June 2016 Chemistry Regents

1 Which statement describes the charge of an electron and the charge of a proton?

(1) An electron and a proton both have a charge of +1.

(2) An electron and a proton both have a charge of −1.

(3) An electron has a charge of +1, and a proton has a charge of −1.

(4) An electron has a charge of −1, and a proton has a charge of +1.

Subatomic particles

particle	location	mass	charg
proton	nucleus	1 amu	+1
neutron	nucleus	1 amu	0
electron	orbital	negligible	-1

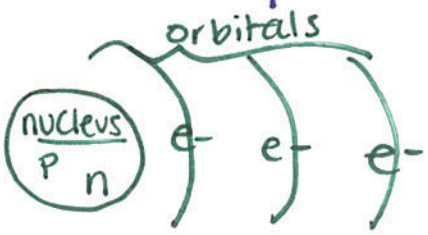
2 Which subatomic particles are found in the nucleus of an atom of beryllium?

(1) electrons and protons

(2) electrons and positrons

(3) neutrons and protons

(4) neutrons and electrons



3 The elements in Period 4 on the Periodic Table are arranged in order of increasing

periods go horizontally

(1) atomic radius

(2) atomic number = to # protons

(3) number of valence electrons

(4) number of occupied shells of electrons

4 Which phrase describes two forms of solid carbon, diamond and graphite, at STP?

(1) the same crystal structure and the same properties

(2) the same crystal structure and different properties

(3) different crystal structures and the same properties

(4) different crystal structures and different properties

These are allotropes. They have atoms of the same element (carbon), but are arranged in a different crystal structure, which gives them different properties.

5 Which element has six valence electrons in each of its atoms in the ground state?

e- config. as printed on Periodic Table.

(1) Se 2-8-18-6

(2) As 2-8-18-5

(3) Kr 2-8-18-8

(4) Ga 2-8-18-3

* look up electron configurations for each element on the periodic table. The last # listed is the valence e.

6 What is the chemical name for $H_2SO_3(aq)$?

(1) sulfuric acid
(2) sulfurous acid
(3) hydrosulfuric acid
(4) hydrosulfurous acid

we know it's an acid because H^+ is the cation, so look up name on Table K

7 Which substance is most soluble in water?

(1) $(NH_4)_3PO_4$ sol.
(2) $Cu(OH)_2$ insol.
(3) Ag_2SO_4 insol.
(4) $CaCO_3$ insol.

use the solubility guidelines on Table F

8 Which type of bonding is present in a sample of an element that is malleable?

(1) ionic
(2) metallic
(3) nonpolar covalent
(4) polar covalent

can be hammered into a sheet
ex) metals (think of aluminum foil)

9 Which atom has the greatest attraction for the electrons in a chemical bond?

(1) hydrogen 2.2
(2) oxygen 3.4
(3) silicon 1.9
(4) sulfur 2.6

* electronegativity *
-look up on Table S!

10 Which type of reaction involves the transfer of electrons?

(1) alpha decay
(2) double replacement
(3) neutralization
(4) oxidation-reduction

-Redox Rxns are a transfer of e-
LEO
loss of electrons is oxidation
GER
gain of electron is reduction

11 A 10.0-gram sample of nitrogen is at STP. Which property will increase when the sample is cooled to 72 K at standard pressure?

(1) mass — not changing
(2) volume — when cooled, particles will take up less room, so vol. will ↓
(3) density — when cooled, the particles will take up less space (volume), but mass will be the same. since density = mass/volume the sample will have a ↑ density.
(4) temperature — "cooling", so temp ↓

12 Which element is a gas at STP?

(1) sulfur solid
(2) xenon NOBLE GAS!
(3) potassium solid
(4) phosphorus solid

gases = diatomics except Br_2 (liquid)
~~Br_2~~ $I_2 N_2 Cl_2 H_2 O_2 F_2$
& all noble gases (group 18)

13 A 5.0-gram sample of Fe(s) is to be placed in 100. milliliters of HCl(aq). Which changes will result in the fastest rate of reaction?

(1) increasing the surface area of Fe(s) and increasing the concentration of HCl(aq)

(2) increasing the surface area of Fe(s) and decreasing the concentration of HCl(aq)

(3) decreasing the surface area of Fe(s) and increasing the concentration of HCl(aq)

(4) decreasing the surface area of Fe(s) and decreasing the concentration of HCl(aq)

How to ↑ rate of reaction:
- ↑ surface area
- ↑ temperature
- ↑ concentration
- add a catalyst

all will increase # of effective collisions, so rxn will speed up!

