

Questions 1–14 cover material from Exam 1

1. Which description identifies a liquid?

- A. no definite shape; definite volume C. definite shape; no definite volume
B. no definite shape; no definite volume D. definite shape; definite volume
-

2. Which state of matter is the most compressible?

- A. solid C. liquid
B. gas D. Solids, liquids and gases are equally compressible.
-

3. Which of the following represents a chemical change?

- A. boiling water C. combustion of C_3H_8 (propane)
B. freezing water D. formation of $CO_2(g)$ from $CO_2(s)$
-

4. A ball at the top of the hill has 342 J of energy and expends 125 J of energy as it rolls down. How much potential energy remains in the system (the ball) at the bottom of the hill?

- A. 217 J C. 467 J
B. 125 J D. 342 J
-

5. What are the identities of these prefix multipliers?

- A. 10^{-9} , nano; 10^{-3} , milli; 10^3 , kilo; 10^6 mega
B. 10^{-9} , mega; 10^{-3} , nano; 10^3 , kilo; 10^6 atto
C. 10^{-9} , giga; 10^{-3} , nano; 10^3 , tera; 10^6 deci
D. 10^{-9} , nano; 10^{-3} , kilo; 10^3 , micro; 10^6 atto
-

6. A 12.28 in^3 cube of $\text{Xe}(s)$ has a mass of 25.84 oz at 161.4 K and 81.8 kPa. What is the density of solid xenon under these conditions? (1 oz = 28.35 g; 1 in = 2.54 cm)

A. 3.640 g/cm^3

C. 10.24 g/cm^3

B. 26.49 g/cm^3

D. 0.4790 g/cm^3

7. What is the result of the following calculation to the correct number of significant figures?

$$\frac{(95.124 + 6.325)}{0.998750}$$

A. 1.016×10^2

C. 1.01576×10^2

B. 1.0158×10^2

D. 1.015759×10^2

8. Which of the following statements is **false** according to Dalton's Atomic Theory?

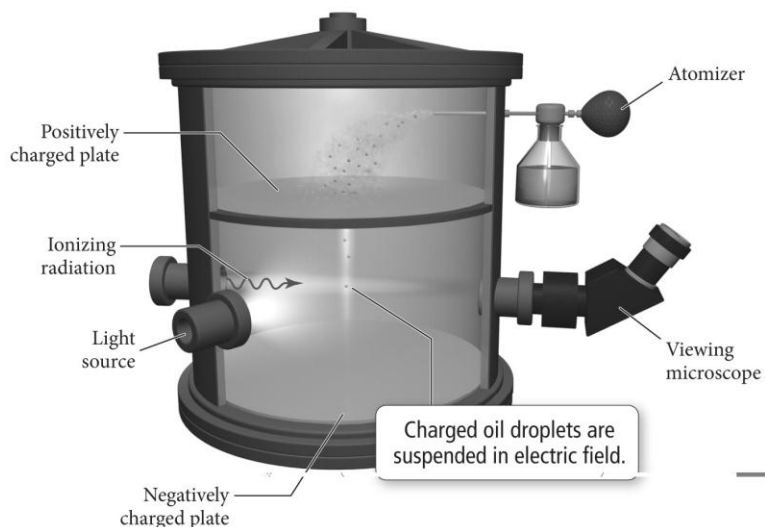
A. An atom of Kr can be broken down into smaller particles that have the same unique properties as Kr.

B. One carbon atom combines with either one or two oxygen atoms to form two different compounds.

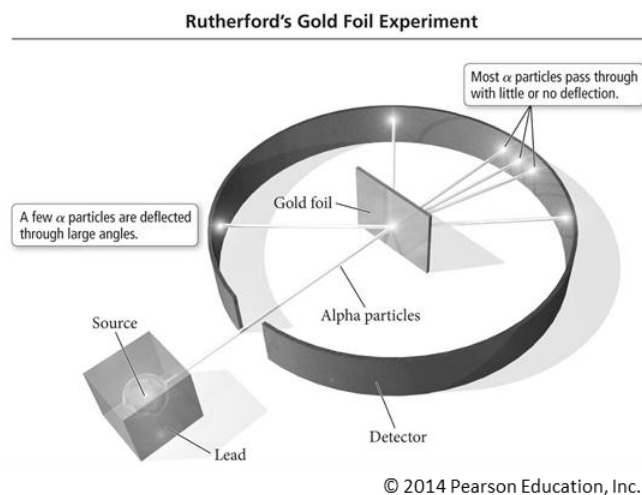
C. Atoms combine in simple whole number ratios to form molecular compounds.

