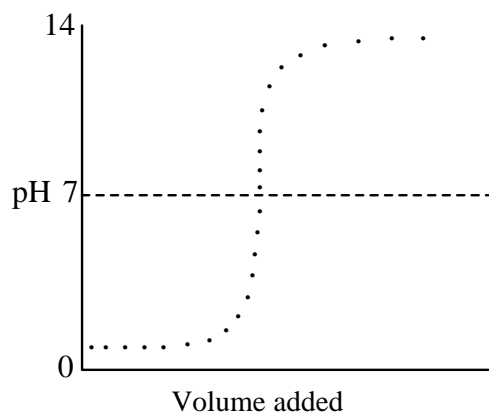


1. A buffered solution is 0.0500 M $\text{CH}_3\text{CO}_2\text{H}$ and 0.0400 M NaCH_3CO_2 . If 0.0100 mol of gaseous HCl is added to 1.00 L of the buffered solution, what is the final pH of the solution? For acetic acid, $\text{p}K_a = 4.76$
- a) 4.76 b) 4.46 c) 4.66 d) 4.86 e) 4.54

2. In each of the following titrations, the first solution is in the burette and the second solution is in the titration flask. For which titration would the curve illustrated be typical?



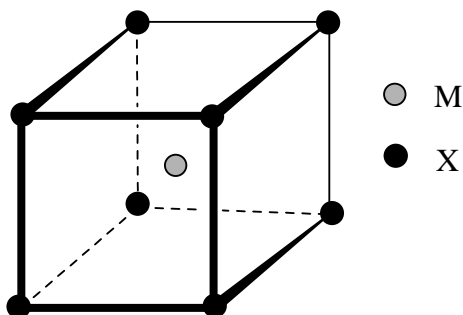
- a) Na_2CO_3 (0.05 M) / HCl (0.1 M)
 b) NaOH (0.1 M) / HI (0.1 M)
 c) NaOH (0.1 M) / CH_3COOH (0.1 M)
 d) NH_3 (0.1 M) / CH_3COOH (0.1 M)
 e) NH_3 (0.1 M) / HCl (0.1 M)

3. In which of the following are the atoms arranged in order of INCREASING first ionisation energy?
- a) Ne, F, O, C
 b) Te, Se, S, O
 c) Ca, K, Cl, Ar
 d) He, Ne, Ar, Kr
 e) N, P, K, Rb
4. Alongside H_2O , what are the major species present in a 1.0 M solution of HCl ?
- a) $\text{HCl}(\text{aq})$, $\text{H}_3\text{O}^+(\text{aq})$ and $\text{Cl}^-(\text{aq})$
 b) $\text{H}_3\text{O}^+(\text{aq})$ and $\text{Cl}^-(\text{aq})$
 c) $\text{HCl}(\text{aq})$
 d) $\text{HCl}(\text{aq})$, $\text{H}_3\text{O}^+(\text{aq})$, $\text{OH}^-(\text{aq})$ and $\text{Cl}(\text{aq})$
 e) $\text{H}_3\text{O}^+(\text{aq})$, $\text{OH}^-(\text{aq})$ and $\text{Cl}^-(\text{aq})$

5. Which one of the following statements concerning crystal structures is correct?
- The arrangement of layers in the hexagonal close-packed structure (hcp) is abcabcabc....
 - The coordination number in a body-centred cubic unit cell of iron is 8.
 - The packing efficiency of the face-centred cubic unit cell of calcium is 68%.
 - The packing efficiency of strontium, which has hexagonal close-packed structure, is 52%.
 - The body-centred cubic unit cell of tungsten contains 4 atoms per unit cell.

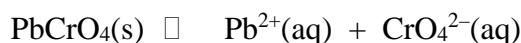
6. The unit cell below has anions (X) at the corners and cations (M) in the centre of the cell. What is the formula of the compound?

