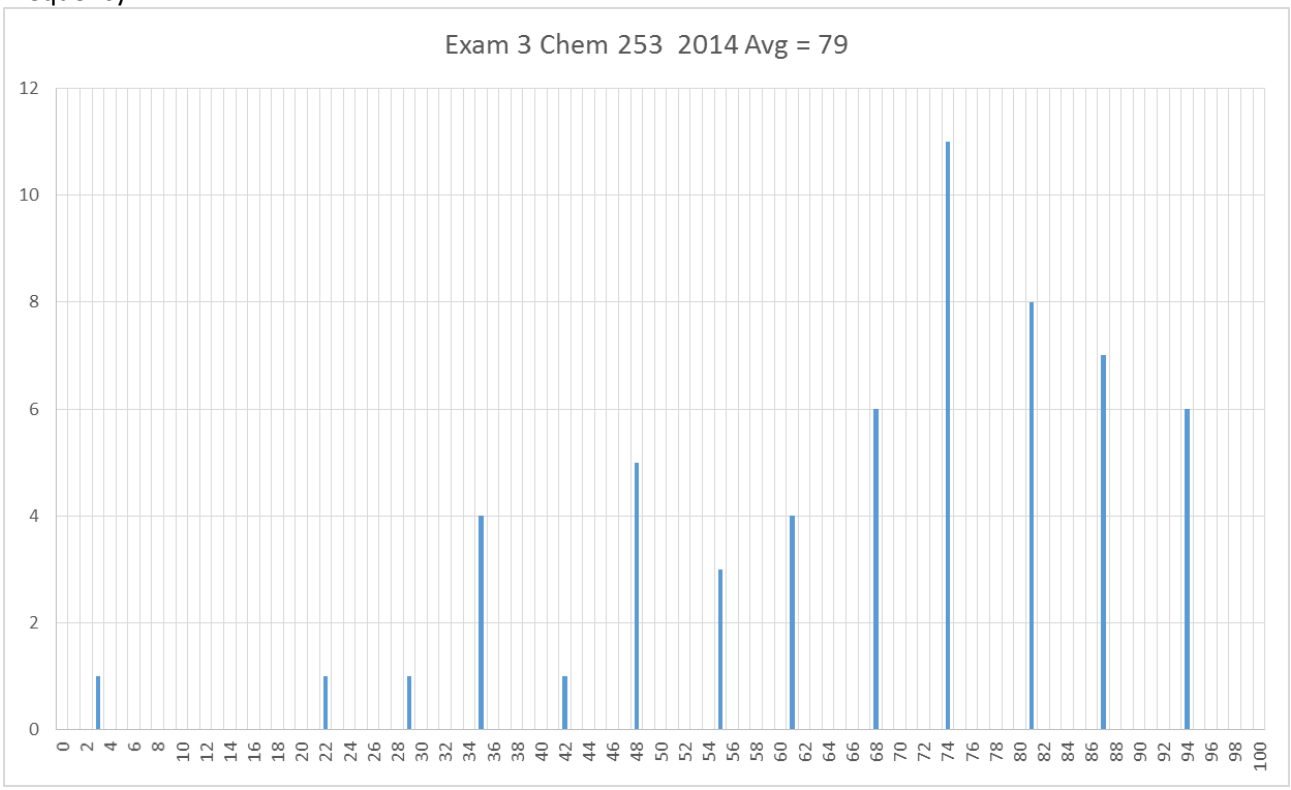
Frequency



Grade

1] What is K_f' for $AgEDTA^{3-}$ at pH 10? [1]

2] Calculate the concentration of free Ca^{2+} when $[Y^{4-}]$ = 5.0e-3 M, and $[CaY^{2-}]$ = 1.0e-2, at pH 10. K_f' = 1.8e10. [2] Note – everyone got full credit for this question.