D. All atoms of chlorine have identical properties that distinguish them from other elements.

-
9. What information about atomic structure was determined by Millikan's oil drop experiment?



- A. existence of electrons
B. mass of a proton
C. existence of the nucleus
D. charge of an electron
-
10. Rutherford's gold-foil experiment is depicted in the figure below. Which of the following statements best describes the implications of the gold-foil experiment?



- A. The mass of an atom is evenly distributed throughout the atom.
B. Electrons have more mass than protons.
C. Positive charges are evenly distributed throughout the atom
D. Most of an atom's mass is localized in a small core called the nucleus.
-

21. An analysis of a 25.00-g sample of a compound containing carbon, hydrogen, nitrogen, and oxygen showed that it contained 5.00 g C, 11.68 g N, 6.65 g O, and the remainder H. What is the empirical formula of the compound?

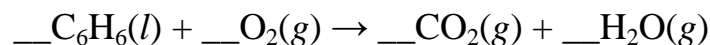
A. CNOH

C. CNOH₂

B. CN₂OH₂

D. CN₂OH₄

22. When the equation below is balanced with the lowest possible whole numbers, what is the coefficient of O₂?



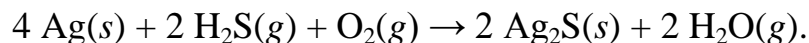
A. 15

C. 3

B. 6

D. 1

23. Sulfur compounds in eggs tarnish silver according to the balanced chemical equation:



If 1.02 mg of H₂S (34.082 g/mol) comes in contact with 5.45 mg of silver and an excess of oxygen, how much tarnished silver (Ag₂S, 247.80 g/mol) will result?

A. 10.9 mg Ag₂S

C. 2.06 mg Ag₂S

B. 6.26 mg Ag₂S

D. 8.43 mg Ag₂S

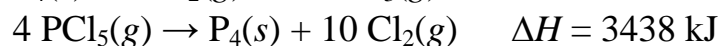
Questions 29–42 cover material from Exam 3

29. Which of the following sentences states the first law of thermodynamics?
- A. The total energy of the universe is increasing.
 - B. The total energy of the universe is constant.
 - C. The total energy of the universe is decreasing.
 - D. There is only one type of energy.
-
30. 12.0 kJ of heat is supplied to a 150.0-g sample of ethanol initially at 25.0 °C. What is the final temperature of the ethanol? The specific heat capacity of ethanol is 2.42 J/g·°C.
- A. 21.7 °C
 - B. 28.3 °C
 - C. 58.1 °C
 - D. 35.7 °C
-
31. A 15.0-g piece of lead at 275 °C is dropped into 50.0 g of H₂O at 23.0 °C. What is the final temperature of the lead? Assume that no water is lost as steam.
- $C_s(\text{Pb}) = 0.128 \text{ J/g}\cdot^\circ\text{C}$
 $C_s(\text{H}_2\text{O}) = 4.18 \text{ J/g}\cdot^\circ\text{C}$
- A. 36.4 °C
 - B. 32.5 °C
 - C. 28.7 °C
 - D. 25.3 °C
-
32. A reaction takes place in a closed system causing the volume to expand from 3.00 L to 9.00 L against a constant external pressure of 1.5 atm. How much work is done by the system? (101.3 J = 1 atm L)
- A. -9.12 kJ
 - B. 5.07 kJ
 - C. 190 kJ
 - D. -1.3 kJ
-

33. Which of the following processes is endothermic?

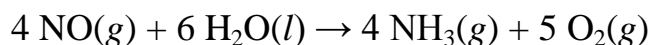
- A. Freezing of water
- B. Hot cup of coffee (system) cools on a countertop
- C. Chemical reaction in a “hot pack” used to treat sore muscles
- D. Evaporation of rubbing alcohol

