Massachusetts
Tests for Educator Licensure® (MTEL®)

MTEL®

Chemistry (12)

PRACTICE TEST

All examinees taking the Chemistry (12) test will be provided with a scientific calculator with functions that include the following: addition, subtraction, multiplication, division, square root, percent, sine, cosine, tangent, exponents, and logarithms. Refer to "Test Selection" in the current MTEL registration bulletin for more information.

www.mtel.nesinc.com

Evaluation Systems, Pearson, P.O. Box 226, Amherst, MA 01004

06/10

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INTRODUCTION

This document is a printable version of the Massachusetts Tests for Educator Licensure® (MTEL®) Chemistry (12) Online Practice Test. This practice test is a sample test consisting of 100 multiple-choice questions and 2 open-response item assignments.

To assist you in recording and evaluating your responses on the practice test, a Multiple-Choice Answer Sheet, an Answer Key Worksheet, and an Evaluation Chart by test objective are included for the multiple-choice questions. A blank Response Sheet, Evaluation Information, and Sample Responses and Analyses, as well as a Scoring Rubric, are included for the open-response items. Lastly, there is a Practice Test Score Calculation worksheet.

PURPOSE OF THE PRACTICE TEST

The practice test is designed to provide an additional resource to help you effectively prepare for the MTEL Chemistry (12) test. The primary purpose of the practice test is to help you become familiar with the structure and content of the test. It is also intended to help you identify areas in which to focus your studies. Education faculty and administrators of teacher preparation programs may also find this practice test useful as they help students prepare for the official test.

TAKING THE PRACTICE TEST

In order to maximize the benefits of the practice test, it is recommended that you take this test under conditions similar to the conditions under which the official MTEL tests are administered. Try to take the practice test in a quiet atmosphere with few interruptions and limit yourself to the four-hour time period allotted for the official test administration. You will find your results to be more useful if you refer to the answer key only after you have completed the practice test.

INCORPORATING THE PRACTICE TEST IN YOUR STUDY PLAN

Although the primary means of preparing for the MTEL is your college education, adequate preparation prior to taking or retaking the MTEL test is strongly recommended. How much preparation and study you need depends on how comfortable and knowledgeable you are with the content of the test.

The first step in preparing to take the MTEL is to identify what information the test will address by reviewing the objectives for your field. A complete, up-to-date list of the Test Objectives is included in the Test Information Booklet for each test field. The test objectives are the core of the testing program and a helpful study tool. Before taking or retaking the official test, focus your study time on those objectives for which you wish to strengthen your knowledge.

This practice test may be used as one indicator of potential strengths and weaknesses in your knowledge of the content on the official test. However, because of potential differences in format and difficulty between the practice test and an official MTEL Chemistry (12) test, it is not possible to predict precisely how you might score on an official MTEL Chemistry (12) test. Keep in mind that the subareas for which the test weighting is greatest will receive emphasis on this test. Refer to the Test Information Booklet for additional information about how to prepare for the test.

CHEMISTRY
PRACTICE TEST

Candidates taking the Chemistry test (field 12) will be provided with the periodic table, constants, and formulas shown below at the test administration.

PERIODIC TABLE OF THE ELEMENTS

1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIIIB	9 VIIIB	10 VIIIB	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1 **H** 1.01																	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** 23.0	12 **Mg** 24.3											13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 39.9
19 **K** 39.1	20 **Ca** 40.1	21 **Sc** 45.0	22 **Ti** 47.9	23 **V** 50.9	24 **Cr** 52.0	25 **Mn** 54.9	26 **Fe** 55.8	27 **Co** 58.9	28 **Ni** 58.7	29 **Cu** 63.5	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 79.0	35 **Br** 79.9	36 **Kr** 83.8
37 **Rb** 85.5	38 **Sr** 87.6	39 **Y** 88.9	40 **Zr** 91.2	41 **Nb** 92.9	42 **Mo** 95.9	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57–71	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89–103	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (266)	107 **Bh** (264)	108 **Hs** (277)	109 **Mt** (268)	110 **Ds** (271)	111 **Rg** (272)	112	113	114	115	116	117	118

Lanthanide Series	57 **La** 138.9	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
Actinide Series	89 **Ac** (227)	90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	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)

Some of the elements 112 and above have been reported but not fully authenticated and named.

CONSTANTS

Description	Value
Ideal gas constant (R)	0.0821 L•atm/mol•K = 8.31 J/mol•K
Faraday constant (F)	9.65×10^4 C/mol e^- = 9.65×10^4 J/V•mol e^-
Rydberg constant (R_H)	1.097×10^7 m^{-1}
Boltzmann constant (k)	1.38×10^{-23} J/K
Planck's constant (h)	6.63×10^{-34} J•s
Molal freezing point depression constant for water (K_f)	1.86°C/m
Molal boiling point elevation constant for water (K_b)	0.51°C/m
Heat of fusion of water (ΔH_{fus})	334 J/g = 80 cal/g = 6.01 kJ/mol
Heat of vaporization of water (ΔH_{vap})	2260 J/g = 540 cal/g = 40.7 kJ/mol
Specific heat (s) of water (liquid)	4.18 J/g•K = 4.18 J/g•°C = 1.0 cal/g•°C
Dissociation constant of water (K_w)	1.0×10^{-14} at 25°C
Standard atmospheric pressure	1 atm = 760 mm Hg = 760 torr = 101.325 kPa
Speed of light in a vacuum (c)	3.00×10^8 m/s
1 calorie (cal)	4.184 J
1 watt (W)	1 J/s

FORMULAS

Description	Formula
Gibbs free energy equation	$\Delta G = \Delta H - T\Delta S$
Nernst equation	$E = E° - \left(\frac{0.0592\ \text{V}}{n}\right) \log Q$ at 298 K
Relationship between emf and free energy change for reactants and products in their standard states	$\Delta G° = -nFE°$
Energy change as an electron transitions between energy states	$\Delta E = R_{\text{H}} hc\left(\frac{1}{n_{\text{i}}^2} - \frac{1}{n_{\text{f}}^2}\right)$
Henderson-Hasselbalch equation	$\text{pH} = \text{p}K_a + \log\left(\frac{[\text{conjugate base}]}{[\text{acid}]}\right)$
Coulombs (C)	C = amperes × seconds
Photon energy	$E = h\nu$
Speed of light	$c = \lambda\nu$
Amount of heat (q)	$q = ms\Delta T$
Root-mean-square speed	$u_{\text{rms}} = \sqrt{\frac{3RT}{M}}$
Graham's law of diffusion	$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$

NOTES FOR CHEMISTRY TEST

Not all constants and formulas necessary are listed, nor are all constants and formulas listed used on this test.

While attention has been paid to significant figures, no answer should be considered incorrect solely because of the number of significant figures.

GENERAL TEST DIRECTIONS

This practice test consists of two sections: (1) a multiple-choice question section and (2) an open-response item assignment section. Each multiple-choice question on the practice test has four answer choices. Read each question carefully and choose the ONE best answer. Record each answer on the answer sheet provided.

Sample Question: 1. What is the capital of Massachusetts?

A. Worcester
B. New Bedford
C. Boston
D. Springfield

The correct answer to this question is C. You would indicate that on the answer sheet.

The open-response section of this practice test requires written responses. Directions for the open-response item assignments appear immediately before those assignments.

You may work on the multiple-choice questions and open-response item assignments in any order that you choose. You may wish to monitor how long it takes you to complete the practice test. When taking the actual MTEL Chemistry (12) test, you will have one four-hour test session in which to complete the test.

MULTIPLE-CHOICE ANSWER SHEET

Question Number	Your Response
1	
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Question Number	Your Response
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Question Number	Your Response
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MULTIPLE-CHOICE QUESTIONS

1. A chemist hypothesizes that a newly developed photodegradable plastic will degrade twice as fast as currently available photodegradable plastics. Which of the following investigations would best test this hypothesis?

   A. modeling the chemical reactions involved in the degradation of the new plastic and using this model to project degradation rates under different environmental conditions

   B. subjecting the new plastic and the existing plastics to the same environmental conditions and measuring their degradation rates

   C. comparing the degradation rate of the new plastic with the degradation rates provided by the manufacturers of the existing photodegradable plastics

   D. exposing the new photodegradable plastic to conditions of constant UV radiation and no UV radiation and comparing the resulting degradation rates

2. Several unknown solutions have been tested for the presence of Group 1 or Group 2 metals using a flame-test protocol. Which of the following methods would be the best way to represent the collected data?

   A. a table

   B. a histogram

   C. a scatter plot

   D. a line graph

3. A chemist is attempting to identify an unknown solid substance by determining its density. The substance is found to have a volume of 70.3 cm^3, and repeated weighing of the solid produced an average mass of 51.12 g. Given these data, which of the following correctly reports the density of the solid substance with the correct number of significant figures?

   A. 7×10^{-1} g/cm^3

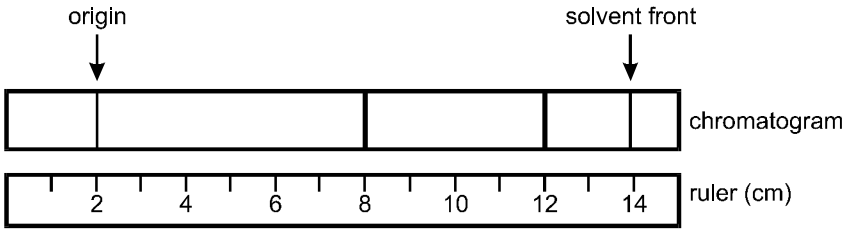
   B. 7.2×10^{-1} g/cm^3

   C. 7.27×10^{-1} g/cm^3

   D. 7.272×10^{-1} g/cm^3

4. **Use the information below to answer the question that follows.**

Chromatography Reference Table	
Cation	$R_f \left(\frac{\text{distance of cation}}{\text{distance of solvent}}\right)$
Ni^{2+}	0.50
Cu^{2+}	0.58
Fe^{3+}	0.83



A chemist is using paper chromatography to identify the components of a sample known to contain at least one of the cations shown in the reference table. Given the chromatogram shown above, the unknown consists of:

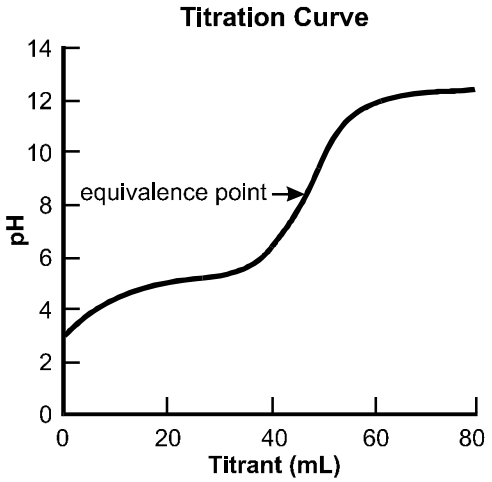
A. Cu^{2+} cations.