3] What is the final concentration of Ca2+ if the initial concentration of CaEDTA2- is 2.50e-2 M? (K_f' = 1.8e10) [3]

4] What is the fraction of free metal, M^{2+} with NH_3 if the $M(NH_3)^{2+}$ complex forms? [4]

$\beta_1 = [M(NH_3)]/[M^{2+}][NH_3]$ $\beta_2 = [M(NH_3)_2]/[M^{2+}][NH_3]^2$

a] $\alpha_{M2+} = 1 / \{1 + \beta_1[NH_3] + \beta_2[NH_3]\}$

b] $\alpha_{M2+} = [M^{2+}] / \{1 + \beta_1[NH_3] + \beta_2[NH_3]^2\}$

c] $\alpha_{M2+} = 1 / \{1 + \beta_1 + \beta_2^2\}$

d] $\alpha_{M2+} = 1 / \{1 + \beta_1[NH_3] + \beta_2[NH_3]^2\}$

e] $\alpha_{M2+} = \{\beta_1\beta_2\} / \{1 + \beta_1[NH_3] + \beta_2[NH_3]^2\}$

5] Which of the following species is the strongest oxidizing agent? [5]

$A + e^- = A^-$ $E^0 = 0.500$ Volts
$A^- + e^- = A^{2-}$ $E^0 = 0.000$ volts
$A^{2-} + e^- = A^{3-}$ $E^0 = -0.500$ volts

6] What is E^0 for the reaction below given the following information? [6]

$FeCO_3 + 2e^- \rightarrow Fe(s) + CO_3^{2-}$ $E^0 = ?$

$FeCO_3$ $K_{sp} = 2.1e\text{-}11$

$Fe^{2+} + 2e\text{-} \rightarrow Fe(s)$ $E^0 = -0.44$ V

7] What is E^0_{cell} for the following reaction given the following? [7]

$2Fe(s) + Ce^{4+} = 2Fe^{2+} + Ce^{3+}$ $E^0_{cell} = ?$

$Fe^{2+} + 2e^- = Fe(s)$ $E^0 = -0.44$ V

$Ce^{4+} + e\text{-} = Ce^{3+}$ $E^0 = 1.44$ V

8] A pH electrode responds with a potential of -0.513 V in a solution of 0.050 M KHP (pH 4.01). What is the pH of an unknown solution if that same electrode responds with a potential of -0.643 V? [8]

9] Fe^{2+} was titrated with $Cr_2O_7^{2-}$ in the following reaction:

$$6\ Fe^{2+} + Cr_2O_7^{2-} + 14\ H^+ = 6\ Fe^{3+} + 2\ Cr^{3+} + 7\ H_2O$$

At the equivalence point, which of the following is true? [9]

a] $6\ [Fe^{2+}] = [Cr_2O_7^{2-}]$ & $3\ [Fe^{3+}] = [Cr^{3+}]$

b] $[Fe^{2+}] = 6\ [Cr_2O_7^{2-}]$ & $[Fe^{3+}] = 3\ [Cr^{3+}]$

c] $[Fe^{2+}] = [Cr_2O_7^{2-}]$ & $[Fe^{3+}] = [Cr^{3+}]$

d] $[Fe^{2+}] = [Fe^{3+}]$ & $[Cr_2O_7^{2-}] = [Cr^{3+}]$

e] $3\ [Fe^{2+}] = 2\ [Fe^{3+}]$ & $2\ [Cr_2O_7^{2-}] = 3\ [Cr^{3+}]$

10] The van Deemter Equation follows as $H = A + B/u + Cu$. Which of the following is true? [10]

a] B/u is the contribution of slow kinetics to band broadening.

b] A is the contribution of slow kinetics to band broadening.

c] Cu is the contribution of linear diffusion to band broadening.

d] Cu is the contribution of slow kinetics to band broadening.

e] A is the contribution of slow kinetics to band broadening.

