Practice Test 4

AP® Chemistry Exam

SECTION I: Multiple-Choice Questions

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

At a Glance

Total Time
1 hour and 30 minutes
Number of Questions
60
Percent of Total Grade
50%
Writing Instrument
Pencil required

Instructions

Section I of this examination contains 60 multiple-choice questions. Fill in only the ovals for numbers 1 through 60 on your answer sheet.

CALCULATORS MAY NOT BE USED IN THIS PART OF THE EXAMINATION.

Indicate all of your answers to the multiple-choice questions on the answer sheet. No credit will be given for anything written in this exam booklet, but you may use the booklet for notes or scratch work. After you have decided which of the suggested answers is best, completely fill in the corresponding oval on the answer sheet. Give only one answer to each question. If you change an answer, be sure that the previous mark is erased completely. Here is a sample question and answer.

Sample Question   Sample Answer

Chicago is a   Ⓐ ● Ⓒ Ⓓ
(A) state
(B) city
(C) country
(D) continent

Use your time effectively, working as quickly as you can without losing accuracy. Do not spend too much time on any one question. Go on to other questions and come back to the ones you have not answered if you have time. It is not expected that everyone will know the answers to all the multiple-choice questions.

About Guessing

Many candidates wonder whether or not to guess the answers to questions about which they are not certain. Multiple-choice scores are based on the number of questions answered correctly. Points are not deducted for incorrect answers, and no points are awarded for unanswered questions. Because points are not deducted for incorrect answers, you are encouraged to answer all multiple-choice questions. On any questions you do not know the answer to, you should eliminate as many choices as you can, and then select the best answer among the remaining choices.

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CHEMISTRY
SECTION I
Time—1 hour and 30 minutes

INFORMATION IN THE TABLE BELOW AND ON THE FOLLOWING PAGES MAY BE USEFUL IN ANSWERING THE QUESTIONS IN THIS SECTION OF THE EXAMINATION

DO NOT DETACH FROM BOOK.

PERIODIC TABLE OF THE ELEMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 **H** 1.008																	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.30											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.87	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.38	31 **Ga** 69.72	32 **Ge** 72.63	33 **As** 74.92	34 **Se** 78.97	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.95	43 **Tc** (97)	44 **Ru** 101.1	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.76	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57 ***La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.84	75 **Re** 186.21	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 †**Ac** (227)	104 **Rf** (267)	105 **Db** (270)	106 **Sg** (271)	107 **Bh** (270)	108 **Hs** (277)	109 **Mt** (276)	110 **Ds** (281)	111 **Rg** (282)	112 **Cn** (285)	113 **Uut** (285)	114 **Fl** (289)	115 **Uup** (288)	116 **Lv** (293)	117 **Uus** (294)	118 **Uuo** (294)

*Lanthanide Series:	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 151.97	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.05	71 **Lu** 174.97
†Actinide Series:	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)

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ADVANCED PLACEMENT CHEMISTRY EQUATIONS AND CONSTANTS

Throughout the test the following symbols have the definitions specified unless otherwise noted.

L, mL	= liter(s), milliliter(s)		mm Hg	= millimeters of mercury
g	= gram(s)		J, kJ	= joule(s), kilojoule(s)
nm	= nanometer(s)		V	= volt(s)
atm	= atmosphere(s)		mol	= mole(s)

ATOMIC STRUCTURE

$$E = h\nu$$

$$c = \lambda\nu$$

E = energy
ν = frequency
λ = wavelength

Planck's constant, $h = 6.626 \times 10^{-34}$ J s

Speed of light, $c = 2.998 \times 10^8$ m s^{-1}

Avogadro's number $= 6.022 \times 10^{23}$ mol^{-1}

Electron charge, $e = -1.602 \times 10^{-19}$ coulomb

EQUILIBRIUM

$$K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}, \text{ where } a\,A + b\,B \rightleftarrows c\,C + d\,D$$

$$K_p = \frac{(P_C)^c(P_D)^d}{(P_A)^a(P_B)^b}$$

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

$$K_b = \frac{[OH^-][HB^+]}{[B]}$$

$$K_w = [H^+][OH^-] = 1.0 \times 10^{-14} \text{ at } 25°C$$

$$= K_a \times K_b$$

$$pH = -\log[H^+], \ pOH = -\log[OH^-]$$

$$14 = pH + pOH$$

$$pH = pK_a + \log\frac{[A^-]}{[HA]}$$

$$pK_a = -\log K_a, \ pK_b = -\log K_b$$

Equilibrium Constants

K_c (molar concentrations)
K_p (gas pressures)
K_a (weak acid)
K_b (weak base)
K_w (water)

KINETICS

$$\ln[A]_t - \ln[A]_0 = -kt$$

$$\frac{1}{[A]_t} - \frac{1}{[A]_0} = kt$$

$$t_{1/2} = \frac{0.693}{k}$$

k = rate constant
t = time
$t_{1/2}$ = half-life

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GASES, LIQUIDS, AND SOLUTIONS

$$PV = nRT$$

$$P_A = P_{total} \times X_A, \text{ where } X_A = \frac{\text{moles A}}{\text{total moles}}$$

$$P_{total} = P_A + P_B + P_C + \ldots$$

$$n = \frac{m}{M}$$

$$K = {}^{\circ}C + 273$$

$$D = \frac{m}{V}$$

$$KE \text{ per molecule} = \frac{1}{2}mv^2$$

Molarity, M = moles of solute per liter of solution

$$A = abc$$

P = pressure
V = volume
T = temperature
n = number of moles
m = mass
M = molar mass
D = density
KE = kinetic energy
v = velocity
A = absorbance
a = molar absorptivity
b = path length
c = concentration

Gas constant, R = 8.314 J mol^{-1} K^{-1}
= 0.08206 L atm mol^{-1} K^{-1}
= 62.36 L torr mol^{-1} K^{-1}
1 atm = 760 mm Hg
= 760 torr

STP = 273.15 K and 1.0 atm
Ideal gas at STP = 22.4 L mol^{-1}

THERMOCHEMISTRY/ ELECTROCHEMISTRY

$$q = mc\Delta T$$

$$\Delta S^{\circ} = \sum S^{\circ} \text{ products} - \sum S^{\circ} \text{ reactants}$$

$$\Delta H^{\circ} = \sum \Delta H_f^{\circ} \text{ products} - \sum \Delta H_f^{\circ} \text{ reactants}$$

$$\Delta G^{\circ} = \sum \Delta G_f^{\circ} \text{ products} - \sum \Delta G_f^{\circ} \text{ reactants}$$

$$\Delta G^{\circ} = \Delta H^{\circ} - T\Delta S^{\circ}$$

$$= -RT \ln K$$

$$= -nFE^{\circ}$$

$$I = \frac{q}{t}$$

q = heat
m = mass
c = specific heat capacity
T = temperature
S° = standard entropy
H° = standard enthalpy
G° = standard free energy
n = number of moles
E° = standard reduction potential
I = current (amperes)
q = charge (coulombs)
t = time (seconds)

Faraday's constant, F = 96,485 coulombs per mole
of electrons

$$1 \text{ volt} = \frac{1 \text{ joule}}{1 \text{ coulomb}}$$

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$$Ag_2CO_3(s) \rightleftharpoons 2Ag^+(aq) + CO_3^{2-}(aq) \quad K_{sp} = 8.5 \times 10^{-12}$$

1. Which of the following is true about a beaker containing a saturated solution of silver carbonate?

   (A) The molar solubility of Ag_2CO_3 is equal to the concentration of the silver ions.
   (B) There would be no solid present at the bottom of the beaker.
   (C) The concentration of the silver ions will be twice that of the carbonate ions.
   (D) Adding more water would increase the solubility product constant.

2. Nitrous acid, HNO_2, has a pK_a value of 3.4. A solution of nitrous acid has some sodium nitrite, $NaNO_2$, added to it, creating a buffer solution. If the pH of the buffer solution is found to be 3.4, which of the following particulate representations shows the correct ratio of acid and conjugate base molecules in the buffer?

