

96% excellent work!!

K/U	14	15	T/I	10 1/2	11	C	7	7	A	11 1/2	12
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**KNOWLEDGE & UNDERSTANDING** [15 marks] Choose the best answer and answer on the Scantron card provided. This section of the paper will not be scored.

- Which of the following property/properties is/are used to determine the **polarity of a molecule**:
  - the number of polar bonds
  - the overall shape/symmetry of the molecule
  - the presence of lone pairs of electrons of the central atom of a molecule
  - all of the above
- Hydrogen bonding** occurs in molecules when...
  - a hydrogen atom forms a covalent bond with one or more other atoms.
  - a hydrogen atom is transferred to another molecule that is more electronegative.
  - ☒ a hydrogen atom bonded to a small electronegative atom is attracted to an electron pair on an electronegative atom on an adjacent molecule.
  - a hydrogen atom forming a diatomic molecule with another hydrogen atom.
- Which of the following is **NOT** an acceptable way to **express concentration**?
  - mass of solute/volume of solution
  - mass of solute/mass of solution
  - ☒ mass of solute/mass of water
  - volume of solute/volume of solution
- Solubility** is...
  - the amount of solvent that will dissolve a given amount of a solute at any temperature.
  - the amount of solute that will dissolve in a given amount of solvent at any temperature
  - the process of dissolving a solute in a solvent
  - ☒ the amount of solute that will dissolve in a given amount of solvent at a given temperature.
- Some **ionic compounds** are **insoluble** in water because...
  - ☒ the attraction between the ions in some ionic compounds is greater than the attraction between ions and dipoles of water molecules.
  - the attraction between the ions in some ionic compounds is weaker than the attraction between ions and dipoles on water molecules.
  - The ionic salt has turned into a hydrate, and therefore, becomes insoluble in water.
  - Some ionic compounds are non-polar.

6. Which of the following describe the property/properties of **water** which allow(s) it to be a '**universal solvent**'?
- Water has strong intermolecular forces due to dipole-dipole interactions
  - Water is a polar molecule
  - The dipole-dipole interactions between polar solute molecules is generally much weaker than the hydrogen bonds between the solute molecules and the water molecules.
  - ☒ all of the above
7. Which of the following accurately shows the **dissociation** equation for aluminum chloride,  $\text{AlCl}_3$ ?
- $\text{AlCl}_3(\text{s}) \rightarrow \text{Al}^{3+}(\text{aq}) + \text{Cl}^{1-}(\text{aq})$
  - ☒  $\text{AlCl}_3(\text{s}) \rightarrow \text{Al}^{3+}(\text{aq}) + 3 \text{Cl}^{1-}(\text{aq})$
  - $\text{Al}^{3+}(\text{aq}) + 3 \text{Cl}^{1-}(\text{aq}) \rightarrow \text{AlCl}_3(\text{s})$
  - $\text{Al}^{3+}(\text{aq}) + \text{Cl}^{1-}(\text{aq}) \rightarrow \text{AlCl}_3(\text{s})$
8. Why does **Coca-Cola** beverage go '**flat**' when left open to the atmosphere?
- The pressure of the carbon dioxide in the atmosphere is much higher than the pressure in the bottle, which causes the gas to come out of solution.
  - The pressure of the carbon dioxide in the atmosphere is much lower than the pressure in the bottle, which causes the gas to come out of solution.
  - The pressure of the carbon dioxide in the atmosphere is equal to the pressure in the bottle, which causes the gas to slowly come out of solution.
  - ☒ none of the above.
9. As **temperature** of a body of water **increases**, the **solubility** of dissolved **gases** such as oxygen gas...
- increases because solubility of solutes increases with increasing temperature.
  - ☒ decreases because these dissolved gases could gain enough energy to leave the body of water.
  - is only slightly increased because the gas particles already have energy to move around the body of water.
  - none of the above are correct.
10. Which of the following product(s) (if any) will **precipitate** out of solution from the following balanced chemical equation:
- $$2\text{Al}(\text{NO}_3)_3(\text{aq}) + 3\text{Ba}(\text{OH})_2(\text{aq}) \rightarrow 2\text{Al}(\text{OH})_3 + 3\text{Ba}(\text{NO}_3)_2$$
- ☒ aluminum hydroxide
  - barium nitrate
  - both products
  - neither product
11. Which of the following statements do **NOT** describe **Arrhenius acids**?
- ☒ are molecular compounds that are held together by covalent bonds
  - ionizes in water to produce one or more hydrogen ions,  $\text{H}^+(\text{aq})$
  - reacts with active metals to produce hydrogen gas
  - ☒ slippery to the touch
12. According to **Arrhenius**, what does the reaction  $\text{Ba}(\text{OH})_2(\text{s}) \rightarrow \text{Ba}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq})$  represent?
- dissociation of an acid
  - ☒ dissociation of a base
  - formation of an acidic solution
  - formation of a basic solution