11] Which is true in regards to the thermal conductivity detector for gas chromatography? [11]

a] It is not a universal detector

b] It is sensitive to the presence of ionic liquids

c] It is a low temperature detector (below 25 ^{0}C)

d] It is a universal detector

e] It requires a vacuum for operation

12] Which of the following is the predominate carrier gas in GC? [12]

a] He

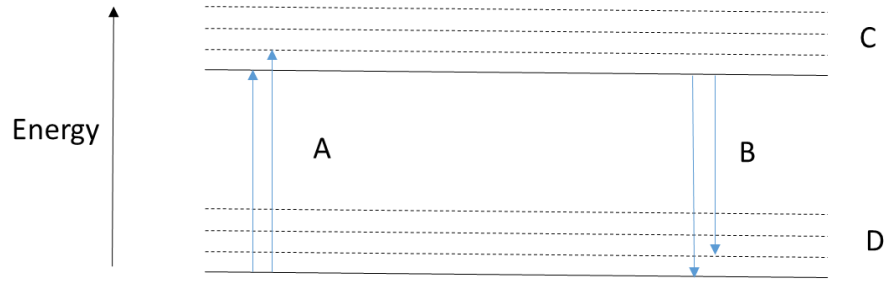
b] air

c] Ar

d] O_2

e] H_2

13] In the following diagram which of the labels best represents the absorption process? [13]



a] A

b] B

c] C

d] D

e] none of the above

14] A GC ethanol analysis was conducted by the method of internal standards. That internal standard was (IS) 1-propanol. The following results were obtained. [14]

		detector response	retention time
Injection 1	0.050 % (m/m) IS	25,100	10.33 mins
	0.050% (m/m) Ethanol	29,200	6.57
Injection 2	0.050 % (m/m) IS	27,200	10.52
	unknown ethanol	46,400	6.62

What is the concentration of the unknown?

15] A UV-vis absorbance analysis was conducted on an analyte. It absorbs at 544 nm. The first run was of the sample itself that had an absorbance of 0.321. In the second run the sample had its concentration of unknown increased by 0.150 mM. The absorbance of that spiked sample is 0.471. What is the concentration of the unknown? [15]

Answers

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1 log K = 7.32 K = 2.1e7 $K_f' = \alpha_{y4} K_f$ = 0.36*2.1e7 = 7.5e6

2 1.8e10 = [1.0e-2] / $[Ca^{2+}]$*[5.0e-3] $[Ca^{2+}]$ = 1.1e-10

3

CaEDTA	=	Ca^{2+}	+ EDTA
2.50e-2		0	0
-x		+x	+x

1.80e10 = $2.50e\text{-}2\text{-}x/x^2 \approx 2.50e\text{-}2/x^2$ x = 1.18e-6 M

4 ans d

5 A is the strongest oxidizing agent

6 Fe^{2+} + 2e- → Fe(s) E^0 = -0.44 V

E = -0.44 – 0.0592/2 log(1/$[Fe^{2+}]$) find $[Fe^{2+}]$ from

Ksp = 2.1e-11 = $[Fe^{2+}][CO_3^{2-}]$ $[Fe^{2+}] = 2.1e\text{-}11/[CO_3^{2-}]$

E = -0.44 – 0.0592/2 log($[CO_3^{2-}]$/2.1e-11) Let $[CO_3^{2-}]$ = 1 for E^0

E^0 = -0.44 – 0.0592/2 log(1/2.1e-11) = -0.756 V

[7] $E^0_{cell} = E^0_{cathode} - E^0_{anode} = 1.44 - (-0.44)\ V = 1.88\ V$

[8] E = const – 0.0592pH find const -0.513 V = const – 0.0592(4.01) const = -0.276 V

-0.643 = -0.276 – 0.0592pH pH = 6.20

[9] b] $[Fe^{2+}] = 6\ [Cr_2O_7^{2-}]$ & $[Fe^{3+}] = 3\ [Cr^{3+}]$

[10] ans. d

[11] and. d

[12] ans. a.

[13] ans. A

[14] Use F factor response or dimensional analysis.

46,400 * (25,100/27,200) * (0.050%/29200) = 0.073%

[15] find x-int in the A vs. c plot

slope = (0.471-0.321)/0.150 = 1.00

line: A = 1.00 c + 0.150

x-int: c = -0.321 ans. 0.321 mM