(A)

(C)

(B)

(D)

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$
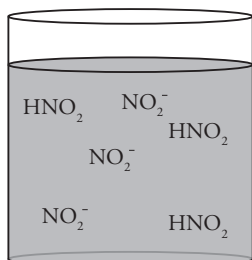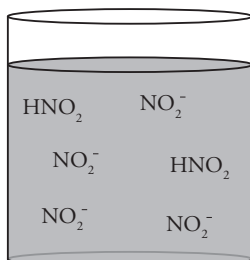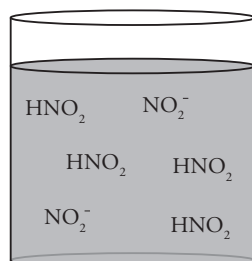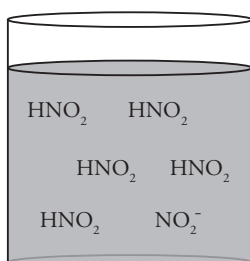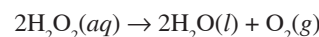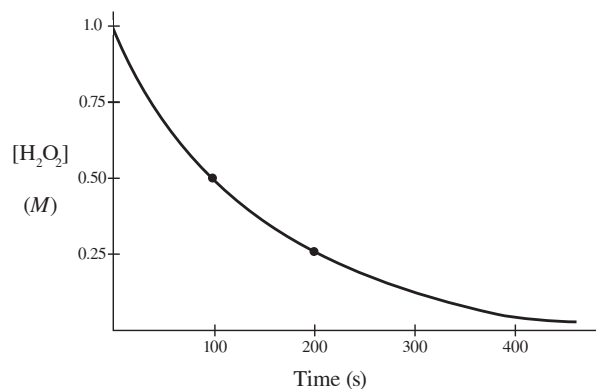
3. A sample of hydrogen peroxide, H_2O_2, will decompose over time. The above graph charts the concentration of an H_2O_2 sample over time. What is the rate law for the overall reaction?

   (A) Rate = k
   (B) Rate = $k[H_2O_2]$
   (C) Rate = $k[H_2O_2]^2$
   (D) Rate = $k[H_2O][O_2]$
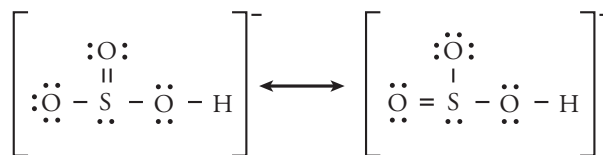
4. The Lewis diagram of the bisulfite ion, HSO_3^-, is drawn above. Which of the following descriptions correctly compares the bond lengths of the three sulfur-oxygen bonds found in bisulfite?

   (A) All bonds are the same length.
   (B) Of the three bonds, there is one longer one and two shorter ones of identical length.
   (C) Of the three bonds, there are two longer ones of identical length and one shorter one.
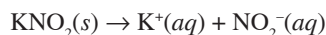   (D) All three bonds are different lengths.

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$2H^+(aq) + 2e^- \rightarrow H_2(g)$ $E° = +0.00$ V
$K^+(aq) + e^- \rightarrow K(s)$ $E° = -2.92$ V

5. A piece of potassium metal is added to a solution of hydrochloric acid, and the metal starts to react. Which of the following is the correct net ionic equation for the reaction that is occurring?

  (A) $2H^+(aq) + K^+(aq) + 3e^- \rightarrow H_2(g) + K(s)$
  (B) $2H^+(aq) + 2K^+(aq) + 4e^- \rightarrow 2K(s) + H_2(g)$
  (C) $2H^+(aq) + K(s) \rightarrow K^+(aq) + H_2(g)$
  (D) $2H^+(aq) + 2K(s) \rightarrow 2K^+(aq) + H_2(g)$

6. A solution of methanol, $CH_3OH(aq)$, has a vapor pressure of 13.2 kPa at room temperature. If the solution were to be heated, what would happen to the vapor pressure, and why?

  (A)   Increase, because intramolecular attractions are breaking
  (B)   Increase, because the molecules in solution are moving faster
  (C)   Decrease, because stronger intermolecular attractions will form
  (D)   Remain unchanged, because the system is already at equilibrium

Use the following information to answer questions 7-10.

$$KNO_2(s) \rightarrow K^+(aq) + NO_2^-(aq)$$

7. A student wants to determine the enthalpy of solution for potassium nitrite, KNO_2 (molar mass = 85.1 g/mol). The student takes a sample of KNO_2 and fully dissolves it into some water that is in a Styrofoam cup, gathering the following data. The density and specific heat of the final solution are identical to that of pure water, 1.0 g/mL and 4.2 J/g°C, respectively.

Mass KNO_2	8.50 g
Volume Water	91.50 mL
Initial Water Temperature	22.5°C
Final Water Temperature	19.5°C

What is the approximate enthalpy of solution for KNO_2?
  (A)   −12.6 kJ/mol
  (B)   −1.26 kJ/mol
  (C)   1.26 kJ/mol
  (D)   12.6 kJ/mol

8. Which of the following statements is correct regarding the favorability of this process?

  (A)   The process is favored and driven by enthalpy and entropy.
  (B)   The process is favored and driven by enthalpy only.
  (C)   The process is favored and driven by entropy only.
  (D)   The process is not favored.

9. For the reaction to be endothermic, the magnitude of the attractive forces between the dissociated ions and the dipoles in the water molecules must be smaller than which of the following?

  (A)   The intermolecular forces between the water molecules
  (B)   The attractive forces between the K^+ and NO_3^- ions in solution
  (C)   The covalent bond strength within the water molecules
  (D)   The strength of the ionic bonds in the $KNO_3(s)$ lattice

10. After the data is gathered, the student notices that not all of the KNO_2 sample dissolved. How would that affect the calculated enthalpy of solution?

  (A)   The calculated enthalpy value would be artificially low.
  (B)   The calculated enthalpy value would be artificially high.
  (C)   The calculated enthalpy value would be unchanged.
  (D)   The calculated enthalpy value would have the incorrect sign.

$Sr(IO_3)_2(s) \rightleftharpoons Sr^{2+}(aq) + 2IO_3^-(aq)$ $K_{sp} = 1.0 \times 10^{-7}$

11. Strontium iodate is a slightly soluble salt that dissociates in water via the above equation. What concentration of Sr^{2+} ions would be necessary to precipitate $Sr(IO_3)_2$ in a solution that contains IO_3^- ions at a concentration of 0.010 M?

  (A)   0.0010 M
  (B)   0.010 M
  (C)   0.10 M
  (D)   1.0 M

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Acid	K_{a1}	K_{a2}	K_{a3}
Formic	1.8×10^{-4}	N/A	N/A
Sulfurous	1.5×10^{-2}	1.0×10^{-7}	N/A
Citric	8.4×10^{-4}	1.8×10^{-5}	4.0×10^{-6}
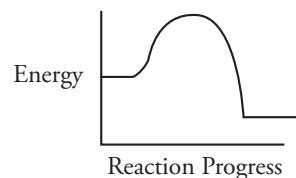
12. The K_a values for three different weak acids are given above. If the acid is polyprotic, all of the K_a values for that acid are given. If each acid were to be titrated with 0.10 M NaOH, which solution would have the highest pH at the endpoint of the titration when each acid has fully reacted?

    (A) Formic
    (B) Sulfurous
    (C) Citric
    (D) All titrations would have identical pHs at the endpoint.

Reaction Progress

13. The above reaction coordinate shows the energy profile of an uncatalyzed reaction. If the reaction is repeated under identical collisions but a catalyst is added, which of the following coordinates is an accurate representation of what the energy profile of the catalyzed reaction could look like?

