|  |  |  |
| --- | --- | --- |
| 1. Use the expression for the Coulomb potential energy to calculate the energy for formation of 1 mole of sodium chloride ion-pairs, that is, the energy change for the following reaction:​Na+(g) + Cl–(g) → Na+Cl–(g)​Use r12 = 283 pm.

|  |  |
| --- | --- |
| *ANSWER:* | –491 kJ·mol–1 |

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|  |  |  |
| --- | --- | --- |
| 2. If 491 kJ·mol–1 is released in the reaction Na+(g) + Cl–(g) → Na+Cl–(g), what is the energy change for the reaction Na(g) + Cl(g) → Na+Cl–(g)? (Hint: See the discussion in the text and apply Hess's Law.)

|  |  |
| --- | --- |
| *ANSWER:* | –346 kJ·mol–1 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 3. If 346 kJ·mol–1 is released in the reaction Na(g) + Cl(g) → Na+Cl–(g), is the energy change for the reaction Na+Cl–(g) → NaCl(s) endothermic or exothermic?

|  |  |  |
| --- | --- | --- |
|   | a.  | Endothermic |
|   | b.  | Exothermic |

|  |  |
| --- | --- |
| *ANSWER:* | b |

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|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 4. The Madelung constant is different for all crystals.

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | a |

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|  |  |  |
| --- | --- | --- |
| 5. Use the expression for the Coulomb potential energy to calculate the energy for formation of 1 mole of rubidium chloride ion-pairs, that is, the energy change for the following reaction:​Rb+(g) + Cl–(g) → Rb+Cl–(g)​Use r12 = 330 pm.

|  |  |
| --- | --- |
| *ANSWER:* | –421 kJ·mol–1 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 6. Which of the following has the lowest lattice energy?

|  |  |  |
| --- | --- | --- |
|   | a.  | KBr |
|   | b.  | KCl |
|   | c.  | KI |
|   | d.  | LiCl |
|   | e.  | NaCl |

|  |  |
| --- | --- |
| *ANSWER:* | c |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 7. Which of the following has the highest lattice energy?

|  |  |  |
| --- | --- | --- |
|   | a.  | BaO |
|   | b.  | CaO |
|   | c.  | KI |
|   | d.  | MgO |
|   | e.  | NaCl |

|  |  |
| --- | --- |
| *ANSWER:* | d |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 8. Which of the following has the highest melting point?

|  |  |  |
| --- | --- | --- |
|   | a.  | KBr |
|   | b.  | KCl |
|   | c.  | KF |
|   | d.  | KI |
|   | e.  | RbF |

|  |  |
| --- | --- |
| *ANSWER:* | c |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 9. Metals rarely lose electrons in chemical reactions because

|  |  |  |
| --- | --- | --- |
|   | a.  | their electron affinities are too high. |
|   | b.  | their ionic radii become too small. |
|   | c.  | their ionization energies are too small. |
|   | d.  | their ionization energies are too high. |
|   | e.  | their size is too small. |

|  |  |
| --- | --- |
| *ANSWER:* | d |

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| --- | --- | --- |
| 10. An element, E, has the electronic configuration [Ne] 3s23p1. Write the formula of its compound with sulfate.

|  |  |
| --- | --- |
| *ANSWER:* | E2(SO4)3 |

 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 11. Predict the electronic configuration in the oxide ion in CaO.

|  |  |  |
| --- | --- | --- |
|   | a.  | [He]2s22p6 or [Ne] |
|   | b.  | [He]2s22p5 |
|   | c.  | [He]2s22p63s2 |
|   | d.  | [Ne]3s13p3 |
|   | e.  | [Ne]3s23p3 |

|  |  |
| --- | --- |
| *ANSWER:* | a |

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|  |  |  |
| --- | --- | --- |
| 12. Write the formula of magnesium phosphide.

|  |  |
| --- | --- |
| *ANSWER:* | Mg3P2 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 13. Which of the following metal ions has the ground-state electron configuration [Ar]3d6?

|  |  |  |
| --- | --- | --- |
|   | a.  | Ca2+ |
|   | b.  | Cu+ |
|   | c.  | Fe2+ |
|   | d.  | Mn2+ |
|   | e.  | Ni3+ |

|  |  |
| --- | --- |
| *ANSWER:* | c |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 14. For the ground-state ion Pb2+, what type of orbital do the electrons with highest energy reside in?

|  |  |  |
| --- | --- | --- |
|   | a.  | 4f |
|   | b.  | 5d |
|   | c.  | 5p |
|   | d.  | 6p |
|   | e.  | 6s |

|  |  |
| --- | --- |
| *ANSWER:* | e |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 15. For the ground-state ion Sn4+, what type of orbital do the electrons with highest energy reside in?

|  |  |  |
| --- | --- | --- |
|   | a.  | 4d |
|   | b.  | 4f |
|   | c.  | 4p |
|   | d.  | 5p |
|   | e.  | 5s |

|  |  |
| --- | --- |
| *ANSWER:* | a |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 16. For the ground-state ion Bi3+, what type of orbital do the electrons with highest energy reside in?

|  |  |  |
| --- | --- | --- |
|   | a.  | 4f |
|   | b.  | 5d |
|   | c.  | 5p |
|   | d.  | 6p |
|   | e.  | 6s |

|  |  |
| --- | --- |
| *ANSWER:* | e |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 17. For the ground-state ion I–, what type of orbital do the electrons with highest energy reside in?

|  |  |  |
| --- | --- | --- |
|   | a.  | 4d |
|   | b.  | 5d |
|   | c.  | 5p |
|   | d.  | 5s |
|   | e.  | 6s |

|  |  |
| --- | --- |
| *ANSWER:* | c |

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|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 18. Because of the octet rule, the gaseous O2– ion is stable. True or false?

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | b |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 19. All the following elements exist as diatomic gases at room temperature and atmospheric pressure except

|  |  |  |
| --- | --- | --- |
|   | a.  | Ar. |
|   | b.  | Cl. |
|   | c.  | H. |
|   | d.  | N. |
|   | e.  | O. |

|  |  |
| --- | --- |
| *ANSWER:* | a |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 20. How many lone pairs of electrons are found in the Lewis structure of the interhalogen compound ICl3?

|  |  |  |
| --- | --- | --- |
|   | a.  | 10 |
|   | b.  | 4 |
|   | c.  | 8 |
|   | d.  | 6 |
|   | e.  | 7 |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 21. How many lone pairs of electrons are found in the Lewis structure of urea, (NH2)2CO?

|  |  |  |
| --- | --- | --- |
|   | a.  | 2 |
|   | b.  | 3 |
|   | c.  | 6 |
|   | d.  | 4 |
|   | e.  | 8 |

|  |  |
| --- | --- |
| *ANSWER:* | d |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 22. How many lone pairs of electrons are found in the Lewis structure of hydrazine, H2NNH2?

|  |  |  |
| --- | --- | --- |
|   | a.  | 8 |
|   | b.  | 4 |
|   | c.  | 1 |
|   | d.  | 0 |
|   | e.  | 2 |

|  |  |
| --- | --- |
| *ANSWER:* | e |

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|  |  |  |
| --- | --- | --- |
| 23. Draw the Lewis structure of xenon difluoride and give the number of lone pairs electrons around the central atom.