B. Ni^{2+} and Fe^{3+} cations.

C. Fe^{3+} and Cu^{2+} cations.

D. Ni^{2+}, Cu^{2+}, and Fe^{3+} cations.

5. **Use the graph below to answer the question that follows.**



The graph above depicts the results of a titration experiment. Which of the following conclusions about the titration experiment is best supported by these data?

A. The acid being titrated is a poly-protic acid.

B. A strong base is being titrated with a weak acid.

C. The titrant used in this experiment is a strong acid.

D. A weak acid is being titrated with a strong base.

6. A chemistry class is planning to use a fume exhaust hood to study the reaction between the elements copper and sulfur. Before beginning the experiment, the teacher will review with the class the proper use of the exhaust hood. Which of the following instructions should be included in this discussion?

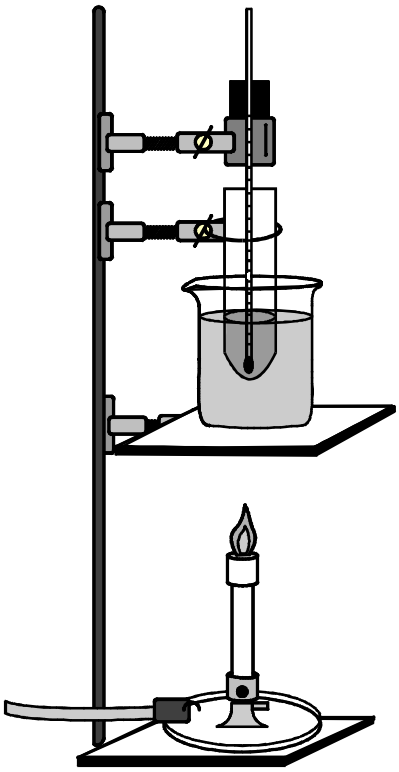
A. Avoid using Bunsen burners within the fume exhaust hood.

B. Turn off the fan while performing the experiment.

C. Keep the sash in its lowered position during the experiment.

D. Step away from the fume exhaust hood once the reaction has begun.

7. **Use the diagram below to answer the question that follows.**



The apparatus shown above is most likely to be used in which of the following scientific experiments?

A. separating a mixture of two unknown liquids

B. determining the boiling point of an unknown liquid

C. constructing a titration curve of an unknown liquid

D. detecting the presence of cations in an unknown liquid

8. When a chemical is transferred from a stock bottle into another container for use in the laboratory, the label on the new container must include the name and formula of the chemical, its concentration, and the:

A. room number of the laboratory.

B. date the stock reagent bottle was received.

C. hazard warnings for the chemical.

D. phone number of the chemical hygiene officer.

9. Which of the following is an example of a chemistry protocol being carried out in a safe manner?

A. heating a compound in a test tube over a flame with the test tube opening oriented away from people

B. evaporating acetone from a beaker using direct heat from a Bunsen burner

C. using a glass stirring rod to assist in pouring a solution of NaClO into a beaker containing HCl

D. transferring a beaker containing boiling water directly from a hot plate into an ice bath

10. A student splashes a chemical into an eye during a lab experiment. Which of the following is the first thing the teacher should do when responding to this situation?

    A. drive the student to an emergency room at the closest area hospital

    B. flush the student's eye with water at the eyewash after checking for the presence of a contact lens

    C. alert the school administrators that an accident has occurred

    D. call the local poison control center for guidance on how to treat the student

11. Which of the following is a serious ethical concern associated with the complete sequencing of the human genome?

    A. The results are maintained by multiple government agencies and universities and are difficult to access.

    B. The DNA used in the study was taken from one individual and is not representative of all human genomes.

    C. The sequencing technology used was inadequate for sequencing such a large genome, and the results have proven to be inaccurate.

    D. An individual could be denied health insurance due to a genetic predisposition for a life-threatening disease.

12. Which of the following correctly identifies both an advantage and a disadvantage of using nuclear fission as a method of generating electricity?

    A. advantage: produces only nonhazardous waste products
    disadvantage: leads to thermal pollution of rivers

    B. advantage: uses an unlimited inexpensive fuel source
    disadvantage: accelerates the rate of ozone depletion

    C. advantage: produces minimal greenhouse gases
    disadvantage: requires long-term storage of radioactive waste

    D. advantage: inhibits the formation of acid rain
    disadvantage: presents problems in safely containing plasma

13. Research into the production of ethanol from corn has been promoted by society's need to:

    A. decrease the price of corn-based food products.

    B. stimulate job growth in automobile manufacturing.

    C. decrease dependence on fossil fuels.

    D. increase the number of small family-owned farms.

14. Which of the following technologies uses X-rays to visualize an object?

    A. positron emission tomography (PET scan)

    B. magnetic resonance imaging (MRI)

    C. computerized axial tomography (CT scan)

    D. scanning tunneling microscopy (STM)

15. Which of the following responses correctly matches a technological development with its corresponding area of chemistry research?

    A. computer chips: chemical analysis of DNA

    B. pest-resistant corn species: chemical equilibrium

    C. photovoltaic cells: electrochemistry

    D. synthetic fertilizers: molecular modeling

16. Potassium hydrogen carbonate is best classified as which of the following types of matter?

    A. heterogeneous mixture

    B. element

    C. homogeneous mixture

    D. compound

17. Fog, which is composed of finely divided water droplets dispersed in air, is an example of which of the following types of mixtures?

    A. solution

    B. aerosol

    C. foam

    D. emulsion

18. The products of a chemical reaction are solid zinc carbonate and aqueous sodium chloride. Which of the following procedures will achieve the best separation of the mixture into its three components?

    A. filtering the mixture and then distilling the filtrate

    B. crystallizing the mixture and then decanting the aqueous portion

    C. centrifuging the mixture and then crystallizing the supernatant

    D. distilling the mixture and then centrifuging the distillate

19. Which of the following statements correctly identifies a difference between a physical change and a chemical change?

    A. New atoms are formed in a chemical change but not in a physical change.

    B. Energy is conserved in a physical change but not in a chemical change.

    C. New substances are formed in a chemical change but not in a physical change.

    D. Mass is conserved in a physical change but not in a chemical change.

20. **Use the table below to answer the question that follows.**

Properties of Selected Alcohols			
Alcohol	**Melting Point (°C)**	**Boiling Point (°C)**	**Density (g/cm^3)**
2-propanol	–90	82	0.786
Cyclopentanol	–19	141	0.948
Cyclohexanol	25	161	0.962
2-methyl-2-propanol	26	82	0.789

An unknown alcohol is a liquid at room temperature (20°C), and a 50.0 mL sample has a mass of 39.4 g. Based on these properties, the unknown alcohol can be identified as:

A. 2-propanol.

B. cyclopentanol.

C. cyclohexanol.

D. 2-methyl-2-propanol.

21. The constituent particles in a substance in its solid state tend to:

A. remain motionless.

B. vibrate about fixed positions.

C. slide freely past one another.

D. move constantly in straight lines.

22. According to the kinetic molecular theory, which of the following happens to the molecules of a gas when the gas is compressed?

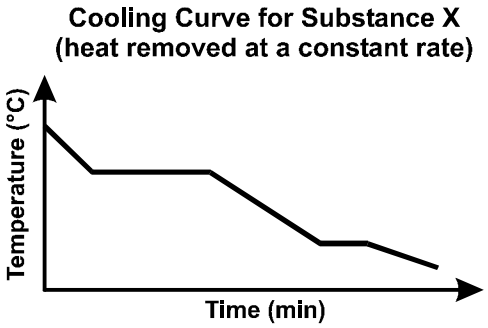
    A. The average distance between the molecules decreases.

    B. The electrostatic repulsion between molecules decreases.

    C. The atomic radii of the atoms in the molecules decrease.

    D. The lengths of the bonds within the molecules decrease.

23. **Use the cooling curve below to answer the question that follows.**



Which of the following statements is supported by the data presented in the cooling curve for substance X shown above?

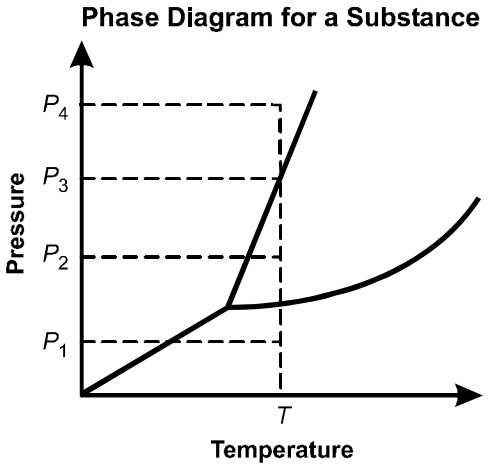
    A. The heat of vaporization for substance X is greater than its heat of fusion.

    B. The specific heat of substance X is greater than its heat of formation.

    C. The boiling point of substance X is greater than its condensing point.

    D. The melting point of substance X is greater than its freezing point.

24. **Use the phase diagram below to answer the question that follows.**



Based on the phase diagram above, which of the following pressures in combination with temperature *T* would result in the substance being present only as a gas?

    A. P_1

    B. P_2

    C. P_3

    D. P_4

25. A 20.0 L cylinder of oxygen gas is at a temperature of 27.0°C and a pressure of 5.00 atm. What is the density of the oxygen gas in the cylinder?

    A. 72.0 g/L

    B. 6.50 g/L

    C. 3.25 g/L

    D. 0.203 g/L

26. An atom with 6 protons, 6 neutrons, and 6 electrons gains an additional electron. What is the resulting charge of the atom?