Reaction Progress

(A)

Reaction Progress

(C)

Reaction Progress

(B)

Reaction Progress

(D)
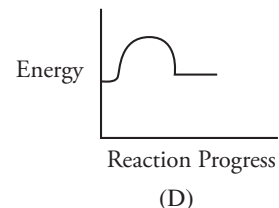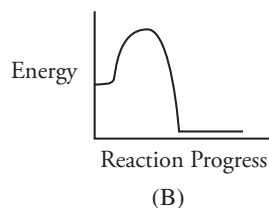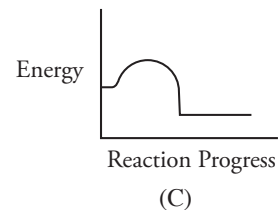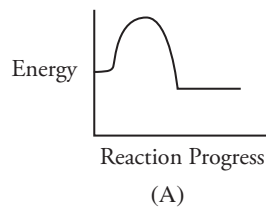
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Use the following information to answer questions 14-18.

Name	Formula	K_a
Chlorous	$HClO_2$	1.0×10^{-2}
Carbonic	H_2CO_3	4.3×10^{-7}
Hypobromous	$HBrO$	2.0×10^{-9}

The K_a values for the first dissociation of three different weak acids are given in the above table.

14. A 0.10 M solution of which acid would have the highest concentration of H^+ ions?

   (A) $HClO_2$
   (B) H_2CO_3
   (C) $HBrO$
   (D) $[H^+]$ would be equal in all solutions.

15. Identify the conjugate base of hyprobromous acid.

   (A) BrO^-
   (B) H_2BrO^+
   (C) H_3O^+
   (D) OH^-

16. Which of the following solutions would create a buffer system with chlorous acid when added in an equimolar amount?

   (A) HCl
   (B) NaOH
   (C) $KClO_2$
   (D) HOCl

17. Calculate the approximate pH of a 1.0 M solution of chlorous acid.

   (A) 1
   (B) 2
   (C) 3
   (D) 4

18. Carbonic acid is a polyprotic acid, and the second K_a value is 4.8×10^{-11}. Which of the following best explains why the K_a for the second dissociation is lower than that of the first?

   (A) HCO_3^- is a more effective base than CO_3^{2-}.
   (B) Acid dissociations are generally endothermic processes, and the first dissociation cools the reaction mixture, lowering the K_a value.
   (C) Fewer water molecules are present to accept protons from HCO_3^- after the first dissociation has occurred.
   (D) The presence of H^+ ions in solution after the first dissociation hinders the second dissociation.
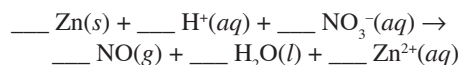
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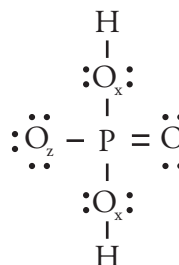
19. A Lewis diagram of the hydrogen phosphate ion is shown above. Based on this diagram, which of the atoms would have a negative formal charge?
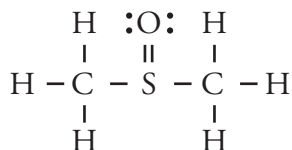
   (A) P
   (B) O_x
   (C) O_y
   (D) O_z

$$4H^+(aq) + NO_3^-(aq) + 3e^- \rightarrow NO(g) + 2H_2O(l)$$

$$Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$$
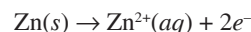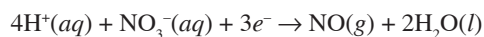
20. Given the above half-reactions, what would the coefficient on the $NO(g)$ be when the full reaction below is balanced?

$$\underline{\quad} Zn(s) + \underline{\quad} H^+(aq) + \underline{\quad} NO_3^-(aq) \rightarrow$$
$$\underline{\quad} NO(g) + \underline{\quad} H_2O(l) + \underline{\quad} Zn^{2+}(aq)$$

   (A) 1
   (B) 2
   (C) 3
   (D) 4

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Use the following information to answer questions 21-23.

$$H \quad :O: \quad H$$
$$| \quad \quad || \quad \quad |$$
$$H - C - S - C - H$$
$$| \quad \quad \quad \quad |$$
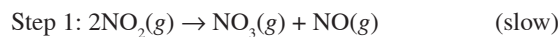$$H \quad \quad \quad \quad H$$

The Lewis diagram of dimethyl sulfoxide, commonly known as DMSO, is shown above.

21. What is the orbital hybridization found around the sulfur atom?

   (A) sp
   (B) sp^2
   (C) sp^3
   (D) sp^4

22. Which of the following bonds would have the longest length?

   (A) S-O
   (B) S-C
   (C) C-H
   (D) All bonds would be equal in length.

23. Where would the strongest dipoles on a molecule of DMSO be located?

   (A) Negative dipole on O, positive dipole on S
   (B) Negative dipole on S, positive dipole on C
   (C) Negative dipole on O, positive dipole on C
   (D) The molecule is completely nonpolar.
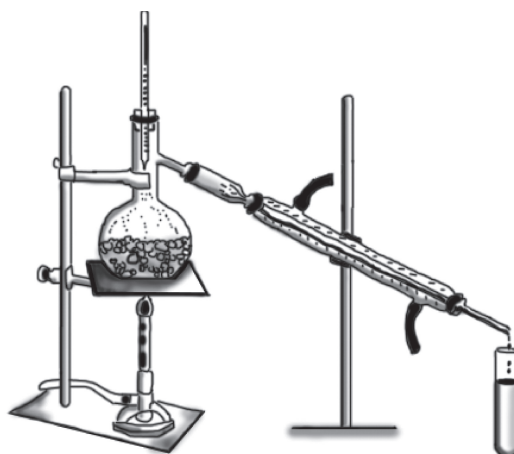
24. A student is attempting to use a distillation apparatus, shown above, to separate a mixture of propanol (boiling point: 97°C) and propionic acid (boiling point: 141°C). Which temperature should the apparatus be set at to obtain as pure a distillate of propanol as possible?

   (A) 85°C
   (B) 105°C
   (C) 125°C
   (D) 145°C

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Step 1: $2NO_2(g) \rightarrow NO_3(g) + NO(g)$ \qquad (slow)

Step 2: $CO(g) + NO_3(g) \rightarrow CO_2(g) + NO_2(g)$ \qquad (fast)

25. The above reaction mechanism shows the accepted elementary steps for a reaction. Which of the following graphs accurately represents the concentration of NO_2 versus time for the full reaction?

(A)

(C)

(B)

(D)
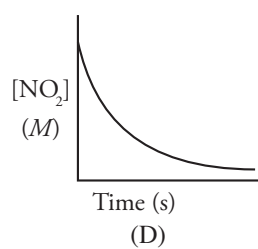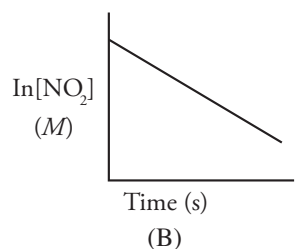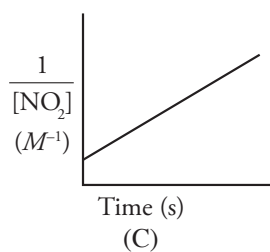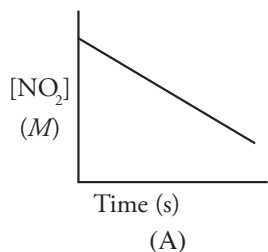
26. Which type of radiation would be best for studying the electron configuration of an individual atom?

(A) Microwave
(B) Infrared
(C) Visible
(D) Ultraviolet

Use the following information to answer questions 27-29.