|  |  |
| --- | --- |
| *ANSWER:* | Three |

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| --- | --- | --- |
| 24. Draw the Lewis structure of the format ion and indicate whether resonance forms are possible.

|  |  |
| --- | --- |
| *ANSWER:* | Two resonance forms are possible. |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 25. Draw the "best" Lewis structures of hydrogen azide, HN1N2N3, and the azide ion, N1N2N3– . The subscripts are used for identification. For each, match the following bond lengths to the correct N–N bond. The bond lengths can be used more than once.​

|  |  |  |
| --- | --- | --- |
| ​ | N–N bond | Bond length, pm |
| hydrogen azide | N1–N2 | 113 |
| ​ | N2–N3 | 116 |
| azide ion | N1–N2 | 124 |
| ​ | N2–N3 | ​ |

​

|  |  |
| --- | --- |
| *ANSWER:* | hydrogen azide: N1–N2, 124 pm; N2–N3, 113 pm; azide ion: N1–N2, 116 pm; N2–N3, 116 pm |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 26. Which of the following do not have resonance structures?

|  |  |  |
| --- | --- | --- |
|   | a.  | CH3CONH– |
|   | b.  | CH2COCH3– |
|   | c.  | H2CO |
|   | d.  | All have resonance structures. |

|  |  |
| --- | --- |
| *ANSWER:* | c |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 27. For dinitrogen monoxide, the arrangement of the atoms is N-N-O. In the Lewis structure with a double bond between NN and NO, the formal charges on N, N, and O, respectively, are

|  |  |  |
| --- | --- | --- |
|   | a.  | 0, –1, +1. |
|   | b.  | –1, +1, 0. |
|   | c.  | 0, +1, –1. |
|   | d.  | 0, 0, 0. |
|   | e.  | –2, +1, +1. |

|  |  |
| --- | --- |
| *ANSWER:* | b |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 28. For dinitrogen monoxide, the arrangement of the atoms is N-N-O. In the Lewis structure with a single bond between NN and a triple bond between NO, the formal charges on N, N, and O, respectively, are

|  |  |  |
| --- | --- | --- |
|   | a.  | –1, +1, 0. |
|   | b.  | 0, 0, 0. |
|   | c.  | 0, +1, –1. |
|   | d.  | 0, –1, +1. |
|   | e.  | –2, +1, +1. |

|  |  |
| --- | --- |
| *ANSWER:* | e |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 29. In the "best" Lewis structure of XeO4, there are two double bonds and the formal charge on Xe is zero. True or false?

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | b |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 30. Write three Lewis structures for the cyanate ion, NCO–, where the arrangement of atoms is N-C-O. In the most plausible structure,

|  |  |  |
| --- | --- | --- |
|   | a.  | the formal charge on N is –1. |
|   | b.  | the formal charge on O is +1. |
|   | c.  | there are two double bonds. |
|   | d.  | there is a triple bond between C and O. |
|   | e.  | there is a triple bond between N and C. |

|  |  |
| --- | --- |
| *ANSWER:* | e |

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|  |  |  |
| --- | --- | --- |
| 31. Predict the N-O bond lengths in NO2–, given the N-O and N=O bond lengths of 140 and 120 pm, respectively.

|  |  |
| --- | --- |
| *ANSWER:* | Both ~ 130 pm |

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| --- | --- | --- |
| 32. Why are the N-O bond lengths in NO3– the same?

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| --- | --- |
| *ANSWER:* | The explanation is resonance. |

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| 33. Which of the following species are radicals?

|  |  |  |
| --- | --- | --- |
|   | a.  | CO2 |
|   | b.  | HNO3 |
|   | c.  | NO2 |
|   | d.  | NO3– |
|   | e.  | HNO3 |

|  |  |
| --- | --- |
| *ANSWER:* | c |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 34. Which of the following species are radicals?

|  |  |  |
| --- | --- | --- |
|   | a.  | CH2O |
|   | b.  | ClO |
|   | c.  | ClONO2 |
|   | d.  | HClO |
|   | e.  | HCN |

|  |  |
| --- | --- |
| *ANSWER:* | b |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 35. In the most plausible Lewis structure of XeOF2, there are

|  |  |  |
| --- | --- | --- |
|   | a.  | 2 single bonds, 1 double bond, and 1 lone pair of electrons around Xe. |
|   | b.  | 3 single bonds and 1 lone pair of electrons around Xe. |
|   | c.  | 2 single bonds, 1 double bond, and 3 lone pairs of electrons around Xe. |
|   | d.  | 2 single bonds, 1 double bond, and 2 lone pairs of electrons around Xe. |
|   | e.  | 3 single bonds and 2 lone pairs of electrons around Xe. |

|  |  |
| --- | --- |
| *ANSWER:* | d |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 36. How many electrons are in the expanded valence in XeOF2?

|  |  |  |
| --- | --- | --- |
|   | a.  | 14 |
|   | b.  | 12 |
|   | c.  | 8 |
|   | d.  | 10 |
|   | e.  | 6 |

|  |  |
| --- | --- |
| *ANSWER:* | b |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 37. How many electrons are in the expanded valence in I3–?

|  |  |  |
| --- | --- | --- |
|   | a.  | 12 |
|   | b.  | 6 |
|   | c.  | 10 |
|   | d.  | 14 |
|   | e.  | 8 |

|  |  |
| --- | --- |
| *ANSWER:* | c |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 38. How many electrons are in the expanded valence in H2SO4?

|  |  |  |
| --- | --- | --- |
|   | a.  | 12 |
|   | b.  | 14 |
|   | c.  | 8 |
|   | d.  | 6 |
|   | e.  | 10 |

|  |  |
| --- | --- |
| *ANSWER:* | a |

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|  |  |  |
| --- | --- | --- |
| 39. How many electrons are in the expanded valence in XeO4?

|  |  |
| --- | --- |
| *ANSWER:* | 16 |

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| --- | --- | --- |
| 40. Consider the following equilibrium:S2O42–(aq) ⇌ 2SO2–(aq) K ~ 10–9Write a Lewis structure for each species.

|  |  |
| --- | --- |
| *ANSWER:* | The arrangement of atoms in S2O42– is O2S—SO2. The latter has a Lewis structure that obeys the octet rule, but SO2– is a radical. |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 41. Which of the following species has bonds with the most ionic character?

|  |  |  |
| --- | --- | --- |
|   | a.  | CO2 |
|   | b.  | NO2 |
|   | c.  | PCl3 |
|   | d.  | P4O10 |
|   | e.  | SiO2 |

|  |  |
| --- | --- |
| *ANSWER:* | e |

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|  |  |  |
| --- | --- | --- |
| 42. Write all possible Lewis structures of sulfur dioxide. Which structure is most feasible?

|  |  |
| --- | --- |
| *ANSWER:* | The structure with the expanded valence is favored. |

 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 43. Which of the following species has bonds with the most ionic character?

|  |  |  |
| --- | --- | --- |
|   | a.  | CO2 |
|   | b.  | NO2 |
|   | c.  | PCl3 |
|   | d.  | P4O10 |
|   | e.  | SnO2 |

|  |  |
| --- | --- |
| *ANSWER:* | e |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 44. Which of the following statements is true?

