Exam II Key

(1) See notes + text

(2) SR = signal ratio = $I_{analyte} / I_{IS}$

CR = concentration ratio = $\frac{[analyte]}{[IS]}$

$$\frac{(SR)_{unk}}{(SR)_{known}} = \frac{(CR)_{unk}}{(CR)_{known}}$$

Let z = ng benzene in 5.00 mL of water sample

Let A = [toluene] in both known & unknown

$$\frac{533/368}{252/376} = \frac{\left(\frac{z\ ng}{25.00\ mL}\right)/A}{\left(\frac{(5.00\ mL)(10.00\ ng/mL)}{25.00\ mL}\right)/A}$$

$$2.161 = \frac{z}{50.0} \Rightarrow z = 108.05\ ng$$

$$\Rightarrow [benzene] = \frac{108.05\ ng}{5.00\ mL} = \boxed{21.6\ ppb}$$

(3)

Concentration of standard: $M_1 = \frac{(.1264\,g)\left(\frac{1\,mol}{181.9}\right)}{.100\,L} = 0.00694_3\,M$

Then a dilution: $M_1V_1 = M_2V_2$

$(0.00694_3\,M)(10.00\,mL) = M_2(250.0\,mL)$

$M_2 = 0.000279_3\,M$

Now find ε:

$A = \varepsilon b c$

$0.473 = \varepsilon(1.00\,cm)(.000279_3\,M)$

$\Rightarrow \varepsilon = 1693\,M^{-1}cm^{-1}$

Unknown:

$A = \varepsilon b c$

$.118 = 1693(2.00)c$

$\Rightarrow c = 3.484 \times 10^{-5}\,M$

$\left(3.484 \times 10^{-5}\,mol/L\right)(.2500\,L)\left(\frac{181.9}{1\,mol}\right) = .00157_1\,g$

$\Rightarrow \frac{.00157_1}{.2162} \times 100 = \boxed{0.729\%}$

(4)

a) $Hg_2Br_{2(s)} \rightleftharpoons Hg_{2(aq)}^{2+} + 2Br_{(aq)}^{-}$

I	–	0	0
C	–	+x	+2x
E	–	x	2x

$K_{sp} = [Hg_2^{2+}][Br^-]^2$ $\qquad x = [Hg_2^{2+}] = 2.44 \times 10^{-8} M$

$= (x)(2x)^2 = 4x^3$

$= 4(2.44 \times 10^{-8})^3 = \boxed{5.81 \times 10^{-23}}$

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b) Precipitate 99% of Hg_2^{2+}: $.10 M - .99(.10 M) = .0010 M\ Hg_2^{2+}$ left over

$5.81 \times 10^{-23} = [Hg_2^{2+}][Br^-]^2$

$[Br^-] = \left(\frac{5.81 \times 10^{-23}}{.0010}\right)^{1/2} = 2.41 \times 10^{-10} M$

K_{sp} for imaginary salt:

$XBr_{(s)} \rightleftharpoons X^+ + Br^-$

$K_{sp} = [X^+][Br^-] = (.20)(2.41 \times 10^{-10}) = \boxed{4.8 \times 10^{-11}}$