

1. Perform the following calculation and express the result with the appropriate number of significant figures.

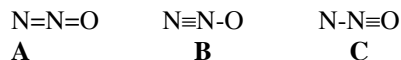
$$\frac{2.792 - 0.982}{9.33 + 2.57} + 0.8922$$

- a. 1.0
b. 1.04
c. 1.044
d. 1.0443
e. 1.04430
2. Convert 37.5 nm to cm.
- a) 3.75×10^{-4} cm d) 3.75×10^{-7} cm
b) 3.75×10^{-5} cm e) 3.75×10^8 cm
c) 3.75×10^{-6} cm
3. Which of the following name/formula combinations is/are correct?
- | | | |
|------|---|------------------------|
| I. | Ca(CN) ₂ | calcium cyanide |
| II. | Fe ₂ O ₃ | iron(II) oxide |
| III. | Al ₂ (SO ₄) ₃ | aluminum sulfate |
| IV. | (NH ₄) ₃ PO ₄ | ammonium phosphate |
| V. | KMnO ₄ | potassium permanganate |
- a) none of these
b) I and V
c) II and III
d) I, III, IV, and V
e) I, II, III, IV, and V
4. The density of tungsten is 19.3 g/cm³. Express this value in lb/ft³.
- a) 1.30 lb/ft³
b) 4.04×10^4 lb/ft³
c) 879 lb/ft³
d) 942 lb/ft³
e) 1.21×10^3 lb/ft³
5. How many protons, neutrons, and electrons are present in ³⁷Cl⁻?
- a) 17 protons, 20 neutrons, 18 electrons
b) 17 protons, 20 neutrons, 16 electrons
c) 17 protons, 37 neutrons, 18 electrons
d) 17 protons, 37 neutrons, 16 electrons
e) 16 protons, 20 neutrons, 17 electrons
6. Write the balanced equation for the complete combustion of cyclobutanol, C₄H₈O, in oxygen. What is the coefficient on oxygen when this equation is balanced using the smallest whole-number coefficients?
- a) 6
b) 7
c) 8
d) 11
e) 12

7. Which of the following acids is not named correctly?
- a) HCl, hydrochloric acid
b) H₂SO₄, sulfuric acid
c) H₃PO₄, phosphoric acid
d) HCN, hydrocyanic acid
e) HNO₂, nitric acid
8. Chlorine has two naturally occurring isotopes, ³⁵Cl and ³⁷Cl. The isotopic mass of ³⁵Cl is 34.969, and the isotopic mass of ³⁷Cl is 36.966. What is the percent natural abundance of ³⁵Cl?
- a) 75.8%
b) 82.1%
c) 67.7%
d) 54.3%
e) 39.5%
9. The density of Hg is 13.6 g/cm³. How many Hg atoms are present in 10.0 cm³ of Hg?
- a) 3.00×10^{22}
b) 4.08×10^{23}
c) 4.43×10^{23}
d) 8.19×10^{25}
e) 8.88×10^{25}
10. Which of the following compounds is not molecular?
- a) NH₃
b) AlCl₃
c) PCl₃
d) H₂S
e) I₂
11. Solid lithium hydroxide is used in space vehicles to remove exhaled carbon dioxide. The lithium hydroxide reacts with gaseous carbon dioxide to form solid lithium carbonate and liquid water. How many grams of carbon dioxide can be absorbed by 10.0 g of lithium hydroxide?
- a) 36.8 g
b) 4.59 g
c) 10.9 g
d) 18.4 g
e) 9.19 g
12. Consider the following balanced equation:
- $$2\text{CO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g})$$
- Suppose that 10.0 g of carbon monoxide is allowed to react with 10.0 g of oxygen gas. If 10.0 g of carbon dioxide is formed, what is the percent yield? (The molar mass of CO is 28.01 g/mol; the molar mass of CO₂ is 44.01 g/mol.)
- a) 100 % d) 36.4%
b) 50.0 % e) 72.7%
c) 63.7%