34. What is ΔH_{rxn} for $\text{PCl}_5(g) \rightarrow \text{PCl}_3(g) + \text{Cl}_2(g)$ given the following reactions?



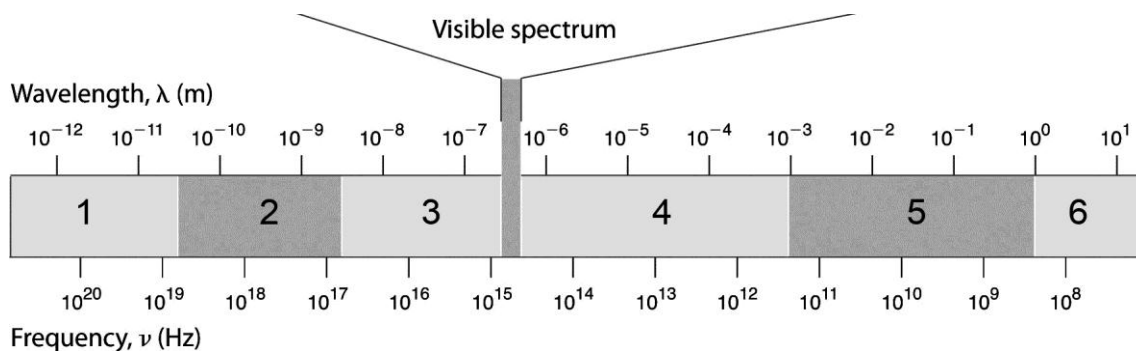
- A. 5877 kJ
- B. -999 kJ
- C. 250. kJ
- D. 999 kJ

35. $\Delta H_{\text{rxn}}^\circ$ of the reaction below is 1166.0 kJ. Given that ΔH_f° of $\text{H}_2\text{O}(l)$ is -285.8 kJ/mol and that ΔH_f° of $\text{NH}_3(g)$ is -45.9 kJ/mol, what is ΔH_f° of $\text{NO}(g)$?



- A. 382.8 kJ/mol
 - B. 91.3 kJ/mol
 - C. -95.7 kJ/mol
 - D. -368.2 kJ/mol
-

36. Which region of the electromagnetic spectrum is correctly identified?



- A. 2 = infrared
B. 6 = X-ray
C. 4 = microwave
D. 3 = ultraviolet

37. An electron initially in the $n = 4$ orbital of a hydrogen atom transitions to another orbital, emitting a photon with a wavelength of 97 nm. What is the n value for the final orbital of the electron?

- A. 3
B. 2
C. 5
D. 1

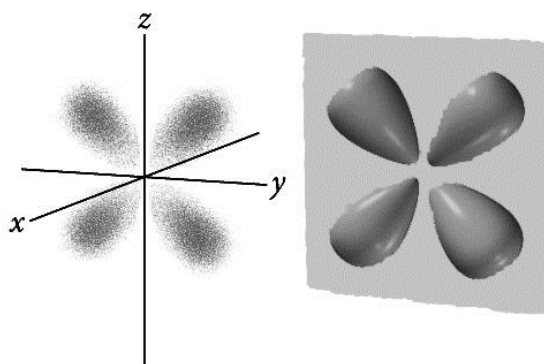
38. Which statement is **true** about atomic orbitals?

- A. A plot of the square of an electron's wave function (ψ^2) represents the position probability distribution map of the electron in an orbital.
B. For a hydrogen atom, the energy of an electron in an orbital is determined by m_l , the magnetic quantum number.
C. The spatial orientation of an orbital is defined by l , the angular momentum quantum number.
D. A single p orbital can hold up to six electrons.

39. Which of the following sets of quantum numbers is **allowed**?

- A. $n = 1, l = 0, m_l = 1, m_s = +\frac{1}{2}$
B. $n = 2, l = 2, m_l = 1, m_s = +\frac{1}{2}$
C. $n = 3, l = 2, m_l = 1, m_s = +\frac{1}{2}$
D. $n = 2, l = 1, m_l = 0, m_s = 0$
-

-
40. Which set of quantum numbers best describes an electron residing in the orbital shown in the two representations below?

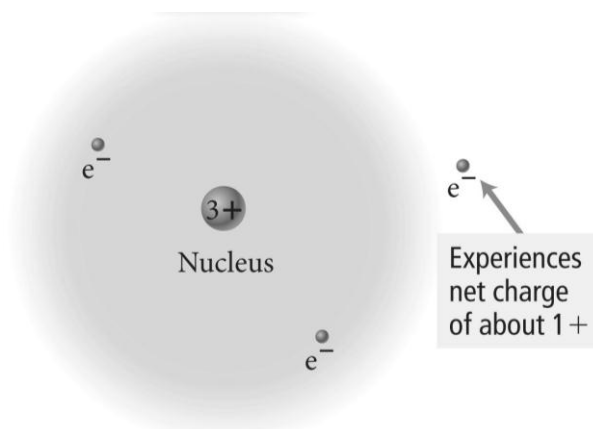


- A. $n = 2, l = 1, m_l = -1, m_s = -1/2$ C. $n = 3, l = 3, m_l = -1, m_s = -1/2$
B. $n = 3, l = 2, m_l = 2, m_s = +1/2$ D. $n = 4, l = 0, m_l = 1, m_s = +1/4$
-

