CHM152 Quiz 6 25 Pts Spring 2018 Name: Key

Show all work to receive credit.

1) For $PbCl_2$ ($K_{sp} = 2.4 \times 10^{-4}$), will a precipitate of $PbCl_2$ form when 0.10 L of 3.0×10^{-2} M $Pb(NO_3)_2$ is added to 400 mL of 9.0×10^{-2} M NaCl? You must show work to support you answer.

A) Yes, because $Q > K_{sp}$.
B) No, because $Q = K_{sp}$
C) Yes, because $Q < K_{sp}$.
D) No, because $Q < K_{sp}$.

$PbCl_2(s) \rightleftharpoons Pb^{2+} + 2Cl^-$ $Q_{sp} = [Pb^{2+}][Cl^-]^2$

M Pb^{2+}: $\frac{0.10\,L\,Pb(NO_3)_2 \mid 3.0\times10^{-2}\,mol \mid Pb^{2+} \mid Pb(NO_3)_2 \mid 0.500\,L}{}$ $= 6.0\times10^{-3}\,M$

M Cl^-: $\frac{0.400\,L\,NaCl \mid 9.0\times10^{-2}\,mol \mid Cl^- \mid NaCl \mid 0.500\,L}{}$ $= 7.2\times10^{-2}\,M$

$Q_{sp} = [6.0\times10^{-3}][7.2\times10^{-2}]^2$

$Q_{sp} = 3.1\times10^{-5}$

$Q_{sp} < K_{sp}$

2) A solution is prepared by mixing 500. mL of 0.10 M NaOCl and 500. mL of 0.20 M HOCl. What is the pH of this solution? [K_a(HOCl) = 3.2×10^{-8}]

$HOCl + H_2O \rightleftharpoons H_3O^+ + OCl^-$

Buffer solution

$pH = pK_a + \log\frac{B}{A}$

$pH = -\log 3.2\times10^{-8} + \log\frac{0.05}{0.1}$

$pH = 7.19$

3) Assuming equal concentrations of conjugate base and acid, which one of the following mixtures is suitable for making a buffer solution with an optimum pH of 9.2–9.3?

A) $NaNO_2$ / HNO_2 ($K_a = 4.5 \times 10^{-4}$)
B) NaCl / HCl
C) CH_3COONa / CH_3COOH ($K_a = 1.8 \times 10^{-5}$)
D) NaOCl / HOCl ($K_a = 3.2 \times 10^{-8}$)
E) NH_3 / NH_4Cl ($K_a = 5.6 \times 10^{-10}$)

$-\log(5.6\times10^{-10}) = 9.25$

4) The molar solubility of tin(II) iodide is 1.28×10^{-2} mol/L. What is K_{sp} for this compound?

$SnI_2(s) \rightleftharpoons Sn^{2+} + 2I^-$

1.28×10^{-2} 2.56×10^{-2}

$K_{sp} = [1.28\times10^{-2}][2.56\times10^{-2}]^2 = 8.39\times10^{-6}$

More on back

Key

5) You have 500.0 mL of a buffer solution containing 0.20 M acetic acid (CH_3COOH) and 0.30 M sodium acetate (CH_3COONa). What will the pH of this solution be after the addition of 20.0 mL of 1.00 M NaOH solution? [$K_a = 1.8 \times 10^{-5}$]

moles $HOAc$: $0.5000\,L \mid 0.20\,mol \mid = 0.10$ (L)

moles OAc^-: $0.5000\,L \mid 0.30\,mol \mid = 0.15$ (L)

moles added Base: $0.0200\,L \mid 1.00\,mol\,OH^- \mid = 0.0200$ (L)

$$pH = -\log 1.8\times10^{-5} + \log \frac{0.15+0.0200}{0.10-0.0200}$$

$pH = 5.07$

6) The solubility of lead(II) iodide is 0.064 g/100 mL at 20°C. What is the solubility product for lead(II) iodide?

$PbI_2(s) \rightleftharpoons Pb^{2+} + 2I^-$ molar mass $PbI_2 = 461\,g/mol$

$$[Pb^{2+}]: \frac{0.064\,g\,PbI_2 \mid mol \mid Pb^{2+}}{0.100\,L \mid 461\,g \mid PbI_2} = 1.39\times10^{-3}\,\frac{mol}{L}$$

$$[I^-]: 2 \times 1.39\times10^{-3} = 2.28\times10^{-3}\,\frac{mol}{L}$$

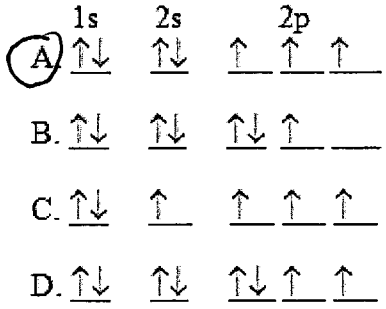
$$K_{sp} = [1.39\times10^{-3}][2.28\times10^{-3}]^2$$

$K_{sp} = 1.1\times10^{-8}$

CHM151 Quiz 6 25 Pts Spring 2018 Name: Key

$c = \nu\lambda$ $c = 3.00 \times 10^8$ m/s $E = h\nu$ $h = 6.63 \times 10^{-34}$ J•s Show all work to receive credit.

1. (2 Pts) The orbital diagram for a ground-state nitrogen atom is



A) A B) B C) C D) D

2. What is the energy in joules of one photon of x-ray radiation with a wavelength of 0.120 nm?

A) 2.50×10^9 J B) 1.66×10^{-24} J C) 1.66×10^{-33} J D) 2.50×10^{18} J E) 1.66×10^{-15} J

$E = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34}\ J \cdot s \mid 3.00 \times 10^8\ m/s}{0.120 \times 10^{-9}\ m} =$

3. (6 Pts) Write the ground state electron configuration for each of the following

a. bromine atom. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^5$ or $[Ar]\ 4s^2\ 3d^{10}\ 4p^5$

b. S^{2-} ion $[Ar]$ or $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

c. Fe^{3+} ion $[Ar]\ 3d^5$ or $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$

4. (3 Pts) What is the wavelength of radiation that has a frequency of $3.4 \times 10^{11}\ s^{-1}$?

$\lambda = c/\nu = \frac{3.00 \times 10^8\ m/s \mid s}{3.4 \times 10^{11}} = 8.8 \times 10^{-4}\ m$

5. (3 Pts) Calculate the frequency of visible light having a wavelength of 686 nm. ($n = 10^{-9}$)

$\nu = c/\lambda$ $\frac{3.00 \times 10^8\ m/s \mid s}{686 \times 10^{-9}\ m} = 4.37 \times 10^{14}\ s^{-1}$

6. (3 Pts) A ground-state atom of vanadium has ___ unpaired electrons and is _____.

A) 0, diamagnetic
B) 2, diamagnetic
C) 3, paramagnetic
D) 5, paramagnetic
E) 4, diamagnetic

7. (2 Pts) If we take away two electrons from the outer shell of calcium, it would have the same electron configuration as what element? Ar

8. (2 Pts) How many unpaired electrons does an atom of sulfur have in its ground state? 2

9. (4 Pts) Calculate the energy of a photon of light with a wavelength of 360 nm. ($n = 10^{-9}$)

$E = h\nu = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34}\ J \cdot s \mid 3.00 \times 10^8\ m/s \mid s}{360 \times 10^{-9}\ m} = 5.5 \times 10^{-19}\ J$

$\nu = c/\lambda$