A. –7

B. –1

C. +1

D. +7

27. Which of the following quantum numbers describes the shape of an orbital?

A. the magnetic quantum number, m_l

B. the angular momentum quantum number, l

C. the electron spin quantum number, m_s

D. the principle quantum number, n

28. How much energy is emitted when an electron in a hydrogen atom transitions from the $n_i = 6$ state to the $n_f = 2$ state?

A. 7.27×10^{-19} J

B. 6.06×10^{-19} J

C. 4.84×10^{-19} J

D. 1.36×10^{-19} J

29. Which of the following is the correct electron configuration for a neutral iron atom?

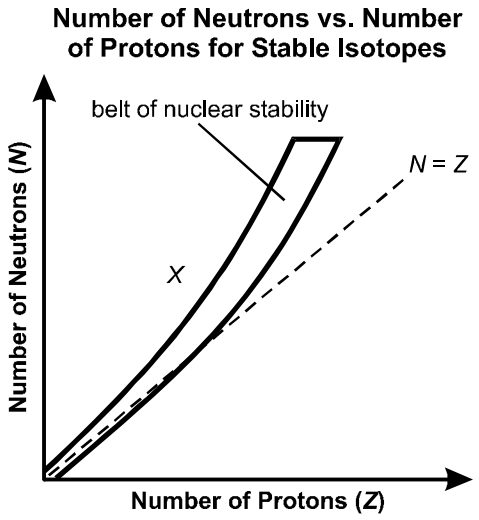
A. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^6$

B. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$

C. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4p^6$

D. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3f^6$

30. **Use the graph below to answer the question that follows.**



The isotope located in position *X* in the graph of nuclear stability shown above is most likely to undergo radioactive decay by emitting:

A. alpha particles.

B. gamma rays.

C. positrons.

D. beta particles.

31. **Use the equation below to answer the question that follows.**

$$^{239}_{94}Pu + ^{4}_{2}He \longrightarrow ^{242}_{96}Cm + ^{1}_{0}n$$

In order to overcome the electrostatic repulsion between alpha particles and the target nucleus, the reaction shown above is carried out using:

A. high speeds.

B. low temperatures.

C. high pressure.

D. low volumes.

32. Given that the half-life of strontium-90 is 28.8 years, what mass of a 50.0 g sample of strontium-90 will remain after 144 years?

A. 25.0 g

B. 6.25 g

C. 1.56 g

D. 0.391 g

33. As atomic number increases in a group of the periodic table, which of the following atomic properties decreases?

A. electronegativity

B. metallic character

C. atomic mass

D. atomic radius

34. Which of the following elements has an atomic radius closest to but smaller than that of sulfur?

A. selenium

B. phosphorus

C. oxygen

D. chlorine

35. Which of the following series of halogens is arranged in order of increasing boiling point?

A. I_2, Br_2, Cl_2, F_2

B. Cl_2, I_2, F_2, Br_2

C. F_2, Cl_2, Br_2, I_2

D. Br_2, F_2, I_2, Cl_2

36. The oxidation state of Mn in the permanganate ion (MnO_4^-) is:

A. –8.

B. –1.

C. +2.

D. +7.

37. Which of the following symbols represents the element silver?

A. Si

B. Hg

C. Sn

D. Ag

38. What is the IUPAC name for the molecule $CH_3CH_2CHClCH_3$?

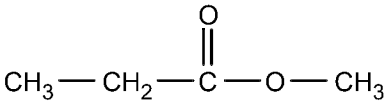
A. 2-chlorobutane

B. 3-chloropropane

C. 2-chloroethane

D. 3-chloropentane

39. **Use the diagram below to answer the question that follows.**



Which of the following organic functional groups does the molecule shown above contain?

A. hydroxyl

B. ether

C. carbonyl

D. ester

40. The complex ion $[Pt(NH_3)_4]^{2+}$ has a square planar structure. Which of the following substances, in which chloride ions replace ammonia as ligands, can exist as geometric isomers?

A. $[PtCl(NH_3)_3]^{1+}$

B. $PtCl_2(NH_3)_2$

C. $[PtCl_3NH_3]^{1-}$

D. $[PtCl_4]^{2-}$

41. What is the molar mass of the compound $Zr(NO_3)_4$?

A. 259.2 g/mol

B. 297.2 g/mol

C. 339.2 g/mol

D. 612.8 g/mol

42. What is the percentage by mass of oxygen in $C_3H_5N_3O_9$?

A. 7.045%

B. 37.18%

C. 63.41%

D. 84.20%

43. A compound is found to be composed of 30.9% sodium, 47.7% chlorine, and 21.5% oxygen. What is the empirical formula of this compound?

A. NaClO

B. $NaClO_2$

C. $NaClO_3$

D. $NaClO_4$

44. A substance with an empirical formula of CH_2 has a molecular weight of 28.05 amu. What is the molecular formula for this substance?

A. CH

B. CH_2

C. C_2H_4

D. C_3H_6

45. In which of the following substances is the bonding between atoms ionic?

A. P_2S_5

B. HBr

C. Al_2O_3

D. P_4

46. Which of the following molecules has the strongest O — H bond?

A. $HClO_4$

B. $HClO_3$

C. $HClO_2$

D. HClO

47. **Use the diagram below to answer the question that follows.**

Lewis Structure for Element "X"

Which of the following elements could the Lewis structure shown above represent?

A. helium

B. beryllium

C. titanium

D. germanium

48. Which of the following molecules has trigonal planar molecular geometry?

A. BF_3

B. PBr_3

C. ClF_4

D. AsH_3

49. Which of the following molecules can form a hydrogen bond with water?

    A. HCl

    B. H_2S

    C. CH_3F

    D. NH_3

50. In which of the following substances are dipole-dipole forces the primary intermolecular force?

    A. PCl_5

    B. CCl_4

    C. $BeCl_2$

    D. NCl_3

51. Methanol is considerably more soluble in water than 1-hexanol. Which of the following best explains this difference in solubility?

    A. Methanol contains fewer hydroxyl groups than 1-hexanol.

    B. The alkyl group is longer in 1-hexanol than in methanol.

    C. 1-hexanol is a significantly more polar molecule than methanol.

    D. The greater number of hydrogen atoms in 1-hexanol increases the amount of hydrogen bonding.

52. **Use the chemical equation below to answer the question that follows.**

    $C_3H_6(g) + H_2(g) \longrightarrow C_3H_8(g)$

    The reaction shown above is an example of which of the following types of chemical reaction?

    A. addition

    B. neutralization

    C. double displacement

    D. combustion

53. Which of the following chemical equations is an example of a neutralization reaction?

A. $2C_2H_6(g) + 7O_2(g) \longrightarrow 4CO_2(g) + 6H_2O(l)$

B. $2KClO_3(s) \longrightarrow 2KCl(s) + 3O_2(g)$

C. $HCl(aq) + NaOH(aq) \longrightarrow NaCl(s) + H_2O(l)$

D. $2Ca(s) + O_2(g) \longrightarrow 2CaO(s)$

54. **Use the chemical equation below to answer the question that follows.**

$2O_3(g) \longrightarrow 3O_2(g)$

Which of the following compounds is a catalyst for the chemical reaction shown above?

A. CH_4

B. H_2SO_4

C. CO_2

D. CF_2Cl_2

55. Which of the following is a primary cause of eutrophication in aquatic ecosystems?

    A. an increase in the amount of acid precipitation

    B. an increase in the concentration of heavy metals

    C. an overabundance of nitrogen-containing compounds

    D. an overabundance of dissolved oxygen

56. In a reaction between KBr and $Pb(NO_3)_2$, which of the following substances will precipitate out of solution?

    A. $PbBr_2$

    B. K_2Pb

    C. KNO_3

    D. NO_3Br

57. Which of the following products is formed when benzene (C_6H_6) undergoes a substitution reaction with nitric acid (HNO_3)?

    A. $C_6H_5NO_2$

    B. CNO_3

    C. $C_6H_7NO_3$

    D. HCO_3

58. What is the pH of a buffer made from 0.25 *M* NH_3 and 0.50 *M* NH_4Cl at 25°C? (K_b for $NH_3 = 1.8 \times 10^{-5}$)

    A. 4.7

    B. 7.5

    C. 9.0

    D. 13

59. A chemist uses 22.0 mL of 0.10 *M* H_2SO_4 to neutralize 10.0 mL of NaOH. What is the concentration of the NaOH solution?

    A. 0.055 *M*

    B. 0.11 *M*

    C. 0.22 *M*

    D. 0.44 *M*

60. **Use the incomplete unbalanced chemical equation below to answer the question that follows.**

$NO_2^-(aq) + Al(s) \longrightarrow NH_3(aq) + Al(OH)_4^-(aq)$

Nitrite ions (NO_2^-) and aluminum (Al) react in a basic environment as shown in the incomplete unbalanced equation above. When this oxidation-reduction reaction is balanced with the lowest set of whole-number coefficients, what is the coefficient for the hydroxide ion (OH^-) and on which side of the equation will it appear?

A. 2, on the product side

B. 1, on the product side

C. 2, on the reactant side

D. 1, on the reactant side

61. Which of the following chemical equations is balanced correctly?

A. $Zn(s) + 2AgNO_3(aq) \longrightarrow 2Ag(s) + Zn(NO_3)_2(aq)$

B. $CH_3OH(l) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$

C. $Al(s) + 3O_2(g) \longrightarrow Al_2O_3(s)$

D. $H_2SO_4(aq) + 2NaOH(aq) \longrightarrow Na_2SO_4(s) + H_2O(l)$

62. **Use the chemical equation below to answer the question that follows.**

$2H_2O_2(l) \longrightarrow 2H_2O(l) + O_2(g)$

Hydrogen peroxide decomposes according to the equation shown above. What volume of oxygen gas, measured at standard temperature and pressure, will be produced from the decomposition of 50.0 g of hydrogen peroxide?

A. 16.5 L

B. 23.5 L

C. 33.0 L

D. 65.9 L

63. **Use the chemical equation below to answer the question that follows.**

$Pb(NO_3)_2(s) + 2NaOH(aq) \longrightarrow Pb(OH)_2(s) + 2NaNO_3(aq)$

According to the reaction shown above, approximately how many grams of $Pb(OH)_2$ will be formed when 100 g of $Pb(NO_3)_2$ is reacted with 250 mL of 2.00 *M* NaOH?