|  |  |  |
| --- | --- | --- |
|   | a.  | Atoms with high ionization energies and high electron affinities are highly electronegative. |
|   | b.  | Atoms with high ionization energies and high electron affinities have low electronegativities. |
|   | c.  | The electronegativity of an atom depends only on the value of the ionization energy of the atom. |
|   | d.  | Atoms with low ionization energies and low electron affinities have high electronegativities. |
|   | e.  | The electronegativity of an atom is defined as half the electron affinity of the atom. |

|  |  |
| --- | --- |
| *ANSWER:* | a |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 45. Which of the following statements is true?

|  |  |  |
| --- | --- | --- |
|   | a.  | The electronegativity of an atom is defined as electron affinity of the atom. |
|   | b.  | The electronegativity of an atom depends only on the value of the ionization energy of the atom. |
|   | c.  | Atoms with high ionization energies and high electron affinities have low electronegativities. |
|   | d.  | Atoms with low ionization energies and low electron affinities have low electronegativities. |
|   | e.  | Atoms with low ionization energies and low electron affinities have high electronegativities. |

|  |  |
| --- | --- |
| *ANSWER:* | d |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 46. Which of the compounds below has bonds with the least covalent character?

|  |  |  |
| --- | --- | --- |
|   | a.  | AgCl |
|   | b.  | AgF |
|   | c.  | AgI |
|   | d.  | AlCl3 |
|   | e.  | BeCl2 |

|  |  |
| --- | --- |
| *ANSWER:* | b |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 47. Which of the compounds below has bonds with the most covalent character?

|  |  |  |
| --- | --- | --- |
|   | a.  | BeCl2 |
|   | b.  | CaCl2 |
|   | c.  | LiCl |
|   | d.  | MgCl2 |
|   | e.  | NaCl |

|  |  |
| --- | --- |
| *ANSWER:* | a |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 48. Which of the compounds below has bonds with the most covalent character?

|  |  |  |
| --- | --- | --- |
|   | a.  | CaO |
|   | b.  | CaS |
|   | c.  | Li2O |
|   | d.  | MgO |
|   | e.  | MgS |

|  |  |
| --- | --- |
| *ANSWER:* | e |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 49. Use the bond enthalpies given to estimate the heat released when 1-bromobutene, CH3CH2CH=CH2, reacts with bromine to give CH3CH2CHBrCH2Br. Bond enthalpies (kJ·mol–1): C-H, 412; C-C, 348; C=C, 612; C-Br, 276; Br-Br, 193.

|  |  |  |
| --- | --- | --- |
|   | a.  | 181 kJ·mol–1 |
|   | b.  | 317 kJ·mol–1 |
|   | c.  | 288 kJ·mol–1 |
|   | d.  | 95 kJ·mol–1 |
|   | e.  | 507 kJ·mol–1 |

|  |  |
| --- | --- |
| *ANSWER:* | d |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 50. Use the bond enthalpies given to estimate the heat released when ethene, CH2=CH2, reacts with HBr to give CH3CH2Br. Bond enthalpies (kJ·mol–1): C-H, 412; C-C, 348; C=C, 612; C-Br, 276; Br-Br, 193; H-Br, 366.

|  |  |  |
| --- | --- | --- |
|   | a.  | 1036 kJ·mol–1 |
|   | b.  | 200 kJ·mol–1 |
|   | c.  | 470 kJ·mol–1 |
|   | d.  | 424 kJ·mol–1 |
|   | e.  | 58 kJ·mol–1 |

|  |  |
| --- | --- |
| *ANSWER:* | e |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 51. Use the bond enthalpies given to estimate the heat released when 2-methyl-1-propene, (CH3)2C=CH2, reacts with HBr to give (CH3)2CBrCH3. Bond enthalpies (kJ·mol–1):C-H, 412; C-C, 348; C=C, 612; C-Br, 276; H-Br, 366.

|  |  |  |
| --- | --- | --- |
|   | a.  | 58 kJ·mol–1 |
|   | b.  | 507 kJ·mol–1 |
|   | c.  | 317 kJ·mol–1 |
|   | d.  | 288 kJ·mol–1 |
|   | e.  | 181 kJ·mol–1 |

|  |  |
| --- | --- |
| *ANSWER:* | a |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 52. Use the bond enthalpies given to estimate the heat released when ethene, CH2=CH2, reacts with hydrogen to give CH3CH3. Bond enthalpies (kJ·mol–1): C-H, 412; C-C, 348; C=C, 612; C-Br, 276; H-H, 436.

|  |  |  |
| --- | --- | --- |
|   | a.  | 124 kJ·mol–1 |
|   | b.  | 342 kJ·mol–1 |
|   | c.  | 288 kJ·mol–1 |
|   | d.  | 148 kJ·mol–1 |
|   | e.  | 560 kJ·mol–1 |

|  |  |
| --- | --- |
| *ANSWER:* | a |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 53. Which of the following compounds contains the weakest bonds to hydrogen?

|  |  |  |
| --- | --- | --- |
|   | a.  | CH4 |
|   | b.  | HF |
|   | c.  | H2O |
|   | d.  | H2S |
|   | e.  | SiH4 |

|  |  |
| --- | --- |
| *ANSWER:* | e |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 54. Which of the following compounds contains the strongest bonds to hydrogen?

|  |  |  |
| --- | --- | --- |
|   | a.  | CH4 |
|   | b.  | HF |
|   | c.  | H2O |
|   | d.  | H2S |
|   | e.  | SiH4 |

|  |  |
| --- | --- |
| *ANSWER:* | b |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 55. Which of the following compounds is the least stable?

|  |  |  |
| --- | --- | --- |
|   | a.  | CH4 |
|   | b.  | GeH4 |
|   | c.  | PbH4 |
|   | d.  | SiH4 |
|   | e.  | SnH4 |

|  |  |
| --- | --- |
| *ANSWER:* | c |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 56. Estimate the CO bond length in acetone, CH3COCH3. Given: covalent radii (pm) ofC–, 77; C=, 67; O–, 74; O=, 60; H, 37.

|  |  |  |
| --- | --- | --- |
|   | a.  | 75.5 pm |
|   | b.  | 127 pm |
|   | c.  | 63.5 pm |
|   | d.  | 151 pm |
|   | e.  | 137 pm |

|  |  |
| --- | --- |
| *ANSWER:* | b |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 57. Estimate the CN bond length in urea, NH2CONH2. Given: covalent radii (pm) of C–, 77; C=, 67; N–, 75; N=, 60; O–, 74; O=, 60; H, 37.

|  |  |  |
| --- | --- | --- |
|   | a.  | 71 pm |
|   | b.  | 127 pm |
|   | c.  | 76 pm |
|   | d.  | 152 pm |
|   | e.  | 142 pm |

|  |  |
| --- | --- |
| *ANSWER:* | d |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 58. If the following all crystallize in the same type of structure, which has the highest lattice energy?

|  |  |  |
| --- | --- | --- |
|   | a.  | KBr |
|   | b.  | KCl |
|   | c.  | KF |
|   | d.  | LiCl |
|   | e.  | LiF |

|  |  |
| --- | --- |
| *ANSWER:* | e |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 59. If the following all crystallize in the same type of structure, which has the highest lattice energy?

