Practice Exam 12_2013 MCQ

1. Complete combustion of a sample of a hydrocarbon in excess oxygen produces equimolar quantities of carbon dioxide and water. Which of the following could be the molecular formula of the compound?

(A) C_2H_2
(B) C_2H_6
(C) C_4H_8
(D) C_6H_6

2.

Substance	Equilibrium Vapor Pressure at 20°C (torr)
$C_6H_6(l)$	75
$C_2H_5OH(l)$	44
$CH_3OH(l)$	92
$C_2H_6O_2(l)$	0.06

Based on the data in the table above, which of the following liquid substances has the weakest intermolecular forces?

(A) $C_6H_6(l)$
(B) $C_2H_5OH(l)$
(C) $CH_3OH(l)$
(D) $C_2H_6O_2(l)$

3.

Ion	Radius (pm)
Zn^{2+}	74
Ca^{2+}	100
Ba^{2+}	135

Based on the data in the table above, which of the following correctly predicts the relative strength of the attraction of Zn^{2+}, Ca^{2+}, and Ba^{2+} ions to water molecules in a solution, from strongest to weakest, and provides the correct reason?

(A) $Zn^{2+} > Ca^{2+} > Ba^{2+}$ because the smaller ions have a stronger coulombic attraction to water
(B) $Zn^{2+} > Ca^{2+} > Ba^{2+}$ because the smaller ions are more electronegative
(C) $Ba^{2+} > Ca^{2+} > Zn^{2+}$ because the larger ions are more polarizable
(D) $Ba^{2+} > Ca^{2+} > Zn^{2+}$ because the larger ions are less electronegative

4. Zn(*s*) is used to reduce other compounds in chemical reactions. If a chemist needs a substance that is more effective in its reducing ability, which of the following species would be the best choice?

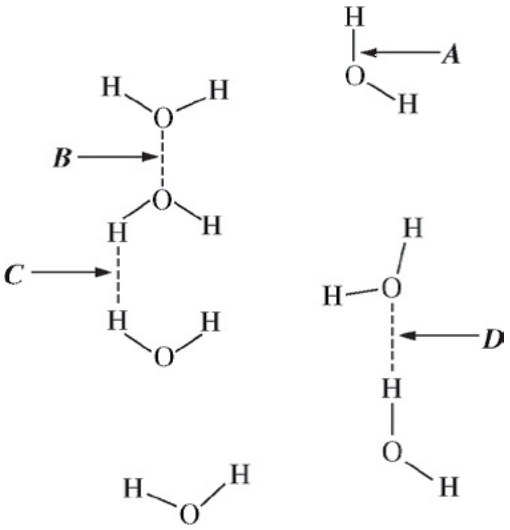
(A) Na

(B) H^+

(C) K^+

(D) Cl^-

5.



In the diagram above, which of the labeled arrows identifies hydrogen bonding in water?

(A) *A*

(B) *B*

(C) *C*

(D) *D*

6. A kinetics experiment is set up to collect the gas that is generated when a sample of chalk, consisting primarily of solid $CaCO_3$, is added to a solution of ethanoic acid, CH_3COOH. The rate of reaction between $CaCO_3$ and CH_3COOH is determined by measuring the volume of gas generated at 22^oC and 1 atm as a function of time. Which of the following experimental conditions is most likely to increase the rate of gas production?

(A) Decreasing the volume of ethanoic acid solution used in the experiment

(B) Decreasing the concentration of the ethanoic acid solution used in the experiment

(C) Decreasing the temperature at which the experiment is performed

(D) Decreasing the particle size of the $CaCO_3$ by grinding it into a fine powder

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7. $H_2(g) + I_2(g) \rightleftarrows 2\ HI(g)$

At 450°C, 2.0 moles each of $H_2(g)$, $I_2(g)$, and $HI(g)$ are combined in a 1.0 L rigid container. The value of K_c at 450°C is 50. Which of the following will occur as the system moves toward equilibrium?

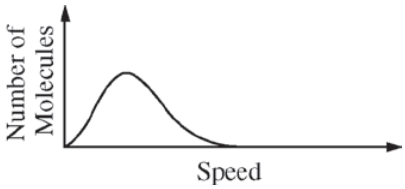
(A) More $H_2(g)$ and $I_2(g)$ will form.

(B) More $HI(g)$ will form.

(C) The total pressure will decrease.

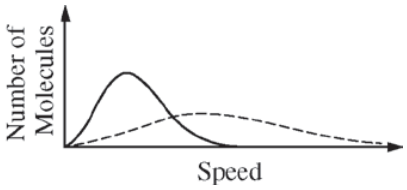
(D) No net reaction will occur, because the number of molecules is the same on both sides of the equation.

8.

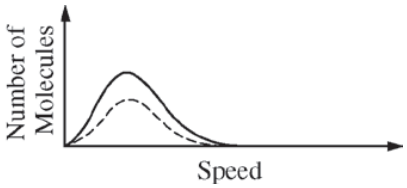


The graph above shows the speed distribution of molecules in a sample of a gas at a certain temperature. Which of the following graphs shows the speed distribution of the same molecules at a lower temperature (as a dashed curve) ?

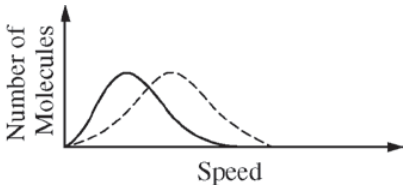
(A)



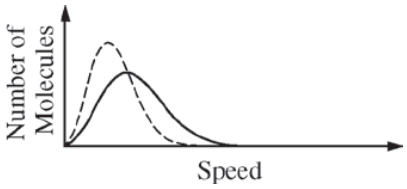
(B)



(C)



(D)



9. A 100g sample of a metal was heated to 100°C and then quickly transferred to an insulated container holding 100g of water at 22°C. The temperature of the water rose to reach a final temperature of 35°C. Which of the following can be concluded?