14 Which process is commonly used to separate a mixture of ethanol and water? separates by phase differences

(1) distillation (3) filtration

(2) ionization (4) titration

Compounds that have different boiling points, like ethanol & water, can be separated by distillation.

15 A sample of hydrogen gas will behave most like an ideal gas under the conditions of

(1) low pressure and low temperature

(2) low pressure and high temperature

(3) high pressure and low temperature

(4) high pressure and high temperature

Ideal gases are like a tropical vacation. High temp, low pressure

16 The collision theory states that a reaction is most likely to occur when the reactant particles collide with the proper

(1) formula masses

(2) molecular masses

(3) density and volume

(4) energy and orientation

In order for a successful collision, reactants must collide with enough energy (activation energy) & the correct orientation (position).

17 At STP, which sample contains the same number of molecules as 3.0 liters of $H_2(g)$?

(1) 1.5 L of $NH_3(g)$ (3) 3.0 L of $CH_4(g)$

(2) 2.0 L of $CO_2(g)$ (4) 6.0 L of $N_2(g)$

Avogadro's Law: equal volumes of gas at the same temp. & pressure will contain an equal # of particles.

18 The addition of a catalyst to a chemical reaction provides an alternate pathway that

(1) increases the potential energy of reactants

(2) decreases the potential energy of reactants

(3) increases the activation energy

(4) decreases the activation energy

19 A sample of water is boiling as heat is added at a constant rate. Which statement describes the potential energy and the average kinetic energy of the water molecules in this sample?

(1) The potential energy decreases and the average kinetic energy remains the same.

(2) The potential energy decreases and the average kinetic energy increases.

(3) The potential energy increases and the average kinetic energy remains the same.

(4) The potential energy increases and the average kinetic energy increases.

phase change

3 Ps – phase change, plateau, PE changes (KE constant)

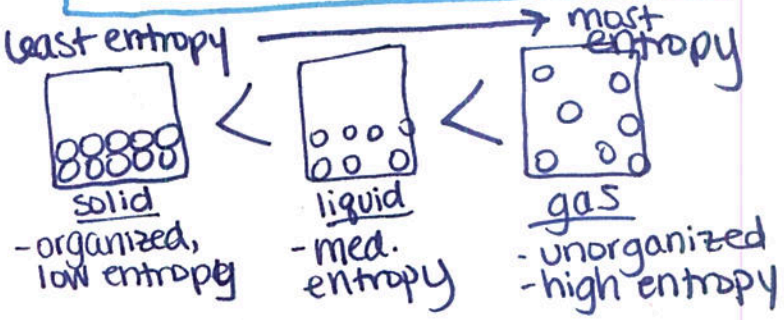
20 Entropy is a measure of the

(1) acidity of a sample

(2) disorder of a system (randomness)

(3) concentration of a solution

(4) chemical activity of an element



solid – organized, low entropy

liquid – med. entropy

gas – unorganized – high entropy

21 Which element has atoms that can bond with each other to form ring, chain, and network structures?

(1) aluminum

(2) calcium

(3) carbon

(4) argon

22 What is the number of electrons shared in the multiple carbon-carbon bond in one molecule of 1-pentyne? Use Tables P & Q

(1) 6

(2) 2

(3) 3

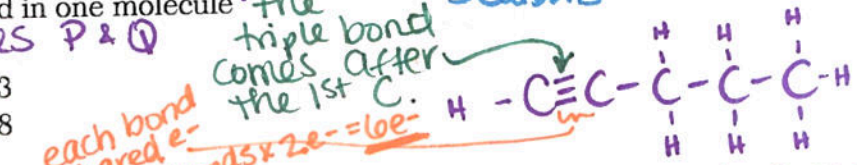
(4) 8

1- pentyne

5 Carbons

contains a triple bond

the triple bond comes after the 1st C.



each bond = 2 shared e-

3 bonds × 2e- = 6e-

*Remember, each C can form 4 bonds. No more + no less.

23 Butanal, butanone, and diethyl ether have different properties because the molecules of each compound differ in their

aldehyde ketone ether

Table R!

(1) numbers of carbon atoms

(2) numbers of oxygen atoms

(3) types of functional groups

(4) types of radioactive isotopes

* see functional groups on Table R!

→ compounds with different functional groups have different properties!

