Class Diagnostic 1

## CaMO USNCO Local Exam Pre-Test

Local Section Diagnostic

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Rules: You have 50 minutes to complete this 27 question multiple choice exam. You may use a non programmable calculator. You are not allowed to access the internet during this exam. I will not aid you during this exam.

## DO NOT TURN THE PAGE UNTIL DIRECTED TO DO SO

$$E = E^{\circ} - \frac{RT}{nF} \ln Q \qquad \ln K = \left(\frac{-\Delta H^{\circ}}{R}\right) \left(\frac{1}{T}\right) + \text{constant} \qquad \ln \left(\frac{k_2}{k_1}\right) = \frac{E_a}{R} \left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

	_																
hydrogen 1																	helium 2
H																	He
1.0079																	4.0026
lithium	beryllium	1										boron	carbon	nitrogen	oxygen	fluorine	neon
3	4											5	6	7	8	9	10
Li	Be											В		N	Ο	F	Ne
6.941	9.0122											10.811	12.011	14.007	15.999	18.998	20.180
sodium 11	magnesium 12											aluminium 13	silicon 14	phosphorus 15	sulfur 16	chlorine 17	argon 18
Na	Mg											Αl	Si	Р	S	Cl	Ar
22.990	24.305											26.982	28.086	30.974	32.065	35.453	39.948
potassium	calcium	scandium	titanium	vanadium	chromium	manganese	iron	cobalt	nickel	copper	zinc	gallium	germanium	arsenic	selenium	bromine	krypton
19	20	21	22	23	24	25 N A	26	27	28 N 1 *	29	30	31	32	33	34	35	36
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
39.098 rubidium	40.078 strontium	44.956 yttrium	47.867 zirconium	50.942 niobium	51.996 molybdenum	54.938 technetium	55.845 ruthenium	58.933 rhodium	58.693 palladium	63.546 silver	65.38 cadmium	69.723 indium	72.64 tin	74.922 antimony	78.96 tellurium	79.904 iodine	83.798 xenon
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
DI.			_			_	_			_					_		
⊥ KD	Sr	Y	/r	Nh	Mo	Tc	Ru	Rh	Pd	Aa	(d	l In	Sn	Sh	Te		l Xe l
<b>Rb</b>	Sr 87.62	<b>Y</b> 88.906	<b>Zr</b>	Nb 92.906	Mo 95.96	<b>Tc</b>	Ru 101.07	Rh	Pd 106.42	Ag	Cd	In 114.82	Sn 118.71	Sb 121.76	Te 127.60	126.90	Xe 131.29
85.468 caesium	87.62 barium	88.906 lanthanum	91.224 hafnium	92.906 tantalum	95.96 tungsten	[98] rhenium	101.07 osmium	102.91 iridium	106.42 platinum	107.87 gold	112.41 mercury	114.82 thallium	118.71 lead	121.76 bismuth	127.60 polonium	126.90 astatine	131.29 radon
85.468 caesium 55	87.62 barium 56	88.906 lanthanum 57	91.224 hafnium 72	92.906 tantalum 73	95.96 tungsten 74	[98] rhenium 75	101.07 osmium 76	102.91 iridium 77	106.42 platinum 78	107.87 gold 79	112.41 mercury 80	114.82 thallium 81	118.71 lead 82	121.76 bismuth 83	127.60 polonium 84	126.90 astatine 85	131.29 radon 86
caesium 55	87.62 barium 56 <b>Ba</b>	88.906 lanthanum 57 La	91.224 hafnium 72 <b>Hf</b>	92.906 tantalum 73	95.96 tungsten 74	rhenium 75 <b>Re</b>	101.07 osmium 76 OS	102.91 iridium 77	platinum 78 Pt	107.87 gold 79	mercury 80 Hg	thallium 81	118.71 lead 82 <b>Pb</b>	bismuth 83	polonium 84 Po	astatine 85	131.29 radon 86 <b>Rn</b>
85.468 caesium 55 CS 132.91	87.62 barium 56 <b>Ba</b> 137.33	88.906 lanthanum 57 <b>La</b> 138.91	91.224 hafnium 72 <b>Hf</b> 178.49	92.906 tantalum 73 <b>Ta</b> 180.95	95.96 tungsten 74 <b>W</b> 183.84	[98] rhenium 75 <b>Re</b> 186.21	101.07 osmium 76 OS 190.23	102.91 iridium 77 <b>I r</b> 192.22	106.42 platinum 78 Pt 195.08	107.87 gold 79 <b>Au</b> 196.97	112.41 mercury 80	114.82 thallium 81	118.71 lead 82	121.76 bismuth 83	127.60 polonium 84	126.90 astatine 85	131.29 radon 86