|  |  |  |
| --- | --- | --- |
|   | a.  | KF |
|   | b.  | NaBr |
|   | c.  | NaCl |
|   | d.  | NaF |
|   | e.  | NaI |

|  |  |
| --- | --- |
| *ANSWER:* | d |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 60. If the following all crystallize in the same type of structure, which has the lowest lattice energy?

|  |  |  |
| --- | --- | --- |
|   | a.  | BaO |
|   | b.  | BaS |
|   | c.  | CaO |
|   | d.  | SrO |
|   | e.  | SrS |

|  |  |
| --- | --- |
| *ANSWER:* | b |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 61. If the following all crystallize in the same type of structure, which has the lowest lattice energy?

|  |  |  |
| --- | --- | --- |
|   | a.  | KCl |
|   | b.  | KI |
|   | c.  | LiCl |
|   | d.  | NaCl |
|   | e.  | NaI |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 62. White phosphorus is composed of tetrahedral molecules of P4 in which every P atom is connected to three other P atoms. In the Lewis structure of P4, there are

|  |  |  |
| --- | --- | --- |
|   | a.  | 3 bonding pairs and 4 lone pairs of electrons. |
|   | b.  | 6 bonding pairs and 2 lone pairs of electrons. |
|   | c.  | 5 bonding pairs and 4 lone pairs of electrons. |
|   | d.  | 6 bonding pairs and no lone pairs of electrons. |
|   | e.  | 6 bonding pairs and 4 lone pairs of electrons. |

|  |  |
| --- | --- |
| *ANSWER:* | e |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 63. Which of the following is a radical?

|  |  |  |
| --- | --- | --- |
|   | a.  | BF4– |
|   | b.  | BrO |
|   | c.  | CH3+ |
|   | d.  | CH3– |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |
| --- | --- | --- |
| 64. If dinitrogen oxide has a dipole moment, what is the arrangement of atoms?

|  |  |
| --- | --- |
| *ANSWER:* | N-N-O |

 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 65. The electronegativity of an element can be expressed as ½(I + Ea) where I is the ionization energy and Ea is the electron affinity. True or false?

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 66. The best Lewis structures of SO2 and O3 include expanded valence structures such as O=S=O and O=O=O. True or false?

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 67. Which of the following has resonance structures?

|  |  |  |
| --- | --- | --- |
|   | a.  | XeOF2 |
|   | b.  | N2H4 |
|   | c.  | CH3CONH– |
|   | d.  | H2CO |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 68. How many resonance structures can be drawn for N2O?

|  |  |  |
| --- | --- | --- |
|   | a.  | 0 |
|   | b.  | 3 |
|   | c.  | 2 |
|   | d.  | 1 |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 69. What is the formal charge on the Xe atom in XeF4?

|  |  |  |
| --- | --- | --- |
|   | a.  | 0 |
|   | b.  | –4 |
|   | c.  | +2 |
|   | d.  | +4 |

|  |  |
| --- | --- |
| *ANSWER:* | a |

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|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 70. There are three resonance structures of the sulfate ion. A resonance structure can be written where the formal charge on sulfur is 0. True or false?

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 71. How many double bonds are present in the "best" resonance structure of the phosphate ion?

|  |  |  |
| --- | --- | --- |
|   | a.  | 2 |
|   | b.  | 3 |
|   | c.  | 1 |
|   | d.  | 0 |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 72. How many lone pairs of electrons are there in the Lewis structure of Al2Cl6?

|  |  |  |
| --- | --- | --- |
|   | a.  | 24 |
|   | b.  | 12 |
|   | c.  | 4 |
|   | d.  | 16 |

|  |  |
| --- | --- |
| *ANSWER:* | d |

 |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 73. Match each of the following compounds with its lattice energy (2961, 1046, 759, 645 kJ/mol).​

|  |  |
| --- | --- |
|  KI |   \_\_\_\_\_\_\_\_          |
|  LiF  |   \_\_\_\_\_\_\_\_  |
|  MgF2 |   \_\_\_\_\_\_\_\_ |
|  LiI   |   \_\_\_\_\_\_\_\_ |

|  |  |
| --- | --- |
| *ANSWER:* | KI (645 kJ/mol), LiF (1046), MgF2 (2961), LiI (759) |

 |

|  |  |  |
| --- | --- | --- |
| 74. White phosphorus is composed of tetrahedral molecules of P4 in which each P atom is bonded to three others. In this molecule the formal charge on each P atom is \_\_\_\_\_\_\_.

|  |  |
| --- | --- |
| *ANSWER:* | 0 |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 75. Of the following molecules, which has the strongest bonds?

|  |  |  |
| --- | --- | --- |
|   | a.  | H2O |
|   | b.  | H2S |
|   | c.  | H2Se |
|   | d.  | H2Te |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 76. An element E has the electronic configuration 1s22s22p4. What is the formula of its compound with lithium?

|  |  |  |
| --- | --- | --- |
|   | a.  | LiE2 |
|   | b.  | LiE |
|   | c.  | Li2E |
|   | d.  | Li4E |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |
| --- | --- | --- |
| 77. How many valence electrons are present in W4+?

|  |  |
| --- | --- |
| *ANSWER:* | 2 |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 78. What is wrong with the following Lewis structure?

|  |  |  |
| --- | --- | --- |
|   | a.  | The charge on the carbon atom |
|   | b.  | The dipole of the molecule |
|   | c.  | The distribution of valence electrons |
|   | d.  | The positioning of the carbon atom |
|   | e.  | The valence electron count |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 79. Sulfur is more electronegative than oxygen. True or false?

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |
| --- | --- | --- |
| 80. What is the electronic configuration of Ag?

|  |  |
| --- | --- |
| *ANSWER:* | 1s2 2s2 2p6 3s2 3p6 4s2 3d10 4p6 5s1 4d10 |

 |

|  |  |  |
| --- | --- | --- |
| 81. What is the formal charge of S in the molecule H2SO4?

|  |  |
| --- | --- |
| *ANSWER:* | 0 |

 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 82. Why is the bond dissociation energy of C—C greater than that of C—H?

|  |  |  |
| --- | --- | --- |
|   | a.  | Because multiple bonds are always stronger than single bonds |
|   | b.  | Because the bond is electrostatically stronger |
|   | c.  | Because of the decreased bond dipole |
|   | d.  | Because of enhanced sigma bond overlap |
|   | e.  | It isn't, the dissociation energy is greater for C—H |

|  |  |
| --- | --- |
| *ANSWER:* | e |

 |

|  |  |  |
| --- | --- | --- |
| 83. List the chalcogens in order of increasing electronegativity.

|  |  |
| --- | --- |
| *ANSWER:* | tellurium < selenium < sulfur < oxygen. |

 |

|  |  |  |
| --- | --- | --- |
| 84. Which has the greater ionic character: H2S or H2O?

|  |  |
| --- | --- |
| *ANSWER:* | H2O |

 |

|  |  |  |
| --- | --- | --- |
| 85. Name all the angles in a trigonal bipyramidal geometry.

