# AP Chemistry Test (Chapter 11)

#### Class Set

#### Multiple Choice (54%)

Please use the following choices to answer questions 1-10.

- A) London dispersion forces (temporary dipole attractions)
- B) Ion-ion attractions
- C) Dipole-dipole attractions
- D) Dipole-ion attractions
- 1) Holds the molecules of asphalt  $(C_{20}H_{42})$  together in a solid
- 2) Strongest of all intermolecular attractions
- 3) Holds water molecules together in a liquid
- 4) Accounts for why some  $O_2$  dissolves in water
- 5) Accounts for sugar dissolving in water
- 6) Accounts for the high melting point of salt
- 7) Accounts for salt dissolving in water
- 8) Accounts for the high boiling point of water
- 9) The weakest of all intermolecular attractions
- 10) Accounts for air being homogeneous

# 11) What thermodynamic pressure encourages solution formation of two nonpolar substances?

A)  $+\Delta H$  B)  $-\Delta H$  C)  $+\Delta S$  D)  $-\Delta S$ 

12) Which of the following substances would be the most soluble in  $C_6H_6$ ?

A)	CH <sub>3</sub> CH <sub>2</sub> OH	B)	NaCl
C)	NH <sub>3</sub>	D)	$H_2O$
E)	$C_8H_{18}$		

# 13) Which of the following is insoluble in $C_{12}H_{26}$ ?

A)	$CF_4$	B)	$O_2$
C)	$C_{6}H_{14}$	D)	CH <sub>3</sub> CH <sub>2</sub> OH
E)	C <sub>3</sub> H <sub>8</sub>		

# 14) Which of the following is most soluble in water?

A)	CH <sub>3</sub> OH	B)	CH <sub>3</sub> CH <sub>2</sub> OH
C)	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> OH	D)	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> OH

- 15) Which one will decrease the solubility of a gaseous solute in a liquid solvent?
  - A) Increase the pressure & decrease the temperature
  - B) Increase the pressure & increase the temperature
  - C) Decrease the pressure & decrease the temperature
  - D) Decrease the pressure & increase the temperature

16) A 0.100 m solution of which one of the following solutes will have the highest vapor pressure?

A)	KClO <sub>4</sub>	B)	$Ca(ClO_3)_2$
C)	Al(NO <sub>3</sub> ) <sub>3</sub>	D)	$Na_2SO_4$

17) Which aqueous solution will have the lowest freezing point?

A)	0.70 M NH <sub>3</sub>	B)	0.30 M NH <sub>4</sub> Br
C)	0.50 M C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	D)	0.40 M FeCl <sub>3</sub>

- 18) Which one is false about adding a nonvolatile solute to a solvent?
  - A) The vapor pressure increases.
  - B) The boiling point increases.
  - C) The freezing point decreases.
  - D) The intermolecular attractions between the solute and solvent affect the properties of the solution.
- 19) A chemistry student is given a sample of a blue liquid. The sample has no Tyndall effect. Which one is definitely not the liquid?

A) Solution	B)	Homogeneous
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- C) Compound D) Colloid
- E) Physically combined

#### 20) Which one is an example of a colloid?

A)	Air	B)	Smoke
C)	Sandy water	D)	14 kt gold
E)	Sugar (aq)		

#### 21) Which one is hydrophilic?

A)	Oil	B)	Gasoline
C)	$C_{7}H_{16}$	D)	Oxygen
E)	C <sub>7</sub> H <sub>15</sub> OH		

22) Which aqueous solution will have the highest boiling point?

A)	0.40 M NH <sub>3</sub>	B)	0.40 M FeCl <sub>3</sub>
C)	$0.80 \text{ M C}_{6}\text{H}_{12}\text{O}_{6}$	D)	0.50 M KI
	0.00 M M (NO)		

E)  $0.20 \text{ M} \text{Mg}(\text{NO}_3)_2$ 

- 23) Which one is arranged in order of increasing solubility in water (least soluble to most soluble)?
  - A) $NaNO_3 < CHCl_3 < CCl_4$ B) $CH_3OH < CH_4 < LiF$ C) $CH_4 < NaNO_3 < CHCl_3$ D) $LiF < NaNO_3 < CHCl_3$
  - E)  $C_5H_{12} < CH_3OH < CaCl_2$
- 24) Which one best describes the behavior of a seed crystal dropped into a saturated solution?
  - A) It falls to the bottom of the solution undissolved.
  - B) It dissolves readily in the solution
  - C) It rapidly precipitates solute from the solution.
  - D) It falls to the bottom of the solution & slowly dissolves.