24 What occurs when a magnesium atom becomes a magnesium ion?

(1) Electrons are gained and the oxidation number increases.
(2) Electrons are gained and the oxidation number decreases.
(3) Electrons are lost and the oxidation number increases.
(4) Electrons are lost and the oxidation number decreases.

Mg : 2-8-2 → can either gain or lose 2. Will lose 2 since that's easier
neutral, on P.T. → lost/gained valence e- to get a full octet
2 e- lost so charge is +2
Mg +2
(charge) 0 → +2

25 Energy is required to produce a chemical change during

(1) chromatography
(2) electrolysis
(3) boiling
(4) melting

physical changes
electrical → chemical energy; requires a battery

26 The reaction of an Arrhenius acid with an Arrhenius base produces water and

(1) a salt
(2) an ester
(3) an aldehyde
(4) a halocarbon

acid + base → salt + water
aka) neutralization rxn
* to find what the salt is, do "innies & outies" as a double replacement rxn.

27 One acid-base theory defines an acid as an

(1) H^- acceptor
(2) H^- donor
(3) H^+ acceptor
(4) H^+ donor

Bases
Accept H+
Acids
Donate H+

28 Which phrase describes the decay modes and the half-lives of K-37 and K-42?

Table N!

(1) the same decay mode but different half-lives
(2) the same decay mode and the same half-life
(3) different decay modes and different half-lives
(4) different decay modes but the same half-life

29 Which particle has a mass that is approximately equal to the mass of a proton?

(1) an alpha particle ^4_2He
(2) a beta particle $^0_{-1}e$
(3) a neutron ^1_0n
(4) a positron $^0_{+1}e$

Table O!
mass of 1 amu
same mass.

30 Which change occurs during a nuclear fission reaction?

(1) Covalent bonds are converted to ionic bonds.
(2) Isotopes are converted to isomers.
(3) Temperature is converted to mass.
(4) Matter is converted to energy.

fission means to split. One atom (heavier) is split into two lighter atoms. There is also a release of lots of energy b/c mass is converted into energy.

31 Which notations represent hydrogen isotopes?

(1) $^{1}_{1}H$ and $^{2}_{1}H$ (3) $^{1}_{2}H$ and $^{1}_{3}H$

(2) $^{1}_{1}H$ and $^{4}_{2}H$ (4) $^{2}_{1}H$ and $^{7}_{2}H$

same atomic # (bottom) diff. mass # (top)

same element w/ same atomic # (# protons, same bottom # on notation), but diff. # of neutrons (so diff. mass # or top #)

32 Naturally occurring gallium is a mixture of isotopes that contains 60.11% of Ga-69 (atomic mass = 68.93 u) and 39.89% of Ga-71 (atomic mass = 70.92 u). Which numerical setup can be used to determine the atomic mass of naturally occurring gallium?

(1) $\frac{(68.93\text{ u} + 70.92\text{ u})}{2}$

(2) $\frac{(68.93\text{ u})(0.6011)}{(70.92\text{ u})(0.3989)}$

(3) (68.93 u)(0.6011) + (70.92 u)(0.3989)

(4) (68.93 u)(39.89) + (70.92 u)(60.11)

mass isotope 1; % abundance isotope 1; mass isotope 2; % abundance isotope 2; avg atomic mass

= (mass of 1st isotope × % abundance 1st isotope in decimal form) + (mass 2nd isotope × % abun 2nd isotope in decimal form)

→ to convert from % to decimal move decimal 2 places left

= (68.93 u × .6011) + (70.92 × .3989)

33 Which list of symbols represents nonmetals, only?

↳ to the right of the "staircase"

(1) B, Al, Ga (3) C, Si, Ge

(2) Li, Be, B (4) P, S, Cl

34 In the formula XSO_4, the symbol X could represent the element

(1) Al (3) Mg

(2) Ar (4) Na

Remember that the overall charge of a neutral compound must be zero.

$X(SO_4)$

So charge of element X must be 2+. Polyatomic ion (Table) Charge = 2−

Group 2 elements, like Mg have a 2+ charge

35 What is the chemical formula for lead(IV) oxide?

(1) PbO_2 (3) Pb_2O

(2) PbO_4 (4) Pb_4O

tells you the charge of Pb.

Pb^{+4} O^{-2}

Pb_2O_4 ÷2 ÷2

$= PbO_2$

36 Which statement describes the general trends in electronegativity and atomic radius as the elements in Period 2 are considered in order from left to right?

