CHEMISTRY LAB—Redox Answer Sheet

Kenston Science Olympiad Invitational January 15, 2011

School _____KEY_____ Team # __KEY___

1. +5	7 A	13. A	19. A
2. -1.5 or -1 ½	8 E	14. D	20. D
3 - ½	9 C	15. B	21 B
4 +6	10 B	16. E	22 A (TB#1)
5 0	11 C	17. B	23 C
6 +1	12 E	18. B	

B

24. oxidation reaction: $SO_2 + 2\ H_2O \rightarrow SO_4^{-2} + 4\ H^+ + 2\ e^-$

25. reduction reaction: $2\ e^- + Br_2 \rightarrow 2\ Br^{-1}$

26. overall reaction : $SO_2 + 2\ H_2O + Br_2 \rightarrow SO_4^{-2} + 4\ H^+ + 2\ Br^{-1}$

27. oxidizing agent: Br_2

28. reducing agent: SO_2

29. What is the anode? **Pt**

30. What is the cathode? **Pt**

31. What is the overall reaction in acidic solution.

$$2\ Fe^{3+}(aq) + H_2(g) \longrightarrow 2\ Fe^{2+}(aq) + 2\ H^+(aq)$$

32. What does the vertical line represent in the line notation for a cell such as that in problem #20..(TB#2) **phase boundary or phase change**

33-34. Write the correct line notation for this reaction.(2pts)

$Pt|\ H_2(g)\ |\ H^+(aq)\ ||\ Fe^{+3}(aq), Fe^{+2}(aq)\ |Pt$ **1 point for each half**

1 pt 1 pt order must be correct!

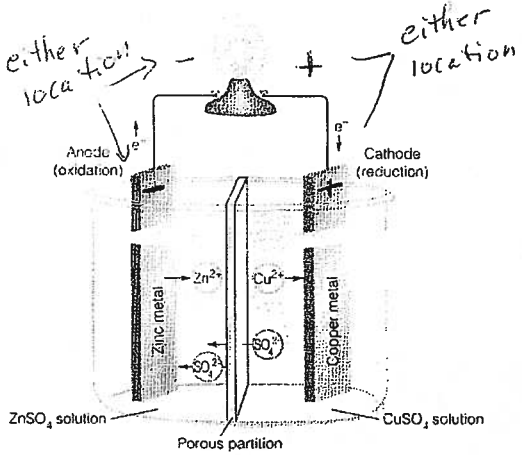
give + ½ pt if Pt are used all else incorrect

-1 pt if no Pt. electrodes but all else correct

1st diagram

either location

either location



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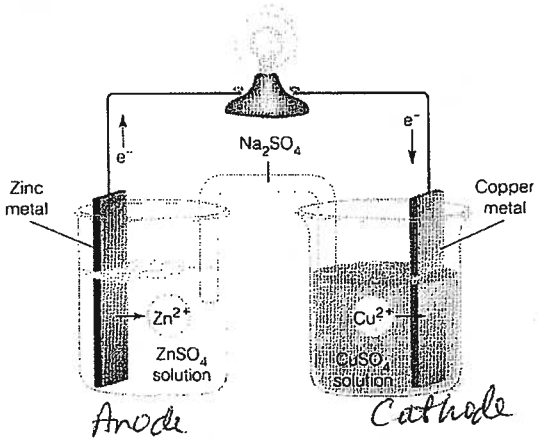
2ND diagram



35 **galvanic** 36. **voltaic** 37. **Daniell** (also accept. Leclancé)

