1. Which of the following statements regarding electromagnetic radiation is **incorrect**?

A. Each type of electromagnetic radiation has its own characteristic range of wavelengths and frequencies.
B. The energy of electromagnetic radiation is directly proportional to its frequency.
C. The wavelength of electromagnetic radiation is inversely proportional to its frequency.
D. The visible portion of the electromagnetic spectrum has the lowest energy of any of the types of electromagnetic radiation.
E. The distance between two corresponding points on a wave is its wavelength.

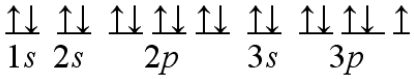
2. Which of the following statements regarding orbitals is **correct**?

A. A 2*p* orbital is smaller than a 3*p* orbital.
B. A 1*s* orbital can be represented as a two-dimensional circle centered around the nucleus of an atom.
C. The *p* orbitals always come in sets of four.
D. There is no difference between the orbitals of the modern model of the atom and the orbits of the Bohr model of the atom.
E. The *d* orbitals always have three lobes.

3. When completing the orbital diagram for the element silicon, which of the following statements is **correct**?

A. There are no electrons in the 3*d* sublevel.
B. The 2*p* sublevel is not full.
C. There are no unpaired electrons in the 3*p* sublevel.
D. There are five electrons in the third energy level.
E. There are no electrons in the 3*s* sublevel.

4. The following orbital diagram corresponds to the element_____.



A. P
B. Si
C. Br
D. Cl
E. S

5. Elements that have five electrons in the highest-energy *p* sublevel in their ground state are called:

A. alkali metals.
B. noble gases.
C. halogens.
D. transition metals.
E. alkaline earth metals.

6. The element that has the abbreviated electron configuration [Ne]$3s^2 3p^2$ is:
   A. Al
   B. Si
   C. P
   D. Cl
   E. Ar

7. The electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6$ applies to all of the following species **except**:
   A. Ca^{2+}
   B. K^+
   C. Na^+
   D. Ar
   E. Cl^-

8. Rank the following elements in order of increasing ionization energy: F, P, Mg, Cs
   A. Cs < Mg < P < F
   B. Cs < Mg < F < P
   C. P < Mg < F < Cs
   D. Cs < F < Mg < P
   E. F < P < Mg < Cs

9. Rank the following elements in order of increasing atomic size: F, P, Mg, Cs
   A. Cs < Mg < F < P
   B. F < P < Mg < Cs
   C. Cs < F < Mg < P
   D. P < Mg < F < Cs
   E. Cs < Mg < P < F

10. Which of the following compounds is likely to have covalent bonds?
   A. NaCl
   B. CO
   C. LiF
   D. MgO
   E. $CaBr_2$

11. Which of the following compounds is likely to have a relatively high boiling point?
   A. $CoCl_3$
   B. NO_2
   C. NH_3
   D. CO
   E. CH_4

12. Using periodic trends, arrange the following atoms in order of increasing electronegativity: Cl, Si, Ga, Sr
    A. Sr < Ga < Si < Cl
    B. Sr > Ga < Cl < Si
    C. Si < Ga < Sr < Cl
    D. Si < Cl < Ga < Sr
    E. Cl < Si < Ga < Sr

13. Arrange the following bonds in order of increasing polarity: F-F, F-C, F-O, F-N
    A. F-F < F-C < F-O < F-N
    B. F-N < F-O < F-F < F-C
    C. F-F < F-O < F-N < F-C
    D. F-O < F-N < F-F < F-C
    E. F-N < F-C < F-O < F-F

14. The correctly drawn Lewis formula for CBr_4 will have _____.
    A. 5 single bonds
    B. 4 single bonds
    C. 4 single bonds and 1 pair of nonbonding electrons on the carbon atom
    D. 4 single bonds and 2 pairs of nonbonding electrons on the carbon atom
    E. 4 single bonds and 3 pairs of nonbonding electrons on the carbon atom