85.468  caesium 55  CS 132.91  francium 87	87.62 barium 56 Ba 137.33 radium 88	88.906 lanthanum 57 La 138.91 actinium 89	91.224 hafnium 72 Hf 178.49 rutherfordium 104	92.906 tantalum 73 Ta 180.95 dubnium 105	95.96 tungsten 74 W 183.84 seaborgium 106	rhenium 75 Re 186.21 bohrium 107	101.07 osmium 76 OS 190.23 hassium 108	iridium 77  r 192.22 meitnerium 109	platinum 78 Pt 195.08 darmstadtium 110	gold 79 Au 196.97 roentgenium	mercury 80 Hg	thallium 81	118.71 lead 82 <b>Pb</b>	bismuth 83	polonium 84 Po	astatine 85	131.29 radon 86 <b>Rn</b>
85.468  caesium 55  CS 132.91  francium 87	87.62 barium 56 Ba 137.33 radium 88	88.906 lanthanum 57 La 138.91 actinium 89	91.224 hafnium 72 Hf 178.49 rutherfordium 104	92.906 tantalum 73 Ta 180.95 dubnium 105	95.96 tungsten 74 W 183.84 seaborgium 106	rhenium 75 Re 186.21 bohrium 107	101.07 osmium 76 OS 190.23 hassium 108	iridium 77  r 192.22 meitnerium 109	platinum 78 Pt 195.08 darmstadtium 110	gold 79 Au 196.97 roentgenium	mercury 80 Hg	thallium 81	118.71 lead 82 <b>Pb</b>	bismuth 83	polonium 84 Po	astatine 85	131.29 radon 86 <b>Rn</b>
85.468 caesium 55 CS 132.91 francium	87.62 barium 56 <b>Ba</b> 137.33 radium	88.906 lanthanum 57 La 138.91 actinium	91.224 hafnium 72 Hf 178.49 rutherfordium	92.906 tantalum 73 Ta 180.95 dubnium	95.96 tungsten 74 W 183.84 seaborgium	rhenium 75 Re 186.21	101.07 osmium 76 OS 190.23 hassium	iridium 77  Ir 192.22 meitnerium	platinum 78 Pt 195.08 darmstadtium	gold 79 Au 196.97	mercury 80 Hg	thallium 81	118.71 lead 82 <b>Pb</b>	bismuth 83	polonium 84 Po	astatine 85	131.29 radon 86 <b>Rn</b>
85.468  caesium 55  CS 132.91  francium 87  Fr	BA BA 137.33 radium 88	88.906 lanthanum 57 La 138.91 actinium 89 Ac [227]	91.224 hafnium 72 Hf 178.49 rutherfordium 104 Rf [261]	92.906 tantalum 73 Ta 180.95 dubnium 105 Db [262]	95.96 tungsten 74 W 183.84 seaborgium 106 Sg [266]	[98] rhenium 75 Re 186.21 bohrium 107 Bh [264]	101.07 osmium 76 OS 190.23 hassium 108 HS [277]	102.91 iridium 77 <b>Ir</b> 192.22 meitnerium 109 <b>Mt</b> [268]	platinum 78 Pt 195.08  darmstadtium 110 DS	gold 79 Au 196.97 roentgenium 111 Rg [272]	112.41 mercury 80 Hg 200.59	114.82 thallium 81 T 204.38	118.71 lead 82 Pb 207.2	121.76 bismuth 83 <b>Bi</b> 208.98	polonium 84 Po [209]	astatine 85	131.29 radon 86 <b>Rn</b>
85.468  caesium 55  CS 132.91  francium 87  Fr	BA BA 137.33 radium 88	88.906 lanthanum 57 La 138.91 actinium 89 AC [227] cerium 58	91.224 hafnium 72 Hf 178.49 rutherfordium 104 Rf [261] praseodymium 59	92.906 tantalum 73 Ta 180.95 dubnium 105 Db [262] neodymium 60	95.96 tungsten 74 W 183.84 seaborgium 106 Sg [266] promethium 61	[98] rhenium 75 Re 186.21 bohrium 107 Bh [264] samarium 62	101.07 osmium 76 OS 190.23 hassium 108 HS [277] europium 63	iridium 77 Ir 192.22 meitnerium 109 Mt [268] gadolinium 64	platinum 78 Pt 195.08 darmstadtium 110 DS [271] terbium 65	107.87 gold 79 Au 196.97 roentgenium 111 Rg [272] dysprosium 66	112.41 mercury 80 Hg 200.59	thallium 81 T 204.38	118.71 lead 82 <b>Pb</b>	bismuth 83 Bi 208.98	polonium 84 Po	astatine 85	131.29 radon 86 <b>Rn</b>