38. Which metal is the anode? **Zn or zinc** 39. Which metal is the cathode? **Cu or copper**
40. What process occurs at the anode? (oxidation or reduction) **oxidation**
41. What process occurs at the cathode? (oxidation or reduction) **reduction**
42. What is the voltage for these cells assuming 1M concentrations of ionic solutions? **+1.10 v**
43. Write the oxidation half-reaction: **$Zn \rightarrow Zn^{+2} + 2\,e^-$**
44. Write the reduction half reaction: **$Cu^{+2} + 2\,e^- \rightarrow Cu$**
45. Write the overall reaction

$$Zn + Cu^{+2} \rightarrow Cu + Zn^{+2}$$

46. Indicate directly on the first image which is the + electrode and which is the – electrode. **– anode, + cathode**
47. Indicate directly on the second image which beaker contains the anode and which contains the cathode.
Zn is anode and Cu Cathode
48. What is the name of the inverted "U" shaped tube in the second image? **Salt bridge**
49. Show the direction of flow of the ions across the porous partition in the first diagram. **As shown**
50. Show the direction of flow of the electrons in the wiring on the second diagram. **As shown**

CHEMISTRY LAB—Aqueous Solutions Answer Sheet

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1. **26 ± 1g**

2. **206 ± 2g** (51.5g/100ml) x(400ml)

3. **less solubility as temperature rises.**

4. **the less soluble decahydrate crystal loses water of crystallization at 32°C to form a more soluble anhydrous phase. (TB #3)**

5 **23 ±1 °C**

6. **94g ± 2g** 85g for $NaHAsO_4$/100 g x 200g = 170 g
38 g ±1g for NaCl/ 100 g x 200g = 76 g ± 2g
difference = **94 g** ± 2g

7. **supersaturated** 16 g/ 50g = 32 g/ 100 g (use this at the temp given)

8. 27 g $NaHAsO_4$ at 20°C 27g (1mol/186 g) = 0.145 mol
m = moles solute/kg solvent = 0.145 mol / 0.100 kg = **1.45 m**
accept 1.4-1.5 values

9 **C**	12 **D**	15. **B**	18 C
10 **D**	13 **B**	16. **A**	19 **D**
11 **A**	14 **D**	17. **A**	

20-24. **#20-24.** Turmeric, a natural compound, is added to mustard for flavor and color. It **(5pts)** changes color from yellow to red at a pH of 7.4. Mustard also contains acetic acid (CH_3COOH). A 0.50 gram sample of mustard is titrated with 5.0 ml of a 0.050 M NaOH. Determine the mass percentage of acetic acid in mustard.
moles base used (V x M) = moles acid present
moles acid present x molar mass acetic acid = mass acetic acid
% CH_3COOH in mustard = mass acetic acid present / mass mustard used

mol OH^- = 0.005 L x 0.05M = **0.00025 mol OH^- = 0.00025 mol H^+** in acetic acid (2pts)
mass CH_3COOH = 0.00025 mol x 60 g/mol = **0.015 g CH_3COOH** (1 pt.)
finally, % CH_3COOH in mustard = 0.015 g /.50 g x100 = approx. **3.0%** (2 pts)

#25-28. (**3pts**) It takes 26.23 mL of a 1.008 M NaOH solution to neutralize a solution of 5 g of an unknown monoprotic acid in 150.2 mL of solution. What is the molecular weight of the unknown?

Moles = L x M
= 0.02623L x 1.008 M (OH^-) = 0.02644 moles OH^- = **0.02644 moles H^+** (1pt)
5g/ 0.02644 moles = molar mass= **189.1 g/mole** (2pt)

 # 29-32 Determine the boiling point ***and*** freezing point of a solution that contains 25.0 g of $CaCl_2$ (111 g/mol) in 200.g of H_2O? Assume the calcium chloride ionizes completely. [HINT : $\Delta T = i K_f m$ *or* $\Delta T = i K_b m$]
K_f = 1.86°C/m K_b = 0.51°C/m

molality of solution = moles of $CaCl_2$ / Kg solvent
= (25.0 g/ 111 g/mol) / 0.200 kg = 1.13 m **1 pt**

i = number of ions in solution **$Ca\,Cl_2 \rightarrow Ca^{+2} + 2\,Cl^-$ forming 3 ions = *i*** **1 pt**

Boling point of solution:
ΔT = 3 x 0.51°C/m x 1.13 m = 1.73°C, 100°C + 1.73°C = 101.73°C **1 pt**