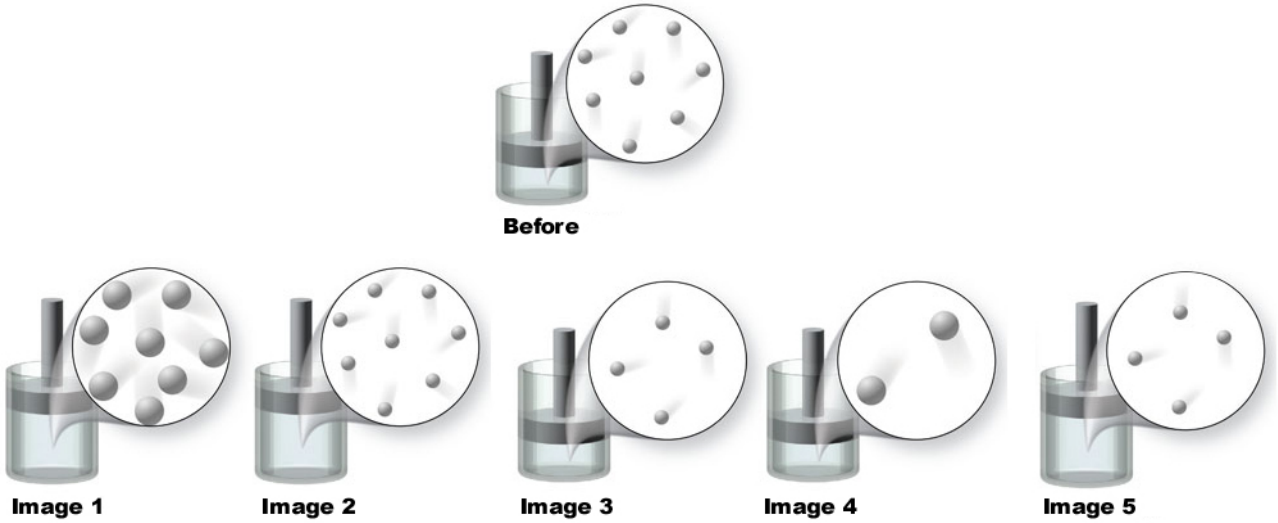
15. Which one of the following molecules would exhibit resonance?
    A. O_2
    B. H_2S
    C. Cl_2
    D. CH_4
    E. SO_2

16. Which of these molecules has a violation of the octet rule?
    A. NF_3
    B. PCl_5
    C. Br_2
    D. CO
    E. OF_2

17. Predict the molecular shape and give the approximate bond angles of the PCl_3 molecule.
    A. linear, 180^o
    B. bent, 120^o
    C. tetrahedral, 109.5^o
    D. trigonal planar, 120^o
    E. trigonal pyramidal, 109.5^o

18. Which one of the following molecules is polar?
    A. BeF_2
    B. CO_2
    C. CCl_4
    D. SO_3
    E. H_2S

19. The "Before" image in the figure shows the initial condition of a gas at a certain temperature in a container with a movable piston. Which of the images represents the condition of the gas when the temperature of the gas is increased, and the external pressure is held constant?



A. image 1
B. image 2
C. image 3
D. image 4
E. image 5

20. Convert 689 torr to atm.

A. 9.98×10^7 atm
B. 0.907 atm
C. 0.689 atm
D. 1.10 atm
E. 0.760 atm

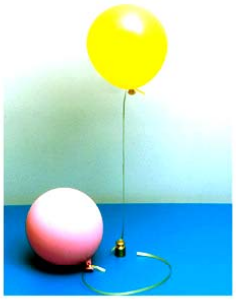
21. If the initial pressure of a 2.00 L gas sample is 2.50 atm, what will the pressure be if the volume is changed to 3.00 L at constant temperature?

A. 0.600 atm
B. 1.50 atm
C. 1.67 atm
D. 3.75 atm
E. 2.40 atm

22. Which of the following statements is **incorrect**? (Assume that pressure and amount of gas are constant.)

A. If the temperature of a gas sample decreases from 50^oC to 25^oC, the pressure will be halved.
B. Charles's law says that volume is directly proportional to temperature.
C. When a gas is cooled, the particles move more slowly.
D. If the absolute temperature of a gas doubles, then the volume of the gas will double.
E. If the volume of a gas is halved, then the absolute temperature of the gas will be halved also.