|  |  |
| --- | --- |
| *ANSWER:* | 90°, 120°, and 180° |

 |

|  |  |  |
| --- | --- | --- |
| 86. Name all the angles in a trigonal planar geometry.

|  |  |
| --- | --- |
| *ANSWER:* | 120° |

 |

|  |  |  |
| --- | --- | --- |
| 87. Predict the HNH bond angle in NH2–.

|  |  |
| --- | --- |
| *ANSWER:* | ~109o |

 |

|  |  |  |
| --- | --- | --- |
| 88. Predict the electron arrangement in NO2–.

|  |  |
| --- | --- |
| *ANSWER:* | trigonal planar |

 |

|  |  |  |
| --- | --- | --- |
| 89. The electron arrangement and shape in IF4+, respectively, are

|  |  |
| --- | --- |
| *ANSWER:* | trigonal bipyramidal; seesaw. |

 |

|  |  |  |
| --- | --- | --- |
| 90. Predict the electron arrangement in ClF3.

|  |  |
| --- | --- |
| *ANSWER:* | Trigonal bipyramidal |

 |

|  |  |  |
| --- | --- | --- |
| 91. Predict the electron arrangement in IF5.

|  |  |
| --- | --- |
| *ANSWER:* | Octahedral |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 92. What is the shape of AlH4–?

|  |  |  |
| --- | --- | --- |
|   | a.  | Seesaw |
|   | b.  | Square planar |
|   | c.  | T-shaped |
|   | d.  | Tetrahedral |
|   | e.  | Trigonal bipyramidal |

|  |  |
| --- | --- |
| *ANSWER:* | d |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 93. What is the shape of BrO4–?

|  |  |  |
| --- | --- | --- |
|   | a.  | Seesaw |
|   | b.  | Square planar |
|   | c.  | T-shaped |
|   | d.  | Tetrahedral |
|   | e.  | Trigonal bipyramidal |

|  |  |
| --- | --- |
| *ANSWER:* | d |

 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 94. What is the shape of AsF3?

|  |  |  |
| --- | --- | --- |
|   | a.  | T-shaped |
|   | b.  | Trigonal planar |
|   | c.  | Trigonal pyramidal |
|   | d.  | Tetrahedral |
|   | e.  | Seesaw |

|  |  |
| --- | --- |
| *ANSWER:* | c |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 95. What is the shape of SO32–?

|  |  |  |
| --- | --- | --- |
|   | a.  | Seesaw |
|   | b.  | T-shaped |
|   | c.  | Tetrahedral |
|   | d.  | Trigonal planar |
|   | e.  | Trigonal pyramidal |

|  |  |
| --- | --- |
| *ANSWER:* | e |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 96. What is the shape of CS32–?

|  |  |  |
| --- | --- | --- |
|   | a.  | Trigonal pyramidal |
|   | b.  | Trigonal planar |
|   | c.  | T-shaped |
|   | d.  | Tetrahedral |
|   | e.  | Seesaw |

|  |  |
| --- | --- |
| *ANSWER:* | b |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 97. What is the shape of COCl2?

|  |  |  |
| --- | --- | --- |
|   | a.  | T-shaped |
|   | b.  | Trigonal planar |
|   | c.  | Trigonal pyramidal |
|   | d.  | Tetrahedral |
|   | e.  | Seesaw |

|  |  |
| --- | --- |
| *ANSWER:* | b |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 98. What is the shape of XeF4?

|  |  |  |
| --- | --- | --- |
|   | a.  | Seesaw |
|   | b.  | Square planar |
|   | c.  | T-Shaped |
|   | d.  | Tetrahedral |
|   | e.  | Trigonal bipyramidal |

|  |  |
| --- | --- |
| *ANSWER:* | b |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 99. What is the shape of ICl4–?

|  |  |  |
| --- | --- | --- |
|   | a.  | Seesaw |
|   | b.  | Square planar |
|   | c.  | T-Shaped |
|   | d.  | Tetrahedral |
|   | e.  | Trigonal bipyramidal |

|  |  |
| --- | --- |
| *ANSWER:* | b |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 100. What is the shape of IF4+?

|  |  |  |
| --- | --- | --- |
|   | a.  | Seesaw |
|   | b.  | Square planar |
|   | c.  | T-shaped |
|   | d.  | Tetrahedral |
|   | e.  | Trigonal bipyramidal |

|  |  |
| --- | --- |
| *ANSWER:* | a |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 101. What is the shape of ClF3?

|  |  |  |
| --- | --- | --- |
|   | a.  | Seesaw |
|   | b.  | Square planar |
|   | c.  | T-shaped |
|   | d.  | Tetrahedral |
|   | e.  | Trigonal bipyramidal |

|  |  |
| --- | --- |
| *ANSWER:* | c |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 102. All the following have a linear shape except

|  |  |  |
| --- | --- | --- |
|   | a.  | BeCl2. |
|   | b.  | CS2. |
|   | c.  | I3–. |
|   | d.  | O3. |
|   | e.  | XeF2. |

|  |  |
| --- | --- |
| *ANSWER:* | d |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 103. All the following have an angular shape except

|  |  |  |
| --- | --- | --- |
|   | a.  | ClO2–. |
|   | b.  | HOCl. |
|   | c.  | I3–. |
|   | d.  | NH2–. |
|   | e.  | S32–. |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 104. All the following have a linear shape except

|  |  |  |
| --- | --- | --- |
|   | a.  | CS2. |
|   | b.  | I3–. |
|   | c.  | I3+. |
|   | d.  | IF2-. |
|   | e.  | XeF2. |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 105. All the following have an angular shape except

|  |  |  |
| --- | --- | --- |
|   | a.  | ClO2–. |
|   | b.  | HOCl. |
|   | c.  | N3–. |
|   | d.  | NH2–. |
|   | e.  | S32–. |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 106. Which of the following has bond angles slightly less than 109°?

|  |  |  |
| --- | --- | --- |
|   | a.  | BH4– |
|   | b.  | BrO3– |
|   | c.  | ClO4– |
|   | d.  | NH4+ |
|   | e.  | PO43– |

|  |  |
| --- | --- |
| *ANSWER:* | b |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 107. Which of the following has bond angles of 180°?

|  |  |  |
| --- | --- | --- |
|   | a.  | ClO2– |
|   | b.  | HO2– |
|   | c.  | I3– |
|   | d.  | NH2– |
|   | e.  | O3 |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 108. Which of the following has bond angles of 180°?

|  |  |  |
| --- | --- | --- |
|   | a.  | ClO2– |
|   | b.  | HO2– |
|   | c.  | NH2– |
|   | d.  | N2O |
|   | e.  | O3 |

|  |  |
| --- | --- |
| *ANSWER:* | d |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 109. Which of the following has bond angles slightly less than 120°?

|  |  |  |
| --- | --- | --- |
|   | a.  | I3– |
|   | b.  | NO3– |
|   | c.  | O3 |
|   | d.  | SF2 |
|   | e.  | SO3 |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 110. Which of the following has bond angles slightly less than 109°?

|  |  |  |
| --- | --- | --- |
|   | a.  | CH2– |
|   | b.  | HOCl |
|   | c.  | I3– |
|   | d.  | NO2– |
|   | e.  | O3 |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 111. Which of the following has bond angles slightly less than 109°?