(1) Both electronegativity and atomic radius increase.
(2) Both electronegativity and atomic radius decrease.
(3) Electronegativity increases and atomic radius decreases.
(4) Electronegativity decreases and atomic radius increases.

Look up on Table S!

37 What is the percent composition by mass of nitrogen in $(NH_4)_2CO_3$ (gram-formula mass = 96.0 g/mol)?

(1) 14.6%
(2) 29.2%
(3) 58.4%
(4) 87.5%

Table T!

% composition = $\frac{\text{mass of part}}{\text{mass of whole}} \times 100\%$

mass of part = mass of N in the compound
mass of whole = mass of entire compound

$= \frac{2 \text{ N atoms} \times 14.0}{96.0} \times 100$

$= \frac{28.0}{96.0} \times 100 = 29.2\%$

38 Given the balanced equation:

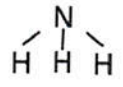
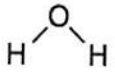
$2KI + F_2 \rightarrow 2KF + I_2$

compound + element → compound + element
single replacement (one swap)

Which type of chemical reaction does this equation represent?

(1) synthesis multiple reactants, 1 product ex) $2H_2 + O_2 \rightarrow 2H_2O$
(2) decomposition 1 reactant, multiple products ex) $2H_2O \rightarrow 2H_2 + O_2$
(3) single replacement compound + element → compound + element (see ex. above in Q38)
(4) double replacement compound + compound → compound + compound (innies/outies) ex) $HCl + NaOH \rightarrow NaCl + H_2O$

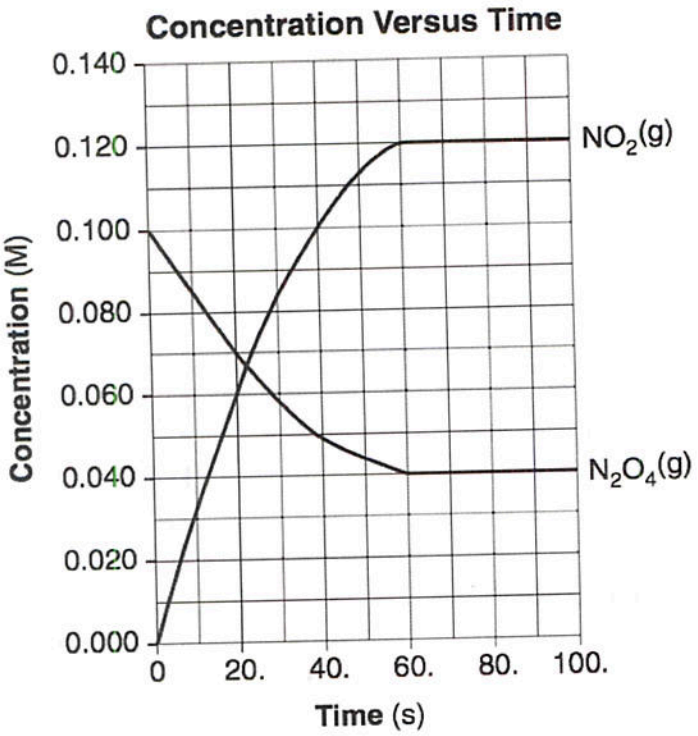
39 Which formula represents a nonpolar molecule containing polar covalent bonds?

(1) H–H
(2) O=C=O
(3) 
(4) 

- molecular polarity is based on symmetry of the molecule — use SNAP
- bond polarity is based on electronegativity difference between 2 atoms joined in a chemical bond.
  - look up electronegativity of the elements on Table S & subtract them.
    - if difference is btwn 0.4 & 1.7, then the bond is polar covalent

40 A reaction reaches equilibrium at 100.°C. The equation and graph representing this reaction are shown below.

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$



The graph shows that the reaction is at equilibrium after 60. seconds because the concentrations of both $NO_2(g)$ and $N_2O_4(g)$ are

(1) increasing
(2) decreasing
(3) constant
(4) zero

@ equilibrium, rates are equal, & concentrations are constant

41 Given the balanced equation representing a reaction:

$$2H_2O + \text{energy} \rightarrow 2H_2 + O_2$$

Which statement describes the changes in energy and bonding for the reactant?

(1) Energy is absorbed as bonds in H_2O are formed.
(2) Energy is absorbed as bonds in H_2O are broken.
(3) Energy is released as bonds in H_2O are formed.
(4) Energy is released as bonds in H_2O are broken.

energy on reactants side, so absorbed.