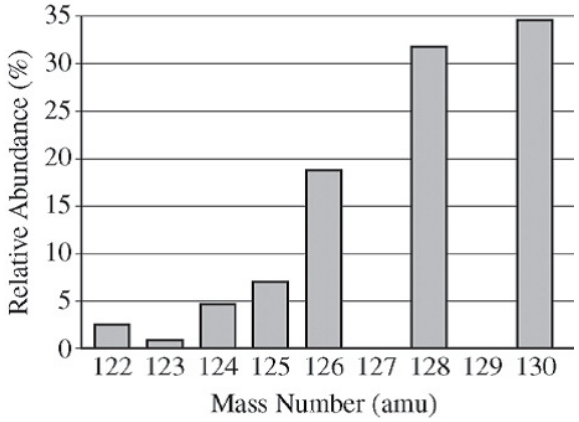
(A) The metal temperature changed more than the water temperature did; therefore the metal lost more thermal energy than the water gained.

(B) The metal temperature changed more than the water temperature did, but the metal lost the same amount of thermal energy as the water gained.

(C) The metal temperature changed more than the water temperature did; therefore the heat capacity of the metal must be greater than the heat capacity of the water.

(D) The final temperature is less than the average starting temperature of the metal and the water; therefore the total energy of the metal and water decreased.

10.



The elements I and Te have similar average atomic masses. A sample that was believed to be a mixture of I and Te was run through a mass spectrometer, resulting in the data above. All of the following statements are true. Which one would be the best basis for concluding that the sample was pure Te?

(A) Te forms ions with a −2 charge, whereas I forms ions with a −1 charge.

(B) Te is more abundant than I in the universe.

(C) I consists of only one naturally occurring isotope with 74 neutrons, whereas Te has more than one isotope.

(D) I has a higher first ionization energy than Te does.

11. $H_2C_2O_4(aq) + H_2O(l) \rightleftarrows H_3O^+(aq) + HC_2O_4\text{-}(aq)$

$HC_2O_4\text{-}(aq) + H_2O(l) \rightleftarrows H_3O^+(aq) + C_2O_4^{2-}(aq)$

$H_2O(l) + H_2O(l) \rightleftarrows H_3O^+(aq) + OH\text{-}(aq)$

All the reactions represented above occur in an aqueous solution of oxalic acid. Which of the following represent a Brønsted-Lowry conjugate acid-base pair?

(A) $H_2C_2O_4(aq)$ and $C_2O_4^{2-}(aq)$

(B) $HC_2O4^-(aq)$ and $C_2O_4^{2-}(aq)$

(C) $HC_2O_4\text{-}(aq)$ and $H_2O(aq)$

(D) $H_3O^+(aq)$ and $OH^-(aq)$

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12. Which of the following reactions is not thermodynamically favored at low temperatures but becomes favored as the temperature increases?

(A)

Reaction	$\Delta H°$ (kJ/mol$_{rxn}$)	$\Delta S°$(J/(mol$_{rxn}$K))
$2\ CO(g) + O_2(g) \rightarrow 2\ CO_2(g)$	-566	-173

(B)

Reaction	$\Delta H°$ (kJ/mol$_{rxn}$)	$\Delta S°$(J/(mol$_{rxn}$K))
$2\ H_2O(g) \rightarrow 2\ H_2(g) + O_2(g)$	484	90.0

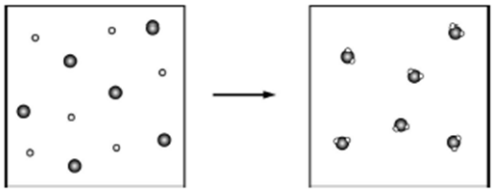
(C)

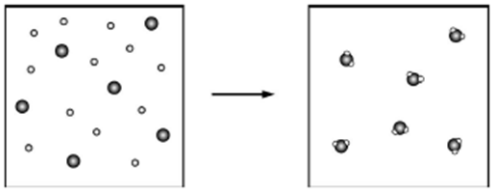
Reaction	$\Delta H°$ (kJ/mol$_{rxn}$)	$\Delta S°$(J/(mol$_{rxn}$K))
$2\ N_2O(g) \rightarrow 2\ N_2(g) + O_2(g)$	-164	149

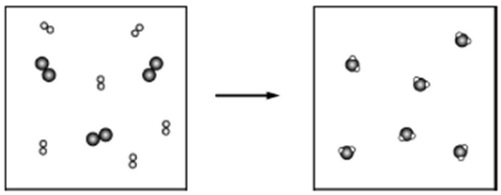
(D)

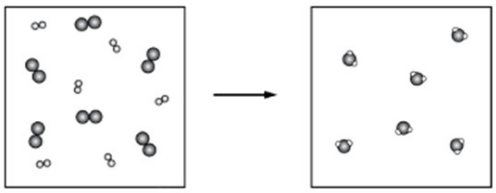
Reaction	$\Delta H°$ (kJ/mol$_{rxn}$)	$\Delta S°$(J/(mol$_{rxn}$K))
$PbCl_2(s) \rightarrow Pb^{2+}(aq) + 2\ Cl^-(aq)$	23.4	-12.5

13. Which of the following particulate diagrams best shows the formation of water vapor from hydrogen gas and oxygen gas in a rigid container at 125°C?

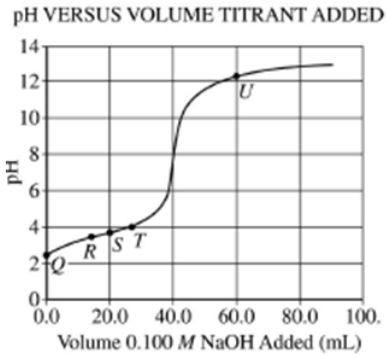
(A) 

(B) 

(C) 

(D) 

Refer to the following.



A 50.0 mL sample of an acid, HA, of unknown molarity is titrated, and the pH of the resulting solution is measured with a meter and graphed as a function of the volume of 0.100 *M* NaOH added.

