

SUNDAY

4/10/11

Pg 1

Part B-1

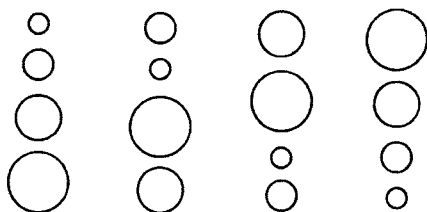
Answer all questions in this part.

Directions (31–50): For *each* statement or question, write on the separate answer sheet the *number* of the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *Reference Tables for Physical Setting/Chemistry*.

31 Which electron configuration could represent a strontium atom in an excited state?

- (1) 2–8–18–7–1 (3) 2–8–18–8–1
(2) 2–8–18–7–3 (4) 2–8–18–8–2

32 Which grouping of circles, when considered in order from the top to the bottom, best represents the relative size of the atoms of Li, Na, K, and Rb, respectively?



- (1) (2) (3) (4)

33 What is the total number of neutrons in an atom of $^{57}_{26}\text{Fe}$?

- (1) 26 (3) 57
(2) 31 (4) 83

34 At STP, which element is brittle and *not* a conductor of electricity?

- (1) S (3) Na
(2) K (4) Ar

35 What is the total number of electrons in a Mg^{2+} ion?

- (1) 10 (3) 14
(2) 12 (4) 24

36 Which formula represents lead(II) chromate?

- (1) PbCrO_4 (3) Pb_2CrO_4
(2) $\text{Pb}(\text{CrO}_4)_2$ (4) $\text{Pb}_2(\text{CrO}_4)_3$

37 Compared to an electron in the first electron shell of an atom, an electron in the third shell of the same atom has

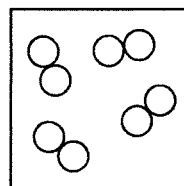
- (1) less mass (3) more mass
(2) less energy (4) more energy

38 Which pair consists of a molecular formula and its corresponding empirical formula?

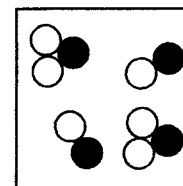
- (1) C_2H_2 and CH_3CH_3 (3) P_4O_{10} and P_2O_5
(2) C_6H_6 and C_2H_2 (4) SO_2 and SO_3

39 Which particle diagram represents a sample of one compound, only?

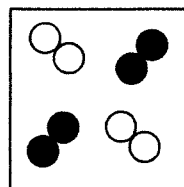
Key	
	= atom of one element
	= atom of a different element



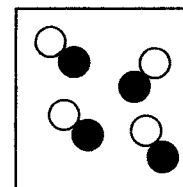
(1)



(3)



(2)

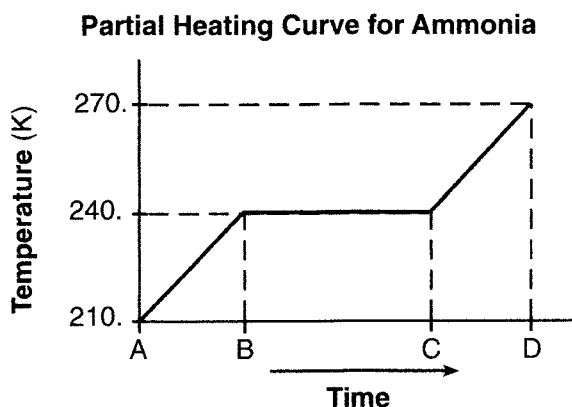


(4)

2

Base your answers to questions 56 through 58 on the information below.

A 5.00-gram sample of liquid ammonia is originally at 210. K. The diagram of the partial heating curve below represents the vaporization of the sample of ammonia at standard pressure due to the addition of heat. The heat is *not* added at a constant rate.



Some physical constants for ammonia are shown in the data table below.