BARF

when bonds are broken energy is absorbed

energy is released when bonds are formed.

42 At standard pressure, what is the temperature at which a saturated solution of NH_4Cl has a concentration of 60. g NH_4Cl/100. g H_2O?

(1) 66°C (3) 22°C
(2) 57°C (4) 17°C

*Use Reference Table G
-Find 60g on y-axis. Trace over to see where it intersects w/ the NH_4Cl curve. Trace down to x-axis for answer.

43 Which aqueous solution has the highest boiling point at standard pressure?

(1) 1.0 M KCl(aq) (3) 2.0 M KCl(aq)
(2) 1.0 M $CaCl_2$(aq) (4) 2.0 M $CaCl_3$(aq)

2 ions: K^+ Cl^-
lower conc., so eliminate
3 ions: Ca^{2+} $2Cl^-$

Colligative Properties: As solute is added, freezing point ↓ & boiling point ↑.
• For ionic compounds you need to take both concentration & # of ions into account b/c as concentration ↑, fp ↓ & bp ↑. Also, the more ions in the formula, the lower the fp & higher the bp.

44 Given the equation representing a system at equilibrium:

$$KNO_3(s) + \text{energy} \rightleftharpoons^{H_2O} K^+(aq) + NO_3^-(aq)$$

Which change causes the equilibrium to shift?

(1) increasing pressure
(2) increasing temperature
(3) adding a noble gas
(4) adding a catalyst

add, away
after shift, this will all ↑ in concentration b/c it's being produced
inc.
Le Chatelier's
will cause shift towards side w/ less moles of gas, but not gases here
(random) - "add away, take towards"
speeds up forward & reverse equally

45 Which hydrocarbon is saturated?

(1) C_2H_2 alkyne
(2) C_3H_4 alkyne
(3) C_4H_6 alkyne
(4) C_4H_{10} alkane

saturated = all single C-C bonds, so an alkane
• gen. formula on Table Q = C_nH_{2n+2}

46 Which volume of 0.600 M H_2SO_4(aq) exactly neutralizes 100. milliliters of 0.300 M $Ba(OH)_2$(aq)?

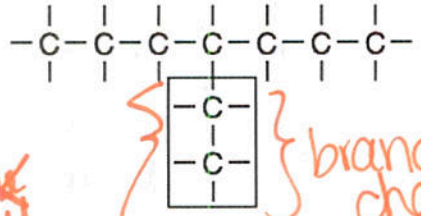
(1) 25.0 mL
(2) 50.0 mL
(3) 100. mL
(4) 200. mL

$V_A = x$
M_A
acid
base
V_B
M_B

key word to use titration formula on Table T.

$$M_A V_A = M_B V_B$$
$$(0.600\,M)(x) = (0.300\,M)(100.\,mL)$$
$$x = 50.0\,mL$$

47 Given the formula for an organic compound:



· 2C = ethyl

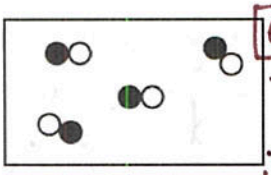
branching group off a hydrocarbon chain is an alkyl group.
Name just like an alkane using tables P + Q, then drop "-ane" ending & add "-yl"

What is the name given to the group in the box?

(1) butyl 4C
(2) ethyl 2C
(3) methyl 1C
(4) propyl 3C

48 Given the particle diagram:

Key
○ = atom of an element
● = atom of a different element



Which type of matter is represented by the particle diagram?

(1) an element only 1 type of atom
(2) a compound 2 or more types of atoms bonded together (connected)
(3) a homogeneous mixture 2 or more different compounds or elements evenly mixed
(4) a heterogeneous mixture 2 or more different compounds or elements unevenly mixed/distributed

Matter
-has mass + volume

- pure substances
  - element
    - 1 type of atom
    - can't be broken down
    - monatomic
    - diatomic
  - compound
    - 2 or more types of elements bonded
    - can only be broken down by chemical means ex)
- mixtures
  - 2 or more different elements or compounds physically combined (mixed together like Chex Mix)
  - can be physically separated
    - distillation
    - filtration
    - chromatography
    - Homogeneous
      - evenly mixed/uniformly distributed
      - ex) salt dissolved in water
      - aka a "solution"
      - needs to be separated by distillation or evaporation or chromatography
    - Heterogeneous
      - unevenly mixed/non-uniformly distributed
      - ex) sand in water
      - needs to be separated by filtration