14. At point *R* in the titration, which of the following species has the highest concentration?

(A) HA

(B) A^-

(C) H_3O^+

(D) OH^-

15. Which of the following is the best particulate representation of the species (other than H_2O) that are present in significant concentrations in the solution at point *U* in the titration?

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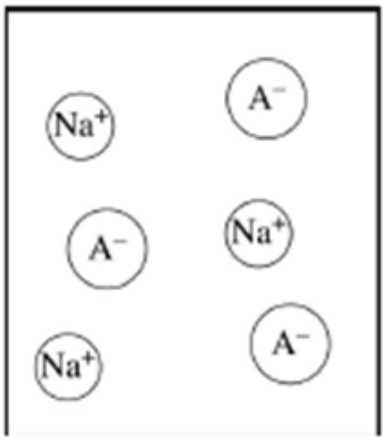
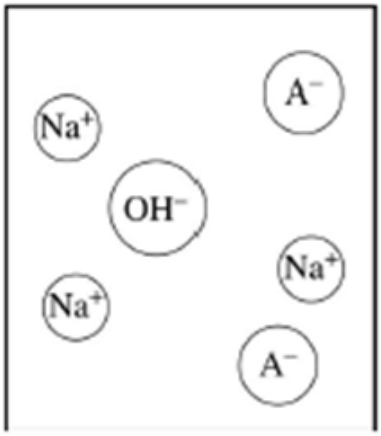
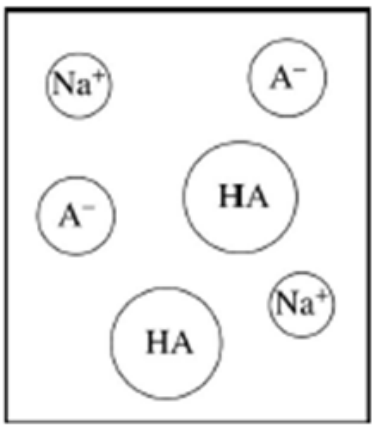
(A)



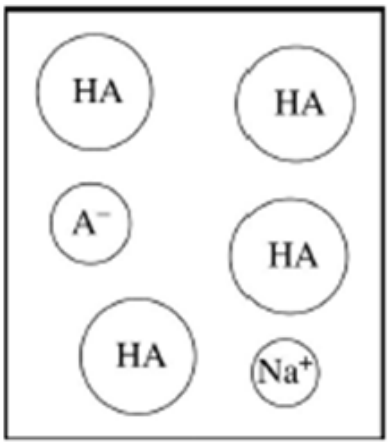
(B)



(C)



(D)



16. At which point on the titration curve is $[A^-]$ closest to twice that of [HA]?

(A) *R*

(B) *S*

(C) *T*

(D) *U*

17. A student carries out the same titration but uses an indicator instead of a pH meter. If the indicator changes color slightly past the equivalence point, what will the student obtain for the calculated concentration of the acid?

(A) Slightly less than 0.0800 *M*

(B) Slightly more than 0.0800 *M*

(C) Slightly less than 0.125 *M*

(D) Slightly more than 0.125 *M*

Refer to three gases in identical rigid containers under the conditions given in the table below.

Container	A	B	C
Gas	Methane	Ethane	Butane
Formula	CH_4	C_2H_6	C_4H_{10}
Molar mass (g/mol)	16	30.	58
Temperature (°C)	27	27	27
Pressure (atm)	2.0	4.0	2.0

18. The average kinetic energy of the gas molecules is

(A) greatest in container A

(B) greatest in container B

(C) greatest in container C

(D) the same in all three containers

19. The density of the gas, in g/L, is

(A) greatest in container A

(B) greatest in container B

(C) greatest in container C

(D) the same in all three containers

20. If the pressure of each gas is increased at constant temperature until condensation occurs, which gas will condense at the lowest pressure?

(A) Methane

(B) Ethane

(C) Butane

(D) All the gases will condense at the same pressure.

---

21. The mass percent of carbon in pure glucose, $C_6H_{12}O_6$, is 40.0 percent. A chemist analyzes an impure sample of glucose and determines that the mass percent of carbon is 38.2 percent. Which of the following impurities could account for the low mass percent of carbon in the sample?

(A) Water, H_2O

(B) Ribose, $C_5H_{10}O_5$

(C) Fructose, $C_6H_{12}O_6$, an isomer of glucose

(D) Sucrose, $C_{12}H_{22}O_{11}$

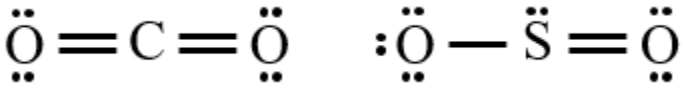
22. Caffeine ($C_8H_{10}N_4O_2$) is a weak base with a K_b value of 4×10^{-4}. The pH of a 0.01 *M* solution of caffeine is in the range of

(A) 2–3

(B) 5–6

(C) 7–8

(D) 11–12

23. 

Lewis electron-dot diagrams for CO_2 and SO_2 are given above. The molecular geometry and polarity of the two substances are

(A) the same because the molecular formulas are similar

(B) the same because C and S have similar electronegativity values

(C) different because the lone pair of electrons on the S atom make it the negative end of a dipole

(D) different because S has a greater number of electron domains (regions of electron density) surrounding it than C has

---

24. $2\ NO(g) + O_2(g) \rightarrow 2\ NO_2(g)$

Consider the following mechanism for the reaction represented above.

Step 1: $2\ NO \rightleftarrows N_2O_2$ (*fast reversible*)

Step 2: $N_2O_2 + O_2 \rightarrow 2\ NO_2$ (*slow*)

Which of the following statements is true?

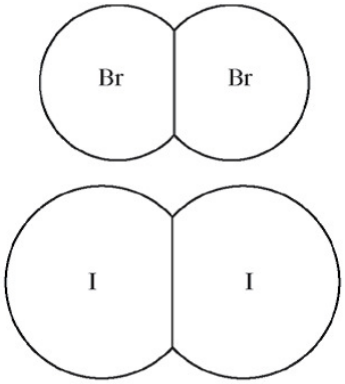
(A) Step 1 represents a unimolecular reaction.

