

When Responding to the AP Chemistry Free Response Questions:

Write This...	...Not That!	Rationale
Generally		
Answer the specific question first, then “justify”, “explain” etc.	Burying the answer in the text of the response	Make it easy to give you points
Answers that are concise and direct	Burying the answer in a long response	Make it easy to give you points
Names of specific elements and compounds, “reactants”, “products”, etc.	“it”	Ambiguous
“Species”	“It”, “stuff”, etc.	Be formal in language
A justification or explanation when it is part of the question	Only the answer without supporting it	Justification/explanation required to earn point
“mass”, “volume”, etc.	“size”	Be specific
References to specific data or graphs when prompted to “explain how the data...” or something similar	Make generalizations about the data without specifically citing provided data or trials	Required to earn point
Net ionic equations only containing species that change	Aqueous ionic compounds in their undissociated form, spectator ions	Including these is not a net ionic, it’s a molecular or complete ionic
Polyatomic ions that are shown as a compound with the correct charge in solution	Polyatomic ions that are broken down into elemental ions in solution	Polyatomic ions themselves do not dissociate in solution, they only dissociate from the other ion in an ionic compound
Particle view diagrams with ions and polar molecules orientated in the correct direction relative to each other	Incorrectly oriented dipoles	Drawings must demonstrate understanding of interactions at the molecular level (ref. 2015 #4)
An answer with units if “include units” is stated in the problem	An answer without units	If “include units” is written in the prompt, a unit is required to earn full points
Show all work used to derive an answer and include units in the work	An answer without supporting work shown	Work is often what earns some/all of the points
Answers expressed to the correct number of significant figures, based on data given in the problem	Answers with an incorrect number of significant figures or significant figures limited by molar mass, constants, etc.	1 pt traditionally is assessed somewhere in the FR for significant figures.
Answers that only refer to substances/data included in the prompt	Answers with justifications based on situations or data that are not indicated in the prompt	Do not suggest the presence of a catalyst, student errors in lab questions that are not mentioned, etc. if it’s not mentioned in the prompt
Answers that refer to specific and correct glassware	Answers that use incorrect glassware for the task, particularly with regard to precision	Glassware has different specialized uses, and should be appropriately referenced/used based on the task
Abbreviations that are generally accepted (M, min, s, IMF, LDF, etc.)	Abbreviations that are not generally accepted (m for min, mol for molecule, etc)	Abbreviations still must convey the correct information; if in doubt, avoid them – don’t create ambiguity in an answer by using an abbreviation
Gases		
Components of the Kinetic Molecular Theory as justifications for changes at the molecular level	Ideal gas law for molecular level justification	arguments based on $PV = nRT$ are at the bulk level and not the molecular level (ref. 2013 #5)

R with the correct units to match the data given in the problem	An incorrect value of R	R has different values based on units
Temperature in K	Temperature in °C	Gas equations typically require temperature in K
There are more collisions with sufficient force between particles with greater kinetic energy	There are more collisions	Collisions must occur AND must have enough energy to overcome activation energy (ref. 2017 #1bi)
An increase in temperature increases the kinetic energy of the substances, both increasing the number of collisions and the likelihood that collisions will have enough energy to overcome E_a and will react	Temperature is a catalyst that speeds up the reaction.	Temperature is not a catalyst (ref. 2017 #1bi)
Thermodynamics		
“Thermodynamically favorable”, “thermodynamically feasible”	“Spontaneous”	Preferred AP language
Values with correct signs	Values with incorrect signs	Necessary for correct calculations and determinations – watch signs based on bonds breaking/forming, heat flow in calorimetry indicated by temperature changes, signs that may change in application of Hess’ Law, etc.
$\Delta H^\circ = \Sigma(\text{enthalpies of bonds broken}) - \Sigma(\text{enthalpies of bonds formed})$ when calculating $\Delta H^\circ_{\text{rxn}}$ from bond energies	$\Delta H^\circ_{\text{rxn}} = \Delta H_{\text{products}} - \Delta H_{\text{reactants}}$ when calculating $\Delta H^\circ_{\text{rxn}}$ from bond energies	Applying the wrong formula will give an incorrect sign for the $\Delta H^\circ_{\text{rxn}}$ (ref. 2017 #2b)
Reference number of molecules and phases when justifying a change in ΔS based on a reaction	Making vague references to “similar structures” or no justification	An increase in ΔS is due to an increase in number of gaseous products (ref. 2017 #2c)
Justify thermodynamic favorability in terms of both enthalpy and entropy	A thermodynamic favorability discussion referencing only enthalpy or entropy	Thermodynamic favorability depends on both ΔH and ΔS
Values with units that match constants and that are the same throughout the equation	Values with units that do not match other values/constants	Values must be the same unit through an equation, for both constants and variables
Kinetics		
Value of k with units	Value of k without units	Units required to earn point
Specific parts of the molecules that must collide in order for the reaction to occur	“Collision must occur in the correct orientation”	AP wants more specific answer
A rate law that includes the rate constant k as part of it	A rate law without k being included	Incomplete rate law if k is not included
A rate law based only on reactants	A rate law that includes products	Rate laws are based only on reactants
Equilibrium		
K without units	K with units	K is a unitless constant
Discussion of Q vs. K	“reduce the stress”, or “due to Le Châtelier’s Principle”	Preferred AP language
“Proceeds”	“Shift” – if equilibrium has not yet been established (i.e. a precipitate has not yet been formed when evaluating K_{sp})	If equilibrium is not yet established, then it cannot “shift” – rxn will proceed in a certain direction until equilibrium is established
K_{sp} expressions that only contain the ions	K_{sp} expressions that contain or imply a species in the denominator	Solids and liquids are not included in equilibrium expressions