|  |  |  |
| --- | --- | --- |
|   | a.  | AsF3 |
|   | b.  | COCl2 |
|   | c.  | COS |
|   | d.  | CS32– |
|   | e.  | SO2 |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 112. Which of the following has bond angles slightly less than 120°?

|  |  |  |
| --- | --- | --- |
|   | a.  | CS32– |
|   | b.  | HO2– |
|   | c.  | I3+ |
|   | d.  | NO2– |
|   | e.  | NO3– |

|  |  |
| --- | --- |
| *ANSWER:* | d |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 113. Which of the following has bond angles of 120°?

|  |  |  |
| --- | --- | --- |
|   | a.  | CS32– |
|   | b.  | HO2– |
|   | c.  | NO2– |
|   | d.  | O3 |
|   | e.  | S32– |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 114. Which of the following has bond angles of 90°, 120°, and 180°?

|  |  |  |
| --- | --- | --- |
|   | a.  | ICl4– |
|   | b.  | IF5 |
|   | c.  | PF6– |
|   | d.  | SF4 |
|   | e.  | XeF4 |

|  |  |
| --- | --- |
| *ANSWER:* | d |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 115. Which of the following only has bond angles of 90°?

|  |  |  |
| --- | --- | --- |
|   | a.  | IF5 |
|   | b.  | IF4+ |
|   | c.  | IO2F3 |
|   | d.  | SF4 |
|   | e.  | XeF2 |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 116. Which of the following only has bond angles of 90° and 180°?

|  |  |  |
| --- | --- | --- |
|   | a.  | BCl3 |
|   | b.  | BrF3 |
|   | c.  | ICl4+ |
|   | d.  | IF5 |
|   | e.  | NO3– |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 117. Which of the following is polar?

|  |  |  |
| --- | --- | --- |
|   | a.  | CO32– |
|   | b.  | I3– |
|   | c.  | NON |
|   | d.  | O3 |
|   | e.  | XeF2 |

|  |  |
| --- | --- |
| *ANSWER:* | d |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 118. Which of the following is polar?

|  |  |  |
| --- | --- | --- |
|   | a.  | I3– |
|   | b.  | ICl4– |
|   | c.  | NON |
|   | d.  | XeF2 |
|   | e.  | XeO2 |

|  |  |
| --- | --- |
| *ANSWER:* | e |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 119. Which of the following is polar?

|  |  |  |
| --- | --- | --- |
|   | a.  | ICl4– |
|   | b.  | IF5 |
|   | c.  | PCl5 |
|   | d.  | SF6 |
|   | e.  | XeF4 |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 120. All of the following are polar except

|  |  |  |
| --- | --- | --- |
|   | a.  | I3–. |
|   | b.  | I3+. |
|   | c.  | NH2–. |
|   | d.  | O3. |
|   | e.  | S32–. |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 121. All of the following are polar except

|  |  |  |
| --- | --- | --- |
|   | a.  | ClF3. |
|   | b.  | ClO2–. |
|   | c.  | IF4+. |
|   | d.  | SF4. |
|   | e.  | XeF4. |

|  |  |
| --- | --- |
| *ANSWER:* | e |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 122. Which of the following is polar?

|  |  |  |
| --- | --- | --- |
|   | a.  | AsF6– |
|   | b.  | ICl4– |
|   | c.  | SF4 |
|   | d.  | SF6 |
|   | e.  | XeF4 |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 123. All the following are polar except

|  |  |  |
| --- | --- | --- |
|   | a.  | BO33–. |
|   | b.  | BrO3–. |
|   | c.  | ClF3. |
|   | d.  | COCl2. |
|   | e.  | O3. |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 124. All of the following are polar except

|  |  |  |
| --- | --- | --- |
|   | a.  | BrO3–. |
|   | b.  | ClF3. |
|   | c.  | COCl2. |
|   | d.  | CS32–. |
|   | e.  | O3. |

|  |  |
| --- | --- |
| *ANSWER:* | d |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 125. All of the following are polar except

|  |  |  |
| --- | --- | --- |
|   | a.  | ClF3. |
|   | b.  | SOCl2. |
|   | c.  | XeF4. |
|   | d.  | XeO2. |
|   | e.  | XeO3. |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 126. The molecule *cis*-dichloroethene is nonpolar. True or false?

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 127. How many σ- and π-bonds, respectively, are there in acrolein, CH2=CHCHO?

|  |  |  |
| --- | --- | --- |
|   | a.  | 4 and 2 |
|   | b.  | 7 and 2 |
|   | c.  | 5 and 2 |
|   | d.  | 5 and 4 |
|   | e.  | 7 and 1 |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 128. How many σ- and π-bonds, respectively, are there in peroxyacetylnitrate, CH3C(O)O-ONO2?

|  |  |  |
| --- | --- | --- |
|   | a.  | 9 and 2 |
|   | b.  | 10 and 2 |
|   | c.  | 10 and 1 |
|   | d.  | 8 and 4 |
|   | e.  | 8 and 2 |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |
| --- | --- | --- |
| 129. How many σ- and π-bonds are present in diazomethane, CH2NN?

|  |  |
| --- | --- |
| *ANSWER:* | 4 σ-bonds and 2 π-bonds |

 |

|  |  |  |
| --- | --- | --- |
| 130. Draw the Lewis structure of formamide, NH2CHO, and give the number of lone pairs of electrons, and the number of σ- and π-bonds.

|  |  |
| --- | --- |
| *ANSWER:* | 3 lone pairs, 5 σ-bonds, and 1 π-bond |

 |

|  |  |  |
| --- | --- | --- |
| 131. Draw the Lewis structure of the cyanamide ion, NCNH–, and give the number of lone pairs of electrons and the number of σ- and π-bonds.

|  |  |
| --- | --- |
| *ANSWER:* | 3 lone pairs, 3 σ-bonds, and 2 π-bonds |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 132. Identify the hybrid orbitals used by the underlined atom in acetone, CH3COCH3.

|  |  |  |
| --- | --- | --- |
|   | a.  | sp |
|   | b.  | sp2 |
|   | c.  | sp3 |
|   | d.  | sp3d |
|   | e.  | None; pure pz-orbitals are used in bonding. |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 133. The hybrid orbitals used by the underlined atoms in CH3CHCHCN, from left to right, respectively, are

|  |  |  |
| --- | --- | --- |
|   | a.  | sp3 and sp. |
|   | b.  | sp2 and sp. |
|   | c.  | sp2 and sp3. |
|   | d.  | sp2 and sp2. |
|   | e.  | sp and sp3. |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 134. The hybrid orbitals used by the underlined atoms in CH3CH2OCH2CH3, from left to right, respectively, are

|  |  |  |
| --- | --- | --- |
|   | a.  | sp and sp. |
|   | b.  | sp3 and sp. |
|   | c.  | sp3 and sp3. |
|   | d.  | sp and sp3. |
|   | e.  | sp2 and sp3. |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 135. The hybrid orbitals used by the underlined atoms in CH2CHCHO, from left to right, respectively, are

|  |  |  |
| --- | --- | --- |
|   | a.  | sp3 and sp2. |
|   | b.  | sp2 and sp2. |
|   | c.  | sp2 and sp. |
|   | d.  | sp and sp. |
|   | e.  | sp3 and sp. |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 136. For the Lewis structure of the cyanamide ion that contains two double bonds, N=C=NH–, the hybrid orbitals used by the underlined nitrogen atom and the carbon atom, respectively, are

|  |  |  |
| --- | --- | --- |
|   | a.  | sp2 and sp3. |
|   | b.  | sp and sp. |
|   | c.  | sp2 and sp2. |
|   | d.  | sp and sp3. |
|   | e.  | sp2 and sp. |

|  |  |
| --- | --- |
| *ANSWER:* | e |

 |

|  |  |  |
| --- | --- | --- |
| 137. The NCO bond angle in formamide, H2NCHO, is \_\_\_\_\_\_\_\_\_\_.