(B) Increasing the concentration of NO will decrease the overall rate of the reaction.

(C) Raising the temperature will have no effect on the numerical value of the rate constant.

(D) The rate law that is consistent with the mechanism is $rate = k[NO]^2[O_2]$.

25.



The diagram above shows molecules of Br_2 and I_2 drawn to the same scale. Which of the following is the best explanation for the difference in the boiling points of liquid Br_2 and I_2, which are 59^oC and 184^oC, respectively?

(A) Solid iodine is a network covalent solid, whereas solid bromine is a molecular solid.

(B) The covalent bonds in I_2 molecules are weaker than those in Br_2 molecules.

(C) I_2 molecules have electron clouds that are more polarizable than those of Br_2 molecules, thus London dispersion forces are stronger in liquid I_2.

(D) Bromine has a greater electronegativity than iodine, thus there are stronger dipole-dipole forces in liquid bromine than in liquid iodine.

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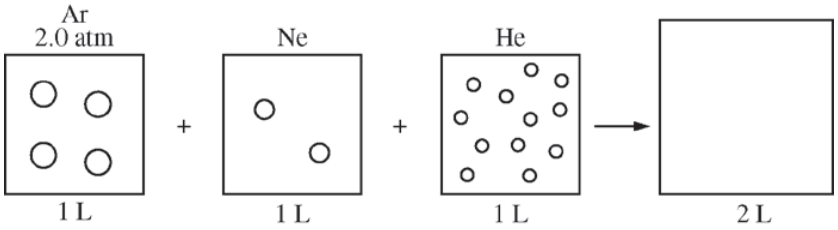
26.



The figure above represents three sealed 1.0 L vessels, each containing a different inert gas at 298 K. The pressure of Ar in the first vessel is 2.0 atm. The ratio of the numbers of Ar, Ne, and He atoms in the vessels is 2:1:6, respectively. After all the gases are combined in a previously evacuated 2.0 L vessel, what is the total pressure of the gases at 298 K?

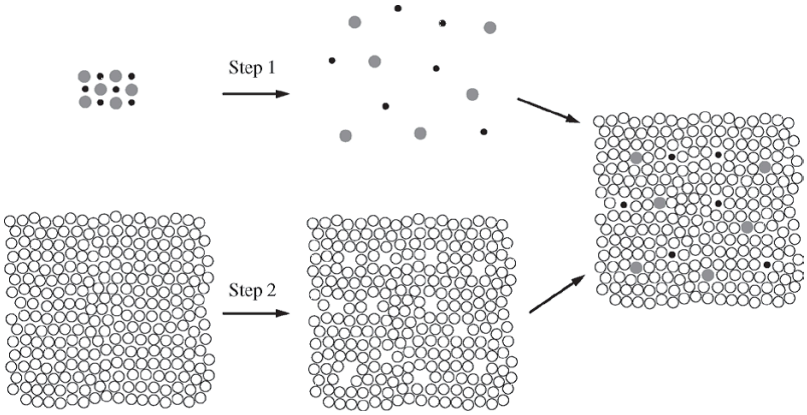
(A) 3.0 atm

(B) 4.5 atm

(C) 9.0 atm

(D) 18 atm

27.



The dissolution of an ionic solute in a polar solvent can be imagined as occurring in three steps, as shown in the figure above. In step 1, the separation between ions in the solute is greatly increased, just as will occur when the solute dissolves in the polar solvent. In step 2, the polar solvent is expanded to make spaces that the ions will occupy. In the last step, the ions are inserted into the spaces in the polar solvent. Which of the following best describes the enthalpy change, ΔH, for each step?

(A) All three steps are exothermic.

(B) All three steps are endothermic.

(C) Steps 1 and 2 are exothermic, and the final step is endothermic.

(D) Steps 1 and 2 are endothermic, and the final step is exothermic.

28. $Ag^{+}(aq) + Cl^{-}(aq) \rightleftarrows AgCl(s)$

A student mixes dilute $AgNO_3(aq)$ with excess $NaCl(aq)$ to form $AgCl(s)$, as represented by the net ionic equation above. Which of the diagrams below best represents the ions that are present in significant concentrations in the solution? (K_{sp} for AgCl is 1.8×10^{-10}.)

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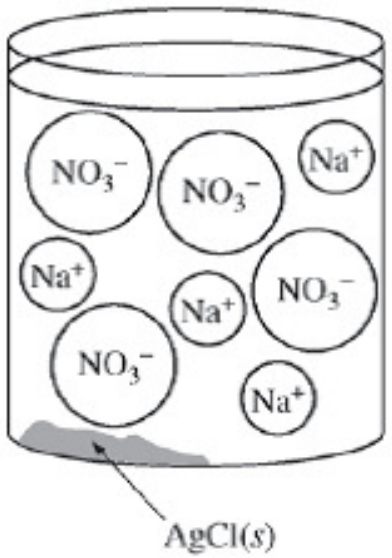
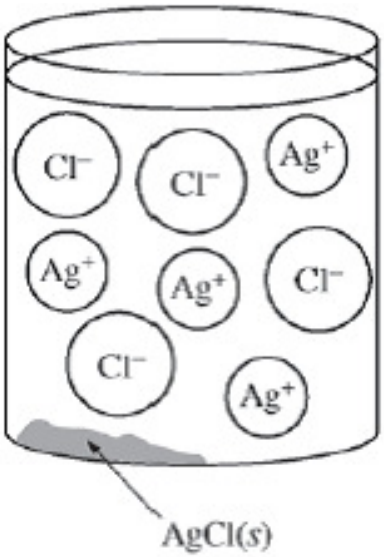
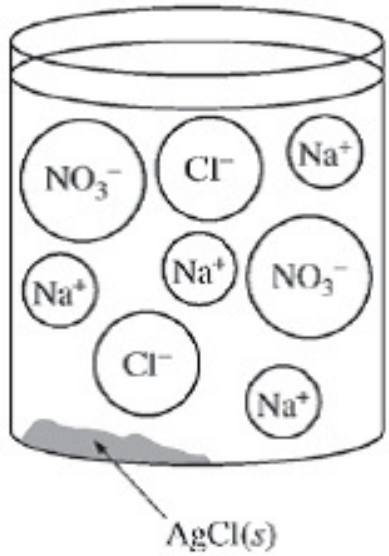
(A)