Correct formulas (including charges!) for all species in equilibrium expressions	Substitutions, abbreviations, chargeless ions, other shorthand that may work out in calculations but does not represent the correct species	Equilibrium expressions must be written formally when requested
In K_p expressions: P_{species}	In K_p expressions: [species]	Concentration is not used in K_p , partial pressures are
“x has been assumed to be so small relative to the original concentrations that it can be ignored”	Nothing about why you ignore x to avoid quadratics	Show you understand why you are making the decision
“K is greater than 1, indicating that the products are present in a higher concentration and therefore equilibrium lies to the right”	“K is large”	Use specific values to demonstrate understanding about the meaning of K relative to the equilibrium position (ref. 2017 #2d)
Use an ICE table to determine equilibrium concentrations and plug in to solve for K	Use initial concentrations to solve for K	K must be used with equilibrium concentrations, not initial concentrations
Acids and Bases		
“The pH > 7 because the salt produced in the neutralization behaves as a base: $A^- + H_2O \rightleftharpoons HA + OH^-$ ”	“The pH > 7 because it’s a battle between weak acid and strong base and strong base wins.”	State the actual reason not the memory aid
“The solution is neutral when $[H_3O^+] = [OH^-]$.”	“The solution is neutral when pH=7.”	True definition of neutral – neutral is only pH of 7 when $K_w = 1.0 \times 10^{-14}$ (at 298 K)
$K_w = K_a \times K_b$ for a conjugate pair	$K_w = K_a \times K_b$ for an unrelated acid/base pair	This equation only holds true for conjugate acid-base pairs
A buffer system containing a weak acid and its conjugate base (or a weak base and its conjugate acid)	A buffer system that contains a strong acid or base; a buffer containing any acid/base with a common ion	A buffer results from the presence of a weak acid or base and its conjugate; a strong-strong system will neutralize without buffering
“This buffer has a higher buffering capacity because it contains a higher concentration of weak acid/base and its conjugate to react with added H^+ or OH^- ions.”	“Higher volume of weak acid/base”	Buffering capacity is related to the presence of both the weak species and its conjugate.
Atomic Structure		
“Effective nuclear charge increases”	“It wants to have a full octet”; “it’s close to having a full octet”	State the actual reason not the memory aid
“It has a more polarizable cloud of electrons”	“It has more electrons”, “it has more mass”, “it has more surface area”, “it is bigger”, “it has more protons”	State the actual reason not the memory aid
“period”	“shell” when referring to elements and their location on the Periodic Table	Elements are in a period, electrons are in a shell
Reference reasons for periodic trends (i.e. effective nuclear charge, coulomb’s law, polarizability, etc.)	Stating the trend as the reason (“because it is to the left”, “because it is further down the periodic table”, etc.)	State the actual reason not the memory aid
“Electrons in higher energy levels are farther from the nucleus, resulting in a larger atom/ion.”	“More electrons/more energy levels makes the atom/ion bigger.”	Explanation of reason, not just statement of fact, required for point (Ref 2016 #1)
Ion electron configurations that show electrons were removed from valence shell orbitals	Ion electron configurations that show electrons were removed from inner orbitals	Ions form by electrons being lost from the outermost shell; this may or may not be the electrons that

