RICE – SPRING AP CHEMISTRY REVIEW PREP

FEBRUARY 22, 2020

Lisa McGaw
Dr. John Gelder

WELCOME!

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- Dr. John Gelder – Oklahoma State University – Professor Chemistry (retired)
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YOUR TURN!

WELCOME!

- This is a safe place….we are all at different levels.
- Questions are appropriate and appreciated.
- If a discussion reminds you of a question which is on a different subject/topic, write on a post-it and place in the parking lot.
- Sharing from your experience is useful. However, all voices need to be heard and everyone's input is equally valued.
- Respect each speaker by trying to minimize interruptions or side conversations.
- Follow the agenda and be on time for each session. Lunch will be staggered.

OVERVIEW OF TRAINING

- 2020 Exam format
- Topic Breakdown
- Multiple choice
- Mock reading – Q4 and Q6
- Topic discussions
  - Equilibrium
  - Acid/base/buffer
  - Laboratory
  - Kinetics
- Free response tips
- Reviewing for the exam

AP Chemistry Exam

- Exam format specifics (see handout)
- New CB equation page and periodic table
- Formulas not found on the equation page (Lisa's)

THE AP EXAM

- Thursday, May 7, 2020 at 8:00 am
- Overview of AP exam –
- 90 minutes MC; 105 minutes FR
  - 60 MC (all count) – 50% of exam
  - 7 FR – added space between each part – 50% of exam
- Resources – equation sheet and periodic table for entire exam
- Calculator ONLY for FR

MULTIPLE CHOICE

- AP Chemistry MC questions require that the students "interact" with their text
- Students should take 3 sweeps through the MC
  - 1st sweep – answer all of the questions that do not take much time and the student is confident about
  - 2nd sweep – answer those questions that require a little more time but the student generally knows how to do (math)
  - 3rd sweep – attempt all of the questions that are left – eliminate answer choices and make your best guess
- Any mathematical problems should be set up – mental math should be relatively simple
- Broad content coverage

MULTIPLE CHOICE BREAKDOWN

The new Course and Exam Description now structures the course into 9 Units instead of 6 Big Ideas. A percentage breakdown for the weight on the AP exam is given below.

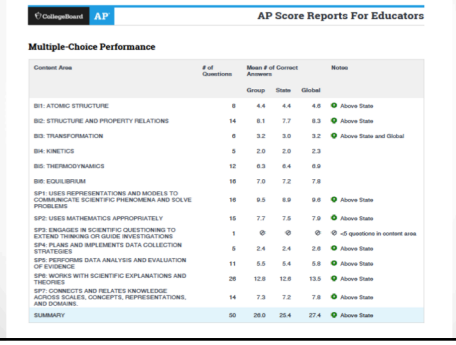
Unit	Topic	Max Class Periods	Max Weight
1	Atomic Structure and Properties	10	9
2	Molecular and Ionic Compound Structure and Properties	13	9
3	Intermolecular Forces and Properties	15	22
4	Chemical Reactions	15	9
5	Kinetics	14	9
6	Thermodynamics	11	9
7	Equilibrium	16	9
8	Acids and Bases	15	15
9	Applications of Thermodynamics	13	9

MULTIPLE CHOICE BREAKDOWN

Science Practices 1, 2, 4, 5 and 6 are all assessed on the multiple-choice section with the following weighting. (Science practice 3 is not assessed in the multiple-choice section.)

SP	Science Practice	Min Weight	Max Weight
1	Models and Representations	8	12
2	Question and Method	8	12
3	Representing Data and Phenomena	---	---
4	Model Analysis	23	30
5	Mathematical Routines	35	42
6	Argumentation	8	12
**	Note: SP's are no longer "married" to a specific LO in the new CED	**	