Diagram X \qquad Diagram Y \qquad Diagram Z
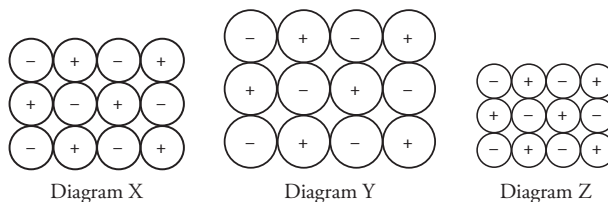
The three diagrams above are particulate-level diagrams of three ionic solids: LiF, NaCl, and KBr. The diagrams are not organized in any particular order, and in each diagram the cations are marked with a + sign and the anions are marked with a – sign. All ions are drawn to scale.

27. Which diagram belongs to which ionic salt?

	Diagram X	Diagram Y	Diagram Z
(A)	LiF	NaCl	KBr
(B)	KBr	NaCl	LiF
(C)	KBr	LiF	NaCl
(D)	NaCl	KBr	LiF

28. Which salt would have the highest melting point?

(A) LiF
(B) NaCl
(C) KBr
(D) The melting points of all three salts would be identical.

29. Which of the following ions would have a completed *p*-subshell in their valence level?

(A) All the cations only (Li^+, Na^+, and K^+)
(B) All the anions only (F^-, Cl^-, and Br^-)
(C) Only K^+ and Br^-
(D) All ions except for Li^+

30. Methanol, CH_3OH, is heated until it boils. During the boiling process, which of the following statements is true?

(A) The speed of the molecules is constant.
(B) The bonds within the molecules are breaking.
(C) The intermolecular forces in the liquid are growing stronger.
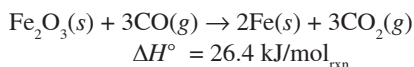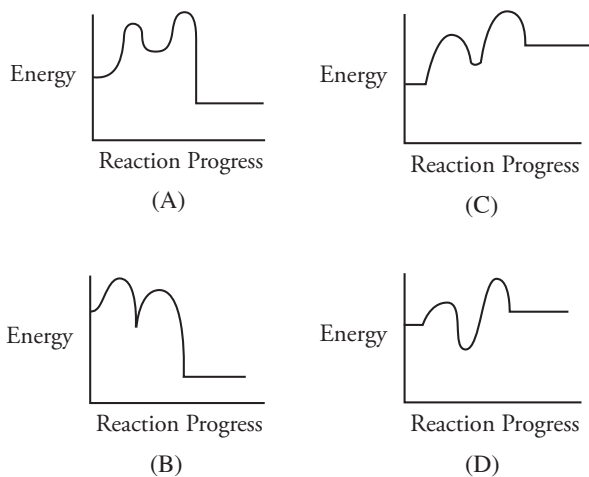(D) The methanol is reacting with atmospheric gases.

GO ON TO THE NEXT PAGE.

Binding Energy (MJ/mol)

Use the following information to answer questions 35-38.

$$\text{Step 1: } NO_2Cl(g) \rightarrow NO_2(g) + Cl(g)$$

$$\text{Step 2: } NO_2Cl(g) + Cl(g) \rightarrow NO_2(g) + Cl_2(g)$$

A proposed mechanism for a reaction is given above. The rate law for the overall reaction is known to be rate = $k[NO_2Cl]$.
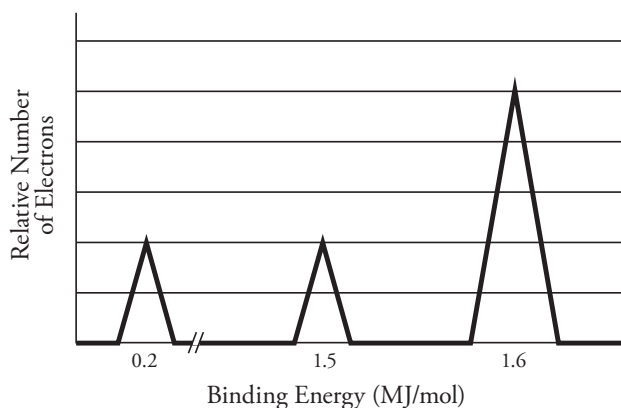
31. The above photoelectron spectrum is for a neutral fluorine atom. Compared to that spectrum, the spectrum for a fluoride ion would have

    (A) one more peak
    (B) one less peak
    (C) the same number of peaks, but the rightmost peak would be taller
    (D) the same number of peaks, but the leftmost peak would be taller

35. What is the molecularity of the slowest elementary step?

    (A) Unimolecular
    (B) Bimolecular
    (C) Trimolecular
    (D) Tetramolecular

36. Which of the following could be the correct units on the rate constant, k?

    (A) s^{-1}
    (B) M^{-1}
    (C) $M^{-1}s^{-1}$
    (D) $M^{-1}s^{-2}$

32. Determine the bond order for the B-F bond in a molecule of boron triflouride, BF_3.

    (A) 1
    (B) 1.33
    (C) 1.67
    (D) 2

37. Identify any catalysts and intermediates present in the proposed mechanism.

    (A) Catalyst: NO_2Cl Intermediate: Cl
    (B) Catalyst: None   Intermediate: Cl
    (C) Catalyst: Cl   Intermediate: None
    (D) There are neither catalysts nor intermediates in the proposed mechanism.

33. Copper (II) sulfate pentahydrate, $CuSO_4 \times 5\ H_2O$, has a molar mass of 250 g/mol. How many grams of oxygen are present in a 25.0 g sample of $CuSO_4 \times 5\ H_2O$?

    (A)   6.40 g
    (B)   8.00 g
    (C)   11.2 g
    (D)   14.4 g

34. A sample of a noble gas at STP with a mass of 10.0 g is found to have a volume of 5.6 L. Which of the following gases correctly identifies the gas in the flask?

    (A) Helium
    (B) Neon
    (C) Argon
    (D) Krypton

GO ON TO THE NEXT PAGE.

38. The overall reaction is known to be exothermic. Which of the following energy profiles represents a potential energy pathway for the total reaction?

Energy | Reaction Progress
(A)

Energy | Reaction Progress
(C)

Energy | Reaction Progress
(B)

Energy | Reaction Progress
(D)

$$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g)$$
$$\Delta H° = 26.4 \text{ kJ/mol}_{rxn}$$

39. How much heat is released or absorbed when 2.80 g of CO reacts with excess Fe_2O_3 via the above reaction?

   (A) 2.63 kJ is released.
   (B) 0.88 kJ is released.
   (C) 2.63 kJ is absorbed.
   (D) 0.88 kJ is absorbed.

$$C(s) + 2F_2(g) \rightleftharpoons CF_4(g) \quad \Delta H° = -680 \text{ kJ/mol}_{rxn}$$

40. The above reaction is at equilibrium in a sealed flask. Which of the following actions would cause an increase in the reverse reaction rate after equilibrium has been reestablished?

   (A) Decreasing the temperature
   (B) Adding more $F_2(g)$
   (C) Removing some $F_2(g)$
   (D) Removing some $C(s)$

41. In which of the following molecules does the sulfur atom have the lowest oxidation number?

   (A) SO_2
   (B) SCl_2
   (C) H_2SO_4
   (D) SF_6

42. At 10°C, the pH of a pure water solution is found to be 7.27. Which of the following best explains why?

   (A) Water becomes more basic as temperature decreases.
   (B) At 10°C, $[OH^-] < [H^+]$.
   (C) The auto-ionization of water is endothermic.
   (D) The strength of water's intermolecular forces decrease at lower temperatures.

$$2HgCl_2(aq) + C_2O_4^{2-}(aq) \rightarrow 2Cl^-(aq) + 2CO_2(g) + Hg_2Cl_2(s)$$

43. Three trials of the above reaction are run with varying concentrations of each reactant and the initial rate of each trial is tracked. Based on the data below, what is the correct rate law for the reaction?