13. The pH of a  $1.25 \times 10^{-3}$  M NaOH solution is:

- a. 2.90  
b. 1.25

- c. 3.00  
d. 11.10

14. Which, if any, of the following species is in the greatest concentration in a 0.100 M solution of  $\text{H}_2\text{SO}_4$  in water?

- a.  $\text{H}_2\text{SO}_4$  molecules  
b.  $\text{H}^+$  ions

- c.  $\text{HSO}_4^-$  ions  
d.  $\text{SO}_4^{2-}$  ions

15. Reverse osmosis is...

- a. the movement of water molecules from an area of high concentration to an area of low concentration until equilibrium is reached.  
b. using an electric current to break apart the hydrogen and oxygen components of water.  
c. the movement of water across a semi-permeable membrane, against the concentration gradient, from lower concentration to higher concentration.  
d. the process of using low pressure to force water from a dilute solution through a semi-permeable membrane to get a more concentrated solution.

### THINKING & INVESTIGATION [11 marks]

1. Magnesium hydroxide solution and phosphoric acid react in a chemical laboratory experiment.

a) Write the balanced chemical equation for this reaction. [1 mark]



b) If 325.00 mL of a 0.16 M magnesium hydroxide is neutralized, how many grams of the precipitate will form? Show all your work and demonstrate the correct significant digits and rounding rules. [3 marks]

	$3 \text{Mg}(\text{OH})_2 (\text{aq}) + 2 \text{H}_3\text{PO}_4 (\text{aq}) \rightarrow \text{Mg}_3(\text{PO}_4)_2 (\text{s}) + 6 \text{H}_2\text{O} (\text{l})$		
m			4.556 g
M			262.9 g/mol
n	0.052 mol	0.03467 mol	0.01733 mol
c	0.16 mol/L		
v	0.325 L		

Therefore, there will be  $4.6 \times 10^1$  grams of precipitate

2 sig digits

c) What volume of a 0.85 M magnesium hydroxide is needed to neutralize 100.50 mL of 0.28 M phosphoric acid? Show all your work and demonstrate the correct significant digits and rounding rules. [3 marks]

	$3 \text{Mg}(\text{OH})_2 (\text{aq}) + 2 \text{H}_3\text{PO}_4 (\text{aq}) \rightarrow \text{Mg}_3(\text{PO}_4)_2 (\text{s}) + 6 \text{H}_2\text{O} (\text{l})$	
m		
M		
n	0.04221 mol	0.02814 mol
c	0.85 mol/L	0.28 mol/L
v	0.04965 L	0.1005 L

Therefore, you need  $5.0 \times 10^{-2}$  L of magnesium hydroxide to neutralize

2 sig digits

\* **CHOOSE TO ANSWER EITHER QUESTION 2 OR 3.** If you choose to answer both questions, only question #2 will be marked.