41. How many electrons in an atom can have **both** quantum numbers $n = 3$ and $m_l = 1$?

- A. 2 C. 6
B. 4 D. 8
-

42. What causes the net charge experienced by the indicated electron to be less than $3+$?



- A. Penetration C. Shielding
B. Hund's rule D. Ionization
-

Questions 43–60 cover material after Exam 3

43. Which of these ions has the ground-state electron configuration $[\text{Ar}]3d^5$?



44. Which atom's valence electrons experience the **greatest** effective nuclear charge?

A. sodium

C. arsenic

B. selenium

D. bromine

45. In the following isoelectronic series, which species has the **largest** radius?



C. Ne



D. Na^+

46. Which pair has the element with the **smaller** first ionization energy written **first**?

A. Li, Na

C. F, Cl

B. Si, N

D. N, C

47. Which of these atoms has the **most exothermic** first electron affinity?

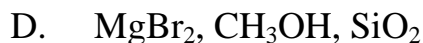
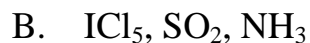
A. $\text{Li}(g)$

C. $\text{O}(g)$

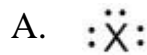
B. $\text{Be}(g)$

D. $\text{Ne}(g)$

48. Which group contains only **covalent** compounds?



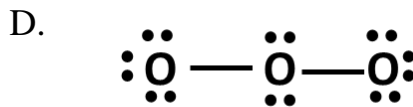
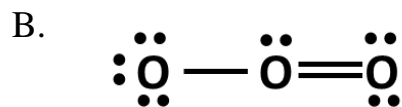
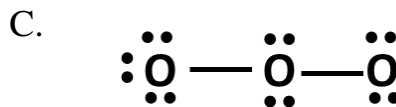
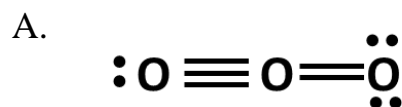
49. Which of the following is the Lewis dot symbol for an atom X, where X = arsenic?



50. Which of these compounds has the largest lattice energy?



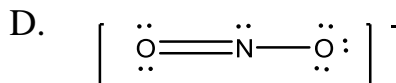
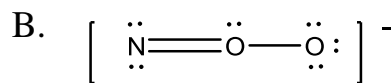
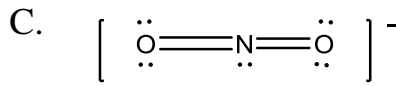
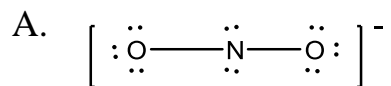
51. Which of the following is the Lewis structure of O_3 ?



52. Which bond is most polar?



53. Which of the following is the **best** Lewis structure for NO_2^- ?



54. Which of the following N–N bonds is the strongest?

- A. the N–N bond in $\text{N}_2(g)$
- B. the N–N bond in $\text{N}_2\text{H}_2(g)$
- C. the N–N bond in $\text{N}_2\text{H}_4(g)$
- D. The N–N bonds in A–C have about the same strengths.

55. In BF_4^- , what are the (1) electron group geometry around B and (2) molecular geometry?

- A. (1) trigonal planar, (2) trigonal planar
- B. (1) tetrahedral, (2) tetrahedral
- C. (1) trigonal bipyramidal, (2) seesaw
- D. (1) octahedral, (2) square planar

56. In IBr_4^- , what are the (1) electron group geometry around I and (2) molecular geometry?

- A. (1) octahedral, (2) tetrahedral
- B. (1) octahedral, (2) square planar
- C. (1) square bipyramidal, (2) seesaw
- D. (1) tetrahedral, (2) tetrahedral