Trial	$[HgCl_2]$ (M)	$[C_2O_4^{2-}]$ (M)	Initial Rate (M/s)
1	0.10	0.10	2.5×10^{-5}
2	0.20	0.10	5.0×10^{-5}
3	0.20	0.20	2.0×10^{-4}

   (A) Rate = $k[HgCl_2][C_2O_4^{2-}]$
   (B) Rate = $k[C_2O_4^{2-}]^2$
   (C) Rate = $k[HgCl_2][C_2O_4^{2-}]^2$
   (D) Rate = $k[HgCl_2]^2[C_2O_4^{2-}]^2$

44. Which of the following ions would have the most unpaired electrons?

   (A) Na^+
   (B) S^{2-}
   (C) Co^{2+}
   (D) Cr^{2+}

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Use the following information to answer questions 45-49.

An 0.740 g sample of an unknown alkali carbonate, identified using M_2CO_3, is dissolved in 100. mL of water. Excess aqueous $Ca(NO_3)_2$ is added to the solution, causing all of the carbonate to precipitate out as calcium carbonate ($CaCO_3$, MM = 100 g/mol). The calcium carbonate is filtered, dried, and then massed. It has a final mass of 1.00 g.
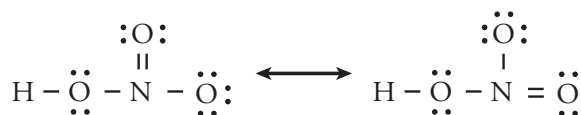
45. Identify the correct net ionic equation for the precipitation reaction.

    (A) $M_2CO_3(aq) + Ca(NO_3)_2(aq) \rightarrow CaCO_3(s) + 2MNO_3(aq)$
    (B) $M_2CO_3(aq) + Ca(NO_3)_2(aq) \rightarrow CaCO_3(aq) + 2MNO_3(s)$
    (C) $2M^+(aq) + CO_3^{2-}(aq) + Ca^{2+}(aq) + 2NO_3^-(aq) \rightarrow CaCO_3(s) + 2MNO_3(aq)$
    (D) $CO_3^{2-}(aq) + Ca^{2+}(aq) \rightarrow CaCO_3(s)$

46. The solution in the beaker after the two solutions are mixed can be best described as

    (A) unsaturated
    (B) saturated
    (C) supersaturated
    (D) hypersaturated

47. Which of the below diagrams correctly shows the ions present in significant amounts after the reaction has gone to completion?


(A)

(C)

(B)

(D)
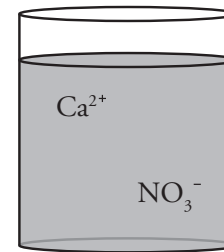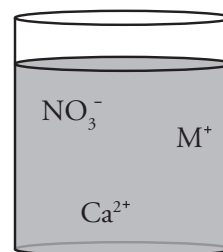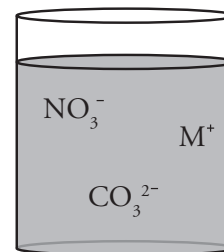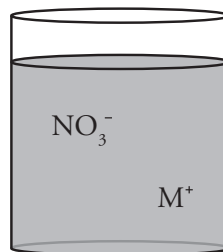
48. Which of the following is the original alkali carbonate?

    (A) Li_2CO_3
    (B) Na_2CO_3
    (C) K_2CO_3
    (D) Rb_2CO_3

49. Which of the following lab errors would NOT affect the identification of the alkali cation present in the original sample?

    (A) Spilling some of the alkali carbonate between the balance and the beaker
    (B) Not fully drying the calcium carbonate that is collected at the end
    (C) Leaving a cloudy filtrate after filtering out the precipitate
    (D) Dissolving the alkali carbonate sample in 150 mL of water instead of 100 mL

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$$:O:$$
$$||$$
$$H - \overset{..}{\underset{..}{O}} - N - \overset{..}{\underset{..}{O}}: \longleftrightarrow H - \overset{..}{\underset{..}{O}} - N = \overset{..}{\underset{..}{O}}$$

50. The Lewis diagram for nitric acid, HNO_3, is above. Which of the following statements is true regarding nitric acid?

    (A) HNO_3 molecules are planar.
    (B) The nitrogen atom carries a negative formal charge.
    (C) All N-O bonds are of identical length.
    (D) There is a third equivalence resonance structure that is not shown.

Use the following information to answer questions 51-53.

$$Ni(IO_3)_2(s) \rightleftharpoons Ni^{2+}(aq) + 2IO_3^{-}(aq)$$
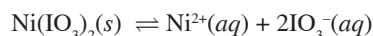
Nickel (II) iodate is a slightly soluble salt which dissociates in water via the above equilibrium reaction.

51. In a fully saturated solution of $Ni(IO_3)_2$, how do the ion concentrations compare?

    (A) $[Ni^{2+}] = [IO_3^{-}]$
    (B) $[Ni^{2+}] = 2[IO_3^{-}]$
    (C) $2[Ni^{2+}] = [IO_3^{-}]$
    (D) $[Ni^{2+}]^2 = [IO_3^{-}]$

52. In which of the following solutions would the least amount of $Ni(IO_3)_2(s)$ dissolve?

    (A) $0.5\ M\ Ni(NO_3)_2$
    (B) $1.0\ M\ KIO_3$
    (C) $2.0\ M\ NaCl$
    (D) Pure water

53. If a saturated solution of $Ni(IO_3)_2$ is left out overnight and some of the water evaporates, how will that affect the mass of the solid present and/or the concentration of the ions in solution? Assume the temperature of the solution remains constant throughout.

	Mass $Ni(IO_3)_2(s)$	$[Ni^{2+}]$ and $[IO_3^{-}]$
(A)	Increase	Increase
(B)	Increase	Unchanged
(C)	Unchanged	Increase
(D)	Unchanged	Unchanged

54. A compound containing only hydrogen and carbon is combusted in excess oxygen, producing 4.4 g of CO_2 and 1.8 g of H_2O. Which of the following options could be the molar mass of the compound?

    (A) 18 g/mol
    (B) 28 g/mol
    (C) 38 g/mol
    (D) 48 g/mol

Number of Molecules
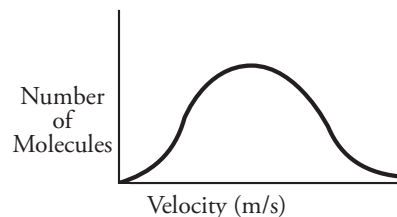
Velocity (m/s)

55. The velocity distribution for $H_2O(g)$ at a given temperature is drawn above. Which of the following distribution plots would represent the velocity distribution of an equimolar sample of $CO_2(g)$ at an identical temperature? The H_2O distribution curve is shown as a dotted line in each option, while the $CO_2(g)$ distribution curve is a solid line.

(A)


(C)

(B)

(D)

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$$CO_2(s) \rightarrow CO_2(g)$$
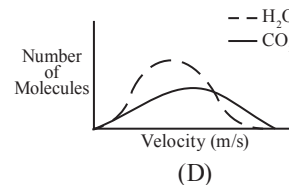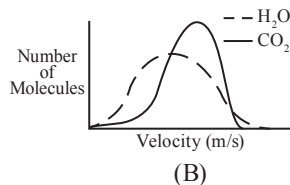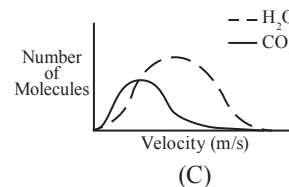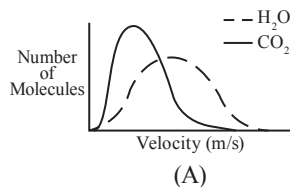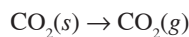
56. Solid carbon dioxide is commonly known by the name dry ice. Dry ice is kept in solid form by sealing it into a high pressure container. When the valve is released, the decrease in pressure causes the CO_2 to sublimate via the above reaction. Predict the signs for $\Delta H°$ and $\Delta S°$ for the sublimation process.