2. You have a 1.0 M stock of "Tris" (a common buffer). You want 4.0L of 0.05 M "Tris" for a lab this afternoon.

a) Design a **procedure** (with clear calculations) for preparing your desired solution with volumes that are logical and not wasteful. [2 marks]

$$C_1 V_1 = C_2 V_2$$

$$(1M)(V_1) = (0.05M)(4L)$$

$$(1M)(V_1) = 0.2$$

$$(V_1) = 0.2L$$

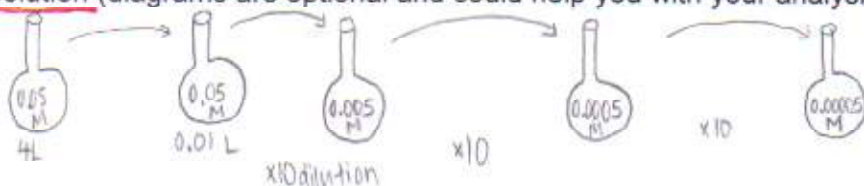
$$\begin{array}{r} 4.0L \\ - 0.2L \\ \hline 3.8L \text{ H}_2\text{O} \end{array}$$

1. take 0.2 L of the 1.0 M Tris

2. add 3.8L of water to it.

3. stir and you will have 4L of 0.05M Tris

b) With the prepared solution from part a, you now need to do a 1000-times dilution for a biology class next door. The amount that they require is only 10 mL. Using clear calculations, show the final concentration of this diluted solution (diagrams are optional and could help you with your analysis) (Hint: serial dilutions) [2 marks]



$$C_1 V_1 = C_2 V_2$$

$$(0.05M)(V_1) = (0.00005M)(0.01L)$$

$$V_1 = 0.00001L$$

$$0.01000L$$

$$- 0.00001L$$

$$= 0.00999L$$

$$= 9.99 \text{ mL water}$$

take 0.01 mL of the 0.05 M Tris

and add 9.99 mL water

then, you have the solution you need for bio

3. Two beakers of clear, colourless and odourless solutions are sitting on the lab bench. The labels "NaBr" and "NaNO<sub>3</sub>" have fallen off from the beakers, and so, you could you identify the solutions.

a) What chemical substances could you add to these solutions in order to identify the contents of each beaker. What would you expect to see? [2 marks]

you can add  $\text{AgF}_{(aq)}$  into the solutions because one will form precipitate and one won't.  
the one that forms precipitate will be NaBr because:



← AgBr not soluble in water

one that doesn't form precipitate will be NaNO<sub>3</sub> because



← both (aq)

b) Using a diagram, show how each substance is soluble in water, and hence, proves the general rule that "like dissolves like" [2 marks]

both substance has Na, and on solubility table, sodium with any anion is soluble in water.

water is polar

so it dissolves other polar stuff like KF

Oxygen gas is non-polar.

it dissolves other non-polar gases



## COMMUNICATION [7 marks]

1. Water supplies that contain more than 500 ppm of dissolved calcium carbonate,  $\text{CaCO}_3(\text{aq})$ , are considered unacceptable for most domestic purposes. What is the **maximum mass of calcium carbonate** that would be acceptable in a 250 mL sample of tap water? Show clear unit conversions. [2 marks]

$$500 \text{ ppm} = \frac{\text{CaCO}_3 \text{ mass}}{250 \text{ mL}} \times 10^6$$

$$0.0005 = \frac{\text{CaCO}_3 \text{ mass}}{250 \text{ mL}} \quad \checkmark$$

$$\text{max CaCO}_3 \text{ mass} = 0.125 \text{ g}$$

therefore, the max mass allowed  
would be 0.125 g of  $\text{CaCO}_3$

2. Summarize the difference between "strong" and "concentrated" when describing a solution of an acid. Give examples to illustrate the difference. [2 marks]

concentrated means how much acid to water  $\checkmark$  — mol/L

strength of an acid is how it ionizes with water. not all dissociates so its less "ouch"