|  |  |
| --- | --- |
| *ANSWER:* | ~ 120° (120° is an acceptable answer) |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 138. All the following are paramagnetic except

|  |  |  |
| --- | --- | --- |
|   | a.  | N22–*.* |
|   | b.  | N22+*.* |
|   | c.  | O2–*.* |
|   | d.  | O2+*.* |
|   | e.  | O2*.* |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 139. Which of the following is diamagnetic?

|  |  |  |
| --- | --- | --- |
|   | a.  | O22– |
|   | b.  | O2+ |
|   | c.  | O2– |
|   | d.  | S2 |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |
| --- | --- | --- |
| 140. What is the ground-state electron configuration of O2–?

|  |  |
| --- | --- |
| *ANSWER:* | (σ2s)2(σ2s\*)2(σ2p)2(π2p)4(π2p\*)2(π2p\*)1 |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 141. Which of the following is paramagnetic?

|  |  |  |
| --- | --- | --- |
|   | a.  | B22– |
|   | b.  | B2 |
|   | c.  | C22– |
|   | d.  | N2 |
|   | e.  | O22– |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 142. Which of the following would have the longest bond?

|  |  |  |
| --- | --- | --- |
|   | a.  | B2 |
|   | b.  | C2 |
|   | c.  | C22– |
|   | d.  | N2 |
|   | e.  | N22– |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 143. The bond order of N22+ is

|  |  |  |
| --- | --- | --- |
|   | a.  | 2.5. |
|   | b.  | 1. |
|   | c.  | 2. |
|   | d.  | 1.5. |
|   | e.  | 3. |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 144. The bond order of O22+ is

|  |  |  |
| --- | --- | --- |
|   | a.  | 1. |
|   | b.  | 2. |
|   | c.  | 3. |
|   | d.  | 2.5. |
|   | e.  | 1.5. |

|  |  |
| --- | --- |
| *ANSWER:* | d |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 145. Which of the following has the longest bond?

|  |  |  |
| --- | --- | --- |
|   | a.  | N2 |
|   | b.  | N22+ |
|   | c.  | N22– |
|   | d.  | NO– |
|   | e.  | O22– |

|  |  |
| --- | --- |
| *ANSWER:* | e |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 146. Which of the following is paramagnetic?

|  |  |  |
| --- | --- | --- |
|   | a.  | N2 |
|   | b.  | N22+ |
|   | c.  | N22– |
|   | d.  | NO+ |
|   | e.  | O22– |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 147. Which of the following species has the shortest bond length?

|  |  |  |
| --- | --- | --- |
|   | a.  | NO2– |
|   | b.  | NO2+ |
|   | c.  | NO– |
|   | d.  | NO |
|   | e.  | NO+ |

|  |  |
| --- | --- |
| *ANSWER:* | e |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 148. Which of the following species has two unpaired electrons?

|  |  |  |
| --- | --- | --- |
|   | a.  | CF+ |
|   | b.  | CO+ |
|   | c.  | NF+ |
|   | d.  | NO+ |
|   | e.  | OF+ |

|  |  |
| --- | --- |
| *ANSWER:* | e |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 149. Which of the following is a p-type semiconductor?

|  |  |  |
| --- | --- | --- |
|   | a.  | GaAs with arsenic in excess of gallium |
|   | b.  | Germanium doped with arsenic |
|   | c.  | Selenium doped with indium |
|   | d.  | Silicon doped with arsenic |
|   | e.  | Silicon doped with phosphorus |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 150. Which of the following is an n-type semiconductor?

|  |  |  |
| --- | --- | --- |
|   | a.  | GaAs with gallium in excess of arsenic |
|   | b.  | Germanium doped with indium |
|   | c.  | Selenium doped with indium |
|   | d.  | Silicon doped with boron |
|   | e.  | Silicon doped with phosphorus |

|  |  |
| --- | --- |
| *ANSWER:* | e |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 151. Germanium is a semiconductor. Which of the following should be added in small amounts to produce a p-type semiconductor?

|  |  |  |
| --- | --- | --- |
|   | a.  | As |
|   | b.  | B |
|   | c.  | Bi |
|   | d.  | P |
|   | e.  | Sb |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 152. Gallium is a semiconductor. Which of the following should be added in small amounts to produce a p-type semiconductor?

|  |  |  |
| --- | --- | --- |
|   | a.  | As |
|   | b.  | B |
|   | c.  | P |
|   | d.  | Sb |
|   | e.  | Si |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 153. How many lone pairs of electrons are there in the Lewis structure of azidocarbonamide, H2NC(O)NNC(O)NH2?

|  |  |  |
| --- | --- | --- |
|   | a.  | 8 |
|   | b.  | 12 |
|   | c.  | 10 |
|   | d.  | 16 |
|   | e.  | 6 |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 154. What is the approximate **NNC** bond angle in azidocarbonamide, H2NC(O)**NNC**(O)NH2?

|  |  |  |
| --- | --- | --- |
|   | a.  | 118° |
|   | b.  | 180° |
|   | c.  | 90° |
|   | d.  | 107° |
|   | e.  | 109° |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 155. What is the hybridization of the bolded atoms **NNC,** from left to right, in azidocarbonamide, H2NC(O)**NNC**(O)NH2?

|  |  |  |
| --- | --- | --- |
|   | a.  | sp3, sp, sp2 |
|   | b.  | sp2, sp, sp3 |
|   | c.  | sp2, sp, sp2 |
|   | d.  | sp, sp, sp2 |
|   | e.  | sp2, sp2, sp2 |

|  |  |
| --- | --- |
| *ANSWER:* | e |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 156. How many σ- and π-bonds, respectively, are there in the Lewis structure of azidocarbonamide, H2NC(O)NNC(O)NH2?

|  |  |  |
| --- | --- | --- |
|   | a.  | 14 and 3 |
|   | b.  | 15 and 3 |
|   | c.  | 14 and 2 |
|   | d.  | 8 and 3 |
|   | e.  | 11 and 3 |

|  |  |
| --- | --- |
| *ANSWER:* | e |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 157. Two Lewis structures can be written for diazomethane, where the arrangement of atoms is H2**C**-**N**-N. The hybrid orbitals used by the bold atoms in these Lewis structures are

|  |  |  |
| --- | --- | --- |
|   | a.  | sp3 or sp2, and sp. |
|   | b.  | sp2 and sp. |
|   | c.  | sp3 and sp. |
|   | d.  | sp3 or sp2, and sp2. |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 158. The fact that B2 has two unpaired electrons means the 2*p*π molecular orbitals have higher energy than the 2pσ molecular orbitals. True or false?