Some Physical Constants for Ammonia

specific heat capacity of $\text{NH}_3(\ell)$	4.71 J/g•K
heat of fusion	332 J/g
heat of vaporization	1370 J/g

56 In the space in *your answer booklet*, calculate the total heat absorbed by the 5.00-gram sample of ammonia during time interval *AB*. Your response must include *both* a correct numerical setup and the calculated result. [2]

57 Describe what is happening to *both* the potential energy and the average kinetic energy of the molecules in the ammonia sample during time interval *BC*. Your response must include *both* potential energy and average kinetic energy. [1]

58 Determine the total amount of heat required to vaporize this 5.00-gram sample of ammonia at its boiling point. [1]

3

Base your answers to questions 73 through 76 on the information below.

The table below lists physical and chemical properties of six elements at standard pressure that correspond to known elements on the Periodic Table. The elements are identified by the code letters, *D*, *E*, *G*, *J*, *L*, and *Q*.

Properties of Six Elements at Standard Pressure

<u>Element D</u> Density 0.00018 g/cm ³ Melting point -272°C Boiling point -269°C Oxide formula (none)	<u>Element E</u> Density 1.82 g/cm ³ Melting point 44°C Boiling point 280°C Oxide formula E ₂ O ₅	<u>Element G</u> Density 0.53 g/cm ³ Melting point 181°C Boiling point 1347°C Oxide formula G ₂ O
<u>Element J</u> Density 0.0013 g/cm ³ Melting point -210°C Boiling point -196°C Oxide formula J ₂ O ₅	<u>Element L</u> Density 0.86 g/cm ³ Melting point 64°C Boiling point 774°C Oxide formula L ₂ O	<u>Element Q</u> Density 0.97 g/cm ³ Melting point 98°C Boiling point 883°C Oxide formula Q ₂ O

- 73 What is the total number of elements in the “Properties of Six Elements at Standard Pressure” table that are solids at STP? [1]
- 74 An atom of element *G* is in the ground state. What is the total number of valence electrons in this atom? [1]
- 75 Letter *Z* corresponds to an element on the Periodic Table other than the six listed elements. Elements *G*, *Q*, *L*, and *Z* are in the same group on the Periodic Table, as shown in the diagram below.

<i>G</i>
<i>Q</i>
<i>L</i>
<i>Z</i>

Based on the trend in the melting points for elements *G*, *Q*, and *L* listed in the “Properties of Six Elements at Standard Pressure” table, estimate the melting point of element *Z*, in degrees Celsius. [1]

- 76 Identify, by code letter, the element that is a noble gas in the “Properties of Six Elements at Standard Pressure” table. [1]
-

4

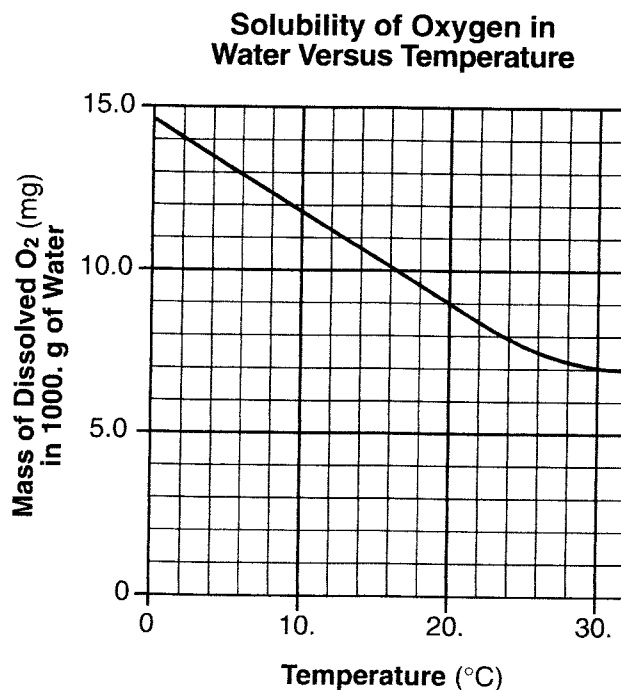
Part C

Answer all questions in this part.

Directions (64–82): Record your answers in the spaces provided in your answer booklet. Some questions may require the use of the *Reference Tables for Physical Setting/Chemistry*.

Base your answers to questions 64 through 66 on the information below.