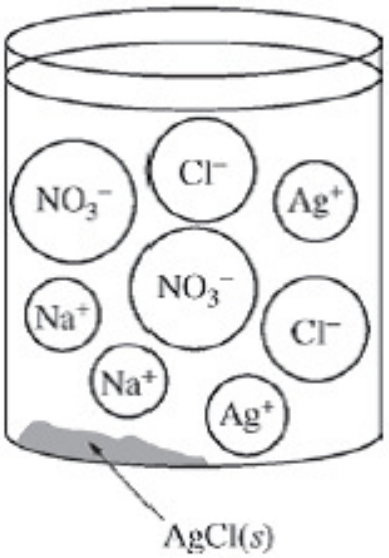
(B)



(C)



(D)



Refer to the following.

$$PCl_5(g) \rightleftarrows PCl_3(g)+Cl_2(g)$$

$PCl_5(g)$ decomposes into $PCl_3(g)$ and $Cl_2(g)$ according to the equation above. A pure sample of $PCl_5(g)$ is placed in a rigid, evacuated 1.00L container. The initial pressure of the $PCl_5(g)$ is 1.00 atm. The temperature is held constant until the $PCl_5(g)$ reaches equilibrium with its decomposition products. The figures below show the initial and equilibrium conditions of the system.

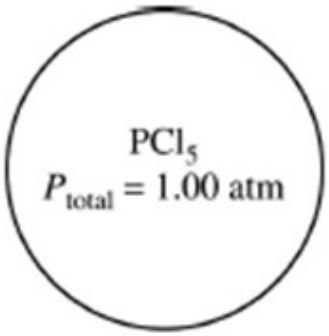


Figure 1: Initial

Figure 2: Equilibrium

29. Which of the following is the most likely cause for the increase in pressure observed in the container as the reaction reaches equilibrium?

(A) A decrease in the strength of intermolecular attractions among molecules in the flask

(B) An increase in the strength of intermolecular attractions among molecules in the flask

(C) An increase in the number of molecules, which increases the frequency of collisions with the walls of the container

(D) An increase in the speed of the molecules that then collide with the walls of the container with greater force

30. As the reaction progresses toward equilibrium, the rate of the forward reaction

(A) increases until it becomes the same as the reverse reaction rate at equilibrium

(B) stays constant before and after equilibrium is reached

(C) decreases to become a constant nonzero rate at equilibrium

(D) decreases to become zero at equilibrium

31. If the decomposition reaction were to go to completion, the total pressure in the container will be

(A) 1.4 atm

(B) 2.0 atm

(C) 2.8 atm

(D) 3.0 atm

32. Which of the following statements about K_p, the equilibrium constant for the reaction, is correct?

(A) $K_p > 1$

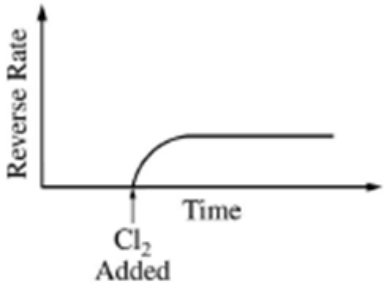
(B) $K_p < 1$

(C) $K_p = 1$

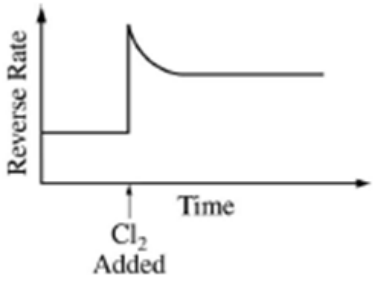
(D) It cannot be determined whether $K_p > 1$, $K_p < 1$, or $K_p = 1$ without additional information.

33. Additional $Cl_2(g)$ is injected into the system at equilibrium. Which of the following graphs best shows the rate of the reverse reaction as a function of time? (Assume that the time for injection and mixing of the additional $Cl_2(g)$ is negligible.)

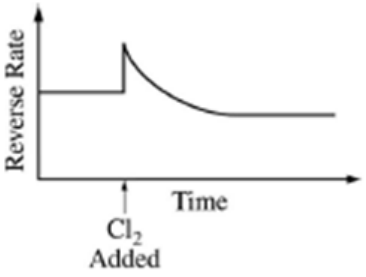
(A)



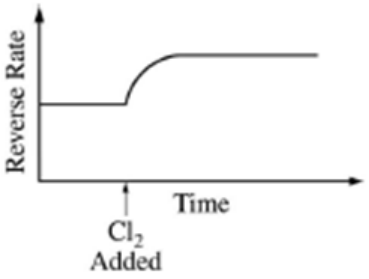
(B)



(C)



(D)



$$K(s) + \tfrac{1}{2}\, Cl_2(g) \rightarrow KCl(s) \qquad \Delta H^\circ = -437 kJ/mol_{rxn}$$

The elements K and Cl react directly to form the compound KCl according to the equation above. Refer to the information above and the table below to answer the questions that follow.

Process	ΔH° (kJ/mol_{rxn})
$K(s) \rightarrow K(g)$	v
$K(g) \rightarrow K^+(g) + e^-$	w
$Cl_2(g) \rightarrow 2\, Cl(g)$	x
$Cl(g) + e^- \rightarrow Cl^-(g)$	y
$K^+(g) + Cl^-(g) \rightarrow KCl(s)$	z

34. How much heat is released or absorbed when 0.050 mol of $Cl_2(g)$ is formed from $KCl(s)$?

(A) 87.4 kJ is released

(B) 43.7 kJ is released

(C) 43.7 kJ is absorbed

(D) 87.4 kJ is absorbed

35. What remains in the reaction vessel after equal masses of $K(s)$ and $Cl_2(g)$ have reacted until either one or both of the reactants have been completely consumed?