Please use the attached solubility graph to answer questions 25-27.

- 25) What mass of KI will dissolve in **50** g  $H_2O$  at 10°C to form a saturated solution?
- 26) When a saturated solution of NaNO<sub>3</sub> in 100 g H<sub>2</sub>O is cooled from  $60^{\circ}$ C to  $10^{\circ}$ C, what mass of NaNO<sub>3</sub> will crystallize or precipitate from the solution?
- 27) Which one is correct for NaNO<sub>3</sub> in 100 g  $H_2O$ ?
  - A) An unsaturated solution forms when 80 g dissolves at  $15^{\circ}$ C.
  - B) An unsaturated solution forms when 85 g dissolves at  $15^{\circ}$ C.
  - C) A saturated solution forms when 94 g dissolves at  $30^{\circ}$ C.
  - D) A supersaturated solution forms when 90 g dissolves in at  $30^{\circ}$ C.

# Problems (55%)

25.0 ml of 0.852 M sodium hydroxide is used to neutralize a solution of 0.222 M phosphoric acid solution.

- 1) What volume of phosphoric acid was neutralized?
- 2) What is the molarity of the product?
- 3) 500.0 ml of 0.250 M Al(ClO<sub>4</sub>)<sub>3</sub> is mixed with 100.0 ml of 0.600 M Mg(ClO<sub>4</sub>)<sub>2</sub>. What is the resulting perchlorate ion concentration?
- 4) A lab calls for 200.0 ml of 0.600 M HNO<sub>3</sub> solution. You have a stock solution of 18.0 M HNO<sub>3</sub>. How do you make the solution?
- 5) What is the boiling point of a solution that contains 35.0 g AlCl<sub>3</sub> dissolved in 100.0 g of water?

6) What is the freezing point of a solution that contains  $10.0 \text{ g } \text{C}_6\text{H}_{12}\text{O}_6$  dissolved in 30.0 g of water?

A solution is 12.5% H<sub>3</sub>PO<sub>4</sub> by mass.

- 7) What is the molality of the solution?
- 8) What is the mole fraction of the  $H_3PO_4$ ?
- 9) What mass of antifreeze (ethylene glycol)  $C_2H_6O_2$ ) must be added to 10.00 L of water in your car's radiator to produce a solution that will not freeze until -19.5°C. Assume the density of water is exactly 1.00 g/ml.
- 10) A chemist is trying to identify a human hormone by its molar mass. A sample weighing 0.821 g was dissolved in 21.0 g benzene. The normal freezing point of benzene is 5.50°C, but the solution containing the hormone had a freezing point of -2.50°C.  $K_f = 5.12^{\circ}C \bullet kg/mol$  for benzene. What is the molar mass of the hormone?
- 11) A chemist is trying to determine the molar mass of a protein. 0.522 g of the protein is dissolved in water to make 2.15 ml of solution. The osmotic pressure of this solution was measured at 1.12 torr at 23.0°C. What is the molar mass of this protein?