A. 60.3 g

B. 72.8 g

C. 121 g

D. 241 g

64. **Use the chemical equation below to answer the question that follows.**

$2NH_3(g) + CO_2(g) \longrightarrow (NH_2)_2CO(aq) + H_2O(l)$

A chemist reacts 258 g of NH_3 with 425 g of CO_2 and produces 298 g $(NH_2)_2CO$ according to the reaction shown above. What is the percent yield for this reaction?

A. 16.4%

B. 32.8%

C. 51.4%

D. 65.5%

65. How many grams of NaCl are contained in 50.0 mL of a 1.75 *M* NaCl solution?

A. 35.0 g

B. 28.6 g

C. 5.12 g

D. 0.875 g

66. Which of the following pairs of gas samples would have closest to the same number of particles?

A. 4.0 g of O_2 and 4.0 g of N_2

B. 73.1 g of SF_6 and 1.0 g of H_2

C. 8.8 g of CO_2 and 10.4 g of C_3H_8

D. 10.8 g of Ne and 36.0 g of Kr

67. What is the pH of a 0.22 *M* hypochlorous acid (HOCl) solution? ($K_a = 3.5 \times 10^{-7}$)

A. 0.66

B. 3.56

C. 5.80

D. 6.46

68. **Use the chemical equation below to answer the question that follows.**

$$Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$$

Which of the following changes will increase the rate of the reaction shown above?

A. decreasing the temperature of the reaction

B. using an open beaker as the reaction vessel

C. decreasing the initial concentration of HCl

D. using zinc powder as a reactant

69. **Use the chemical equation below to answer the question that follows.**

$$2KClO_3(s) \longrightarrow 2KCl(s) + 3O_2(g)$$

Why does the reaction rate for the combustion of glucose increase with the addition of $KClO_3$?

A. The presence of $KClO_3$ lowers the activation energy of the reaction.

B. The decomposition of $KClO_3$ increases the concentration of a combustion reactant.

C. The decomposition of $KClO_3$ yields a large quantity of heat.

D. The KCl formed from the decomposition of $KClO_3$ is very reactive.

70. **Use the table below to answer the question that follows.**

Experiment	Initial [A_2] (*M*)	Initial [B] (*M*)	Initial Rate (*M*/s)
1	0.25	0.10	2.8×10^{-2}
2	0.25	0.30	8.3×10^{-2}
3	0.25	0.40	1.1×10^{-1}
4	0.50	0.10	5.5×10^{-2}
5	0.75	0.30	2.5×10^{-1}

The table above shows initial concentrations and reaction rates for the hypothetical reaction $A_2 + 2B \longrightarrow 2AB$. Using these data, which of the following is the rate law for this reaction?

A. rate = $k[A_2]$

B. rate = $k[A_2][B]^2$

C. rate = $k[A_2][B]$

D. rate = $k[A_2]^3[B]$

71. **Use the table below to answer the question that follows.**

Experiment	Initial $[H_2O_2]$ (*M*)	Initial Rate (*M*/min)
1	1.50×10^{-2}	1.59×10^{-5}
2	3.00×10^{-2}	3.18×10^{-5}
3	4.50×10^{-2}	4.77×10^{-5}
4	7.50×10^{-2}	7.95×10^{-5}

Using the data for the decomposition of H_2O_2 shown above, what is the reaction rate when $[H_2O_2] = 6.50 \times 10^{-1}$?

A. 6.36×10^{-5} *M*/min

B. 6.89×10^{-4} *M*/min

C. 4.60×10^{-2} *M*/min

D. 6.50×10^{-1} *M*/min

72. **Use the information below to answer the question that follows.**

The proposed mechanism for the reaction between NO_2 and CO at temperatures less than 600 K is shown below.

step 1: $2NO_2(g) \rightleftharpoons NO_3(g) + NO(g)$ (slow)

step 2: $NO_3(g) + CO(g) \longrightarrow NO_2(g) + CO_2(g)$ (fast)

overall: $NO_2(g) + CO(g) \longrightarrow NO(g) + CO_2(g)$

Given this information, which of the following rate laws best represents this reaction mechanism?

A. rate = $k[CO]$

B. rate = $k[NO_2]^2$

C. rate = $k[NO_3][CO]$

D. rate = $k[NO_2]^2[CO]$

73. **Use the information below to answer the question that follows.**

The proposed mechanism for the reaction between I^- and OCl^- is shown below.

step 1: $OCl^-(aq) + H_2O(l) \longrightarrow HOCl(aq) + OH^-(aq)$

step 2: $I^-(aq) + HOCl(aq) \longrightarrow HOI(aq) + Cl^-(aq)$

step 3: $HOI(aq) + OH^-(aq) \longrightarrow H_2O(l) + IO^-(aq)$

overall: $I^-(aq) + OCl^-(aq) \longrightarrow IO^-(aq) + Cl^-(aq)$

Given the reaction mechanism shown above, how many intermediates are involved in the reaction between I^- and OCl^-?

A. 1

B. 2

C. 3

D. 4

74. **Use the chemical equation below to answer the question that follows.**

$2AB + C_2 \longrightarrow 2AC + 2B$

Experimental data have shown that the reaction above has the following experimental rate law.

rate = $k[AB]^2[C_2]$

What is the overall order for this reaction?

A. first order

B. second order

C. third order

D. fourth order

75. **Use the table below to answer the question that follows.**

Experiment	Initial $[NH_4^+]$ (M)	Initial $[NO_2^-]$ (M)	Initial Rate (M/s)
1	0.08	0.065	1.40×10^{-6}
2	0.16	0.065	2.80×10^{-6}
3	0.16	0.26	1.12×10^{-5}

The table above shows rate data for the following reaction.

$NH_4^+(aq) + NO_2^-(aq) \longrightarrow N_2(g) + 2H_2O(l)$

Using these data, what is the value of the rate constant for this reaction?

A. $1.04 \times 10^{-3}\ M^{-1}s^{-1}$

B. $2.70 \times 10^{-4}\ M^{-1}s^{-1}$

C. $1.21 \times 10^{-7}\ M^{-1}s^{-1}$

D. $7.28 \times 10^{-9}\ M^{-1}s^{-1}$

76. **Use the equation below to answer the question that follows.**

$S = k \times \log W$

Which of the following best describes what happens to the variables in the equation above as a compound undergoes a phase transition from solid to liquid to gas?

A. The value of S decreases.

B. The value of k increases.

C. The values of S, k, and W decrease.

D. The value of W increases.

77. A system undergoes an exothermic process releasing 2.5 kJ of heat. During this process, the system does 0.5 kJ of work. According to the first law of thermodynamics, what is the change in the system's internal energy?

A. –3.0 kJ

B. –2.0 kJ

C. 2.0 kJ

D. 3.0 kJ

78. Given that the specific heat of copper is 0.385 J/g•K, how much heat is required to raise the temperature of 50.0 g of copper from 25.0°C to 100°C?

A. 1.44 kJ

B. 1.93 kJ

C. 6.70 kJ

D. 7.18 kJ

79. When 1.0×10^2 g of an unknown metal at 80.0°C is placed in a calorimeter containing 1.0×10^2 g of water, the temperature of the water rises from 20.0°C to 25.0°C. Given that the specific heat of water is 4.184 J/g•K, what is the specific heat of the metal?

A. 0.26 J/g•K

B. 0.38 J/g•K

C. 1.52 J/g•K

D. 1.90 J/g•K

80. A constant pressure calorimeter with negligible heat capacity contains 200.0 g of H_2O at 25.00°C. When 12.3 g of $KClO_3$ is dissolved in the H_2O, the temperature of the solution in the calorimeter drops to 20.05°C. Assuming the specific heat of the solution is 4.184 J/g•K, what is the heat of solution of $KClO_3$?

A. 0.255 kJ/mol

B. 0.337 kJ/mol

C. 44.0 kJ/mol

D. 168 kJ/mol

81. **Use the table and chemical equation below to answer the question that follows.**

Bond	Bond Enthalpy (kJ/mol)
N — N	159
N = N	418
N ≡ N	941
F — F	153
N — F	272

$\frac{1}{2}N_2(g) + \frac{3}{2}F_2(g) \longrightarrow NF_3(g)$

Based on the bond enthalpies and chemical equation shown above, what is the best estimate for the enthalpy of formation for 1 mol of NF_3?

A. –816 kJ/mol

B. –507 kJ/mol

C. –387 kJ/mol

D. –116 kJ/mol

82. **Use the table and chemical equation below to answer the question that follows.**

Bond	Bond Enthalpy (kJ/mol)
O — O	138
O = O	498
Cl — Cl	243

$\frac{1}{2}O_2(g) + Cl_2(g) \longrightarrow OCl_2(g)$

The standard enthalpy of formation of OCl_2 is 105 kJ/mol. Based on the bond enthalpies and chemical equation shown above, what is the best estimate for the bond enthalpy for an O — Cl bond?

A. 104 kJ/mol

B. 194 kJ/mol

C. 318 kJ/mol

D. 387 kJ/mol

83. The bond energy for oxygen gas (O_2) is 499 kJ/mol. Based on this information, what is the standard enthalpy of formation of gaseous oxygen atoms (O)?

A. 0.00 kJ/mol

B. 250 kJ/mol

C. 499 kJ/mol

D. 998 kJ/mol

84. **Use the table below to answer the question that follows.**

Reaction	Chemical Equation	$\Delta H°$ (kJ)	$\Delta S°$ (J/K)
1	$2SO_3(g) \longrightarrow 2SO_2(g) + O_2(g)$	198	188
2	$2AsF_3(l) \longrightarrow 2As(s) + 3F_2(g)$	–1643	316
3	$N_2O(g) + 2H_2O(l) \longrightarrow NH_4NO_3(s)$	36	–446
4	$4Fe(s) + 3O_2(g) \longrightarrow 2Fe_2O_3(s)$	–1650	–549

Which of the reactions shown in the table above is spontaneous only at sufficiently high temperatures?