(A) KCl only

(B) KCl and K only

(C) KCl and Cl_2 only

(D) KCl, K, and Cl_2

36. Which of the values of ΔH^o for a process in the table is (are) less than zero (i.e., indicate(s) an exothermic process)?

(A) z only

(B) y and z only

(C) x, y, and z only

(D) w, x, y, and z

37. It is observed that the reaction producing KCl from its elements goes essentially to completion. Which of the following is a true statement about the thermodynamic favorability of the reaction?

(A) The reaction is favorable and driven by an enthalpy change only.

(B) The reaction is unfavorable and driven by an entropy change only.

(C) The reaction is favorable and driven by both enthalpy and entropy changes.

(D) The reaction is unfavorable due to both enthalpy and entropy changes.

38. $Cl_2(g) + 2e^- \rightarrow 2Cl^-(g)$

Which of the following expressions is equivalent to ΔH^o for the reaction represented above?

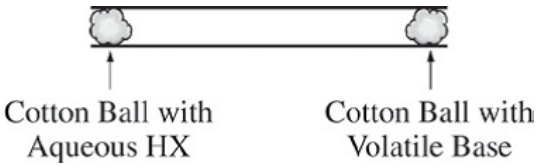
(A) $x + y$

(B) $x - y$

(C) $x + 2y$

(D) $\frac{x}{2} - y$

39.



The experimental apparatus represented above is used to demonstrate the rates at which gases diffuse. When the cotton balls are placed in the ends of a tube at the same time, the gases diffuse from each end and meet somewhere in between, where they react to form a white solid. Which of the following combinations will produce a solid closest to the center of the tube?

(A) HCl and CH_3NH_2

(B) HCl and NH_3

(C) HBr and CH_3NH_2

(D) HBr and NH_3

40. N_2 molecules absorb ultraviolet light but not visible light. I_2 molecules absorb both visible and ultraviolet light. Which of the following statements explains the observations?

(A) More energy is required to make N_2 molecules vibrate than is required to make I_2 molecules vibrate.

(B) More energy is required to remove an electron from an I_2 molecule than is required to remove an electron from a N_2 molecule.

(C) Visible light does not produce transitions between electronic energy levels in the N_2 molecule but does produce transitions in the I_2 molecule.

(D) The molecular mass of I_2 is greater than the molecular mass of N_2.

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41.

Element	Metallic Radius (pm)	Melting Point (°C)	Common Oxidation State
Au	144	1064	1+, 3+
Cu	128	1085	1+, 2+
Ag	144	961	1+

To make Au stronger and harder, it is often alloyed with other metals, such as Cu and Ag. Consider two alloys, one of Au and Cu and one of Au and Ag, each with the same mole fraction of Au. If the Au/Cu alloy is harder than the Au/Ag alloy, then which of the following is the best explanation based on the information in the table above?

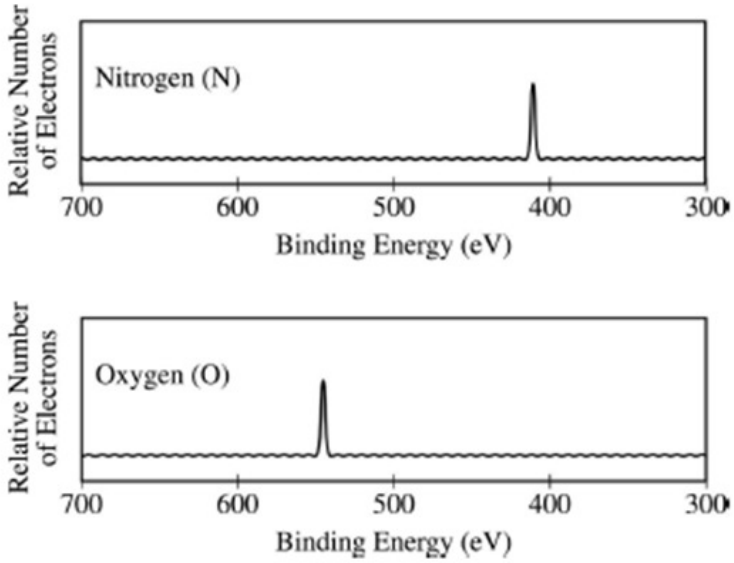
(A) Cu has two common oxidation states, but Ag has only one.

(B) Cu has a higher melting point than Au has, but Ag has a lower melting point than Au has.

(C) Cu atoms are smaller than Ag atoms, thus they interfere more with the displacement of atoms in the alloy.

(D) Cu atoms are less polarizable than are Au or Ag atoms, thus Cu has weaker interparticle forces.

42.



The photoelectron spectra above show the energy required to remove a 1*s* electron from a nitrogen atom and from an oxygen atom. Which of the following statements best accounts for the peak in the upper spectrum being to the right of the peak in the lower spectrum?

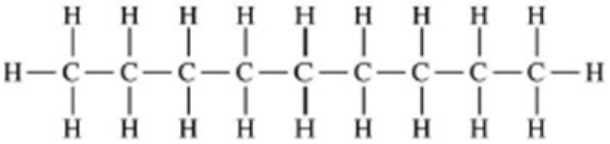
(A) Nitrogen atoms have a half-filled *p* subshell.

(B) There are more electron-electron repulsions in oxygen atoms than in nitrogen atoms.

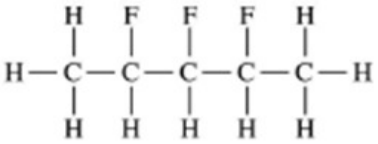
(C) Electrons in the *p* subshell of oxygen atoms provide more shielding than electrons in the *p* subshell of nitrogen atoms.

(D) Nitrogen atoms have a smaller nuclear charge than oxygen atoms.

43.