85.468  caesium 55  CS 132.91  francium 87  Fr	BA BA 137.33 radium 88	88.906 lanthanum 57 La 138.91 actinium 89 AC [227]	91.224 hafnium 72 Hf 178.49 rutherfordium 104 Rf [261]	92.906 tantalum 73 Ta 180.95 dubnium 105 Db [262]	95.96 tungsten 74 W 183.84 seaborgium 106 SG [266]	rhenium 75 Re 186.21 bohrium 107 Bh [264]	101.07 osmium 76 OS 190.23 hassium 108 HS [277] europium 63	iridium 77  Ir 192.22 meitnerium 109 Mt [268]	platinum 78 Pt 195.08 darmstadtium 110 DS [271] terbium	107.87 gold 79 Au 196.97 roentgenium 111 Rg [272] dysprosium 66	112.41 mercury 80 Hg 200.59	thallium 81 T 204.38	118.71 lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 PO [209]	astatine 85	131.29 radon 86 <b>Rn</b>
85.468  caesium 55  CS 132.91  francium 87  Fr	BA BA 137.33 radium 88	88.906 lanthanum 57 La 138.91 actinium 89 AC [227] cerium 58 Ce 140.12	91.224 hafnium 72 Hf 178.49 rutherfordium 104 Rf [261] praseodymium 59 Pr 140.91	92.906 tantalum 73 Ta 180.95 dubnium 105 Db [262]  neodymium 60 Nd 144.24	95.96 tungsten 74 W 183.84 seaborgium 106 SG [266] promethium 61 Pm [145]	[98] rhenium 75 Re 186.21 bohrium 107 Bh [264] samarium 62 Sm 150.36	101.07 osmium 76 OS 190.23 hassium 108 HS [277] europium 63 EU 151.96	iridium 77 Ir 192,22 meitnerium 109 Mt [268] gadolinium 64 Gd 157,25	platinum 78 Pt 195.08 darmstadtium 110 DS [271] terbium 65 Tb 158.93	gold 79 Au 196.97 roentgenium 1111 Rg [272] dysprosium 66 Dy 162.50	112.41 mercury 80 Hg 200.59	114.82 thallium 81 TI 204.38 erbium 68 Er 167.26	118.71 lead 82 Pb 207.2 thulium 69 Tm 168.93	ytterbium 70 Yb 173.05	127.60 polonium 84 Po [209]	astatine 85	131.29 radon 86 <b>Rn</b>
85.468  caesium 55  CS 132.91  francium 87  Fr	BA BA 137.33 radium 88	88.906 lanthanum 57 La 138.91 actinium 89 AC [227] cerium 58 Ce 140.12 thorium	91.224 hafnium 72 Hf 178.49 rutherfordium 104 Rf [261] praseodymium 59 Pr 140.91 protactinium	92.906 tantalum 73 Ta 180.95 dubnium 105 Db [262] neodymium 60 Nd 144.24 uranium	95.96 tungsten 74 W 183.84 seaborgium 106 SG [266] promethium 61 Pm [145] neptunium	[98]	osmium 76 OS 190.23 hassium 108 HS [277] europium 63 EU 151.96 americium	indium 77 Ir 192.22 meitnerium 109 Mt [268] gadolinium 64 Gd 157.25 curium	platinum 78 Pt 195.08 darmstadtium 110 DS [271] terbium 65 Tb 158.93 berkelium	gold 79 Au 196.97 roentgenium 111 Rg [272] dysprosium 66 Dy 162.50 californium	112.41 mercury 80 HG 200.59	thallium 114.82 thallium 11 204.38 erbium 68 Er 167.26 fermium	thulium 69 Tm 16.93 mendelevium	121.76 bismuth 83 Bi 208.98  ytterbium 70 Yb 173.05 nobelium	127.60 polonium 84 PO [209]  lutetium 71 LU 174.97 lawrencium	astatine 85	131.29 radon 86 <b>Rn</b>
85.468  caesium 55  CS 132.91  francium 87  Fr	BA BA 137.33 radium 88	88.906 lanthanum 57 La 138.91 actinium 89 AC [227] cerium 58 Ce 140.12	91.224 hafnium 72 Hf 178.49 rutherfordium 104 Rf [261] praseodymium 59 Pr 140.91	92.906 tantalum 73 Ta 180.95 dubnium 105 Db [262]  neodymium 60 Nd 144.24	95.96 tungsten 74 W 183.84 seaborgium 106 SG [266] promethium 61 Pm [145]	[98] rhenium 75 Re 186.21 bohrium 107 Bh [264] samarium 62 Sm 150.36	101.07 osmium 76 OS 190.23 hassium 108 HS [277] europium 63 EU 151.96	iridium 77 Ir 192,22 meitnerium 109 Mt [268] gadolinium 64 Gd 157,25	platinum 78 Pt 195.08 darmstadtium 110 DS [271] terbium 65 Tb 158.93	gold 79 Au 196.97 roentgenium 1111 Rg [272] dysprosium 66 Dy 162.50	112.41 mercury 80 Hg 200.59	114.82 thallium 81 TI 204.38 erbium 68 Er 167.26	118.71 lead 82 Pb 207.2 thulium 69 Tm 168.93	ytterbium 70 Yb 173.05	127.60 polonium 84 Po [209]	astatine 85	131.29 radon 86 <b>Rn</b>