	$\Delta H°$	$\Delta S°$
(A)	+	+
(B)	+	−
(C)	−	+
(D)	−	−

$$2N_2O_5(s) \rightleftharpoons 4NO(g) + 3O_2(g) \quad \Delta H_{rxn} = +247.4 \text{ kJ/mol}$$
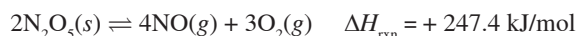
57. Which of the following changes would cause the value for the equilibrium constant for the above reaction to increase?

(A) Adding some $N_2O_5(s)$
(B) Increasing the pressure
(C) Adding some $O_2(g)$
(D) Increasing the temperature

Use the following information to answer questions 58-60.

volume HCl (mL)

$$HONH_2(aq) + H^+(aq) \rightleftharpoons HONH_3^+(aq)$$
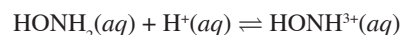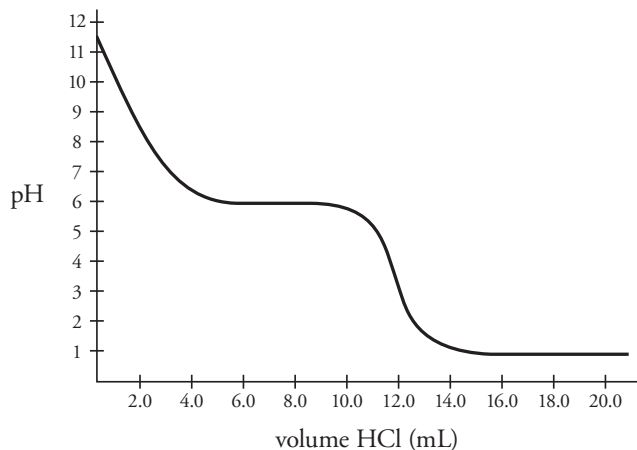
Hydroxylamine, a weak base, is titrated with 1.0 M hydrochloric acid, creating the above titration curve. The temperature of the solution is a constant 25°C.

58. Which of the following reactions best explains why the solution is acidic at the equivalence point of the reaction?

(A) $HONH_3^+(aq) + H_2O(l) \rightleftharpoons HONH_2(aq) + H_3O^+(aq)$
(B) $HONH_2(aq) + H^+(aq) \rightleftharpoons HONH_3^+(aq)$
(C) $HONH_2(aq) + H_2O(l) \rightleftharpoons HONH_3^+(aq) + OH^-(aq)$
(D) $HONH_3^+(aq) + OH^-(aq) \rightleftharpoons HONH_2(aq) + H_2O(l)$

59. What is the approximate pK_b for $HONH_2$?

(A) 4
(B) 6
(C) 8
(D) 10

60. Which of the following statements correctly identifies the concentration of the various ions in solution after 15.0 mL of HCl has been added?

(A) $[H^+] > [HONH_3^+] > [HONH_2]$
(B) $[HONH_3^+] > [HONH_2] > [H^+]$
(C) $[HONH_3^+] > [H^+] > [HONH_2]$
(D) $[HONH_2] > [H^+] > [HONH_3^+]$

END OF SECTION I

INFORMATION IN THE TABLE BELOW AND ON THE FOLLOWING PAGES MAY BE USEFUL IN ANSWERING THE QUESTIONS IN THIS SECTION OF THE EXAMINATION

DO NOT DETACH FROM BOOK.

PERIODIC TABLE OF THE ELEMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 **H** 1.008																	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.30											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.87	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.38	31 **Ga** 69.72	32 **Ge** 72.63	33 **As** 74.92	34 **Se** 78.97	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.95	43 **Tc** (97)	44 **Ru** 101.1	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.76	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57 ***La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.84	75 **Re** 186.21	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 **†Ac** (227)	104 **Rf** (267)	105 **Db** (270)	106 **Sg** (271)	107 **Bh** (270)	108 **Hs** (277)	109 **Mt** (276)	110 **Ds** (281)	111 **Rg** (282)	112 **Cn** (285)	113 **Uut** (285)	114 **Fl** (289)	115 **Uup** (288)	116 **Lv** (293)	117 **Uus** (294)	118 **Uuo** (294)

*Lanthanide Series:

58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 151.97	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.05	71 **Lu** 174.97

†Actinide Series:

90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)

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ADVANCED PLACEMENT CHEMISTRY EQUATIONS AND CONSTANTS

Throughout the test the following symbols have the definitions specified unless otherwise noted.

L, mL	= liter(s), milliliter(s)	mm Hg	= millimeters of mercury
g	= gram(s)	J, kJ	= joule(s), kilojoule(s)
nm	= nanometer(s)	V	= volt(s)
atm	= atmosphere(s)	mol	= mole(s)

ATOMIC STRUCTURE

$$E = h\nu$$
$$c = \lambda\nu$$

E = energy
ν = frequency
λ = wavelength

Planck's constant, $h = 6.626 \times 10^{-34}$ J s

Speed of light, $c = 2.998 \times 10^8$ m s^{-1}

Avogadro's number $= 6.022 \times 10^{23}$ mol^{-1}

Electron charge, $e = -1.602 \times 10^{-19}$ coulomb

EQUILIBRIUM

$$K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}, \text{ where } a\,A + b\,B \rightleftharpoons c\,C + d\,D$$

$$K_p = \frac{(P_C)^c(P_D)^d}{(P_A)^a(P_B)^b}$$

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

$$K_b = \frac{[OH^-][HB^+]}{[B]}$$

$$K_w = [H^+][OH^-] = 1.0 \times 10^{-14} \text{ at } 25°C$$
$$\quad = K_a \times K_b$$

$$pH = -\log[H^+], \ pOH = -\log[OH^-]$$

$$14 = pH + pOH$$

$$pH = pK_a + \log\frac{[A^-]}{[HA]}$$

$$pK_a = -\log K_a, \ pK_b = -\log K_b$$

Equilibrium Constants

K_c (molar concentrations)
K_p (gas pressures)
K_a (weak acid)
K_b (weak base)
K_w (water)

KINETICS

$$\ln[A]_t - \ln[A]_0 = -kt$$

$$\frac{1}{[A]_t} - \frac{1}{[A]_0} = kt$$

$$t_{1/2} = \frac{0.693}{k}$$

k = rate constant
t = time
$t_{1/2}$ = half-life

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GASES, LIQUIDS, AND SOLUTIONS

$$PV = nRT$$

$$P_A = P_{total} \times X_A, \text{ where } X_A = \frac{\text{moles A}}{\text{total moles}}$$

$$P_{total} = P_A + P_B + P_C + \ldots$$

$$n = \frac{m}{M}$$

$$K = {}^\circ C + 273$$

$$D = \frac{m}{V}$$

$$KE \text{ per molecule} = \frac{1}{2} mv^2$$

Molarity, M = moles of solute per liter of solution

$$A = abc$$

P = pressure
V = volume
T = temperature
n = number of moles
m = mass
M = molar mass
D = density
KE = kinetic energy
v = velocity
A = absorbance
a = molar absorptivity
b = path length
c = concentration

Gas constant, R = 8.314 J mol^{-1}K^{-1}

$\qquad$ = 0.08206 L atm mol^{-1}K^{-1}

$\qquad$ = 62.36 L torr mol^{-1}K^{-1}

1 atm = 760 mm Hg

$\qquad$ = 760 torr

STP = 273.15 K and 1.0 atm

Ideal gas at STP = 22.4 L mol^{-1}

THERMOCHEMISTRY/ ELECTROCHEMISTRY

$$q = mc\Delta T$$

$$\Delta S^\circ = \sum S^\circ \text{ products} - \sum S^\circ \text{ reactants}$$

$$\Delta H^\circ = \sum \Delta H_f^\circ \text{ products} - \sum \Delta H_f^\circ \text{ reactants}$$

$$\Delta G^\circ = \sum \Delta G_f^\circ \text{ products} - \sum \Delta G_f^\circ \text{ reactants}$$

$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$

$$= -RT \ln K$$

$$= -nFE^\circ$$

$$I = \frac{q}{t}$$

q = heat
m = mass
c = specific heat capacity
T = temperature
S° = standard entropy
H° = standard enthalpy
G° = standard free energy
n = number of moles
E° = standard reduction potential
I = current (amperes)
q = charge (coulombs)
t = time (seconds)

Faraday's constant, F = 96,485 coulombs per mole of electrons

$$1 \text{ volt} = \frac{1 \text{ joule}}{1 \text{ coulomb}}$$

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CHEMISTRY
Section II
7 Questions
(Total time—105 minutes)

YOU MAY USE YOUR CALCULATOR FOR THIS SECTION

Directions: Questions 1-3 are long free-response questions that require about 23 minutes each to answer and are worth 10 points each. Questions 4-7 are short free-response questions that require about 9 minutes each to answer and are worth 4 points each.