Nonane



2,3,4-trifluoropentane

Consider the molecules represented above and the data in the table below.

Compound	Molecular Formula	Molar Mass (g/mol)	Boiling Point (°C)
Nonane	C_9H_{20}	128	151
2,3,4-trifluoropentane	$C_5H_9F_3$	126	89

Nonane and 2,3,4-trifluoropentane have almost identical molar masses, but nonane has a significantly higher boiling point. Which of the following statements best helps explain this observation?

(A) The C-F is easier to break than the C-H bond.

(B) The C-F is more polar than the C-H bond.

(C) The carbon chains are longer in nonane than they are in 2,3,4-trifluoropentane.

(D) The carbon chains are farther apart in a sample of nonane than they are in 2,3,4-trifluoropentane.

44.

Half-cell 1: strip of Al(s) in 1.00 M $Al(NO_3)_3(aq)$
Half-cell 2: strip of Cu(s) in 1.00 M $Cu(NO_3)_2(aq)$
Half-cell 3: strip of Fe(s) in 1.00 M $Fe(NO_3)_2(aq)$

Galvanic Cell	Half-cells	Cell Reaction	E°_{cell} (V)
X	1 and 2	$2\ Al(s) + 3\ Cu^{2+}(aq) \rightarrow 2\ Al^{3+}(aq) + 3\ Cu(s)$	2.00
Y	1 and 3	$2\ Al(s) + 3\ Fe^{2+}(aq) \rightarrow 2\ Al^{3+}(aq) + 3\ Fe(s)$	1.22
Z	2 and 3	$Fe(s) + Cu^{2+}(aq) \rightarrow Fe^{2+}(aq) + Cu(s)$	?

If the half-cell containing 1.00 M $Fe(NO_3)_2(aq)$ in galvanic cells Y and Z is replaced with a half-cell containing 5.00 M $Fe(NO_3)_2(aq)$, what will be the effect on the cell voltage of the two galvanic cells?

(A) The voltage will increase in both cells.

(B) The voltage will decrease in both cells.

(C) The voltage will increase in cell Y and decrease in cell Z.

(D) The voltage will decrease in cell Y and increase in cell Z.

Refer to the following.

Concentration (*M*)	pH of Acid 1	pH of Acid 2	pH of Acid 3	pH of Acid 4
0.010	3.44	2.00	2.92	2.20
0.050	3.09	1.30	2.58	1.73
0.10	2.94	1.00	2.42	1.55
0.50	2.69	0.30	2.08	1.16
1.00	2.44	0.00	1.92	0.98

The pH of solutions of four acids prepared at various concentrations were measured and recorded in the table above.

The four acids are, in no particular order, chlorous, hydrochloric, lactic, and propanoic.

45. Which of the four acids listed in the table is hydrochloric acid?

(A) Acid 1

(B) Acid 2

(C) Acid 3

(D) Acid 4

46. For which acid is the value of the acid-dissociation constant, K_a , the smallest?

(A) Acid 1

(B) Acid 2

(C) Acid 3

(D) Acid 4

47. Of the following species, which has the greatest concentration in a 1.0 *M* solution of acid 1 at equilibrium?

(A) OH^-

(B) H_3O^+

(C) Acid 1

(D) The conjugate base of acid 1

48. If equal volumes of the four acids at a concentration of 0.50 *M* are each titrated with a strong base, which will require the greatest volume of base to reach the equivalence point?

(A) Acid 1

(B) Acid 2

(C) Acid 3

(D) All the acids will require the same volume of base to reach the equivalence point.

49. A 25 mL sample of a 1.0 *M* solution of acid 1 is mixed with 25 mL of 0.50 *M* NaOH. Which of the following best explains what happens to the pH of the mixture when a few drops of 1.0 *M* HNO_3 are added?

(A) The pH of the mixture increases sharply, because HNO_3 is a strong acid.

(B) The pH of the mixture decreases sharply, because H_3O^+ ions were added.

(C) The pH of the mixture stays about the same, because the conjugate base of acid 1 reacts with the added H_3O^+ ions.

(D) The pH of the mixture stays about the same, because the OH^- ions in the solution react with the added H_3O^+ ions.

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50. Step 1: $Cl(g) + O_3(g) \rightarrow ClO(g) + O_2(g)$

Step 2: $ClO(g) + O(g) \rightarrow Cl(g) + O_2(g)$

A proposed mechanism for destruction of ozone gas in the stratosphere is represented above. Which of the following is evidence that the mechanism is occurring?

(A) The presence of Cl(*g*) increases the rate of the overall reaction.

(B) The presence of Cl(*g*) decreases the rate of the overall reaction.

(C) The presence of Cl(*g*) increases the equilibrium constant of the overall reaction.

(D) The presence of Cl(*g*) decreases the equilibrium constant of the overall reaction.

51.

	NaF	MgO
Boiling Point (°C)	1695	3600

	Na^+	Mg^{2+}	F^-	Cl^-	O^{2-}
Ionic Radius (pm)	76	72	133	181	140

Based on the data in the tables above, which of the following statements provides the best prediction for the boiling point of NaCl?

(A) NaCl will have a lower boiling point than NaF because the coulombic attractions are weaker in NaCl than in NaF.

(B) NaCl will have a boiling point between that of NaF and MgO because the covalent character of the bonds in NaCl is intermediate between that of MgO and NaF.

(C) NaCl will have a higher boiling point than MgO because the ions are spaced farther apart in NaCl.

(D) NaCl will have a higher boiling point than MgO because the energy required to transfer electrons from the anion to the cation is larger in NaCl than in MgO.

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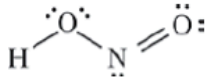
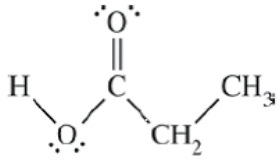
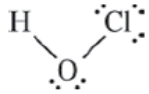
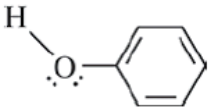
52.