Instructional Planning Reports - 2019



AP Score Reports For Educators

Multiple-Choice Performance

Content Area	# of Questions	Mean # of Correct Answers			Notes
		Group	State	Global	
B1: ATOMIC STRUCTURE	8	4.4	4.4	4.6	Above State
B2: STRUCTURE AND PROPERTY RELATIONS	14	8.1	7.7	8.3	Above State
B3: TRANSFORMATION	6	3.2	3.0	3.2	Above State and Global
B4: KINETICS	5	2.0	2.0	2.3	
B5: THERMODYNAMICS	12	6.3	6.4	6.9	
B6: EQUILIBRIUM	16	7.0	7.2	7.8	
SP1: USES REPRESENTATIONS AND MODELS TO COMMUNICATE SCIENTIFIC PHENOMENA AND SOLVE PROBLEMS	16	9.5	8.9	9.6	Above State
SP2: USES MATHEMATICS APPROPRIATELY	15	7.7	7.5	7.9	Above State
SP3: ENGAGES IN SCIENTIFIC QUESTIONING TO EXTEND THINKING OR GUIDE INVESTIGATIONS	1	@	@	@	<5 questions in content area
SP4: PLANS AND IMPLEMENTS DATA COLLECTION STRATEGIES	5	2.4	2.4	2.8	Above State
SP5: PERFORMS DATA ANALYSIS AND EVALUATION OF EVIDENCE	11	5.5	5.4	5.8	Above State
SP6: WORKS WITH SCIENTIFIC EXPLANATIONS AND THEORIES	26	12.8	12.6	13.5	Above State
SP7: CONNECTS AND RELATES KNOWLEDGE ACROSS SCALES, CONCEPTS, REPRESENTATIONS, AND DOMAINS.	14	7.3	7.2	7.8	Above State
SUMMARY	50	26.0	25.4	27.4	Above State

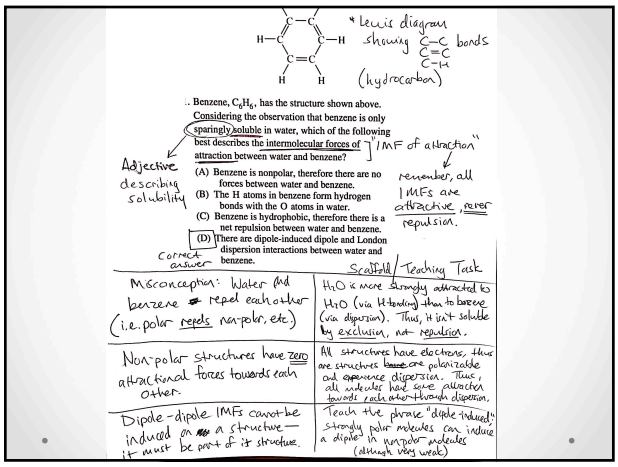
Instructional Planning Reports

Free-Response Performance

Question	Science Practice	Max Score	Mean			Notes
			Group	State	Global	
UREA - STRUCTURE/THERMODYNAMICS OF DISSOLUTION	1, 2, 4, 5, 6	10	4.8	4.8	5.5	
HALOGENS - IMFS, EQUILIBRIUM, AND BOND ENERGY	1, 2, 6, 7	10	4.0	4.0	4.7	Above State
ANALYSIS OF SODIUM CARBONATE SOLUTION	1, 2, 4, 5, 6, 7	10	2.1	2.4	3.0	
KMT AND GAS LAWS - CARBON DIOXIDE	1, 2, 5, 6	4	2.2	2.2	2.4	
PES AND RADIATION WAVELENGTH	5, 6	4	2.5	2.3	2.6	Above State
KINETICS - NITROGEN OXIDES	5, 6	4	1.1	1.1	1.3	Above State
REDOX TITRATION	2, 4, 5, 6	4	1.4	1.5	1.8	
SUMMARY		50	19.5	19.8	23.3	

MULTIPLE CHOICE MENTALITY

- With a partner you will scaffold two MC questions – do your work on chart paper
  - Underline any chemistry specific jargon
  - Circle any non-chemistry vocabulary that might be confusing
  - **Summarize** what the question is asking in a few words
  - Identify any **misconceptions** found in incorrect answer choices
  - Identify an activity, demonstration, etc. to address that misconception



AP READING 2019

308 Readers
39 Table Leaders
17 Question Leaders
3 Exam Leaders
1 CR

368 People

143,397 Operational Exams
12,690 International Exam
3,612 Alternate Exams
115 Form Z

159,814 Exams
1,118,698 Questions
7,351,444 Points Scored

We have a job to do…

MOCK READING

- General steps:

- Take 7 minutes to answer the question
- Look over the rubric alone
- Review the rubric together
- Calibrate by scoring sample student papers
- Divide into five groups of three – designate the reader with the most years of experience as the table leader for your group
- Score the papers

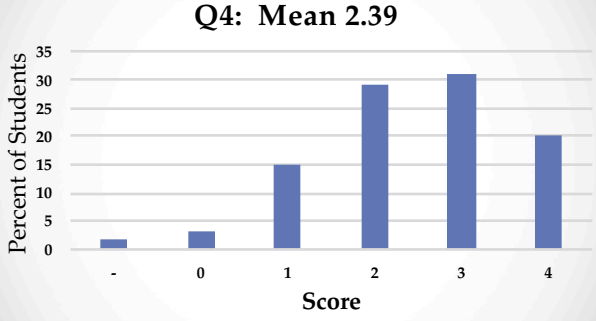
4. A student is doing experiments with $CO_2(g)$. Originally, a sample of the gas is in a rigid container at 299 K and 0.70 atm. The student increases the temperature of the $CO_2(g)$ in the container to 425 K.