Freezing point of solution:
ΔT= 3 x 1.86°C/m x 1.13m = 6.31°C, 0°C -6.31°C = - 6.31°C **1 pt**

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The data collected is shown in this chart. Trials are summarized below:

Trial Number	0.400 M $C_6H_{12}O_6$ (mL)	H_2O (mL)	Concentration of $C_6H_{12}O_6$ (mol/L)	Specific Gravity
1	0.00	20.0	**0.000**	1.000
2	5.00	15.0	**0.100**	1.011
3	10.0	10.0	**0.200**	1.022
4	15.0	5.00	**0.300**	1.033
5	20.0	0.00	**0.400**	1.043
7-Up	10 mL 7-Up	10 mL H_2O	**0.313** *	1.034

*** accept 0.31→0.32**

1. Calculate the concentration of fructose for each solution and complete the data table.(5pts)

2. Construct the graph plotting **Fructose Concentration (x axis) vs. Specific Gravity (y axis).** Circle all data points and label the graph. Make the best line possible. (5 pts)

3. Using the specific gravity of the 7-Up, determine from the graph the fuctose molarity of the diluted sample. (1 pt) **0.313 M (accept 0.31→0.32)**

4. What is the concentration of the undiluted 10ml sample of 7-Up? (1pt)
from the graph: 2 × (0.313 M) = 0.626 M solution. Accept 0.62M→0.64M

5. Calculate the number of moles of $C_6H_{12}O_6$ from the known volume (10.0 mL) of the fructose/7-Up solution. (1pt)
Moles $C_6H_{12}O_6$ = (Molarity $C_6H_{12}O_6$)(L of solution)
Moles $C_6H_{12}O_6$ = (0.626 M)(0.0100 L)
Moles $C_6H_{12}O_6$ = 0.00626 mol $C_6H_{12}O_6$ Accept 0.0062mol→0.0064mol

6. Calculate the number of grams in the 10ml sample. (1 pt)

$$= 0.00626 \text{ mol } C_6H_{12}O_6 \times \frac{180.16 \text{ g } C_6H_{12}O_6}{1 \text{ mole}} = 1.13 \text{ g } C_6H_{12}O_6 \text{ in 10ml of 7-Up}$$

accept: 1.12 →1.15 g

7. If 8 fluid ounces are equivalent to 240. mL, how many milliliters are equivalent to a 12 ounce can of soda? (1pt)

$$\frac{8 \text{oz}}{240 \text{ ml}} = \frac{12 \text{ oz}}{X \text{ml}} \quad \text{so } X = \frac{240 \text{ml} \times 12 \text{ oz}}{8 \text{ oz}} = 360 \text{ ml}$$

8. How many grams are in a 12 ounce can of soda? (1pt)

$$\frac{1.13 \text{ g } C_6H_{12}O_6}{10 \text{ ml}} = \frac{X \text{g. } C_6H_{12}O_6}{360 \text{ml}} \qquad X = 40.6 \text{ g } C_6H_{12}O_6 \text{ (360ml)/10ml}$$

