response System use to be enjoyable to use in this course?***
  - ***3.43 (out of 5, neutral to somewhat***

Conclusions

- ***We certainly need more data to reach definitive conclusions.***
- ***However, the best statement is that the interaction and engagement that helped the students. It does NOT appear to have to be through use of these devices!***

Acknowledgements

- ***Quinnipiac University Academic Technology Grant, Summer 2011***