49 Which substance is an electrolyte?

(1) O_2 covalent
(2) Xe element
(3) C_3H_8 covalent
(4) KNO_3 ionic/salt

acids, bases, + salts (ionic)

50 Which type of organic reaction produces both water and carbon dioxide?

(1) addition (alkene + halogen → halogenated alkane)
(2) combustion
(3) esterification (organic acid + alcohol → ester + water)
(4) fermentation ($C_6H_{12}O_6$ (sugar/glucose) $\xrightarrow{\text{yeast catalyst}}$ ethanol + CO_2)

hydrocarbon + $O_2 \rightarrow CO_2 + H_2O$

51 Draw a Lewis electron-dot diagram for a chloride ion, Cl^-. [1]

1 extra valence e⁻; & must draw brackets w/ charge

* For Lewis dot diagrams, only draw valence e⁻.

Base your answers to questions 52 and 53 on the information below and on your knowledge of chemistry.

At STP, Cl_2 is a gas and I_2 is a solid. When hydrogen reacts with chlorine, the compound hydrogen chloride is formed. When hydrogen reacts with iodine, the compound hydrogen iodide is formed.

52 Balance the equation *in your answer booklet* for the reaction between hydrogen and chlorine, using the smallest whole-number coefficients. [1]

$$\_\_\_\_ H_2(g) + \_\_\_\_ Cl_2(g) \rightarrow \underline{2} HCl(g)$$

* Remember that coefficients must be reduced if possible.

53 Explain, in terms of intermolecular forces, why iodine is a solid at STP but chlorine is a gas at STP. [1]

The intermolecular forces in iodine are stronger than the intermolecular forces in chlorine.

Base your answers to questions 54 and 55 on the information below and on your knowledge of chemistry.

Some properties of the element sodium are listed below.

- is a soft, silver-colored metal – physical property
- melts at a temperature of 371 K – physical property
- oxidizes easily in the presence of air – chemical property
- forms compounds with nonmetallic elements in nature – chemical property
- forms sodium chloride in the presence of chlorine gas – chemical property

54 Identify *one* chemical property of sodium from this list. [1]

- oxidizes easily in the presence of air
- forms compounds w/ nonmetallic elements in nature
- forms sodium chloride in the presence of chlorine gas

55 Convert the melting point of sodium to degrees Celsius. [1]

Table T!

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

$371\ K = {}^\circ C + 273$

$-273 \qquad\qquad -273$

$98^\circ C = {}^\circ C$

Base your answers to questions 56 through 58 on the information below and on your knowledge of chemistry.

At standard pressure, water has unusual properties that are due to both its molecular structure and intermolecular forces. For example, although most liquids contract when they freeze, water expands, making ice less dense than liquid water. Water has a much higher boiling point than most other molecular compounds having a similar gram-formula mass.

56 Explain why $H_2O(s)$ floats on $H_2O(\ell)$ when both are at 0°C. [1]

. $H_2O(s)$ is less dense than $H_2O(\ell)$

57 State the type of intermolecular force responsible for the unusual boiling point of $H_2O(\ell)$ at standard pressure. [1]

hydrogen bonding

(occur between molecules that have H w/ N, O, or F

58 Determine the total amount of heat, in joules, required to completely vaporize a 50.0-gram sample of $H_2O(\ell)$ at its boiling point at standard pressure. [1]

m → 50.0-gram sample

Table T

$q = mH_v$ ← on Table B

Keyword!

$q = (50.0\,g)(2260\,J/g)$

$q = 113{,}000\,J$

At 1023 K and 1 atm, a 3.00-gram sample of $SnO_2(s)$ (gram-formula mass = 151 g/mol) reacts with hydrogen gas to produce tin and water, as shown in the balanced equation below.

$$SnO_2(s) + 2H_2(g) \rightarrow Sn(\ell) + 2H_2O(g)$$

gfm SnO_2

59 Show a numerical setup for calculating the number of moles of $SnO_2(s)$ in the 3.00-gram sample. [1]

don't need to calculate

*Use mole calculations on Table T

$$\text{moles} = \frac{\text{given mass}}{\text{gfm}} = \frac{3.00\,g}{151\,g/mol}$$

60 Determine the number of moles of $Sn(\ell)$ produced when 4.0 moles of $H_2(g)$ is completely consumed. [1]

x

*Use the mole ratios!

$$\frac{\text{given } (H_2)}{\text{coefficient}} = \frac{\text{wanted } (Sn)}{\text{coefficient}}$$

moles

$$\frac{H_2}{4.0\,mol} = \frac{Sn}{x\,mol}$$

$$\frac{4.0\,mol}{2} = \frac{x\,mol}{1}$$

$x = 2.0\,mol$

Base your answers to questions 61 and 62 on the information below and on your knowledge of chemistry.