Class Diagnostic 2

- 1. How many atoms are in  $4.0 \times 10^{-5}$  grams of Al?
  - (a)  $8.9 \times 10^{17}$
  - (b)  $2.4 \times 10^{19}$
  - (c)  $6.5 \times 10^{20}$
  - (d)  $2.0 \times 10^{22}$
- 2. Barium chloride reacts with sodium sulfate according to the following equation:

$$BaCl_2(aq) + Na_2SO_4(aq) \longrightarrow BaSO_4(s) + 2NaCl(aq)$$

A student mixes a solution containing  $10.0 \text{ g BaCl}_2$  (M=208.2) with a solution containing 10.0 g Na<sub>2</sub>SO<sub>4</sub> (M=142.1) and obtains  $12.0 \text{ g BaSO}_4$  (M=233.2). What is the percent yield of this reaction.

- (a) 60.0%
- (b) 73.1 %
- (c) 93.3 %
- (d) The isolated barium sulfate is most likely wet, since the yield would otherwise be greater than 100%
- 3. A 5.73 g sample of a liquid hydrocarbon burned in excess oxygen produces 17.48 g CO<sub>2</sub>. What is the formula of the hydrocarbon?
  - (a)  $C_5H_{12}$
  - (b)  $C_6H_6$
  - (c)  $C_6H_{10}$
  - (d)  $C_6H_{12}$
- 4. A student determined the density of a solid to be 2.90, 2.91, and 2.93 g cm<sup>-3</sup>. If the actual density of this solid is 2.70 g cm<sup>-3</sup>, how should the student's results be described?
  - (a) high accuracy and high precision
  - (b) low accuracy and high precision
  - (c) high accuracy and low precision
  - (d) low accuracy and low precision
- 5. A flame test was performed to confirm the identity of a metal ion in solution. The result was a green flame. Which of the following metal ions is indicated?
  - (a) copper
  - (b) sodium
  - (c) strontium
  - (d) zinc