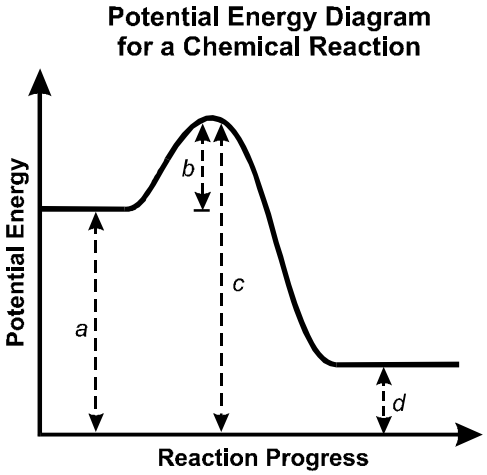
A. reaction 1

B. reaction 2

C. reaction 3

D. reaction 4

85. **Use the diagram below to answer the question that follows.**



Which of the following expressions best represents the change in enthalpy for the reaction in the potential energy diagram shown above?

A. $b - c$

B. $c - b$

C. $a - d$

D. $d - a$

86. **Use the chemical equation below to answer the question that follows.**

$2CO_2(g) \rightleftharpoons 2CO(g) + O_2(g)$

Which of the following changes would affect the value of the equilibrium constant for the reaction shown above?

A. increasing the pressure

B. removing O_2 as it is formed

C. adding a catalyst to the reaction

D. decreasing the temperature

87. **Use the chemical equation below to answer the question that follows.**

$2N_2(g) + 6H_2O(l) \rightleftharpoons 4NH_3(g) + 3O_2(g) \quad \Delta H = 1530 \text{ kJ}$

Which of the following changes would cause the equilibrium reaction shown above to shift to the right?

A. removing $NH_3(g)$

B. increasing the pressure

C. decreasing the temperature

D. adding $H_2O(l)$

88. What mass of silver ion is present in a 500 mL solution of saturated silver acetate ($AgC_2H_3O_2$)? ($K_{sp} = 1.9 \times 10^{-3}$)

A. 0.10 g

B. 0.21 g

C. 2.4 g

D. 4.7 g

89. **Use the information below to answer the question that follows.**

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
$K_p = 2.79 \times 10^{-5}$ at 472°C

Compound	Initial Partial Pressure (atm)
N_2	3.69
H_2	11.1
NH_3	0.415

The compounds shown in the table above are placed in a sealed flask at 472°C. Using the given initial partial pressures, what is the value for the reaction quotient (Q_p) and how will the reaction proceed from these initial conditions to reach equilibrium?

A. $Q_p = 1.01 \times 10^{-2}$ and the reaction will shift left.

B. $Q_p = 1.01 \times 10^{-2}$ and the reaction will shift right.

C. $Q_p = 3.41 \times 10^{-5}$ and the reaction will shift left.

D. $Q_p = 3.41 \times 10^{-5}$ and the reaction will shift right.

90. **Use the information below to answer the question that follows.**

$2N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

Temperature (°C)	K_{eq}
200	4×10^{-1}
300	4×10^{-3}
400	2×10^{-4}
500	2×10^{-5}

The equilibrium constant (K_{eq}) for the formation of NH_3 from N_2 and H_2 at various temperatures is shown in the table above. Given this information, at which temperature is the formation of NH_3 most favored?

A. 200°C

B. 300°C

C. 400°C

D. 500°C

91. Assuming complete dissociation of the solute, what is the freezing point of a solution containing 24.0 g of $SrCl_2$ and 100.0 g of water?

A. –2.32°C

B. –2.81°C

C. –5.62°C

D. –8.44°C

92. Assuming complete dissociation of electroytes, which of the following solutions would have the lowest boiling point?

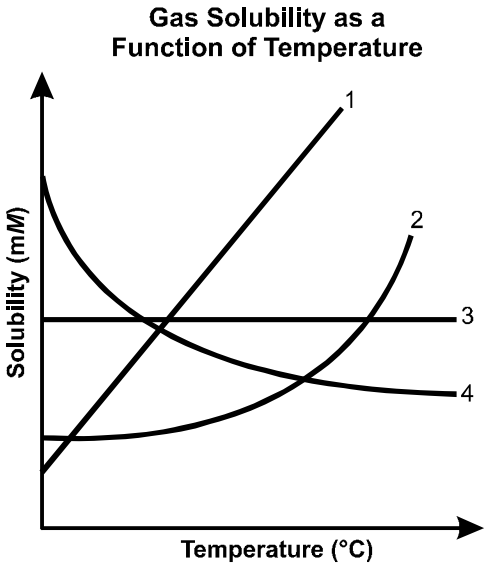
A. 120.0 g of $C_6H_{12}O_6$ in 1.0 L of H_2O

B. 100.0 g of $C_3H_8O_3$ in 1.0 L of H_2O

C. 80.0 g of $ZnSO_4$ in 1.0 L of H_2O

D. 60.0 g of NH_4Cl in 1.0 L of H_2O

93. **Use the graph below to answer the question that follows.**



Which of the lines indicated in the solubility curve above best represents the relationship between temperature and gas solubility at a constant pressure?

A. line 1

B. line 2

C. line 3

D. line 4

94. An elevation in temperature will increase the solubility in water of which of the following compounds?

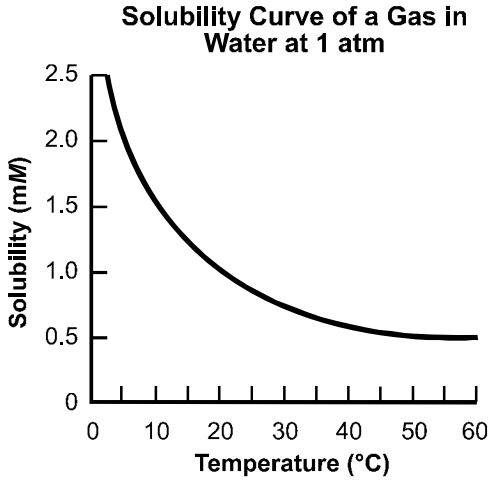
A. $CO_2(g)$

B. $NaCl(s)$

C. $O_2(g)$

D. $CCl_4(l)$

95. **Use the graph below to answer the question that follows.**



Based on the gas solubility curve shown above, which of the following changes will cause gas to be evolved?

A. cooling a 0.50 m*M* solution from 25°C to 10°C at constant pressure

B. warming a 2.0 m*M* solution from 5°C to 20°C at constant pressure

C. cooling a 1.5 m*M* solution from 10°C to 5°C at constant pressure

D. warming a 1.0 m*M* solution from 5°C to 15°C at constant pressure

96. **Use the table below to answer the question that follows.**

Standard Reduction Potentials (1.0 *M* at 25°C)	
Half-reaction	***E*° (V)**
$Ba^{2+}(aq) + 2e^- \longrightarrow Ba(s)$	–2.91
$Na^+(aq) + e^- \longrightarrow Na(s)$	–2.71
$Mn^{2+}(aq) + 2e^- \longrightarrow Mn(s)$	–1.18
$Tl^+(aq) + e^- \longrightarrow Tl(s)$	–0.34
$Ag^+(aq) + e^- \longrightarrow Ag(s)$	+0.80
$Au^{3+}(aq) + 3e^- \longrightarrow Au(s)$	+1.50

Using the standard reduction potentials shown above, which of the following cells is spontaneous at standard conditions?

A. $Mn \mid Mn^{2+} \parallel Tl^+ \mid Tl$

B. $Ag \mid Ag^+ \parallel Mn^{2+} \mid Mn$

C. $Ag \mid Ag^+ \parallel Na^+ \mid Na$

D. $Na \mid Na^+ \parallel Ba^{2+} \mid Ba$

97. **Use the table below to answer the question that follows.**

Standard Reduction Potentials (1.0 *M* at 25°C)	
Half-reaction	***E*° (V)**
$Sn^{2+}(aq) + 2e^- \longrightarrow Sn(s)$	–0.138
$Pb^{2+}(aq) + 2e^- \longrightarrow Pb(s)$	–0.126

A voltaic cell using the half-reactions shown in the table above begins operation at standard conditions. At what ratio of the concentration of Sn^{2+} to Pb^{2+} will the cell potential become zero?

A. 0.331

B. 0.930

C. 1.11

D. 2.53

98. Ni-Cd storage batteries are rechargeable, whereas standard Zn-MnO_2 dry-cell batteries are not rechargeable. Which of the following statements best accounts for this difference between these two types of batteries?

A. The salt bridge in a Ni-Cd battery is unidirectional.

B. An applied current can be used to reverse the reaction of a Ni-Cd battery.

C. In a Zn-MnO_2 battery, either electrode can serve as the anode.

D. In a Zn-MnO_2 battery, the oxidation and reduction reactions are not linked.

99. **Use the information below to answer the question that follows.**

Standard Reduction Potentials (1.0 *M* at 25°C)	
Half-reaction	***E*° (V)**
$O_2(g) + 4H^+(aq) + 4e^- \longrightarrow 2H_2O(l)$	+1.23
$Br_2(l) + 2e^- \longrightarrow 2Br^-(aq)$	+1.08

The following reaction takes place at 25°C.

$4Br^-(aq) + O_2(g) + 4H^+(aq) \longrightarrow 2H_2O(l) + 2Br_2(l)$

Using the equations and half-reactions shown above, what is the value of the equilibrium constant (K) for this chemical reaction?

A. 1.1×10^{39}

B. 1.9×10^{20}

C. 1.4×10^{10}

D. 3.5×10^{2}

100. An oxidation-reduction reaction has a negative electrochemical potential at standard conditions. Which of the following is true about the standard free energy change ($\Delta G°$) and equilibrium constant (K) for this reaction at 25°C?

A. $\Delta G° > 0, K < 1$

B. $\Delta G° > 0, K > 1$

C. $\Delta G° < 0, K < 1$

D. $\Delta G° < 0, K > 1$

DIRECTIONS FOR THE OPEN-RESPONSE ITEM ASSIGNMENTS

This section of the test consists of two open-response item assignments that appear on the following pages. You will be asked to prepare a written response of approximately 150–300 words (1–2 pages) for each assignment. You should use your time to plan, write, review, and edit your response for each assignment.