The incomplete data table below shows the pH value of solutions *A* and *B* and the hydrogen ion concentration of solution *A*.

Hydrogen Ion and pH Data for HCl(aq) Solutions

HCl(aq) Solution	Hydrogen Ion Concentration (M)	pH
A	1.0×10^{-2}	2.0
B	?	5.0

61 State the color of methyl orange in a sample of solution *A*. [1]

*Use Table M: red

62 Determine the hydrogen ion concentration of solution *B*. [1]

1.0×10^{-PH} = 1.0×10^{-5}

Base your answers to questions 63 through 65 on the information below and on your knowledge of chemistry.

A sample of helium gas is placed in a rigid cylinder that has a movable piston. The volume of the gas is varied by moving the piston, while the temperature is held constant at 273 K. The volumes and corresponding pressures for three trials are measured and recorded in the data table below. For each of these trials, the product of pressure and volume is also calculated and recorded. For a fourth trial, only the volume is recorded.

Pressure and Volume Data for a Sample of Helium Gas at 273 K

Trial Number	Pressure (atm)	Volume (L)	P × V (L•atm)
1	1.000	0.412	0.412
2	0.750	0.549	0.412
3	0.600	0.687	0.412
4	?	1.373	? 0.412

63 State evidence found in the data table that allows the product of pressure and volume for the fourth trial to be predicted. [1]

PxV is the same for trials 1-3.

64 Determine the pressure of the helium gas in trial 4. [1]

$P \times V = 0.412$

$P \times 1.373 = 0.412$

$\div 1.373 \quad \div 1.373$

$P = 0.300$ atm

65 Compare the average distances between the helium atoms in trial 1 to the average distances between the helium atoms in trial 3. [1]

In trial 3, the atoms are further apart since they occupy a greater volume.

Base your answers to questions 66 through 69 on the information below and on your knowledge of chemistry.

Potassium phosphate, K_3PO_4, is a source of dietary potassium found in a popular cereal. According to the Nutrition-Facts label shown on the boxes of this brand of cereal, the accepted value for a one-cup serving of this cereal is 170. milligrams of potassium. The minimum daily requirement of potassium is 3500 milligrams for an adult human.

66 Identify *two* types of chemical bonding in the source of dietary potassium in this cereal. [1]

ionic & covalent

*whenever you see a compound w/ a polyatomic ion, it has both ionic + covalent bonding

67 Identify the noble gas whose atoms have the same electron configuration as a potassium ion. [1]

K: 2-8-8-1

K^{+1} = lost 1e- : 2-8-8 like Ar

68 Compare the radius of a potassium ion to the radius of a potassium atom. [1]

the radius of a potassium ion is smaller than the radius of a potassium atom

neutral, no e- lost/gained

69 The mass of potassium in a one-cup serving of this cereal is determined to be 172 mg. Show a numerical setup for calculating the percent error for the mass of potassium in this serving. [1]

Table T

$$\%\ \text{error} = \frac{\text{measured value} - \text{accepted value}}{\text{accepted value}} \times 100$$

$$= \frac{172 - 170}{170} \times 100$$

Base your answers to questions 70 and 71 on the information below and on your knowledge of chemistry.

During photosynthesis, plants use carbon dioxide, water, and light energy to produce glucose, $C_6H_{12}O_6$, and oxygen. The reaction for photosynthesis is represented by the balanced equation below.

$$6CO_2 + 6H_2O + \text{light energy} \rightarrow C_6H_{12}O_6 + 6O_2$$

70 Write the empirical formula for glucose. [1]

$C_6H_{12}O_6 \div 2 = CH_2O$

71 State evidence that indicates photosynthesis is an endothermic reaction. [1]

energy is on the reactants side of the equation.

Base your answers to questions 72 through 74 on the information below and on your knowledge of chemistry.

Fireworks that contain metallic salts such as sodium, strontium, and barium can generate bright colors. A technician investigates what colors are produced by the metallic salts by performing flame tests. During a flame test, a metallic salt is heated in the flame of a gas burner. Each metallic salt emits a characteristic colored light in the flame.