$\text{H}_2\text{SO}_4(\text{aq})$   
with 10000 L  $\text{H}_2\text{O}$   
- less concentrated

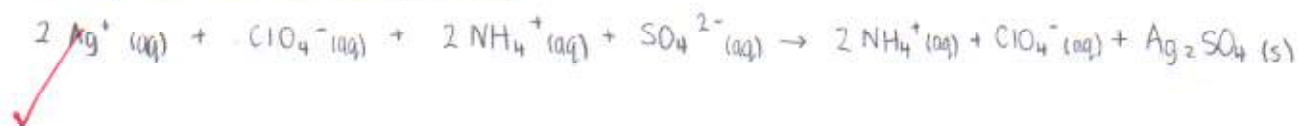
$\text{H}_2\text{SO}_4$  with 1 L  
of  $\text{H}_2\text{O}$   
- more concentrated

burn skin  
 $\checkmark$   $\text{H}_2\text{SO}_4(\text{aq})$   
strong  
acid

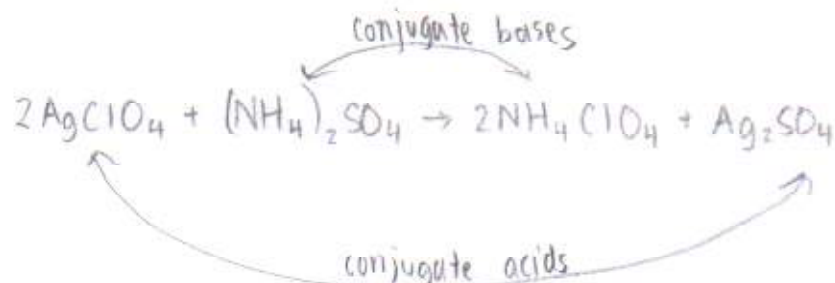
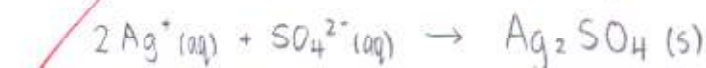
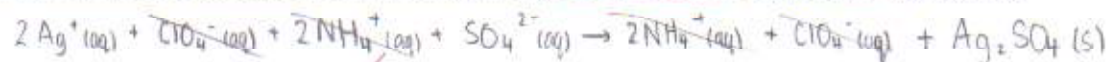
$\text{HCH}_3\text{COO}(\text{aq})$  ← makes  
- vinegar  
weak  
acid

3. Given the following balanced chemical equation:  $2\text{AgClO}_4 + (\text{NH}_4)_2\text{SO}_4 \rightarrow 2\text{NH}_4\text{ClO}_4 + \text{Ag}_2\text{SO}_4$

a) Write the **complete ionic equation**: [1 mark]



b) Write the **net ionic equation** and identify the **conjugate acid base pairs**. [2 marks]



7

# APPLICATION [12 marks]

1. When silver nitrate is added to sodium chromate, a brick-red precipitate forms. Calculate the **mass of precipitate** that forms when 50.0 mL of 0.100 mol/L silver nitrate is added to excess sodium chromate.



[3 marks]

m			0.83 g
M			332 g/mol
n	0.005 mol	0.0025 mol	0.0025 mol
C	0.1 mol/L		
V	0.05 L		

ER

Therefore, 0.83 g of  $\text{Ag}_2\text{CrO}_4(\text{s})$  precipitate is formed

2. In an experiment, Kendra mixed 40.0 mL of 0.552 mol/L lead(II) nitrate with 50.0 mL of 1.22 mol/L hydrochloric acid. A white precipitate forms, which Kendra filtered and dried.

a) Write the **complete chemical equation** for the reaction [1 marks].



c) What **mass of the precipitate** would form when the reaction goes to completion? [4 marks]