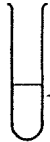
Scientists who study aquatic ecosystems are often interested in the concentration of dissolved oxygen in water. Oxygen, O_2 , has a very low solubility in water, and therefore its solubility is usually expressed in units of milligrams per 1000. grams of water at 1.0 atmosphere. The graph below shows a solubility curve of oxygen in water.



- 64 A student determines that 8.2 milligrams of oxygen is dissolved in a 1000.-gram sample of water at 15°C and 1.0 atmosphere. In terms of saturation, what type of solution is this sample? [1]
- 65 Explain, in terms of molecular polarity, why oxygen gas has low solubility in water. Your response must include *both* oxygen and water. [1]
- 66 An aqueous solution has 0.0070 gram of oxygen dissolved in 1000. grams of water. In the space in *your answer booklet*, calculate the dissolved oxygen concentration of this solution in parts per million. Your response must include *both* a correct numerical setup and the calculated result. [2]
-

5

24 Each of four test tubes contains a different concentration of HCl(aq) at 25°C . A 1-gram cube of Zn is added to each test tube. In which test tube is the reaction occurring at the fastest rate?

1 M HCl(aq)	0.1 M HCl(aq)	0.01 M HCl(aq)	0.001 M HCl(aq)
			
(1)	(2)	(3)	(4)

25 Which energy conversion occurs during the operation of an electrolytic cell?

- (1) chemical energy to electrical energy
- (2) electrical energy to chemical energy
- (3) nuclear energy to electrical energy
- (4) electrical energy to nuclear energy

26 Which compound is an Arrhenius acid?

- | | |
|------------------|--------------------------|
| (1) CaO | (3) K_2O |
| (2) HCl | (4) NH_3 |

27 Based on the results of testing colorless solutions with indicators, which solution is most acidic?

- (1) a solution in which bromthymol blue is blue
- (2) a solution in which bromcresol green is blue
- (3) a solution in which phenolphthalein is pink
- (4) a solution in which methyl orange is red

28 According to one acid-base theory, water acts as an acid when an H_2O molecule

- | | |
|-----------------------------|-----------------------------|
| (1) accepts an H^+ | (3) accepts an H^- |
| (2) donates an H^+ | (4) donates an H^- |

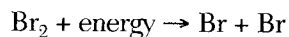
29 In which type of reaction is an atom of one element converted to an atom of a different element?

- | | |
|--------------------|--------------------|
| (1) decomposition | (3) saponification |
| (2) neutralization | (4) transmutation |

30 Which nuclide is listed with its half-life and decay mode?

- (1) K-37 , 1.24 h, α
- (2) N-16 , 7.2 s, β^-
- (3) Rn-222 , 1.6×10^3 y, α
- (4) U-235 , 7.1×10^8 y, β^-

- 12 Given the balanced equation representing a reaction:



Which statement describes the energy change and bonds in this reaction?

- (1) Energy is released as bonds are broken.
 - (2) Energy is released as bonds are formed.
 - (3) Energy is absorbed as bonds are broken.
 - (4) Energy is absorbed as bonds are formed.
- 13 Which substance can *not* be broken down by a chemical change?
- (1) methane
 - (2) propanal
 - (3) tungsten
 - (4) water
- 14 Object A at 40.°C and object B at 80.°C are placed in contact with each other. Which statement describes the heat flow between the objects?
- (1) Heat flows from object A to object B.
 - (2) Heat flows from object B to object A.
 - (3) Heat flows in both directions between the objects.
 - (4) No heat flow occurs between the objects.
- 15 Which unit can be used to express the concentration of a solution?
- (1) L/s
 - (2) J/g
 - (3) ppm
 - (4) kPa
- 16 Which formula represents a mixture?
- (1) $\text{C}_6\text{H}_{12}\text{O}_6(\ell)$
 - (2) $\text{C}_6\text{H}_{12}\text{O}_6(\text{s})$
 - (3) $\text{LiCl}(\text{aq})$
 - (4) $\text{LiCl}(\text{s})$
- 17 Which sample has particles with the *lowest* average kinetic energy?
- (1) 1.0 g of I_2 at 50.°C
 - (2) 2.0 g of I_2 at 30.°C
 - (3) 7.0 g of I_2 at 40.°C
 - (4) 9.0 g of I_2 at 20.°C

- 18 Which gas sample at STP has the same total number of molecules as 2.0 liters of $\text{CO}_2(\text{g})$ at STP?