72 Explain why the electron configuration of 2-7-1-1 represents a sodium atom in an excited state. [1]

The ground state configuration of sodium is 2-7-2. In the configuration of 2-7-1-1, an e- has moved from the third shell to the fourth shell

73 Explain, in terms of electrons, how a strontium salt emits colored light. [1]

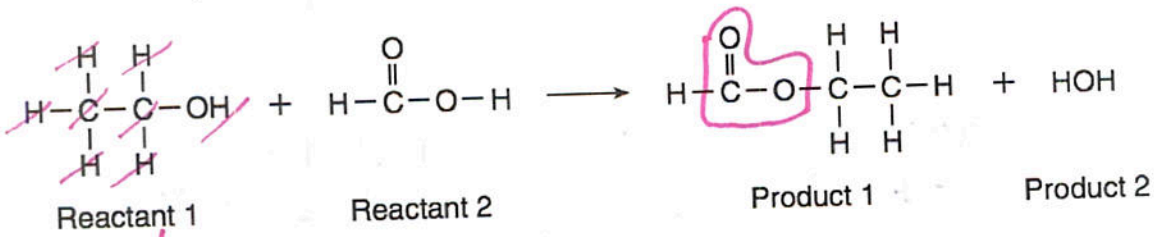
when electrons fall from excited state back down to ground state, energy is emitted in the form of light.

74 State how bright-line spectra viewed through a spectroscope can be used to identify the metal ions in the salts used in the flame tests. [1]

You can compare the spectral wavelengths of the known elements to the spectral wavelength of an unknown element.

Base your answers to questions 75 through 77 on the information below and on your knowledge of chemistry.

The unique odors and flavors of many fruits are primarily due to small quantities of a certain class of organic compounds. The equation below represents the production of one of these compounds.



Reactant 1 Reactant 2 Product 1 Product 2

75 Show a numerical setup for calculating the gram-formula mass for reactant 1. [1]

C: 2 × 12.0 = 24.0
H: 6 × 1.0 = 6.0
O: 1 × 16.0 = +16.0

76 Explain, in terms of molecular polarity, why reactant 2 is soluble in water. [1]

Reactant 2 is a polar molecule, like water. (*remember, like dissolves like.)

77 State the class of organic compounds to which product 1 belongs. [1]

*Use Table R!

ester

Base your answers to questions 78 through 81 on the information below and on your knowledge of chemistry.

A student develops the list shown below that includes laboratory equipment and materials for constructing a voltaic cell.

Laboratory Equipment and Materials

- a strip of zinc
- a strip of copper
- a 250-mL beaker containing 150 mL of 0.1 M zinc nitrate
- a 250-mL beaker containing 150 mL of 0.1 M copper(II) nitrate
- wires
- a voltmeter
- a switch
- a salt bridge

78 State the purpose of the salt bridge in the voltaic cell. [1]

Permits the exchange of ions between the two half cells to keep the solutions neutral.

79 Complete and balance the half-reaction equation *in your answer booklet* for the oxidation of the Zn(s) that occurs in the voltaic cell. [1]

$$Zn(s) \rightarrow \underline{\quad Zn^{+2} \quad} + \underline{\quad 2e^- \quad}$$

*add e- to the more (+) side.

80 Compare the activities of the two metals used by the student for constructing the voltaic cell. [1]

*Use Table J

Zn is more active than copper.

81 Identify *one* item of laboratory equipment required to build an electrolytic cell that is *not* included in the list. [1]

- a battery

Base your answers to questions 82 through 85 on the information below and on your knowledge of chemistry.

In 1896, Antoine H. Becquerel discovered that a uranium compound could expose a photographic plate wrapped in heavy paper in the absence of light. It was shown that the uranium compound was spontaneously releasing particles and high-energy radiation. Further tests showed the emissions from the uranium that exposed the photographic plate were *not* deflected by charged plates.

82 Identify the highly penetrating radioactive emission that exposed the photographic plates. [1]

gamma radiation

83 Complete the nuclear equation *in your answer booklet* for the alpha decay of U-238. [1]

(*) Remember, top #s on either side of arrow must add up to be equal. same w/ bottom #s.

$^{238}_{92}U \rightarrow {}^{4}_{2}He + {}^{234}_{90}Th$

84 Determine the number of neutrons in an atom of U-233. [1]

mass # ←

neutrons = mass # - atomic

= 233 - 92 = 141

85 Identify the type of nuclear reaction that occurs when an alpha or a beta particle is spontaneously emitted by a radioactive isotope. [1]

natural transmutation