PASS MOCK MIDTERM – FOR PRACTICE ONLY

Course: **CHEM 1002 A, N, T** Facilitator: **John Mesman**

Date and location of the Review Class:
Tuesday, March 3rd, 2015
7:30 – 9:30 pm
AT 101

IMPORTANT:

It is **most beneficial** to you to write this mock midterm **UNDER EXAM CONDITIONS**. This means:

- Complete the exam in 1 hour.
- Work on your own.
- Keep your notes and textbook closed.
- Attempt every question.

After the time limit, go back over your work with a different colour or on a separate piece of paper and try to do the questions you are unsure of. Record your ideas in the margins to remind yourself of what you were thinking when you take it up at PASS.

The purpose of this mock exam is to give you practice answering questions in a timed setting and to help you to gauge which aspects of the course content you know well and which are in need of further development and review. Use this mock exam as a ***learning tool*** in preparing for the actual exam.

Please note:

- Come to the PASS session with your mock exam complete. There, you can work with other students to review your work.
- Often, there is not enough time to review the entire exam in the PASS session. Decide which questions you most want to review – the facilitator may ask students to vote on which questions they want to discuss.
- Facilitators do not bring copies of the mock exam to the session. Please print out and complete the exam before you attend.
- **Facilitators do not produce or distribute an answer key for mock exams**. Facilitators help students to work together to compare and assess the answers they have. If you are not able to attend the PASS session, you can work alone or with others in the class.

Part A.

Answer each of the six questions with a few sentences or equations where necessary. (5 Marks each)

1. Briefly explain how an acid-base indicator works.

2. Will an aqueous solution of NaOCl be acidic, basic or neutral? Why?

(K_a for HOCl = 3.5×10^{-8}; K_b for NaOH is very large.)

3. Will the solubility of strontium carbonate, $SrCO_{3(s)}$, increase or decrease as the pH is raised? Why?

4. Name or give the formula of a salt that could be used together with carbonic acid, $H_2CO_{3(aq)}$, to make an acidic buffer system.

5. How many d-electrons does the metal have in each of the following complexes?

(a) $[Ti(H2O)_6]^{3+}_{(aq)}$

(b) $Na_2[Ti(OH)_6]$

(c) $Ni(Cl)_4^{2-}{}_{(aq)}$

(d) $[Cr(en)I_2(NH_3)_2]Br$

(e) $Na_2[Au(CN)_2]$

6. Both $[Cr(H_2O)_6]^{3+}$ and $Co(H_20)_6]^{2+}$ are metal complexes which are coloured. What colour are these complexes, and why are they different?

Part B.

Answer B1. Answer any two of B2, B3 and B4. If you answer all three of B2, B3 and B4, the best two of those three answers will count. (20 marks each)

B1. (a) Name the following transition metal complexes.

$CuCl_2(CH_3NH_2)_2$

$[Co(NH_3)_5Cl]Cl_2$

$Na_2[Fe(CN)_5NO]$

$[Co(NH_3)_5Cl]Cl_2$

$Ni(CO)_4$

(b) Draw the following transition metal complexes.

fac-triamminetrichlorocobalt(III)

sodium bis(thiosulfato)argentate(I)

potassium pentachloronitridoosmate(VI)

trans-tetraamminedichlorocobalt(III) chloride

bromopentacarbonylmanganese(I)

B2. An aqueous solution contains 0.5 M hydrazine, H_2NNH_2 ($K_b = 1.3 \times 10^{-6}$) and 0.25 M hydrazine hydrochloride, H_2NNH_3Cl.

(a) Calculate the pH of the solution.

(b) 0.010 mol of HNO_3 ($K_a = 30$) are added to 1 L of the buffered solution from part (a). Write the reaction that occurs, and calculate the resultant pH.

B3. Calculate the pH and the concentrations of all species (except water) in a 2 M solution of chromic acid, $H_2CrO_{4(aq)}$. For this acid, $K_{a1} = 0.18$ and $K_{a2} = 3.2 \times 10^{-7}$.

B4. How many moles of sodium hypochlorite, NaOCl, must be added to 200 mL of 0.22 M hypochlorous acid, HOCl, to produce a buffer having a pH of 6.75? K_a for HOCl is 3.5×10^{-8}.

Wavelength (nm)	Colour Absorbed	Complementary Colour	Δ (kJ/mol)
>720	Infrared	Colourless	<165
720	Red	Green	166
680	Red-orange	Blue-green	176
610	Orange	Blue	196
580	Yellow	Indigo	206
560	Yellow-green	Violet	214
530	Green	Purple	226
500	Blue-green	Red	239
480	Blue	Orange	249
430	Indigo	Yellow	279
410	Violet	Lemon-yellow	292
<400	Ultraviolet	Colourless	>299

Spectrochemical Series

$I^- < Br^- < Cl^- < F^- < OH^- < H_2O < NH^- < en < NO_2^- < CN^- < CO$

Some Useful Constants

$N_{Av} = 6.02 \times 10^{23}\ mol^{-1}$

$R = 8.314\ J\ K^{-1}\ mol^{-1}$

$0^oC = 273.15\ K$

$K_w = 1.0 \times 10^{-14}$

IA (1)																	VIIIA (18)
1 H 1.008	IIA (2)											IIIA (13)	IVA (14)	VA (15)	VIA (16)	VIIA (17)	2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	IIIB (3)	IVB (4)	VB (5)	VIB (6)	VIIB (7)	(8)	VIIIB (9)	(10)	IB (11)	IIB (12)	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.70	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc 98	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3.	57 La 138.9	72. Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (269)	109 Mt (268)	110 Ds (269)	111 Rg (280)	112 Cp (277)		114 Fl (289)		116 Lv (293)		

58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)