For each assignment, read the topic and directions carefully before you begin to work. Think about how you will organize your response. You may use any blank space in this test booklet to make notes, write an outline, or otherwise prepare your response.

As a whole, your response to each assignment must demonstrate an understanding of the knowledge of the field. In your response to each assignment, you are expected to demonstrate the depth of your understanding of the subject area by applying your knowledge rather than by merely reciting factual information.

Your response to each assignment will be evaluated based on the following criteria.

- **PURPOSE:** the extent to which the response achieves the purpose of the assignment
- **SUBJECT KNOWLEDGE:** appropriateness and accuracy in the application of subject knowledge
- **SUPPORT:** quality and relevance of supporting evidence
- **RATIONALE:** soundness of argument and degree of understanding of the subject area

The open-response item assignments are intended to assess subject knowledge. Your responses must be communicated clearly enough to permit valid judgment of the evaluation criteria by scorers. Your responses should be written for an audience of educators in this field. The final version of each response should conform to the conventions of edited American English. Your responses should be your original work, written in your own words, and not copied or paraphrased from some other work.

Be sure to write about the assigned topics. Please write legibly. You may not use any reference materials during the test. Remember to review your work and make any changes you think will improve your responses.

Write or print your response in the space provided following the assignment.

OPEN-RESPONSE ITEM ASSIGNMENT #1

Read the information below; then complete the exercise that follows.

A chemist wants to design a laboratory investigation demonstrating the law of conservation of mass. The chemist is planning to heat $KClO_3$ and study its decomposition into KCl and O_2.

Using your knowledge of scientific inquiry, describe a suitable experiment addressing this topic. In your response:

- describe the data to be collected;
- list the equipment needed to collect the data; and
- describe the methods used in collecting and analyzing the data generated in the experiment, including a description of the formulas and associated calculations that would be needed.

OPEN-RESPONSE SHEET—ASSIGNMENT #1

OPEN-RESPONSE SHEET—ASSIGNMENT #1

OPEN-RESPONSE ITEM ASSIGNMENT #2

Read the information below; then complete the exercise that follows.

A chemist wants to increase the rate of the following chemical reaction.

$H_3C_6H_5O_7(aq) + HCO_3^-(aq) \longrightarrow H_2C_6H_5O_7^-(aq) + H_2O(l) + CO_2(g)$.

Prepare an organized, developed response on this topic in which you:

- describe two changes that will lead to an increase in reaction rate; and
- explain how at the molecular level these changes lead to an increase in the reaction rate.

OPEN-RESPONSE SHEET—ASSIGNMENT #2

OPEN-RESPONSE SHEET—ASSIGNMENT #2

PRACTICE TEST RESULTS

PRACTICE TEST RESULTS OVERVIEW

The practice test provides valuable information regarding your preparedness for the MTEL Chemistry (12) test. In this section, you will find information and tools to help you determine your preparedness on the various sections of the test.

Multiple-Choice Questions

A Multiple-Choice Question Answer Key Worksheet is provided to assist you in evaluating your multiple-choice responses. The worksheet contains five columns. The first column indicates the multiple-choice question number, the second column indicates the objective to which the test question was written, and the third column indicates the correct response. The remaining columns are for your use in calculating the number of multiple-choice questions you answered correctly or incorrectly.

An Evaluation Chart for the multiple-choice questions is also provided to help you assess which content covered by the test objectives may require additional study.

Open-Response Items

Evaluation Information, Sample Responses and Analyses, as well as a Scoring Rubric are provided for these items. You may wish to refer to this information when evaluating your practice test responses.

Total Test

Practice Test Score Calculation information is provided to help you estimate your score on the practice test. Although you cannot use this practice test to precisely predict how you might score on an official MTEL Chemistry (12) test, you may be able to determine your degree of readiness to take an MTEL test at an operational administration. No passing score has been determined for the practice test.

MULTIPLE-CHOICE QUESTION ANSWER KEY WORKSHEET

Question Number	Objective Number	Correct Response	Your Response	
			Correct?	Incorrect?
1	0001	B		
2	0001	A		
3	0001	C		
4	0001	B		
5	0001	D		
6	0002	C		
7	0002	B		
8	0002	C		
9	0002	A		
10	0002	B		
11	0003	D		
12	0003	C		
13	0003	C		
14	0003	C		
15	0003	C		
16	0004	D		
17	0004	B		
18	0004	A		
19	0004	C		
20	0004	A		
21	0005	B		
22	0005	A		
23	0005	A		
24	0005	A		
25	0005	B		
26	0006	B		
27	0006	B		
28	0006	C		
29	0006	B		
30	0007	D		
31	0007	A		
32	0007	C		
33	0008	A		
34	0008	D		

MULTIPLE-CHOICE QUESTION
ANSWER KEY WORKSHEET (continued)

Question Number	Objective Number	Correct Response	Your Response	
			Correct?	Incorrect?
35	0008	C		
36	0008	D		
37	0009	D		
38	0009	A		
39	0009	D		
40	0009	B		
41	0010	C		
42	0010	C		
43	0010	A		
44	0010	C		
45	0011	C		
46	0011	D		
47	0011	D		
48	0011	A		
49	0012	D		
50	0012	D		
51	0012	B		
52	0013	A		
53	0013	C		
54	0013	D		
55	0013	C		
56	0013	A		
57	0013	A		
58	0013	C		
59	0013	D		
60	0014	D		
61	0014	A		
62	0014	A		
63	0014	A		
64	0014	D		
65	0014	C		
66	0014	B		
67	0014	B		
68	0015	D		

MULTIPLE-CHOICE QUESTION
ANSWER KEY WORKSHEET (continued)

Question Number	Objective Number	Correct Response	Your Response	
			Correct?	Incorrect?
69	0015	B		
70	0015	C		
71	0015	B		
72	0015	B		
73	0015	C		
74	0015	C		
75	0015	B		
76	0016	D		
77	0016	A		
78	0016	A		
79	0016	B		
80	0016	C		
81	0017	D		
82	0017	B		
83	0017	B		
84	0017	A		
85	0017	D		
86	0018	D		
87	0018	A		
88	0018	C		
89	0018	C		
90	0018	A		
91	0019	D		
92	0019	A		
93	0019	D		
94	0019	B		
95	0019	B		
96	0020	A		
97	0020	D		
98	0020	B		
99	0020	C		
100	0020	A		

Count the number of multiple-choice questions you answered correctly:

_____ of 100 multiple-choice questions

MULTIPLE-CHOICE QUESTION PRACTICE TEST EVALUATION CHART

In the evaluation chart that follows, the multiple-choice questions are arranged in numerical order and by test objective. Check your responses against the correct responses provided to determine how many questions within each objective you answered correctly.

Subarea I: Nature of Science and Properties of Matter

Objective 0001: Understand the processes of gathering, organizing, analyzing, and reporting scientific data.	
1B____ 2A_____ 3C_____ 4B_____ 5D_____	**_____/5**

Objective 0002: Understand scientific tools, instruments, materials, and safety practices.	
6C____ 7B_____ 8C_____ 9A_____ 10B_____	**_____/5**

Objective 0003: Understand the relationships among science, technology, and society.	
11D____ 12C____ 13C_____ 14C_____ 15C_____	**_____/5**

Objective 0004: Understand chemical and physical properties and changes in matter.	
16D____ 17B_____ 18A_____ 19C_____ 20A_____	**_____/5**

Objective 0005: Understand the kinetic molecular theory, the nature of phase changes, and the gas laws.	
21B____ 22A_____ 23A_____ 24A_____ 25B_____	**_____/5**

Subarea I (Objectives 0001–0005) Total _____/25

MULTIPLE-CHOICE QUESTION
PRACTICE TEST EVALUATION CHART (continued)

Subarea II: Atomic Structure and Chemical Bonding

Objective 0006: Understand atomic structure, the properties and interactions of subatomic particles, and the principles of quantum theory.	
26B____ 27B_____ 28C_____ 29B_____	**_____/4**

Objective 0007: Understand the process of nuclear transformation.	
30D____ 31A_____ 32C_____	**_____/3**

Objective 0008: Understand the organization of the periodic table.	
33A____ 34D_____ 35C_____ 36D_____	**_____/4**

Objective 0009: Understand the nomenclature and structure of inorganic and organic compounds.	
37D____ 38A_____ 39D_____ 40B_____	**_____/4**

Objective 0010: Understand the mass relationships in chemical compounds.	
41C____ 42C_____ 43A_____ 44C_____	**_____/4**

Objective 0011: Understand chemical bonding and the effect of bond type on the properties of substances.	
45C____ 46D_____ 47D_____ 48A_____	**_____/4**

Objective 0012: Understand the connection between intramolecular bonding and intermolecular forces.	
49D____ 50D_____ 51B_____	**_____/3**

Subarea II (Objectives 0006–0012) Total _____/26

MULTIPLE-CHOICE QUESTION
PRACTICE TEST EVALUATION CHART (continued)

Subarea III: Chemical Reactions and Solutions

Objective 0013: Understand the types and characteristics of chemical reactions.
52A____ 53C____ 54D_____ 55C_____ 56A_____ 57A_____ 58C_____ 59D_____ _____/8

Objective 0014: Understand the quantitative relationships expressed in chemical equations.
60D____ 61A_____ 62A_____ 63A_____ 64D_____ 65C_____ 66B_____ 67B_____ _____/8

Objective 0015: Understand the factors that affect reaction rates and methods of measuring reaction rates.
68D____ 69B_____ 70C_____ 71B_____ 72B_____ 73C_____ 74C_____ 75B_____ _____/8

Subarea III (Objectives 0013–0015) Total _____/24

MULTIPLE-CHOICE QUESTION
PRACTICE TEST EVALUATION CHART (continued)

Subarea IV: Thermodynamics

Objective 0016: Understand the principles of thermodynamics and calorimetry.	
76D____ 77A_____ 78A_____ 79B_____ 80C_____	_____/5

Objective 0017: Understand the energy relationships in chemical bonding and chemical reactions.	
81D____ 82B____ 83B_____ 84A_____ 85D_____	_____/5

Objective 0018: Understand the principles of chemical equilibrium.	
86D____ 87A____ 88C_____ 89C_____ 90A_____	_____/5

Objective 0019: Understand the properties of solutions as they relate to equilibrium.	
91D____ 92A_____ 93D_____ 94B_____ 95B_____	_____/5

Objective 0020: Understand electrochemistry.	
96A____ 97D_____ 98B_____ 99C_____ 100A_____	_____/5

Subarea IV (Objectives 0016–0020) Total _____/25

OPEN-RESPONSE ITEM EVALUATION INFORMATION

How Open-Response Items Are Scored

Open-response items are scored through a process called focused holistic scoring. Scorers judge the overall effectiveness of the response rather than individual aspects considered in isolation. Scorer judgments are based on the quality of the response, not on length or neatness. Responses must be long enough to cover the topic adequately and scorers must be able to read what is written.