   (a) Describe the effect of raising the temperature on the motion of the $CO_2(g)$ molecules.

   (b) Calculate the pressure of the $CO_2(g)$ in the container at 425 K.

   (c) In terms of kinetic molecular theory, briefly explain why the pressure of the $CO_2(g)$ in the container changes as it is heated to 425 K.

   (d) The student measures the actual pressure of the $CO_2(g)$ in the container at 425 K and observes that it is less than the pressure predicted by the ideal gas law. Explain this observation.



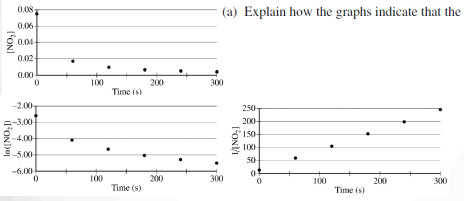
MOCK READING

- We will follow the same general steps as we did for Q4 but this time when we check the rubric you will use the highlight/re-write strategy.
- Take 7 minutes to answer the question
- Look over the rubric and follow guide for highlight/re-write (on later slide)
- Review the rubric together- any questions
- Calibrate by scoring sample student papers
- Divide into five groups of three – designate the reader with the most years of experience as the table leader for your group
- Score the papers

6. Nitrogen dioxide, $NO_2(g)$, is produced as a by-product of the combustion of fossil fuels in internal combustion engines. At elevated temperatures $NO_2(g)$ decomposes according to the equation below.

$$2\ NO_2(g) \rightarrow 2\ NO(g) + O_2(g)$$

The concentration of a sample of $NO_2(g)$ is monitored as it decomposes and is recorded on the graph directly below. The two graphs that follow it are derived from the original data.



(a) Explain how the graphs indicate that the reaction is second order.

$2\ NO_2(g) \rightarrow 2\ NO(g) + O_2(g)$

(b) Write the rate law for the decomposition of $NO_2(g)$.

(c) Consider two possible mechanisms for the decomposition reaction.

(i) Is the rate law described by mechanism I shown below consistent with the rate law you wrote in part (b) ? Justify your answer.

Mechanism I

Step 1:	$NO_2(g) + NO_2(g) \rightarrow NO(g) + NO_3(g)$	*slow*
Step 2:	$NO_3(g) \rightarrow NO(g) + O_2(g)$	*fast*

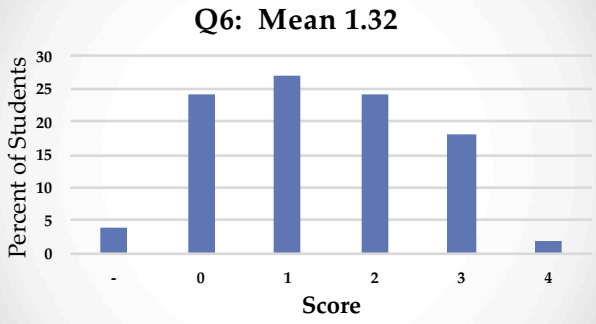
(ii) Is the rate law described by mechanism II shown below consistent with the rate law you wrote in part (b) ? Justify your answer.

Mechanism II

Step 1:	$NO_2(g) + NO_2(g) \rightleftarrows N_2O_4(g)$	*fast equilibrium*
Step 2:	$N_2O_4(g) \rightarrow 2\ NO(g) + O_2(g)$	*slow*

ANALYZING CLAIMS AND SUPPORTING EVIDENCE

- Highlight – students are timed to complete a FRQ; give each student the rubric and have them highlight with different colors.
- Green – highlight everything that is correct
- Pink – everything that is incorrect
- Yellow – everything that is extra but not incorrect
- Blue or orange– write by hand anything that is missing and highlight
- Addition – take away notes and have them repeat answering the same question and see how well they respond



YOUR QUESTIONS

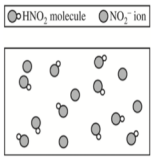
- Equilibrium – 7.8 and 7.14
- Acid/base/buffer
- Nuggets of wisdom
- Testable vs not testable
- Review materials
- Review schedule
- Electrochemistry
- Kinetics