# AP Chemistry Test (Chapter 11) Name\_\_\_\_\_

# Multiple Choice (50%)

1)	 10)	 19)	
2)	 11)	 20)	
3)	 12)	 21)	
4)	 13)	 22)	
5)	 14)	 23)	
6)	 15)	 24)	
7)	 16)	 25)	
8)	 17)		
9)	 18)		

Please show all your work for any credit. Problems (50%)

AP Chemistry Test (Chapter 11)

Name Key

#### Multiple Choice (50%)

1)	В	10)	В	19)	В
2)	D	11)	E	20)	E
3)	С	12)	А	21)	С
4)	А	13)	D	22)	D
5)	A or B	14)	С	23)	В
6)	А	15)	E	24)	C
7)	А	16)	А	25)	A
8)	В	17)	С		
9)	С	18)	В		
Proble	<u>ms (50%)</u>	Please	show all your	work fo	r any credit.
1)	1.60 ml	Write	reaction; PV=r	nRT; st	oichiometry from mol NH <sub>3</sub> to ml H <sub>3</sub> PO <sub>4</sub>

$2)$ 0.477 IVI Storemonieu y 11011 (1) 1101 IVI 3 to 1101 (1VI 4)31 04, $\cdot$ 0 y 1	2)	0.477 M	Stoichiometry from (1) mol NH <sub>3</sub> to mol (NH <sub>4</sub> ) <sub>3</sub> PO <sub>4</sub> ; $\cdot$	÷by L
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- 3) 0.763 M Find total mol  $ClO_4^- = 0.225 \text{ mol} + 0.0800 \text{ mol}; \div \text{ by L}$
- 4) Add 5.63 ml concentrated HNO<sub>3</sub> to 294 ml  $H_2O$
- 5) 2.02 m Find mol  $H_3PO_4$  (16.5 g  $H_3PO_4 = 100$  g sol'n); find kg  $H_2O$  (83.5 g  $H_2O = 100$  g sol'n)

6)	4.09 kg antifre	we zero Use $\Delta T = K_b m$ to find 8.22 mol antifreeze/1 kg H <sub>2</sub> O; dimensional analysis to find kg antifreeze
7)	104.82°C	Find mol ions in water = 0.567 mol ions; find m = 9.46; use $\Delta T = K_f m$ to find $\Delta T = 4.82^{\circ}C$ ; add to $100^{\circ}C = 104.82^{\circ}C$
8)	27.3 g/mol	Use $\Delta T = K_f$ m to find 1.367 mol hormone/1 kg benzene; dimensional analysis to find mol hormone = 0.0273 mol hormone; find molar mass = 0.746 g/0.0273 mol
9)	332 torr	Find mol acetone = $0.51317$ mol; find mol chloroform = $0.16671$ mol; find total mol = $0.67988$ total mol; find X for acetone = $0.7548$ ; find X for chloroform = $0.2452$ ; use $P_{soln} = X_{solvent} P^{\circ}$ to find each vapor pressure 260.405 torr acetone and 71.845 torr chloroform; add vapor pressure b/c both solutes are volatile
10)	2.75 X 10 <sup>6</sup> g/n	nol Use $\pi = MRT$ to find M = 5.8644 X 10 <sup>-5</sup> M; dimensional analysis to find mol protein = 1.1729 X 10 <sup>-7</sup> mol; find molar mass = 0.322 g/1.1729 X 10 <sup>-7</sup> mol
AP Chemistry Retest (Chapter 11) Name		
Short Answer (50%)		
1)	How do two polar covalent molecules dissolve?	

- 2) When argon is placed in a container of neon, why does the argon spontaneously disperse throughout the neon?
- 3) Please write an equation showing the dissolution of glucose in water?
- 4) Please give an example of a compound that would be soluble in  $CCl_4$ .
- 5) Please give an example of a compound that would be insoluble in  $C_6H_6$ .
- 6) Please give an organic formula for a compound that would be soluble in water.
- 7) Please give 2 methods of decreasing the solubility of a gaseous solute in a liquid solvent?
- 8) The magnitudes of  $K_f$  and  $K_b$  depend on the identity of the \_\_\_\_\_.
- 9) Please contrast the vapor pressures of each of these solutions:  $0.10 \text{ M } C_{12}H_{22}O_{11} \& 0.10 \text{ M } Na_2SO_4$ . Support your answer.

- 10) Please contrast the boiling points of each of these solutions: 0.20 M KI& 0.10 M Na<sub>2</sub>SO<sub>4</sub>. Support your answer.
- 11) What effect does a nonvolatile solute have on the vapor pressure of a solution? Why?
- 12) How are a solution & a colloid alike? How are they different?
- 13) What effect does a volatile solute have on the vapor pressure of a solution? Why?
- 14) Please give an example of each one & support your answer.

