

## 2024 ACES Sectional Chemistry Solution Set

Answer	Explanation																
1. Answer is B.	When reacting with sulfide ion ( $S^{2-}$ ) iron ion must carry 2+ charge in the formula. (Iron can also assume 3+ charge when the formula will be $Fe_2S_3$ ).																
2. Answer is D.	Choice-III is the only one that is correct. Choice-I: some molecules are not compounds $O_2$ . Choice-II: some elements exist in molecular form such as $N_2$ . Choice-IV: some molecular formulas show a multiplicity of the empirical formula.																
3. Answer is D.	Adding more water will aid in solubility.																
4. Answer is D.	Assuming 100.00 g of compound, convert gram to mole, take ratio to smallest mole to get to $CH_2O$ . <table style="margin-left: 20px;"> <thead> <tr> <th>Atom</th> <th>mass, g</th> <th>mole</th> <th>ratio to smallest mole</th> </tr> </thead> <tbody> <tr> <td>C</td> <td>40.00</td> <td>3.33</td> <td>1</td> </tr> <tr> <td>H</td> <td>6.71</td> <td>6.71</td> <td>2</td> </tr> <tr> <td>O</td> <td>53.29</td> <td>3.33</td> <td>1</td> </tr> </tbody> </table>	Atom	mass, g	mole	ratio to smallest mole	C	40.00	3.33	1	H	6.71	6.71	2	O	53.29	3.33	1
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5. Answer is B.	Alkanes have single bonds in the carbon chain. All inner C-atoms will be bonded to two H atoms while the terminal C-atoms will be bonded to three H atoms to generate the general formula of $C_nH_{2n+2}$ .																
6. Answer is E.	The bond between two different nonmetals is considered covalent. The bond is also polar due to the large difference in electronegativity between H and O.																
7. Answer is A.	Temperature rise in this problem is $\Delta t = 75 - 55 = 20$ °C. Plug this value in the following formula. $q = m \times c_p \times \Delta t = 48.2 \text{ g Cd} \times 6.2 \frac{\text{cal}}{\text{mol} \cdot ^\circ\text{C}} \times \frac{1 \text{ mol Cd}}{112.4 \text{ g Cd}} \times 20 \text{ }^\circ\text{C} = 53.17 \text{ cal}$																
8. Answer is A.	$CH_4$ , $N_2$ , and He are all non-polar species. While CO and $H_2O$ are both polar and contribute to the higher intermolecular force, $H_2O$ displays hydrogen bonding and CO doesn't. Therefore, water possesses the strongest intermolecular forces.																
9. Answer is E.	$pH = -\log [H^+] = -\log [0.0004 \text{ M}] = -(-4) = 4$ This leads to $pOH = 14 - 4 = 10$ . Therefore, $[OH^-] = 1 \times 10^{-10} \text{ M}$ .																
10. Answer is C.	Zero Kelvin is absolute zero on the temperature scale. Ideal behavior predicts a gas will have zero volume, as $V \propto T$ (in K) at constant pressure and number of moles.																
11. Answer is A.	Alpha rays contain particles of helium ions, $He^{2+}$ . Since they are heavier among the radioactive rays, they are slower in speed (lower energy) and unable to penetrate a paper barrier.																
12. Answer is D.	$0.5 \text{ mg} \times \frac{1 \text{ g}}{1000 \text{ mg}} \times \frac{1,000,000 \mu\text{g}}{1 \text{ g}} = 500 \mu\text{g}$																
13. Answer is A.	Comparing the atomic numbers of sodium and chlorine, we find that sodium contains 11 protons and chlorine contains 17 protons. The sum of protons is 28. $Na^+$ means that an electron was lost, so the number of electrons is 10. $Cl^-$ means that an electron was gained, so the number of electrons is 18. The sum of electrons is 28.																
14. Answer is B.	Choice A: $100 \text{ g } CO_2 \times \frac{2 \text{ mol O-atom}}{44 \text{ g } CO_2} = 4.55 \text{ mol O-atom}$ Choice B: $100 \text{ g } H_2O \times \frac{1 \text{ mol O-atom}}{18 \text{ g } H_2O} = \boxed{5.56 \text{ mol O-atom, the largest value}}$ Choice C: $1 \text{ mol } CO_2 \times \frac{2 \text{ mol O-atom}}{1 \text{ mol } CO_2} = 2.0 \text{ mol O-atom}$ Choice D: $2 \text{ mol } H_2O \times \frac{1 \text{ mol O-atom}}{1 \text{ mol } H_2O} = 2.0 \text{ mol O-atom}$ Since $1 \text{ mol} = 6.022 \times 10^{23}$ answer B produces the highest number of O-atoms.																