- (1) 5.0 L of $\text{CO}_2(\text{g})$
- (2) 2.0 L of $\text{Cl}_2(\text{g})$
- (3) 3.0 L of $\text{H}_2\text{S}(\text{g})$
- (4) 6.0 L of $\text{He}(\text{g})$

- 19 Petroleum can be separated by distillation because the hydrocarbons in petroleum are

- (1) elements with identical boiling points
- (2) elements with different boiling points
- (3) compounds with identical boiling points
- (4) compounds with different boiling points

- 20 Which compound is insoluble in water?

- (1) KOH
- (2) NH_4Cl
- (3) Na_3PO_4
- (4) PbSO_4

- 21 A gas sample is at 25°C and 1.0 atmosphere. Which changes in temperature and pressure will cause this sample to behave more like an ideal gas?

- (1) decreased temperature and increased pressure
- (2) decreased temperature and decreased pressure
- (3) increased temperature and increased pressure
- (4) increased temperature and decreased pressure

- 22 The isotopes K-37 and K-42 have the same

- (1) decay mode
- (2) bright-line spectrum
- (3) mass number for their atoms
- (4) total number of neutrons in their atoms

- 23 Which element is present in all organic compounds?

- (1) carbon
- (2) hydrogen
- (3) nitrogen
- (4) oxygen

7

Part A

Answer all questions in this part.

Directions (1–30): For *each* statement or question, write in your answer booklet the *number* of the word or expression that, of those given, best completes the statement or answers the question. Some questions may require the use of the *Reference Tables for Physical Setting/Chemistry*.

- 1 What is the total number of valence electrons in a calcium atom in the ground state?
 - (1) 8
 - (2) 2
 - (3) 18
 - (4) 20
- 2 Which subatomic particles are located in the nucleus of an He-4 atom?
 - (1) electrons and neutrons
 - (2) electrons and protons
 - (3) neutrons and protons
 - (4) neutrons, protons, and electrons
- 3 In the late 1800s, experiments using cathode ray tubes led to the discovery of the
 - (1) electron
 - (2) neutron
 - (3) positron
 - (4) proton
- 4 The atomic mass of titanium is 47.88 atomic mass units. This atomic mass represents the
 - (1) total mass of all the protons and neutrons in an atom of Ti
 - (2) total mass of all the protons, neutrons, and electrons in an atom of Ti
 - (3) weighted average mass of the most abundant isotope of Ti
 - (4) weighted average mass of all the naturally occurring isotopes of Ti
- 5 An atom of which element has the largest atomic radius?
 - (1) Fe
 - (2) Mg
 - (3) Si
 - (4) Zn
- 6 Which element requires the *least* amount of energy to remove the most loosely held electron from a gaseous atom in the ground state?
 - (1) bromine
 - (2) calcium
 - (3) sodium
 - (4) silver
- 7 A balanced equation representing a chemical reaction can be written using
 - (1) chemical formulas and mass numbers
 - (2) chemical formulas and coefficients
 - (3) first ionization energies and mass numbers
 - (4) first ionization energies and coefficients
- 8 Every water molecule has two hydrogen atoms bonded to one oxygen atom. This fact supports the concept that elements in a compound are
 - (1) chemically combined in a fixed proportion
 - (2) chemically combined in proportions that vary
 - (3) physically mixed in a fixed proportion
 - (4) physically mixed in proportions that vary
- 9 The percent composition by mass of nitrogen in NH_4OH (gram-formula mass = 35 grams/mole) is equal to
 - (1) $\frac{4}{35} \times 100$
 - (2) $\frac{14}{35} \times 100$
 - (3) $\frac{35}{14} \times 100$
 - (4) $\frac{35}{4} \times 100$
- 10 Which Group 15 element exists as diatomic molecules at STP?
 - (1) phosphorus
 - (2) nitrogen
 - (3) bismuth
 - (4) arsenic
- 11 What is the total number of electrons shared in a double covalent bond?
 - (1) 1
 - (2) 2
 - (3) 3
 - (4) 4