

Qualitative Molecular-Orbital and Bonding Models

g11_u07_w25

Purpose and boundary

Use original fictional orbital occupancy cards and diagrams only. No materials, instruments, synthesis, or magnetic-property testing is requested.

Targets: I can use a stated occupancy model to calculate bond order, compare unpaired electrons, and name the model's limits. **Vocabulary:** bonding orbital, antibonding orbital, bond order, unpaired electron, paramagnetic, model. **Prerequisites:** electron count, valence, bonding/antibonding distinction.

For items 4–12 use bond order = $(N_{\text{bonding}} - N_{\text{antibonding}})/2$ with fictional occupancy cards. This is a qualitative comparison model.

1. Distinguish a bonding orbital from an antibonding orbital in an energy-model diagram.

2. What does a star in an orbital label conventionally indicate?

3. Why is orbital occupancy a model rather than a photograph of electrons?

4. Card A has $N_{\text{bonding}} = 6$ and $N_{\text{antibonding}} = 2$. Find bond order.

5. Card B has $N_{\text{bonding}} = 5$ and $N_{\text{antibonding}} = 3$. Find bond order.

6. Compare Cards A and B using only the stated bond-order model.

7. Card C has 1 unpaired electron. What magnetic-model tendency does this support?

8. Card D has no unpaired electrons. What contrasting tendency does this support?

9. Explain why the tendencies in items 7–8 are not a measurement result for a real sample.

10. A student doubles every occupancy in Card A and doubles the calculated bond order. Correct the reasoning.

11. A fictional ion card removes one electron from a specified antibonding orbital. Predict the bond-order direction before calculating.
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12. Starting from Card A, remove one antibonding electron. Find the new bond order.
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13. Starting from Card A, remove one bonding electron. Find the new bond order.
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14. Why do items 12 and 13 change bond order in opposite directions?
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15. A card has bond order zero. What does that say within the stated simple model?
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16. Why does bond order alone not determine exact bond length or chemical stability?
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17. Identify one assumption that limits a simplified orbital ordering card.
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18. A student uses one unpaired electron to claim a material is safe for a device. Explain the unsupported leap.
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19. State one supported and one unsupported claim from a higher bond order on a fictional card.
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20. Write a two-sentence bounded conclusion using fictional occupancy and unpaired-electron data.
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