	$\text{Pb}(\text{NO}_3)_2(\text{aq}) + 2\text{HCl}(\text{aq}) \rightarrow \text{PbCl}_2(\text{s}) + 2\text{HNO}_3(\text{aq})$	
m		6.138 g
M		278 g/mol
n	0.02208 mol	0.061
C	0.552 mol/L	1.22 mol/L
V	0.04 L	0.05 L

Cal error...  
-1/2.

$$\begin{aligned} 0.02208 \\ \div 1 \\ = 0.02208 \\ \text{successful rxn} \end{aligned}$$

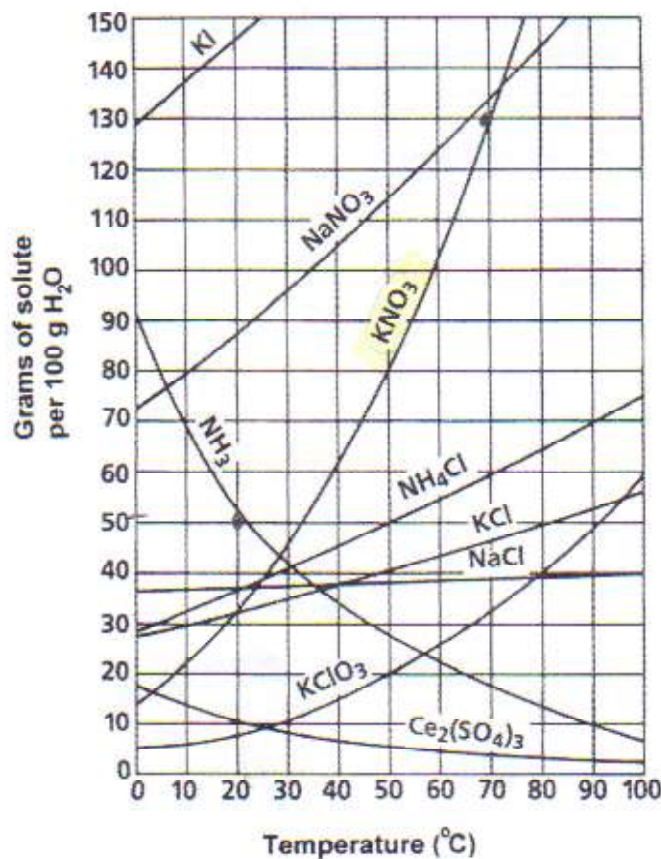
$$\begin{aligned} 0.061 \\ \div 2 \\ = 0.0305 \\ \text{successful rxn} \end{aligned}$$

ER

Therefore, the mass of precipitate is 12.76 g

7 1/2.

3. 37 mL of a 5.0 mol/L potassium nitrate solution is cooled to a temperature of 20°C. If the temperature is then increased to 70°C, what **mass of potassium nitrate** must be slowly added make a supersaturated solution? [4 marks]



	KNO <sub>3</sub>
m	18.685 g
M	101 g/mol
n	0.185
C	5 mol/L
v	0.037 L

$$50.5 \text{ g/L}$$

$$= 50.5 \text{ g/100mL}$$

$$130 \text{ g/100mL}$$

$$= 1300 \text{ g/L}$$

	new KNO <sub>3</sub>
m	48.1 g
M	
n	
C	
v	0.037 L

$$48.1 \text{ g}$$

$$- 18.7 \text{ g}$$

$$= 29.4 \text{ g}$$

therefore,  
you need to  
add more than 29.4g

4



100	90	80	70	60
50	40	30	20	10
9	8	7	6	5
4	3	2	1	0

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24	A	B	C
25	A	B	C

IMPORTANT

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TO USE SUBJECTIVE SCORE FEATURE:

- MAKE DARK MARKS
- ERASE COMPLETELY TO CHANGE
- Mark total possible subjective points
- Only one mark per line on key
- 163 points maximum

EXAMPLE OF STUDENT SCORE

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