- 6. Which of the following is a weak electrolyte in aqueous solution?
  - (a) HF
  - (b) NaF
  - (c) HCl
  - (d) KCl
- 7. A sample of He gas in a flexible container at room temperature exhibits a certain pressure. What will be the new pressure when the absolute temperature and volume of the container are both halved? The pressure of the He will be
  - (a) the same
  - (b) doubled
  - (c) halved
  - (d) quadrupled
- 8. A gas mixture at 27  $^{\circ}$  C and 1 atm contains equal masses of He, H<sub>2</sub>, CO<sub>2</sub>, and CH<sub>4</sub>. How do their molecular velocities compare?
  - (a)  $He = H_2 = CO_2 = CH_4$
  - (b) He;  $H_2$ ;  $CO_2$ ;  $CH_4$
  - (c)  $H_2$ ; He;  $CH_4$ ;  $CO_2$
  - (d)  $CO_2$ ;  $CH_4$ ; He;  $H_2$
- 9. The molecules in a sample of pure liquid dichloromethane, CH<sub>2</sub>Cl<sub>2</sub>, experience which of the following intermolecular forces?
  - I dispersion forces
  - II dipole-dipole forces
  - III hydrogen bonding
  - (a) I only
  - (b) II only
  - (c) I and II only
  - (d) I, II, III
- 10. The standard enthalpy of formations for NH<sub>3</sub>(g)  $-46.1\,\mathrm{kJ\,mol^{-1}}$ . Calculate  $\Delta H^{\circ}$  for the reaction:

$$2 NH_3(g) \longrightarrow N_2(g) + 3 H_2(g)$$

- (a)  $-92.2 \, \text{kJ}$
- (b) -46.1 kJ
- (c)  $46.1 \, \text{kJ}$
- (d)  $92.2 \,\mathrm{kJ}$

Class Diagnostic 4

- 11. Which is a statement of the Second Law of Thermodynamics?
  - (a) The energy of the universe is conserved.
  - (b) The energy of the universe is decreasing.
  - (c) The entropy of the universe is conserved.
  - (d) The entropy of the universe is increasing.
- 12. A gold ring that weighs 3.81 g is heated to 84.0 °C and placed in 50.0 g of H<sub>2</sub>O at 22.1 °C. What is the final temperature?
  - (a)  $22.2\,^{\circ}\text{C}$
  - (b) 24.0 °C
  - (c)  $26.5\,^{\circ}\text{C}$
  - (d) 53.1 °C
- 13. The activation energy for a reaction can be determined by measuring the reaction rate at different
  - (a) temperatures.
  - (b) catalyst concentrations.
  - (c) reactant concentrations.
  - (d) times on the reaction curve.
- 14. A catalyst speeds up a chemical reaction by
  - (a) shifting the equilibrium.
  - (b) increasing the activation energy.
  - (c) decreasing the reaction enthalpy.
  - (d) providing an alternate reaction pathway.
- 15. For the reaction:

$$(CH_3)_3CBr(aq) + OH^-(aq) \longrightarrow (CH_3)_3COH(aq) + Br^-(aq)$$

it is found that halving the concentration of  $(CH_3)_3CBr$  causes the reaction rate to be halved but halving the concentration of  $OH^-$  has no effect on the rate. What is the rate law?