Write your response in the space provided following each question. Examples and equations may be included in your responses where appropriate. For calculations, clearly show the method used and the steps involved in arriving at your answers. You must show your work to receive credit for your answer. Pay attention to significant figures.

$NaNO_3$ (aq)

Ni (s)

Al (s)

$Ni(NO_3)_2$ (aq)

$Al(NO_3)_3$ (aq)
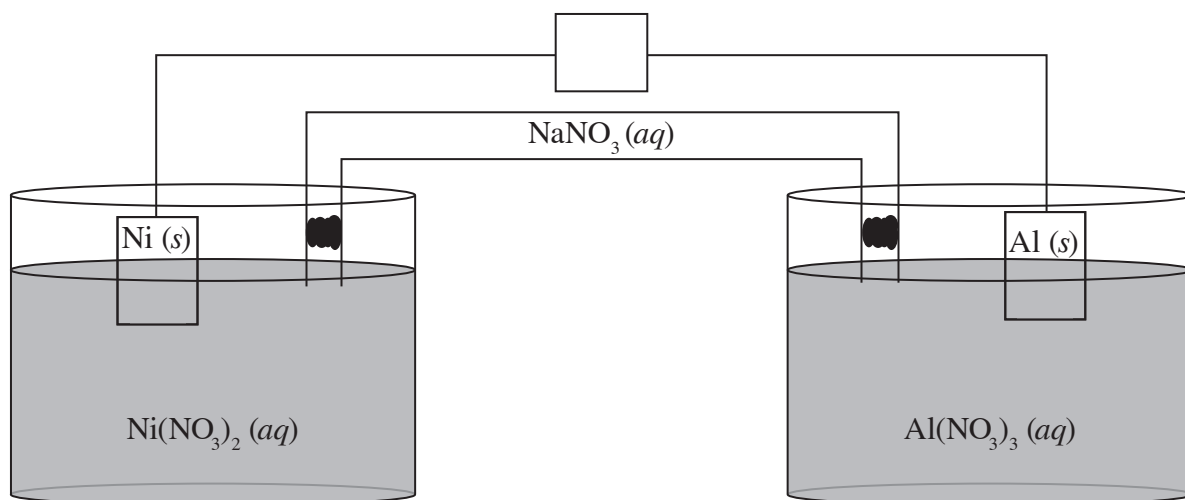
1. A nickel-aluminum voltaic cell is connected as shown above and held at 25°C. The concentration of all solutions is initially at 1.0 M. Some of the standard reduction potentials below may help you in answering the following questions.

Half-Reaction	Standard Reduction Potential (V)
$O_2(g) + 4H^+(aq) + 4e^- \rightarrow 2H_2O(l)$	1.23
$Ni^{2+}(aq) + 2e^- \rightarrow Ni(s)$	−0.25
$2H_2O(l) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$	−0.83
$Al^{3+}(aq) + 3e^- \rightarrow Al(s)$	−1.66

(a)   (i)   Write out and balance the full net ionic equation occurring in the galvanic cell.
      (ii) Determine $E°_{cell}$ for the reaction in (a)(i).

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(b) If the concentration of the nickel (II) nitrate were to be doubled to 2.0 M while the concentration of the aluminum nitrate remained the same, how would that change the E°_{cell} value, if at all? Justify your answer.

(c) A student studying this cell claims that the electrons flow through the salt bridge from the anode to the cathode. Is this statement correct? Why or why not?

Battery

Pt (*s*)   Pt (*s*)

$Ni(NO_3)_2$ (*aq*)
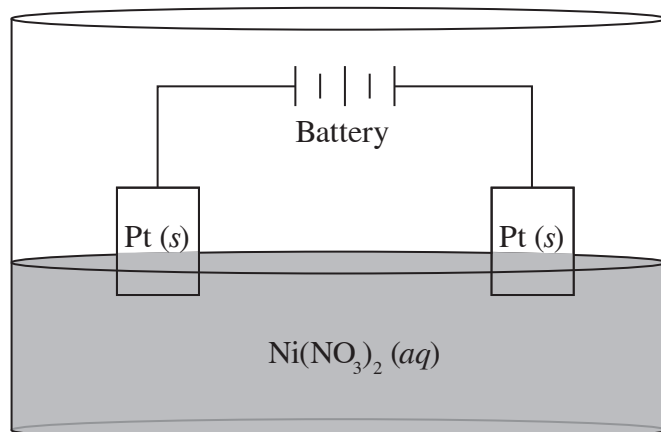
(d) In a separate experiment, two inert platinum electrodes are placed in a solution of 1.0 M nickel (II) nitrate and a current is run through the electrodes.

(i)   If a current of 2.0 A is run through the nickel (II) nitrate solution for 360. s, how many grams of nickel will plate out?

(ii) Will the nickel plate out at the platinum anode, or the platinum cathode? Justify your answer.

(iii) Is this reaction thermodynamically favored? Justify your answer.

(e) When the platinum electrodes are placed in a 1.0 M aluminum nitrate and current is run through the solution, no aluminum plates out on either electrode. Why?

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$$2Na(s) + 2H_2O(l) \rightarrow 2Na^+(aq) + 2OH^-(aq) + H_2(g)$$
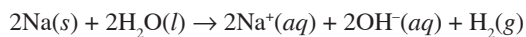
2. Like all alkali metals, sodium reacts with water to produce hydrogen gas.

   (a) (i) Which element is being oxidized, and which is being reduced?
       (ii) What property of alkali metals allows them to react so easily with water?

   (b) (i) If 2.00 g of sodium were to react with 250. mL of pure water at 25°C with an atmospheric pressure of 715 torr, what volume of hydrogen gas would be produced?
       (ii) What would the pH of the remaining solution be after the reaction has gone to completion? Assume the total volume remains unchanged.

   | 10.0 g of H_2 | 10.0 g of F_2 | 10.0 g of CO_2 |
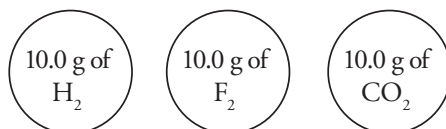
   (c) Three containers are filled completely with identical masses of three different gases, as is shown in the diagram. All containers are held at 25°C.
       (i) In which container, if any, would the pressure be the greatest? Justify your answer.
       (ii) In which container, if any, would the gas molecules have the highest average speed? Justify your answer.

   (d) The three containers are cooled rapidly.
       (i) As the containers are cooled, will the pressure inside them increase, decrease, or stay the same? Justify your answer by discussing the behavior of the gas molecules on a particulate level.
       (ii) Which gas would condense first? Justify your answer.