How to Evaluate Your Practice Responses

On the following pages, you will find two "strong" and two "weak" sample responses. PLEASE DO NOT REVIEW THE SAMPLE RESPONSES UNTIL AFTER YOU HAVE WRITTEN YOUR OWN RESPONSE. When you do review the two "strong" and "weak" sample responses and analyses included here, please note the following points:

- ✓ For the purposes of the practice test, responses are identified as "strong" or "weak" rather than given a score point of 1–4.
- ✓ The responses identified as "strong" may contain flaws; however, these responses do demonstrate the performance characteristics of a "strong response."
- ✓ The two "strong" responses demonstrate the examinees' appropriate understanding and application of the subject matter knowledge. However, these responses do not necessarily reflect the full range of "correct answers" that would demonstrate an understanding of the subject matter.
- ✓ The "Analysis" accompanying each "strong" and "weak" response discusses the main attributes of the responses, but does not identify all flaws or strengths that may be present.

Compare your practice responses to the Sample Responses to determine whether your responses are more similar to the strong or weak responses. Also review the Analyses on those pages and the Scoring Rubric to help you better understand the characteristics of strong and weak responses. This evaluation will help you identify specific problems or weaknesses in your practice responses. Further information on scoring can be found in the Test Information Booklet and Faculty Guide at www.mtel.nesinc.com and at www.doe.mass.edu/mtel; select "FAQ," then "After the Test."

OPEN-RESPONSE ITEM
SCORING RUBRIC, SAMPLE RESPONSES, AND ANALYSES

Massachusetts Tests for Educator Licensure®
SCORING RUBRIC FOR SUBJECT TESTS

Performance Characteristics:

Purpose	The extent to which the response achieves the purpose of the assignment.
Subject Matter Knowledge	Accuracy and appropriateness in the application of subject matter knowledge.
Support	Quality and relevance of supporting details.
Rationale	Soundness of argument and degree of understanding of the subject matter.

Scoring Scale:

Score Point	Score Point Description
4	**The "4" response reflects a thorough knowledge and understanding of the subject matter.** • The purpose of the assignment is fully achieved. • There is a substantial, accurate, and appropriate application of subject matter knowledge. • The supporting evidence is sound; there are high-quality, relevant examples. • The response reflects an ably reasoned, comprehensive understanding of the topic.
3	**The "3" response reflects an adequate knowledge and understanding of the subject matter.** • The purpose of the assignment is largely achieved. • There is a generally accurate and appropriate application of subject matter knowledge. • The supporting evidence is adequate; there are some acceptable, relevant examples. • The response reflects an adequately reasoned understanding of the topic.
2	**The "2" response reflects a limited knowledge and understanding of the subject matter.** • The purpose of the assignment is partially achieved. • There is a limited, possibly inaccurate or inappropriate, application of subject matter knowledge. • The supporting evidence is limited; there are few relevant examples. • The response reflects a limited, poorly reasoned understanding of the topic.
1	**The "1" response reflects a weak knowledge and understanding of the subject matter.** • The purpose of the assignment is not achieved. • There is little or no appropriate or accurate application of subject matter knowledge. • The supporting evidence, if present, is weak; there are few or no relevant examples. • The response reflects little or no reasoning about or understanding of the topic.

U	**The response is unrelated to the assigned topic, illegible, primarily in a language other than English, not of sufficient length to score, or merely a repetition of the assignment.**
B	**There is no response to the assignment.**

FIRST SAMPLE WEAK RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #1

In order to confirm that mass is conserved, a scientist must measure the total mass before and after a reaction. The scientist must account for the mass of any gas as well as any reactants or products that are not part of the core mass. A suitable data table might look like this:

	mass $KClO_3$	mass KCl	mass O_2
Trial 1			
Trial 2			

The scientist will need a flask, a heat source, a thermometer, and a device for conserving the $2KClO_3$ gas. I do not know the formula.

ANALYSIS FOR FIRST WEAK RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #1

This is an example of a weak response because it is characterized by the following:

Purpose: The purpose of the assignment is partially achieved. The response indicates an understanding that the total mass before the reaction should equal the total mass after the reaction. In addition, some of the needed equipment is identified. Methods of collecting and analyzing data are not addressed.

Subject Matter Knowledge: There is little subject matter knowledge demonstrated. There are no balanced equations for the reaction. The candidate does not explain the method for obtaining the mass of oxygen nor provide a complete list of the equipment needed to collect the data. $2KClO_3$ is incorrectly identified as a gas. The inclusion of two trials in the chart indicates some understanding of the scientific method.

Support: The response to the second bullet is weak; there is no information on how to collect oxygen. For the third bullet, the candidate does not describe a method for calculating the mass of gas.

Rationale: The candidate states "I do not know the formula," demonstrating little or no reasoning or understanding of topic.

SECOND SAMPLE WEAK RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #1

The law of conservation of mass states that matter is neither created or destroyed. Therefore, in any reaction, the masses of each element must remain constant as they transition from reactants to products.

For this experiment, $KClO_3$ should be placed in a boiler flask, which is connected to a ring stand, and contains boiler chips. A Bunsen burner is used to heat the compound. Attached to the boiler flask should be a condenser, which will aid in the separation of products based on their individual boiling points. Finally, at the other end of the condenser, a collection flask should be placed.

Data to be recorded includes the mass of $KClO_3$ used, the boiling point of $KClO_3$, the time at the start of the experiment, the time when KCl begins to condense, and the time when condensation of KCl is completed. The temperature of the $KClO_3$ should be taken at each of these time points, so an experimental-grade metric thermometer should also be included in the equipment lists.

ANALYSIS FOR SECOND WEAK RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #1

This is an example of a weak response because it is characterized by the following:

Purpose: The purpose of the assignment is partially achieved. While the massing of $KClO_3$ is identified correctly, boiling point, time, and temperature are not relevant parameters. Appropriate methods used in collecting and analyzing the data are omitted along with an appropriate method for collecting oxygen.

Subject Matter Knowledge: The candidate demonstrates limited subject matter knowledge. Inappropriate parameters are included within the response (i.e., boiling point, time, and temperature). The candidate shows understanding of the law of conservation of matter. Minimal knowledge of equipment necessary to collect data is presented; boiling chips and condenser are erroneous. The mathematical processes that are required are not addressed.

Support: The response lacks relevant supporting details. There is no mention of the method of collecting and calculating the mass of oxygen. There is no balanced equation.

Rationale: There is a weak understanding shown of the topic. Experimentally, the candidate cannot verify the conservation of matter. Timing, "temperature taking," and incorrect process move the response in the wrong direction.

FIRST SAMPLE STRONG RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #1

Conservation of mass states that mass can neither be created nor destroyed. Accordingly, the mass of $KClO_3$ prior to decomposition should be equal to the mass of the products of its decomposition, KCl and O_2.

The following equipment will be needed: a balance, a clean test tube, glass and plastic tubing, a ring stand, test tube clamp, a Bunsen burner, a water bath, and a bottle filled with water.

In order to verify that mass has been conserved, measurements of mass will be critical. $KClO_3$ and KCl are both solids at room temperature and stable, so any standard balance will suffice. The oxygen released by the reaction will be in gaseous form, however, so a more complicated calculation will be required. This reaction will have to be performed in a hermetically sealed environment by displacement of water. The apparatus will also have to be heat resistant, as this decomposition reaction is strongly exothermic.

The decomposition reaction will proceed according to the formula

$2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$

Ideally, the apparatus in which the reaction is to be conducted will allow for the entire apparatus to be weighed prior to and after the reaction, much like Antoine Lavoisier's apparatus for capturing the mass of the products of combustion.

Comparing the masses prior to and after the reaction is conducted will verify that mass is conserved during this decomposition. The oxygen gas should be collected by displacement of water and its volume measured. Dalton's law of partial pressures must be used to determine the correct pressure of the pure oxygen: total gas pressure minus the pressure of water vapor at the experimental temperature and conditions equals the pressure of oxygen. The next part of the process would involve determining the mass of oxygen collected in grams. $PV = nRT$ can be used to determine the moles of oxygen produced, and then the number of moles can be converted to grams by multiplying by 32 grams/mole.

This shows conservation of matter or, that no matter was lost:

Mass of $2KClO_3$ = Mass of 2KCl + mass of $3O_2$

ANALYSIS FOR FIRST STRONG RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #1

This is an example of a strong response because it is characterized by the following:

Purpose: The purpose of the assignment is fully achieved. Each part of the assignment is thoroughly addressed. The method of collecting and analyzing the data is clear.

Subject Matter Knowledge: The response demonstrates a complete understanding of the scientific method. The methods of investigation are well presented, including the "hermetically sealed environment" so that oxygen will not escape, which recognizes the effect of such on measuring the mass.

Support: The level of detail is strong—the response includes the relevant application of Dalton's law and Lavoisier's work. In addition, the response cites the formula $PV = nRT$, the ideal gas law, as a proper method for converting volume of gas collected to the number of moles. Further, converting the number of moles to the mass in grams by multiplying the molecular weight provides precise, high-quality detail.

Rationale: There is a logical, well-reasoned, and clear flow to show that mass of reactants equals mass of products.

SECOND SAMPLE STRONG RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #1

A known mass of $KClO_3$ will be measured and recorded. The sample will be placed in a clean stoppered test tube. A small amount of pure MnO_2 should be used as a catalyst and mixed with the $KClO_3$ to facilitate the reaction by lowering the activation energy required. A rubber hose will be connected to a glass tube and the glass tube will be inserted into the rubber stopper. A gas bottle filled with H_2O will be inverted and placed in a water trough. The other end of the hose will be inserted into the collection bottle(s).