accept 40.3 → 41.4

9. If 1 teaspoon is 4 grams, how many teaspoons of sugar are in each can? (1pt)

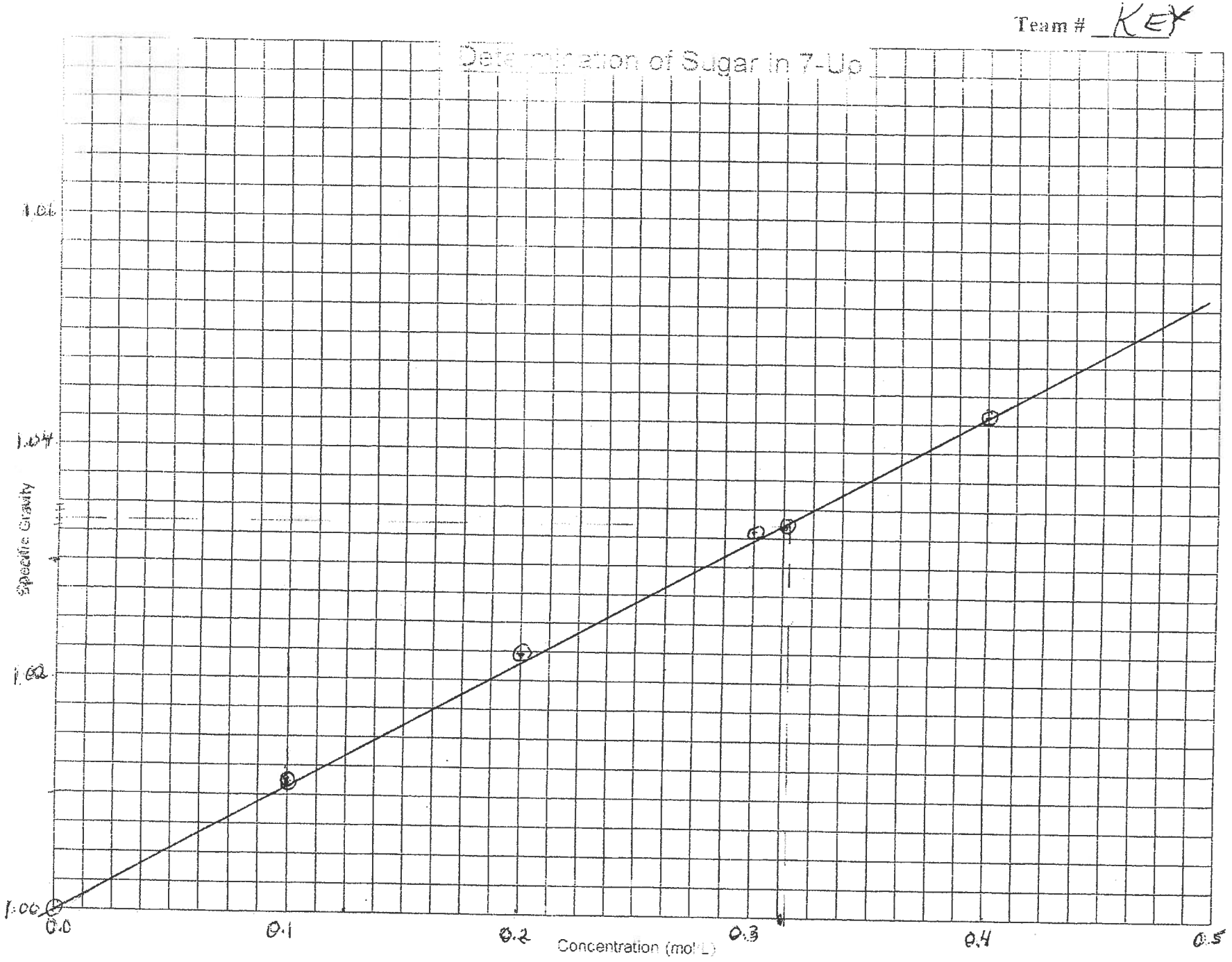
$$\frac{40.6 \text{ g}}{4 \text{ g/teaspoon}} = 10.15 \text{teaspoons or } 10 \text{ teaspoons.}$$

10. Since it is reported that a 12-ounce can of 7-Up contains 39.0 grams of sugar, calculate the percent error based upon your answer to question #8. (1pt)

$$\% \text{ error} = \frac{\text{your value- accepted value}}{\text{accepted value}} \times 100 = \frac{40.6 \text{ g} - 39 \text{ g}}{39 \text{ g}} \times 100 = 4.1\% \text{ error}$$

accept 3.3% (for 40.3g) →6.1% (for 41.4g)

Team # KEY


Determination of Sugar in 7-Up
Specific Gravity
1.08
1.04
1.02
1.00
0.0
0.1
0.2
0.3
0.4
0.5
Concentration (mol/L)