13. If 10.0 g of CaCl_2 and 10.0 g of NaCl are dissolved in 100.0 mL of solution, what is the concentration of chloride ions? (The molar mass of CaCl_2 is 111.0 g/mol; the molar mass of NaCl is 58.44 g/mol.)
- 0.901 M
 - 1.71 M
 - 1.80 M
 - 2.62 M
 - 3.51 M
14. Ascorbic acid (vitamin C) contains 40.92% C, 4.58% H, and 54.50% O by mass. What is the empirical formula of ascorbic acid?
- $\text{C}_3\text{H}_4\text{O}_3$
 - CH_3O
 - $\text{C}_2\text{H}_6\text{O}$
 - $\text{C}_{10}\text{H}_{13}\text{O}_7$
 - $\text{C}_2\text{H}_2\text{O}$
15. Which of the compounds below is/are expected to be insoluble in water?
- CuSO_4
 - $\text{Mg}_3(\text{PO}_4)_2$
 - AgNO_3
 - $(\text{NH}_4)_2\text{CO}_3$
- II only
 - I only
 - I and II
 - III and IV
 - I, II, and IV
16. Place the following regions of the electromagnetic spectrum in order of increasing wavelength: microwaves, orange light, X rays, red light
- red light < orange light < microwaves < X rays
 - orange light < red light < microwaves < X rays
 - X rays < microwaves < red light < orange light
 - microwaves < red light < orange light < X rays
 - X rays < orange light < red light < microwaves
17. One of the lines in the spectrum of a mercury vapor lamp has a wavelength of 254 nm. What is the energy, in kJ/mol, of this electromagnetic radiation?
- 471 kJ/mol
 - 47.1 kJ/mol
 - 4.71×10^8 kJ/mol
 - 7.82×10^{-16} kJ/mol
 - 7.82×10^{-19} kJ/mol
18. What is the de Broglie wavelength, in meters, associated with a proton (mass = 1.673×10^{-24} g) accelerated to a velocity of 4.5×10^7 m/s?
- 8.8×10^{-4} m
 - 8.8×10^{-18} m
 - 8.8×10^{-15} m
 - 8.8×10^{-21} m
 - 8.8×10^{-29} m
19. The electron configuration shown below is incorrect because it violates:
- $$\begin{array}{ccc} \uparrow\downarrow & \uparrow\downarrow & \uparrow\downarrow \quad _ \quad _ \\ \text{1s} & \text{2s} & \text{2p} \end{array}$$
- the Heisenberg Uncertainty Principle
 - Hund's Rule
 - the Pauli exclusion principle
 - the aufbau principle
 - the de Broglie wavelength
20. What is/are the angular momentum quantum number(s) for the highest energy electron in a strontium atom (Sr)?
- 0, 1, 2, 3, 4
 - 4, -3, -2, -1, 0, +1, +2, +3, +4
 - 1
 - 4
 - 0
21. What is/are the possible magnetic quantum number(s) for the highest energy electrons in a phosphorus atom?
- 1, 0, +1
 - 2, -1, 0, +1, +2
 - 0, 1, 2
 - 0
 - 1
22. What is the electron configuration of radon (Rn, atomic number 86)?
- $[\text{Xe}] 6s^2 5p^6$
 - $[\text{Xe}] 6s^2 5f^{14} 5d^{10} 6p^6$
 - $[\text{Xe}] 6s^2 5d^{10} 6p^6$
 - $[\text{Xe}] 6s^2 4f^{14} 5d^{10} 6p^6$
 - $[\text{Xe}] 6s^2 4f^{10} 5d^{14} 6p^6$
23. Consider the electron configurations indicated below:
- Ti : $[\text{Ar}] 4s^2 4d^2$
 - Cu : $[\text{Ar}] 4s^2 3d^9$
 - Cl^- : $[\text{Ne}] 3s^2 3p^4$
- Which of these electron configurations is/are correct?
- I
 - II
 - III
 - II and III
 - none of these
24. Place the following atoms in order of increasing first ionization energy: Be, B, N, O.
- B < Be < O < N
 - O < N < B < Be
 - Be < B < N < O
 - Be < B < O < N
 - N < O < B < Be
25. Consider the nitrate anion. How many resonance structures can be drawn for nitrate in which all of the atoms obey the octet rule, and what is the formal charge on nitrogen in those resonance structures? (Note: N is the central atom.)
- 1 resonance structure; +1 formal charge on N
 - 2 resonance structures; +1 formal charge on N
 - 3 resonance structures; no formal charge on N
 - 3 resonance structures; +1 formal charge on N
 - 3 resonance structures; +2 formal charge on N

26. Consider the following resonance structures for N_2O , labeled **A**, **B**, and **C** below. Which resonance structure contributes most and which contributes least to the resonance hybrid? (Note: Formal charges and lone pair electrons are not shown.)