Carefully heat the test tube until no more bubbles appear in the collector bottle(s). After allowing the gas to cool, use Dalton's law of partial pressures to determine the pressure of oxygen gas in the bottle(s). Then use the ideal gas law, $PV = nRT$, to determine the n (moles of gas). Then, multiply this by the atomic weight (32) to obtain the number of grams of O_2. The mass of the $KClO_3$ should be equal to the mass of the products--KCl and O_2.

The equation representing what actually happened is: $2KClO_3 \rightarrow 2KCl + 3O_2$ gas.

Due to the nature of the experiment, care must be taken to have clean equipment, gentle heating, and use of pure chemicals.

ANALYSIS FOR SECOND STRONG RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #1

This is an example of a strong response because it is characterized by the following:

Purpose: The response shows thorough knowledge and understanding of the topic. All parts of the assignment are clearly addressed.

Subject Matter Knowledge: The correct steps of the scientific method are clearly stated in an ordered manner. The use of proper equipment and procedure is demonstrated. The chemical equation is accurate. Calculations to obtain the mass of gas are straightforward and correct. A safety concern is evidenced.

Support: The candidate provides supporting evidence by suggesting the addition of a catalyst and including the application of the gas law.

Rationale: The response demonstrates sound procedures and reflects a precise understanding of the calculations needed. The degree of understanding of the topic is thorough.

FIRST SAMPLE WEAK RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #2

$H_3C_6H_5O_7\ (aq) + HCO_3^-\ (aq) \rightarrow H_2C_6H_5O_7^-\ (aq) + H_2O\ (l) + CO_2\ (g)$

To propel this reaction forward, allowing the CO_2 (g) to escape would help favor the products. If CO_2 (g) was escaping, more products would be made to keep equilibrium. In this chemical reaction the equation is balanced, showing conservation of matter. More reactants could also be added to keep equilibrium.

ANALYSIS FOR FIRST WEAK RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #2

This is an example of a weak response because it is characterized by the following:

Purpose: The candidate's response to the first part of the assignment is that CO_2 (*g*) should be allowed to escape and more reactants should be added. The given reaction is not a system at equilibrium, and as a result, neither of the factors cited is relevant. The second part of the assignment is not addressed since there is no explanation of reactants at a molecular level.

Subject Matter Knowledge: The response demonstrates some knowledge of a balanced equation and conservation of matter. However, by concentrating on equilibrium instead of the factors that affect reaction rate (temperature, reactant concentration, catalysts), the focus of the assignment is lost. Knowledge of what occurs on a molecular level is not demonstrated.

Support: No relevant examples of factors that increase reaction rate are cited.

Rationale: The response reflects no understanding of the factors that affect reaction rates and how at the molecular level these changes occur.

SECOND SAMPLE WEAK RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #2

By heating the solution we could cause the rate of reacting to increase.

At the molecular level atoms are more attracted to each other as temperature is increased. The greater the attraction, the more products are produced. This increases the reaction rate.

The reaction rate could also be increased by adding more concentration of H_2O. Because water is a polar molecule, the atoms are more attracted.

ANALYSIS FOR SECOND WEAK RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #2

This is an example of a weak response because it is characterized by the following:

Purpose: Two changes are cited, but only an increased temperature is correct; the addition of water would actually have the reverse effect. The behavior on a molecular level is incorrect as reactions are due to random collisions, not molecular attraction.

Subject Matter Knowledge: While temperature will increase the reaction rate, the explanation for the way in which this affects a rate change is incorrect. The connection between increased temperature and increased kinetic energy and the frequency, strength, and orientation of collisions is not made.

Support: The response correctly cites temperature as a way to increase the rate of reaction. However, the response lacks additional supportive details that would demonstrate a clear understanding of the topic.

Rationale: The degree of understanding of the topic is limited, as evidenced by inaccuracies. The response discusses an attraction between molecules (as opposed to collisions) and the addition of water, which are both incorrect.

FIRST SAMPLE STRONG RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #2

Two changes that would increase the rate of this reaction are (1) increasing the molarity of the reactants and (2) increasing the temperature of the reactants. Both changes would allow more molecules of $H_3C_6H_5O_7$ (aq) (citric acid) to combine with bicarbonate ions.

Increasing the molarity of the reactants allows more collision opportunities per unit of time, thus increasing the rate of the reaction. For example, by doubling molarity, the molecules of the reactants are twice as likely to encounter one another and create products. Increasing the concentration of reactants increases the reaction rate because the higher concentration increases the frequency of collisions between molecules.

Increasing the temperature of the reactants increases the molecules' kinetic energy. As the molecules move around faster, they have a greater chance of colliding. These higher-energy collisions have more energy for bond breakage and formation. The reaction rate can therefore be increased by increasing the frequency of the collisions.

ANALYSIS FOR FIRST STRONG RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #2

This is an example of a strong response because it is characterized by the following:

Purpose: Purpose is fully achieved by citing two examples that would increase reaction rate—increase in molarity and temperature. In response to the second bullet, purpose is also achieved by explaining that an increase in collision will occur by increasing temperature and/or increasing molarity.

Subject Matter Knowledge: There is a substantial, accurate, and appropriate application of subject matter knowledge as shown by the discussion of increasing molarity and temperature—both of which would increase the reaction rate. In addition, the response correctly identifies the formulae of citric acid and bicarbonate ions.

Support: The response includes relevant supporting evidence by citing two examples of changes. An increase of kinetic energy is also cited as a way of increasing the number of collisions.

Rationale: By showing ways to increase the number of collisions, the response demonstrates a comprehensive understanding of the topic.

SECOND SAMPLE STRONG RESPONSE FOR OPEN-RESPONSE ITEM ASSIGNMENT #2

In this reaction, two ways to increase the reaction rate are by increasing the temperature of the reaction mixture or by adding a catalyst to the reaction mixture.

By increasing the temperature of the reaction mixture, the kinetic energy of the reactants will increase. This will lead to more frequent and energetic collisions between $H_3C_6H_5O_7$ and HCO_3^-. As the number and energy of collisions between the reactants increase, the likelihood that they will undergo a chemical reaction increases.

While the given reaction between $H_3C_6H_5O_7$ and HCO_3^- may or may not involve a catalyst, in general, reaction rates can be increased by the addition of a catalyst. A catalyst does not change chemically during a reaction, but it can change the speed of a reaction between other reactants. A catalyst does this by lowering the activation energy of the reaction. A catalyst lowers the activation energy by helping the bonds in a molecule break more easily, which then allows the molecule to react with other reactants. Overall, this can help the reaction speed up.

ANALYSIS FOR SECOND STRONG RESPONSE TO OPEN-RESPONSE ITEM ASSIGNMENT #2

This is an example of a strong response because it is characterized by the following:

Purpose: The purpose of the assignment is fully achieved. The response accurately cites two ways in which reaction rates can be increased—by increasing temperature or by adding a catalyst. The response correctly describes how, at the molecular level, a change in temperature or a catalyst leads to an increase in the reaction rate.

Subject Matter Knowledge: There is accurate and appropriate application of subject matter knowledge as demonstrated by discussion of the effects of increasing temperature on the kinetic energy of the reactants and their movements. The description of the nature and role of catalysts in chemical reactions is accurate.

Support: The response includes relevant supporting evidence by citing two accurate examples of ways to increase reaction rate. Details about how temperature affects the kinetic energy of molecules and how catalysts function are provided.

Rationale: The response is concise and accurate and addresses all parts of the assignment in a well-reasoned and logical manner.

PRACTICE TEST SCORE CALCULATION

The practice test score calculation is provided so that you may better gauge your performance and degree of readiness to take an MTEL test at an operational administration. Although the results of this practice test may be used as one indicator of potential strengths and weaknesses in your knowledge of the content on the official test, it is not possible to predict precisely how you might score on an official MTEL test.

The Sample Responses and Analyses for the open-response items may help you determine whether your responses are more similar to the strong or weak samples. The Scoring Rubric can also assist in estimating a score for your open responses. You may also wish to ask a mentor or teacher to help evaluate your responses to the open-response questions prior to calculating your total estimated score.

How to Calculate Your Practice Test Score

Review the directions in the sample below and then use the blank practice test score calculation worksheet on the following page to calculate your estimated score.

SAMPLE

Multiple-Choice Section

Enter the total number of multiple-choice questions you answered correctly:	77	
Use Table 1 below to convert that number to the score and write your score in **Box A**:		**A:** 194

Open-Response Section

Enter the number of points (1 to 4) for your first open-response question:	3	
Enter the number of points (1 to 4) for your second open-response question:	3	
	======	
Add those two numbers (Number of open-response question points):	6	
Use Table 2 below to convert that number to the score and write your score in **Box B**:		**B:** 48

Total Practice Test Score (Estimated MTEL Score)

Add the numbers in **Boxes A and B** for an estimate of your MTEL score:	**A + B =** 242

Practice Test Score Calculation Worksheet: Chemistry

Table 1:

Number of Multiple-Choice Questions Correct	Estimated MTEL Score	Number of Multiple-Choice Questions Correct	Estimated MTEL Score
0 to 25	80	61 to 65	163
26 to 30	90	66 to 70	173
31 to 35	100	71 to 75	184
36 to 40	111	76 to 80	194
41 to 45	121	81 to 85	205
46 to 50	131	86 to 90	215
51 to 55	142	91 to 95	225
56 to 60	152	96 to 100	236

Table 2:

Number of Open-Response Question Points	Estimated MTEL Score
2	24
3	30
4	36
5	42
6	48
7	54
8	60

Print the form below to calculate your estimated practice test score.

Multiple-Choice Section

Enter the total number of multiple-choice questions you answered correctly:

Use Table 1 above to convert that number to the score and write your score in **Box A**: **A:** ____

Open-Response Section

Enter the number of points (1 to 4) for your first open-response question:

Enter the number of points (1 to 4) for your second open-response question:

======

Add those two numbers (Number of open-response question points):

Use Table 2 above to convert that number to the score and write your score in **Box B**: **B:** ____

Total Practice Test Score (Estimated MTEL Score)

Add the numbers in **Boxes A and B** for an estimate of your MTEL score: **A + B =** ____