- (a) Rate =  $k [(CH_3)_3 CBr]^{\frac{1}{2}} [OH^-]$
- (b) Rate =  $k \left[ (CH_3)_3 CBr \right]^2 \left[ OH^- \right]$
- (c) Rate =  $k [(CH_3)_3 CBr]^{\frac{1}{2}}$
- (d) Rate =  $k [(CH_3)_3 CBr]$
- 16. What is the pH of a 0.0015 M solution of HNO<sub>3</sub>?
  - (a) 1.41
  - (b) 2.82
  - (c) 5.65
  - (d) 11.18

- 17. In a solution of formic acid  $(K_a = 1.7 \times 10^{-4})$ , the  $[H^+] = 2.3 \times 10^{-3}$ . What is the concentration of formic acid in mol L<sup>-1</sup>?
  - (a)  $7.2 \times 10^{-2}$
  - (b)  $3.1 \times 10^{-2}$
  - (c)  $5.3 \times 10^{-6}$
  - (d)  $3.9 \times 10^{-7}$
- 18. For the equilibrium system:

$$CO(g) + 2H_2(g) \Longrightarrow CH_3COH(l)$$

what is  $K_c$ ?

(a) 
$$K_c = \frac{\text{[CH_3OH]}}{2\text{[CO][H_2]}}$$

(b) 
$$K_c = \frac{[\text{CH}_3\text{OH}]}{[\text{CO}][\text{H}_2]^2}$$

(c) 
$$K_c = \frac{1}{2[\text{CO}][\text{H}_2]}$$

(d) 
$$K_c = \frac{1}{[\text{CO}][\text{H}_2]^2}$$

- 19. Which change represents an oxidation
  - (a)  $NO_2^- \longrightarrow N_2$
  - (b)  $VO^{2+} \longrightarrow VO_3^{-}$
  - (c)  $ClO^- \longrightarrow Cl^-$
  - $(\mathrm{d}) \ \mathrm{CrO_4}^{2-} \longrightarrow \mathrm{Cr_2O_7}^{2-}$
- 20. Which is a consistent set of values for a specific redox reaction carried out under standard conditions?

 $E^{\circ}$   $\Delta G^{\circ}$  Description

- (a) + spontaneous
- (b) + spontaneous
- (c) + + nonspontaneous
- (d) nonspontaneous
- 21. For a galvanic cell involving the half-reactions at standard conditions,

$$\mathrm{Au^{3+}} + \mathrm{3\,e^{-}} \longrightarrow \mathrm{Au}$$
  $E^{\circ} = 1.50\,\mathrm{V}$   
 $\mathrm{Tl^{+}\,e^{-}} \longrightarrow \mathrm{Tl}$   $E^{\circ} = -0.34\,\mathrm{V}$ 

what is  $E_{cell}^{\circ}$ ?

- (a)  $0.48\,\mathrm{V}$
- (b) 1.16 V
- (c)  $1.84\,\mathrm{V}$
- (d)  $2.52\,\mathrm{V}$

- 22. Which set of quantum numbers is not possible?
  - (a)  $n=2, l=1, m_l=+1, m_s=-\frac{1}{2}$
  - (b)  $n = 3, l = 2, m_l = +1, m_s = +\frac{1}{2}$
  - (c)  $n = 4, l = 4, m_l = -1, m_s = +\frac{1}{2}$
  - (d)  $n = 5, l = 2, m_l = 2, m_s = -\frac{1}{2}$
- 23. In which list are the ions arranged in order of decreasing size?
  - (a)  $S^{2-}$ , Br-,  $K^+$ ,  $Ca^{2+}$
  - (b)  $Br-,S^{2-},K^+,Ca^{2+}$
  - (c)  $K^+, Ca^{2+}, S^{2-}, Br^{-}$
  - (d)  $Ca^{2+}, K^+, S^{2-}, Br^-$
- 24. The removal of an electron from which gaseous atom requires the greatest amount of energy?
  - (a) Na
  - (b) Cl
  - (c) K
  - (d) Br
- 25. Which ionic solid has the greatest lattice energy?
  - (a) NaCl
  - (b) MgO
  - (c) KBr
  - (d) SrS
- 26. What is the shape of the ClF<sub>3</sub> molecule?
  - (a) trigonal planar
  - (b) trigonal pyramidal
  - (c) T-shaped
  - (d) tetrahedral
- 27. Which molecule has no permanent dipole moment?
  - (a) BCl<sub>3</sub>
  - (b) NCl<sub>3</sub>
  - (c) CHCl<sub>3</sub>
  - (d) PCl<sub>3</sub>

## END OF TEST