		were filled last in the electron configuration
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Bonding and Intermolecular Forces		
“Overcome intermolecular forces”	“break up” a solid/liquid, break covalent bonds	IMFs should be used to justify phase changes
“Stronger intermolecular forces increase boiling point”	“Stronger covalent bonds increase boiling point”	IMF’s, not bonds, are what are overcome during phase changes
Ion interactions	LDF’s when discussing ionic compounds	Ionic compounds have ions with whole charges, which dominate interactions
“Coulombic attraction”	“Opposites attract”	State the actual reason not the memory aid
Describe the process of overcoming intermolecular forces/polarity	“Like dissolves like”	State the actual reason not the memory aid
“Has hydrogen bonds between the molecules”	“Has hydrogen bonds”	Shows that you understand hydrogen bonds are not actually bonds
“ionic compound”	“molecule” when discussing an ionic compound	A molecule is a covalent compound
“ions”	“atoms” when discussing ionic compounds	Ionic compounds contain ions
“atoms”	“ions” when discussing covalent compounds	Covalent compounds do not contain ions
Lewis structures that are complete with necessary lone pairs and/or resonance	Lewis structures that are missing lone pairs and/or resonance (if needed for correct structures)	Lewis structures are incorrect without necessary lone pairs
Identify specific intermolecular forces at play	“stronger intermolecular forces”	Shows your understanding of the chemistry at play
LDFs increase within an increasing number of electrons and therefore polarizability	LDFs increase with increasing size/mass	Increased number of electrons in an atom is what actually increases the LDF; increased size usually parallels this but is not the reason for increased strength of LDF
Multiple bonds when there are not enough valence electrons to satisfy the octet rule	Multiple bonds when the octet rule for the structure would have been satisfied without them	Multiple bonds are only needed when there are not enough valence electrons to satisfy the octet rule
Hydrogen bonding, dipole-dipole, London dispersion forces, etc. when asked to identify intermolecular forces	Ionic bonds, covalent bonds, metallic bonds when asked to identify intermolecular forces	Intermolecular forces are attractions between molecules; bonds are intramolecular forces (within molecules)
Comparison of R_f values in chromatography	Comparison of absolute height of spots on chromatograms	It is important to take into account a difference in the distance the solvent front travelled between different chromatograms (ref. 2017 #4)
Discussion of intermolecular forces between analyte molecules and stationary/mobile phases	Repulsions between analyte molecules and stationary/mobile phases	The movement in chromatography is determined by the attraction for the stationary/mobile phase (ref 2017 #4)
Electrochemistry		
Loss of mass of electrode is due to atoms of electrode going into solution as ions	Loss of mass of electrode is due to loss of electrons	Electrons have extremely small (negligible in this case) mass (ref. 2014 #3)
Discussion of Q vs. K for changes in cell potential after a change, or	Discussion of Le Châtelier’s principle	Preferred AP language (ref. 2014 #3)

qualitative discussion of Nernst Equation		
An equation that is balanced with respect to both number of atoms and charge	An equation that is unbalanced in atoms, charge or both; an equation that shows electrons	Recognize that equations need to be balanced with respect to both atoms and charge – this means that half-reactions may need to be multiplied by a coefficient to balance charge for the overall reaction, even if atoms are already balanced, and then the electrons on both sides cancel out and are not written
E° value not multiplied by stoichiometric factors	E° value that has been multiplied by a stoichiometric value	E° is intensive and therefore does not change if the half-cell is multiplied by a stoichiometric factor to balance charge
Standard Cell potential when discussing a REDOX reaction	Standard reduction potential when discussing a REDOX reaction	A redox reaction contains both oxidation and reduction; therefore the E° for the reaction is the sum of the standard reduction potentials of both the oxidation and reduction half-reactions
“Ions flow through the salt bridge to maintain a charge balance in each half-cell.”	“Electrons flow through the salt bridge to equilibrate charge.”	Electrons do not flow through the salt bridge; ions flow through the salt bridge, electrons flow through the wire

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Sources: Review of Released Free-Response Questions with Samples and Commentary
 Adrian Dingle’s Blog Posts on Writing Good Answers (<https://www.adriandingleschemistrypages.com/>)
 AACT Webinar: Teaching Students How to Better Answer Non-Calculator Problems
 AP Teacher Community
 AP Teachers in the National AP Chemistry Teachers Facebook Group

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