Hydrophilic compound

- 15) Please contrast the freezing points of each of these solutions: 0.30 M NH<sub>3</sub> & 0.30 M Na<sub>2</sub>SO<sub>4</sub>. Support your answer.
- 16) Please arrange these compounds in order of increasing solubility in water (least soluble to most soluble). KCl, CCl<sub>4</sub>, CHCl<sub>3</sub>, CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OH,

Please use this information to answer questions 17-18.







Hydrophobic compound

Unsaturated solution

Saturated solution

Supersaturated solution

- 17) Please describe each solution.
- 18) Please describe what occurs when a seed crystal is added to each solution.
- 19) Charles & Chris placed pure baking soda on one of the osmosis lab eggs. What did they observe after a period of time had passed? Why?
- 20) What is the concentration of  $SO_4^{-2}$  in a solution that is 0.900 M Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>?
- 21) Please describe briefly what caused the Lake Nyos Tragedy?

22) What happens to a red blood cell when it is placed in a hypotonic solution? Why?

Please use the attached solubility graph to answer questions 23-25

- 23) What mass of NaNO<sub>3</sub> will dissolve in **300 g H<sub>2</sub>O** at 20<sup>o</sup>C to form a saturated solution?
- 24) When a saturated solution of  $KNO_3$  in 100 g H<sub>2</sub>O is cooled from 60°C to 25°C, what mass of  $KNO_3$  will crystallize or precipitate from the solution?
- 25) Please describe how to make a supersaturated solution of  $KNO_3$  in 100 g H<sub>2</sub>O at 20°C.

# Problems (50%)

# <u>1-2</u>

A volume of 30.0 ml of ammonia gas at a pressure of 1.22 atm & a temperature of  $35.0^{\circ}$ C is bubbled through a 0.578 M phosphoric acid solution.

- 1) What volume of phosphoric acid is neutralized so that there is no limiting or excess reagent?
- 2) What is the molarity of the product?
- 3)  $100.0 \text{ ml of } 0.150 \text{ M Fe}(\text{NO}_3)_4 \text{ is mixed with } 200.0 \text{ ml of } 0.400 \text{ M Mg}(\text{NO}_3)_2$ . What is the resulting nitrate ion concentration?
- 4) A lab calls for 400.0 ml of 0.200 M HNO<sub>3</sub> solution. You have a stock solution of 16.0 M HNO<sub>3</sub>. How do you make the solution?
- 5) A solution is 42.5% H<sub>3</sub>PO<sub>4</sub> by mass. What is the molality of the solution?
- 6) What mass of antifreeze (ethylene glycol)  $C_2H_6O_2$ ) must be added to 6.00 L of water in your car's radiator to produce a solution that will not freeze until -5.32°C. Assume the density of water is exactly 1.00 g/ml.
- 7) What is the boiling point of a solution that contains  $15.0 \text{ g} (\text{NH}_4)_2 \text{SO}_4$  dissolved in 45.0 g water?
- 8) A chemist is trying to identify a human hormone by its molar mass. A sample weighing 0.146 g was dissolved in 30.0 g benzene. The normal freezing point of benzene is 5.50°C, but the solution containing the hormone had a freezing point of  $1.50^{\circ}$ C.  $K_f = 5.12^{\circ}$ C kg/mol for benzene. What is the molar mass of the hormone?

- 9) A solution is prepared by mixing 40.0 g acetone  $C_3H_6O$  (a volatile liquid) and 50.0 g chloroform HCCl<sub>3</sub> (another volatile liquid) at 35°C. The vapor pressure of pure acetone is 345 torr and the vapor pressure of pure chloroform is 293 torr. What is the vapor pressure of the solution?
- 10) A chemist is trying to determine the molar mass of a protein. 0.422 g of the protein is dissolved in water to make 8.00 ml of solution. The osmotic pressure of this solution was measured at 2.08 torr at 40.0°C. What is the molar mass of this protein?