- a) A contributes most; B contributes least.
 b) A contributes most; C contributes least.
 c) B contributes most; A contributes least.
 d) B contributes most; C contributes least.
 e) C contributes most; B contributes least
27. Which of the following species is/are expected to be square planar?

- I. XeF_4
 II. SO_4^{2-}
 III. SF_4
 IV. CCl_4

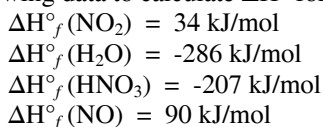
- a) I only
 b) I and II
 c) II and III
 d) II only
 e) I, II, and IV
28. How is the central atom (Xe) hybridized in XeF_4 ?

- a) sp d) sp^3d
 b) sp^2 e) sp^3d^2
 c) sp^3

29. Consider the following reaction:



Use the following data to calculate ΔH° for reaction.



- a) +64 kJ d) -508 kJ
 b) +140 kJ e) -712 kJ
 c) -140 kJ
30. For which of the following reactions is the value of ΔH° equal to ΔH_f° for the product?

- I. $2\text{Ca}(\text{s}) + \text{O}_2(\text{g}) \rightarrow 2\text{CaO}(\text{s})$
 II. $\text{C}_2\text{H}_2(\text{g}) + \text{H}_2(\text{g}) \rightarrow \text{C}_2\text{H}_4(\text{g})$
 III. $\text{S}(\text{s}) + \text{O}_3(\text{g}) \rightarrow \text{SO}_3(\text{g})$
 IV. $3\text{Mg}(\text{s}) + \text{N}_2(\text{g}) \rightarrow \text{Mg}_3\text{N}_2(\text{s})$

- a) II, III, and IV
 b) I, III, and IV
 c) IV only
 d) II and IV
 e) I, II, III, and IV

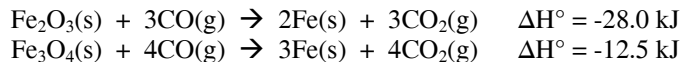
31. Consider the following thermochemical equation:



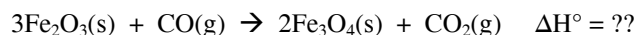
How much heat would be evolved by the reaction of 25.0 g of Na_2O_2 with water?

- a) 10.1 kJ
 b) 20.2 kJ
 c) 40.4 kJ
 d) 67.5 kJ
 e) 80.8 kJ

32. Given the following thermochemical equations:

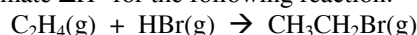


Determine the value of ΔH° for the following reaction:



- a) 40.5 kJ
 b) -15.5 kJ
 c) -109.0 kJ
 d) -96.5 kJ
 e) -59.0 kJ

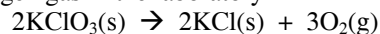
33. Use the table of bond dissociation energies below to estimate ΔH° for the following reaction:



Bond	D (kJ/mol)
C-C	348
C=C	614
C≡C	835
C-H	413
H-Br	366
C-Br	276

- a) +291 kJ d) +356 kJ
 b) +2017 kJ e) -57 kJ
 c) -356 kJ

34. The decomposition of potassium chlorate can be used to produce oxygen gas in the laboratory:



What volume of gas, measured under STP conditions, can be produced by the decomposition of 12.7 g of $\text{KClO}_3(\text{s})$? (The molar mass of KClO_3 is 122.5 g/mol.)

- a) 4.65 L d) 2.32 L
 b) 6.97 L e) 3.49 L
 c) 1.55 L

Answers

- | | | | | | | |
|------|-------|-------|-------|-------|-------|-------|
| 1. d | 6. d | 11. e | 16. e | 21. a | 26. d | 31. b |
| 2. c | 7. e | 12. c | 17. a | 22. d | 27. a | 32. e |
| 3. d | 8. a | 13. e | 18. c | 23. e | 28. e | 33. e |
| 4. e | 9. b | 14. a | 19. b | 24. a | 29. c | 34. e |
| 5. a | 10. b | 15. a | 20. e | 25. d | 30. c | |