Acid	Structure	K_a
HNO_2		4.0×10^{-4}
$HC_3H_5O_2$		1.3×10^{-5}
HClO		3.0×10^{-8}
HOC_6H_5		1.6×10^{-10}

The table above shows the values of K_a for four weak acids. Which of the following pairs of chemical species, when combined in equimolar amounts, results in a buffer with a pH closest to 7.5 ?

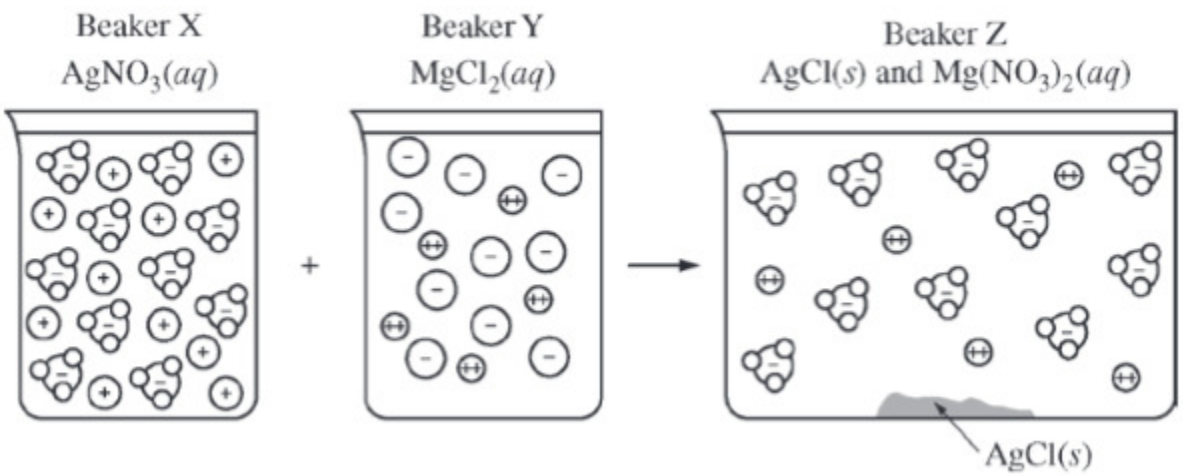
(A) HNO_2 and OH^-

(B) $HC_3H_5O_2$ and $C_3H_5O_2-$

(C) HClO and ClO^-

(D) C_6H_5OH and $C_6H_5O^-$

53.



Beaker X and beaker Y each contain 1.0 L of solution, as shown above. A student combines the solutions by pouring them into a larger, previously empty beaker Z and observes the formation of a white precipitate. Assuming that volumes are additive, which of the following sets of solutions could be represented by the diagram above?

(A)

Beaker X	Beaker Y	Beaker Z
2.0 *M* $AgNO_3$	2.0 *M* $MgCl_2$	4.0 *M* $Mg(NO_3)_2$ and $AgCl(s)$

(B)

Beaker X	Beaker Y	Beaker Z
2.0 *M* $AgNO_3$	2.0 *M* $MgCl_2$	2.0 *M* $Mg(NO_3)_2$ and $AgCl(s)$

(C)

Beaker X	Beaker Y	Beaker Z
2.0 *M* $AgNO_3$	1.0 *M* $MgCl_2$	1.0 *M* $Mg(NO_3)_2$ and $AgCl(s)$

(D)

Beaker X	Beaker Y	Beaker Z
2.0 *M* $AgNO_3$	1.0 *M* $MgCl_2$	0.50 *M* $Mg(NO_3)_2$ and $AgCl(s)$

54.

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

A sample of N_2O_5 was placed in an evacuated container, and the reaction represented above occurred. The value of $P_{N_2O_5}$, the partial pressure of $N_2O_5(g)$, was measured during the reaction and recorded in the table below.

Time (min)	$P_{N_2O_5}$	$\ln(P_{N_2O_5})$	$\frac{1}{P_{N_2O_5}}$ (atm^{-1})
0	150	5.0	0.0067
100	75	4.3	0.013
200	38	3.6	0.027
300	19	2.9	0.053

Which of the following correctly describes the reaction?

(A) The decomposition of N_2O_5 is a zero-order reaction.

(B) The decomposition of N_2O_5 is a first-order reaction.

(C) The decomposition of N_2O_5 is a second-order reaction.

(D) The overall reaction order is 3.

55.

Element	Atomic Radius	First Ionization Energy
Calcium	194 pm	590 kJ/mol
Potassium	—	—

Based on periodic trends and the data in the table above, which of the following are the most probable values of the atomic radius and the first ionization energy for potassium, respectively?

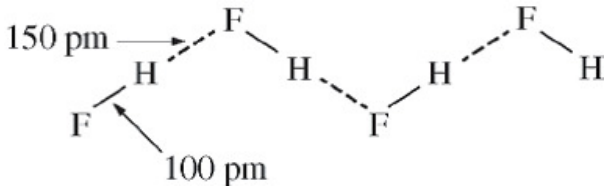
(A) 242 pm, 633 kJ/mol

(B) 242 pm, 419 kJ/mol

(C) 120 pm, 633 kJ/mol

(D) 120 pm, 419 kJ/mol

56.



The figure above shows that in solid hydrogen fluoride there are two different distances between H atoms and F atoms. Which of the following best accounts for the two different distances?

(A) Accommodation of the necessary bond angles in the formation of the solid

(B) Difference in strength between covalent bonds and intermolecular attractions

(C) Different isotopes of fluorine present in the samples

(D) Uneven repulsions among nonbonding electron pairs

57.

$$COCl_2(g) \rightleftarrows CO(g) + Cl_2(g)$$

$COCl_2(g)$ decomposes according to the equation above. When pure $COCl_2(g)$ is injected into a rigid, previously evacuated flask at 690 K, the pressure in the flask is initially 1.0 atm. After the reaction reaches equilibrium at 690 K, the total pressure in the flask is 1.2 atm. What is the value of K_p for the reaction at 690 K?

(A) 0.040

(B) 0.050

(C) 0.80

(D) 1.0