EQUILIBRIUM

- Topic 7.8:
  Representations of Equilibrium
  Particulate representations can be used to describe the relative numbers of reactant and product particles present prior to and at equilibrium, and the value of the equilibrium constant.
  - John's graphical representations of equilibrium
  - Retired FRQ with particulate images here – work through these
- 2018 – Q5
- 2017 – Q3

PARTICULATE DIAGRAMS

(e) A new buffer is made using $HNO_2(aq)$ as one of the ingredients. A particulate representation of a small representative portion of the buffer solution is shown below. (Cations and water molecules are not shown.) Is the pH of the buffer represented in the diagram greater than, less than, or equal to 3.40 ? Justify your answer.

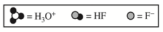


PARTICULATE DIAGRAMS

$$HF(aq) + H_2O(l) \rightleftarrows F^-(aq) + H_3O^+(aq)$$

5. The ionization of $HF(aq)$ in water is represented by the equation above. In a 0.0350 M $HF(aq)$ solution, the percent ionization of HF is 13.0 percent.

(a) Two particulate representations of the ionization of HF molecules in the 0.0350 M $HF(aq)$ solution are shown below in Figure 1 and Figure 2. Water molecules are not shown. Explain why the representation of the ionization of HF molecules in water in Figure 1 is more accurate than the representation in Figure 2. (The key below identifies the particles in the representations.)



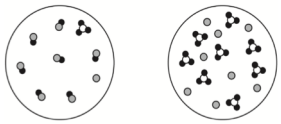


Figure 1 Figure 2

EQUILIBRIUM CONT'D

- Topic 7.14:
  Free Energy of Dissolution
  The free energy change (ΔG°) for dissolution of a substance reflects a number of factors: the breaking of the intermolecular interactions that hold the solid together, the reorganization of the solvent around the dissolved species, and the interaction of the dissolved species with the solvent. It is possible to estimate the sign and relative magnitude of the enthalpic and entropic contributions to each of these factors. However, making predictions for the total change in free energy of dissolution can be challenging due to the cancellations among the free energies associated with the three factors cited.
- Animation of the solution process from John's site

ACID-BASE-BUFFER

- What's in the beaker?
- Show your work!
- Titration ppt from Benigna
  - make cut-outs with magnetic sheets and have students arrange the particulate pictures here

WHAT'S IN THE BEAKER?

- Each group of two will receive a notecard with 2 solutions
- For each solution:
  - Identify as: strong acid/strong base/weak acid/weak base/acidic salt/basic salt/neutral salt
  - Calculate the pH of the solution
- For each mixture:
  - Identify as: strong acid/strong base/weak acid/weak base/acidic salt/basic salt/neutral salt/acidic buffer/basic buffer
  - Calculate the pH of the solution
  - PUT ALL OF YOUR WORK ON CHART PAPER

NUGGETS OF WISDOM

- Claim, evidence and reasoning for free response
- Refer to evidence in the problem
- Show your work! (mole calculations; pH)
- Set up the problems in a logical format
- Intramolecular (between atoms or ions) vs Intermolecular between species
- Others?

TESTABLE/NOT

- Refer to the CED
- Look for exclusion statements

**know that the "answers are the same" but the questions will be asked in a different way

REVIEW MATERIALS

- AP Classroom – retired questions
- Practice exams
- Review books
- AP review from previous years – ppt
- Labs to review topics (any labs not yet completed; labs from beginning of year; labs that cover many concepts)
- Rotation stations for any topic
- Other ideas?

ELECTROCHEMISTRY

- Simulations of galvanic and electrolytic cells
- Guided FR

Kinetics

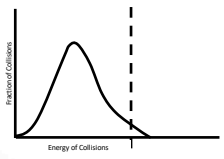
- Unit 5–
- Mechanisms –
  - Mechanism A
  - Mechanism B

What benefits do you see by teaching mechanisms first?

Introduce – BCE's ACA's DCI's – where to find all of this information
Student Page
Teacher Page

Maxwell-Boltzman

- Where is the Ea on this curve?
- What happens when the temperature is increased?
- What happens when a catalyst is added?



THE AP EXAM - Resources

AP Central

- AP Classroom
- Calculator policies
- Past exams
- Chief reader report
- AP Verbs Document
- IPR information
- Quantitative Skills Handbook

THANK YOU!

- Thank you for joining us today in the Spring AP Exam Prep workshop hosted by Rice University
- Good luck with the rest of the semester and best wishes for review and exam time!

John and Lisa