57. Which of these molecules has a **zero** net dipole moment?

- A. OCS
- B. BF_2Cl
- C. PF_5
- D. SiF_2Cl_2

58. What is the hybridization of orbitals on phosphorus in PH_3 ?

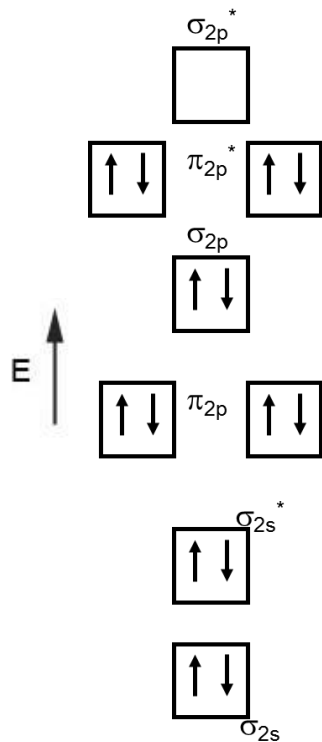
- A. sp^4
- B. sp^3
- C. sp^2
- D. sp

59. How many sigma (σ) and pi (π) bonds are in a CH_2CHCH_3 molecule?

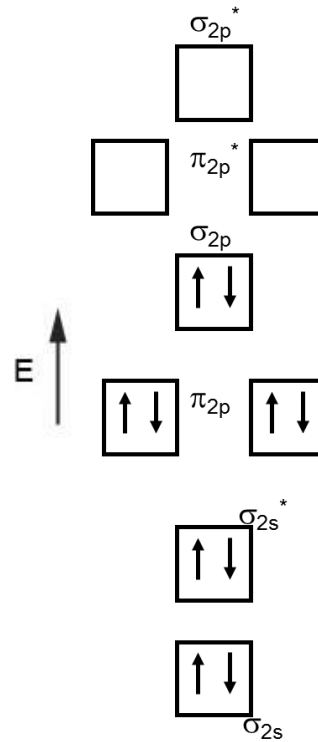
- A. 9 σ , 0 π
 - B. 7 σ , 2 π
 - C. 8 σ , 1 π
 - D. 8 σ , 2 π
-

60. Which diagram shows the molecular orbital energy diagram for N_2 ?

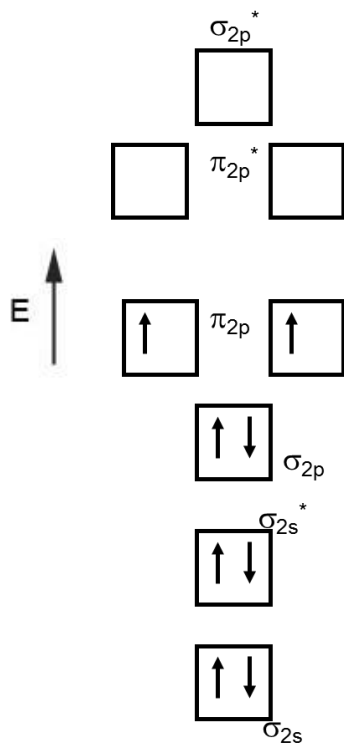
A.



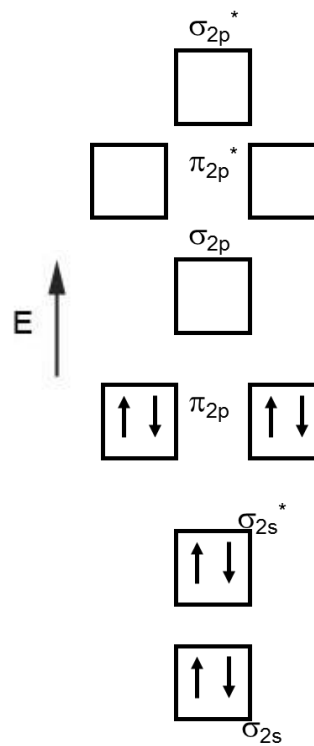
C.



B.



D.



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1. A
2. B
3. C
4. A
5. A
6. A
7. C
8. A
9. D
10. D
11. D
12. C
13. A
14. D
15. C
16. C
17. D
18. B
19. B
20. D
21. D
22. A
23. B
24. A
25. B
26. D
27. A
28. A
29. B
30. C
31. D
32. A
33. D
34. C
35. B
36. D
37. D
38. A
39. C
40. B
41. B
42. C
43. A

- 44. D
- 45. A
- 46. B
- 47. C
- 48. B
- 49. C
- 50. D
- 51. B
- 52. C
- 53. D
- 54. A
- 55. B
- 56. B
- 57. C
- 58. B
- 59. C
- 60. C