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |
| --- | --- | --- |
| 159. How many peaks would you predict for the photoelectron spectrum of water using 1) the molecular orbital model and 2) the VSEPR model?

|  |  |
| --- | --- |
| *ANSWER:* | molecular orbital, 4; VSEPR, 2; the experimental result is 4 peaks |

 |

|  |  |  |
| --- | --- | --- |
| 160. The OSO bond angle in the sulfite ion is \_\_\_\_\_\_\_ (greater than/equal to/ less than) 109.5°.

|  |  |
| --- | --- |
| *ANSWER:* | less than |

 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 161. An AX3E2 molecule has a trigonal planar shape. True or false?

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 162. Which of the following molecules is (are) polar?(a) AsCl4+     (b) I3+     (c) I3–     (d) N3–     (e) S32–

|  |  |  |
| --- | --- | --- |
|   | a.  | (b) and (e) |
|   | b.  | (b) and (c) |
|   | c.  | (c) and (e) |
|   | d.  | only (e) |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |
| --- | --- | --- |
| 163. What is the bond order in the OH radical?

|  |  |
| --- | --- |
| *ANSWER:* | 0.5 |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 164. When two atoms are brought together along the *x*-axis, what is the number of σ bonds that can be formed by overlap of p-orbitals on each atom?

|  |  |  |
| --- | --- | --- |
|   | a.  | 0 |
|   | b.  | 1 |
|   | c.  | 2 |
|   | d.  | 3 |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 165. What hybrid orbitals are used by the N atoms in urea, H2NCONH2?

|  |  |  |
| --- | --- | --- |
|   | a.  | sp |
|   | b.  | sp2 |
|   | c.  | sp3 |
|   | d.  | dsp3 |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |
| --- | --- | --- |
| 166. In the NO molecule, which atom makes the larger contribution to the lowest energy molecular orbital?

|  |  |
| --- | --- |
| *ANSWER:* | O |

 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 167. For A2, the LCAO-MO, ψ = *c*AψA + *c*BψB, has *c*A = *c*B. True or false?

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 168. For HF, the LCAO-MO, ψ = *c*HψH + *c*FψF, has *c*H = *c*F. True or false?

|  |  |  |
| --- | --- | --- |
|   | a.  | True |
|   | b.  | False |

|  |  |
| --- | --- |
| *ANSWER:* | b |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 169. For peroxyacetylnitrate, CH3C(O)**O**—ONO2, what hybrid orbitals are used by the oxygen atom in bold?

|  |  |  |
| --- | --- | --- |
|   | a.  | dsp |
|   | b.  | sp |
|   | c.  | sp2 |
|   | d.  | sp3 |

|  |  |
| --- | --- |
| *ANSWER:* | d |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 170. The molecules OF2 and O3 both have bent shapes. What are the approximate bond angles in OF2 and O3, respectively?

|  |  |  |
| --- | --- | --- |
|   | a.  | 109o and 120o |
|   | b.  | Both 109o |
|   | c.  | Both 120o |
|   | d.  | Both 180o |
|   | e.  | 109o and 180o |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 171. What are the electron arrangements around the central atom and the shape, respectively, of SF4?

|  |  |  |
| --- | --- | --- |
|   | a.  | Both square pyramidal |
|   | b.  | Both tetrahedral |
|   | c.  | Octahedral and square pyramidal |
|   | d.  | Seesaw |
|   | e.  | Trigonal bipyramidal and seesaw |

|  |  |
| --- | --- |
| *ANSWER:* | e |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 172. What is the shape of the molecule AX4E2?

|  |  |  |
| --- | --- | --- |
|   | a.  | Octahedral |
|   | b.  | Seesaw |
|   | c.  | Square planar |
|   | d.  | Square pyramidal |
|   | e.  | Tetrahedral |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 173. The molecules OF2 and O3 both have bent shapes. What is the hybridization of the central atom in OF2 and O3, respectively?

|  |  |  |
| --- | --- | --- |
|   | a.  | sp3 and sp2 |
|   | b.  | both sp3 |
|   | c.  | both sp2 |
|   | d.  | sp3 and sp |
|   | e.  | both sp |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |
| --- | --- | --- |
| 174. Dinitrogen monoxide has a dipole moment. Draw the arrangement of atoms and indicate the shape of dinitrogen monoxide.

|  |  |
| --- | --- |
| *ANSWER:* | N-N-O; linear |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 175. The structure of Tylenol is given below:Estimate the C-N-H bond angle.

|  |  |  |
| --- | --- | --- |
|   | a.  | ~ 109o |
|   | b.  | ~ 120o |
|   | c.  | > 109o |
|   | d.  | > 120o |
|   | e.  | ~ 90o |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 176. The structure of Tylenol is given below:What hybrid orbitals are used on the N atom and the carbonyl carbon, respectively?

|  |  |  |
| --- | --- | --- |
|   | a.  | sp3 and sp2 |
|   | b.  | sp2 and sp2 |
|   | c.  | sp3 and sp3 |
|   | d.  | sp2 and sp |
|   | e.  | sp3 and sp |

|  |  |
| --- | --- |
| *ANSWER:* | a |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 177. All of the following are polar except

|  |  |  |
| --- | --- | --- |
|   | a.  | NO2–. |
|   | b.  | N2O (N is the central atom). |
|   | c.  | NO3–. |
|   | d.  | NO2Cl. |
|   | e.  | SO32–. |

|  |  |
| --- | --- |
| *ANSWER:* | c |

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 178. In NO, the unpaired electron occupies what type of molecular orbital?

|  |  |  |
| --- | --- | --- |
|   | a.  | 3σ |
|   | b.  | 4σ\* |
|   | c.  | 2π\* |
|   | d.  | 1π |
|   | e.  | The oxygen 2p orbital. |

|  |  |
| --- | --- |
| *ANSWER:* | c |

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| 179. Both C2 and C22– are diamagnetic. True or false?

|  |  |  |
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|   | a.  | True |
|   | b.  | False |

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| --- | --- |
| *ANSWER:* | a |

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| 180. What are the electron arrangements and the shape around the central atom of SeCl4?

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| --- | --- | --- |
|   | a.  | Both square pyramidal |
|   | b.  | Both tetrahedral |
|   | c.  | Octahedral and square pyramidal |
|   | d.  | Seesaw |
|   | e.  | Trigonal bipyramidal and seesaw |

|  |  |
| --- | --- |
| *ANSWER:* | e |

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| 181. Why does the best Lewis structure for sulfuric acid (H2SO4) have the sulfur atom formally possessing five bonds?

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| --- | --- | --- |
|   | a.  | It is the best expanded octet structure for the molecule. |
|   | b.  | It doesn't; it should possess four bonds. |
|   | c.  | It doesn't; it should possess six bonds. |
|   | d.  | This configuration gives all atoms in the molecule a formal charge of 0. |

|  |  |
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| *ANSWER:* | c |

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