23. The figure shows two balloons. They are at the same temperature and pressure, and contain equal volumes of gas, but one is floating, and the other is not. The reason for this behavior is that:



A. the balloon that is floating has a more dense gas than the one that is not floating, so it holds up the balloon better.
B. the balloon that is not floating has a gas with a higher molar mass than that of air.
C. the balloon that is not floating has the molecules more closely spaced than the other.
D. the balloon that is floating has molecules with more kinetic energy.
E. the balloon that is not floating has molecules that have slowed down, since it was filled before the floating balloon.

24. Which of the following statements related to kinetic-molecular theory of gases is **correct** for an ideal gas?
A. In a mixture of gases, attractive forces between particles cause the measured pressure to be lower than that expected for a pure gas.
B. Gases are composed of small particles with a small amount of space between them.
C. Gas particles move in a zigzag pattern until they collide with something.
D. When gas particles collide, they lose some of their kinetic energy, and will slow down over time.
E. The pressure of a gas arises from the sum of the collisions of the particles with the walls of the container.

25. Propane burns in air according to the equation:

$$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$$

What volume of CO_2 would be formed if 8.00 L of propane burns, assuming that all of the gases are under the same conditions?
A. 12.0 L
B. 24.0 L
C. 3.00 L
D. 4.80 L
E. 8.00 L

Exam 3 Key
Version #1

1.D

2.A

3.A

4.D

5.C

6.B

7.C

8.A

9.B

10.B

11.A

12.A

13.C

14.B

15.E

16.B

17.E

18.E

19.E

20.B

21.C

22.A

23.B

24.E

25.B

1. Which of the following statements regarding electromagnetic radiation is **incorrect**?
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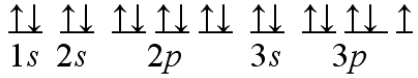

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    C. 5 single bonds
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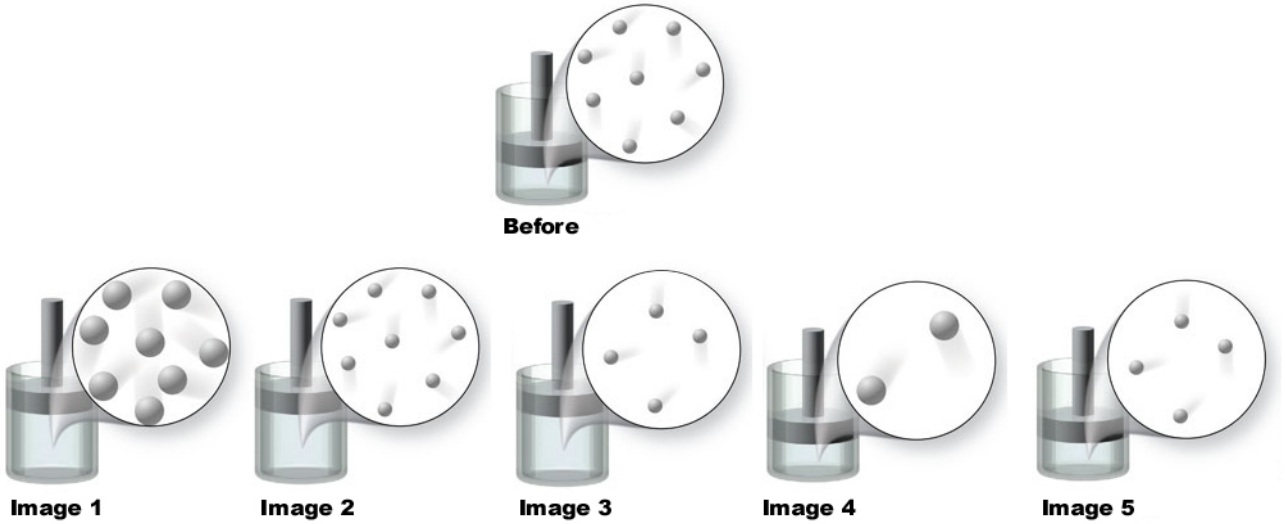

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C. 6.00 L
D. 2.40 L
E. 4.00 L

Exam 3 Key
Version #2

1.D

2.A

3.A

4.D

5.E

6.D

7.A

8.A

9.A

10.E

11.C

12.D

13.A

14.E

15.D

16.E

17.D

18.A

19.C

20.B

21.A

22.D

23.C

24.B

25.A