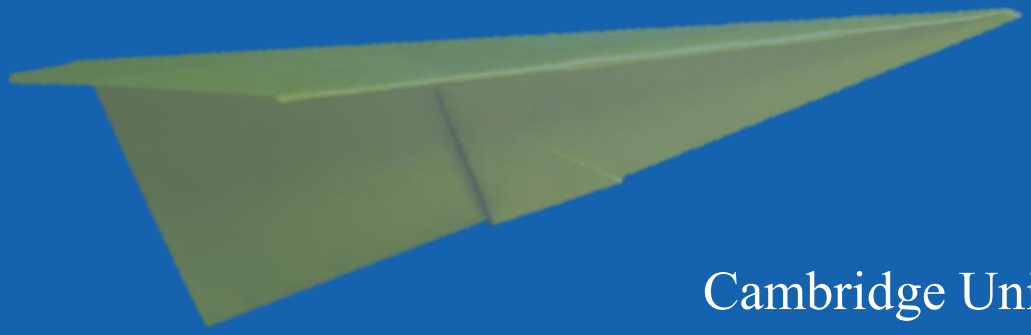
Clicker Questions

Modern Physics

by Gary Felder and Kenny Felder



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cambridge.org/core/resources/felder-modernphysics/
felderbooks.com

Instructions

- These questions are offered in two formats: a deck of PowerPoint slides, and a PDF file. The two files contain identical contents. There are similar files for each of the 14 chapters in the book, for a total of 28 files.
- Each question is marked as a "Quick Check" or "ConcepTest."
  - Quick Checks are questions that most students should be able to answer correctly if they have done the reading or followed the lecture. You can use them to make sure students are where you think they are before you move on.
  - ConcepTests (a term coined by Eric Mazur) are intended to stimulate debate, so you don't want to prep the class too explicitly before asking them. Ideally you want between 30% and 80% of the class to answer correctly.
- Either way, if a strong majority answers correctly, you can briefly discuss the answer and move on. If many students do not answer correctly, consider having them talk briefly in pairs or small groups and then vote again. You may be surprised at how much a minute of unguided discussion improves the hit rate.
- Each question is shown on two slides: the first shows only the question, and the second adds the correct answer.
- Some of these questions are also included in the book under "Conceptual Questions and ConcepTests," but this file contains additional questions that are not in the book.
- Some of the pages contain multiple questions with the same set of options. These questions are numbered as separate questions on the page.
- Some questions can have multiple answers. (These are all clearly marked with the phrase "Choose all that apply.") If you are using a clicker system that doesn't allow multiple responses, you can ask each part separately as a yes-or-no question.

9 Molecules

9.1 Ionic and Covalent Bonds

Which of the following configurations has the lowest energy? Which has the highest?

A. A neutral sodium atom and a neutral chlorine atom, far away from each other

B. A sodium ion with one missing electron and a chlorine ion with one extra electron, far away from each other

C. A sodium ion with one missing electron at rest 0.236 nm from a chlorine ion with one extra electron

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Solution: Lowest: C. Highest: B.

Which of the following are likely to form as ionically bound molecules? (Choose all that apply.)

A. LiF

B. $BeCl_2$

C. Be_2Cl

D. LiNe

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C. Be_2Cl

D. LiNe

Solution: A, B

An atom is a good candidate for covalent bonding if... (Choose one.)

A. It has a high ionization energy.

B. It has a low ionization energy.

C. It has a high electron affinity.

D. It has a low electron affinity.

E. Its outermost subshell has unpaired electrons.

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C. It has a high electron affinity.

D. It has a low electron affinity.

E. Its outermost subshell has unpaired electrons.

Solution: E

Consider an atom whose outermost subshell is p^3. How many of its electrons are available for covalent bonding? (Choose one.)

A. None

B. 1

C. 2

D. All 3

Consider an atom whose outermost subshell is p^3. How many of its electrons are available for covalent bonding? (Choose one.)

A. None

B. 1

C. 2

D. All 3

Solution: D

Which of the following are stable covalent molecules? (Choose all that apply.)

A. Na_2

B. NaS

C. H_2S

D. H_3S

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A. Na_2

B. NaS

C. H_2S

D. H_3S

Solution: A, C

9.2 Bonding and Antibonding States

Two eigenstates of a system are degenerate, meaning they have the same energy. When you subtract those two eigenstates and normalize, you end up with... (Choose one.)

A. another eigenstate with the same energy.

B. another eigenstate with different energy.

C. not an eigenstate at all.

D. It depends.

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D. It depends.

Solution: A

In an H_2 molecule, which of the following describes the energies (per electron) of the states $\psi_S = A(\psi_1 + \psi_2)$ and $\psi_D = B(\psi_1 - \psi_2)$? (Choose one.)

A. They are both equal to −13.6 eV.

B. They are both lower (more negative) than −13.6 eV.

C. They are both higher (less negative) than −13.6 eV.

D. The energy of ψ_S is lower than −13.6 eV and the energy of ψ_D is higher than −13.6 eV.

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C. They are both higher (less negative) than −13.6 eV.

D. The energy of ψ_S is lower than −13.6 eV and the energy of ψ_D is higher than −13.6 eV.

Solution: D

9.3 Vibrations, Rotations, and Molecular Spectra

Which of the following statements are true about molecular vibrations and rotations? (Choose all that apply.)

A. The vibrational energy states are evenly spaced.

B. The rotational energy states are evenly spaced.

C. The photon energies of the rotational transitions are evenly spaced.

Which of the following statements are true about molecular vibrations and rotations? (Choose all that apply.)

A. The vibrational energy states are evenly spaced.

Solution: T

B. The rotational energy states are evenly spaced.

Solution: F

C. The photon energies of the rotational transitions are evenly spaced.

Solution: T

True or false? A diatomic atom will settle into its equilibrium radius and remain in that state until perturbed.

True or false? A diatomic atom will settle into its equilibrium radius and remain in that state until perturbed.

Solution: F

Which of the following statements are true about molecular spectra? (Choose all that apply)

A. At room temperature the absorption spectra for electronic transitions only involve transitions from the ground state to higher energies.

B. At room temperature the absorption spectra for vibrational transitions only involve transitions from the ground state to higher energies.

C. At room temperature the absorption spectra for rotational transitions only involve transitions from the ground state to higher energies.

Which of the following statements are true about molecular spectra? (Choose all that apply)

A. At room temperature the absorption spectra for electronic transitions only involve transitions from the ground state to higher energies.

Solution: T

B. At room temperature the absorption spectra for vibrational transitions only involve transitions from the ground state to higher energies.

Solution: T

C. At room temperature the absorption spectra for rotational transitions only involve transitions from the ground state to higher energies.

Solution: F