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3.
$$2KClO_3(s) \rightleftharpoons 2KCl(s) + 3\,O_2(g)$$

Potassium chlorate, $KClO_3$, will partially decompose at any temperature. 1.00 g of solid potassium chlorate is placed in a 250 mL flask at 23.0°C. The flask is capped, and the pressure inside is monitored until it stabilizes.
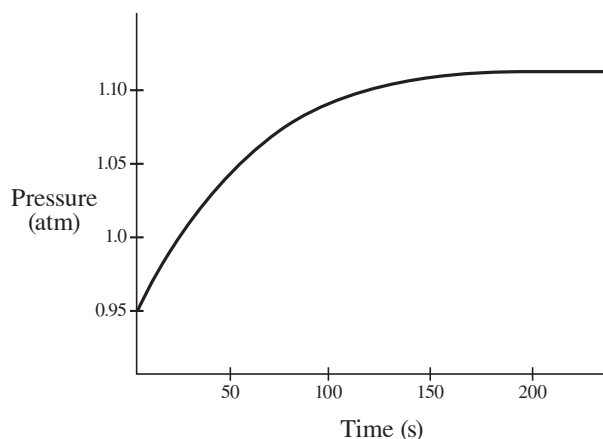
(a) (i) Calculate the partial pressure of the oxygen gas produced by the decomposition of the $KClO_3$.
    (ii) Calculate the value for the equilibrium constant expression, K_p, at 23.0°C.

(b) Would the mass of the $KClO_3$ increase, decrease, or remain the same between the beginning of the experiment and the point at which equilibrium is established? Justify your answer.

(c) If the experiment were repeated at the same temperature, but using a 125 mL flask, how would that change the total pressure inside the flask at the end, if at all? Justify your answer.

(d) Catalysts are often used to lower the activation energy for a given reaction. The experiment is repeated, this time with an MnO_2 catalyst added.
    (i) How do catalysts lower a reaction's activation energy?
    (ii) Using a dashed line, sketch a line on the graph that would indicate any changes that would occur in the data gathered during this trial.

(e) Calculate the value for ΔG for this reaction at 23.0°C.

(f) Is the entropy change that occurs during this reaction positive or negative? Justify your answer.

4. The primary acid in lemonade is citric acid ($H_3C_6H_5O_7$, $pK_a = 3.08$). To control the pH of many commercially available lemonade drinks, some sodium dihydrogen citrate ($NaH_2C_6H_5O_7$) is added to create a buffer system.

(a) Write out the reaction which would occur if a strong base were added to a buffered lemonade solution such as the one described above.
(b) What is the mol ratio of $H_2C_6H_5O_7^- : H_3C_6H_5O_7$ in a buffered solution with a pH of 3.25?
(c) If a buffered solution of lemonade were to be diluted, would that increase the pH, decrease it, or leave it the same? Justify your answer.

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5.

Binding Energy (kJ/mol)
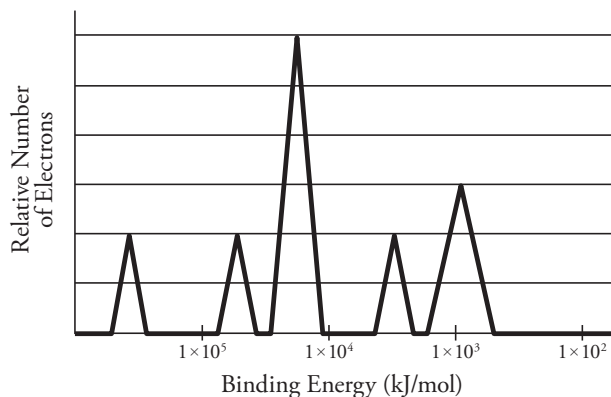
Peak 1	Peak 2	Peak 3	Peak 4	Peak 5
2.7×10^5 kJ/mol	5.4×10^4 kJ/mol	2.1×10^4 kJ/mol	4.9×10^3 kJ/mol	1.0×10^3 kJ/mol

The photoelectron spectrum for a neutral atom is displayed above.

(a)   What is the total number of valence electrons shown on the above spectrum?

A separate sample of the element is bombarded with radiation that has a frequency of 6.3×10^{15} s^{-1}. The energy level is sufficient to only remove the outmost electron.

(b)   How much energy does a single photon of the radiation have?

(c)   How much kinetic energy would the ejected electron have?

6. Glyoxal is an organic compound commonly used in many synthesis reactions.

(a)   In the box below, complete the Lewis electron-dot diagram for the glyoxal molecule by drawing in all electron pairs

O   O
C   C
H   H
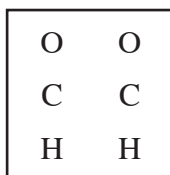
(b)   Identify all types of intermolecular forces that are present in a solution of glyoxal.

(c)   Would you expect glyoxal to be miscible with water? Justify your answer.

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7. $$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$$

The decomposition of N_2O_5 is a first-order reaction that goes to completion. A sample of N_2O_5 gas with a concentration of 1.0 M is placed in a sealed container at 50°C and allowed to decompose. The half-life of the reaction at 50°C is 1200 seconds.

(a) On the graph below, draw a graph showing how the concentration of the N_2O_5 sample will change over time.

[graph with y-axis labeled $[N_2O_5]$ (m) ranging from 0.25 to 1.0, and x-axis labeled Time (s) with markings at 1,000, 2,000, 3,000, 4,000]
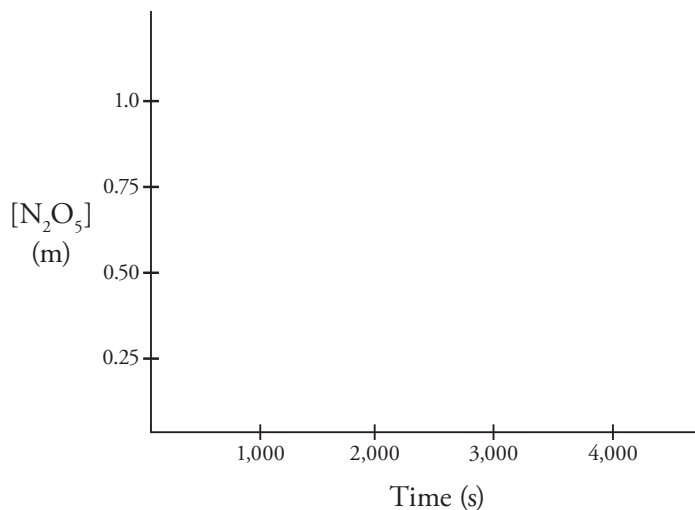
(b) Calculate the rate constant for this reaction at 50°C.

(c) Using your graph, determine the instantaneous rate of disappearance for N_2O_5 at $t = 2000$ s.

STOP

END OF EXAM

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1.

YOUR NAME: _____
(Print)   Last   First   M.I.

SIGNATURE: _____ DATE: ___ / ___ / ___

HOME ADDRESS: _____
(Print)   Number and Street

_____
                City   State   Zip Code

PHONE NO.: _____

IMPORTANT: Please fill in these boxes exactly as shown on the back cover of your test book.

2. TEST FORM

_____

3. TEST CODE

0	A	J	0
1	B	K	1
2	C	L	2
3	D	M	3
4	E	N	4
5	F	O	5
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4. REGISTRATION NUMBER

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6. DATE OF BIRTH

Month	Day		Year	
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○ FEB	0	0	0	0
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○ APR	2	2	2	2
○ MAY	3	3	3	3
○ JUN		4	4	4
○ JUL		5	5	5
○ AUG		6	6	6
○ SEP		7	7	7
○ OCT		8	8	8
○ NOV		9	9	9
○ DEC				

7. GENDER

○ MALE
○ FEMALE

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5. YOUR NAME

First 4 letters of last name				FIRST INIT	MID INIT
A	A	A	A	A	A
B	B	B	B	B	B
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D	D	D	D	D	D
E	E	E	E	E	E
F	F	F	F	F	F
G	G	G	G	G	G
H	H	H	H	H	H
I	I	I	I	I	I
J	J	J	J	J	J
K	K	K	K	K	K
L	L	L	L	L	L
M	M	M	M	M	M
N	N	N	N	N	N
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S	S	S	S	S	S
T	T	T	T	T	T
U	U	U	U	U	U
V	V	V	V	V	V
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X	X	X	X	X	X
Y	Y	Y	Y	Y	Y
Z	Z	Z	Z	Z	Z

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