- MX
- MX₂
- M₂X₃
- M₂X
- MX₃



7. The K_{sp} for silver chloride is 1.8×10^{-10} at 25 °C. What is the solubility of silver chloride (in mol L⁻¹) in 0.025 M tin(IV) chloride solution?
- 8.5×10^{-5}
 - 6.7×10^{-8}
 - 7.2×10^{-9}
 - 1.8×10^{-9}
 - 1.3×10^{-5}

Questions 8 & 9 refer to the solubility of lead chromate, PbCrO₄:



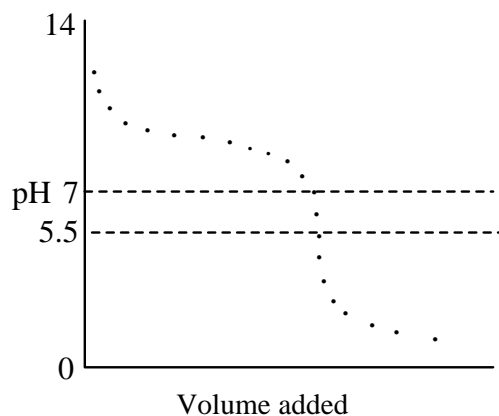
8. The K_{sp} for PbCrO₄ is 2.0×10^{-16} at 25 °C. What is the solubility of PbCrO₄ in mol L⁻¹?
- 1.4×10^{-8}
 - 2.8×10^{-8}
 - 2.0×10^{-16}
 - 7.1×10^7
 - 5.0×10^{15}
9. If 5.0 mL of 1.0×10^{-5} M Pb(NO₃)₂ is added to 5.0 mL of a solution of 1.0×10^{-10} M K₂CrO₄, which statement is correct?
- The ionic product is 1.0×10^{-15} and PbCrO₄(s) precipitates.
 - The ionic product is 2.5×10^{-16} and PbCrO₄(s) does not precipitate.
 - The ionic product is 1.0×10^{-15} and PbCrO₄(s) does not precipitate.
 - The ionic product is 2.5×10^{-16} and PbCrO₄(s) precipitates.
 - none of the above
10. How many different stereoisomers (*i.e.* geometrical and optical isomers) of the complex [Co(en)₃]³⁺ are possible? en = ethane-1,2-diamine = ethylenediamine = NH₂CH₂CH₂NH₂
- 1
 - 2
 - 3
 - 4
 - 5

Correct answers: 1B, 2B, 3B, 4B, 5B, 6A, 7D, 8A, 9D, 10B

1. A buffered solution is 0.450 M $\text{CH}_3\text{CO}_2\text{H}$ and 0.450 M NaCH_3CO_2 . If 0.0800 mol of solid NaOH is added to 1.00 L of the buffered solution, what is the final pH of the solution? For acetic acid, $\text{p}K_a = 4.76$ (*Hint: Use the Henderson-Hasselbalch Equation*)

- a) 4.58 b) 4.60 c) 4.76 d) 4.90 e) 4.92

2. In each of the following titrations, the first solution is in the titration flask and the second solution is in the burette. For which titration would the curve illustrated be typical?



- a) Na_2CO_3 (0.05 M) / HCl (0.1 M)
 b) NaOH (0.1 M) / HI (0.1 M)
 c) NaOH (0.1 M) / CH_3COOH (0.1 M)
 d) NH_3 (0.1 M) / CH_3COOH (0.1 M)
 e) NH_3 (0.1 M) / HCl (0.1 M)

3. In which of the following are the ions arranged in order of DECREASING ionic radius?

- a) Sn^{4+} , In^{3+} , Sr^{2+} , Rb^+
 b) Na^+ , Mg^{2+} , O^{2-} , F^-
 c) I^- , Cl^- , Br^- , F^-
 d) Cs^+ , Ba^{2+} , Tl^{3+} , Pb^{4+}
 e) Mg^{2+} , Al^{3+} , S^{2-} , Cl^-

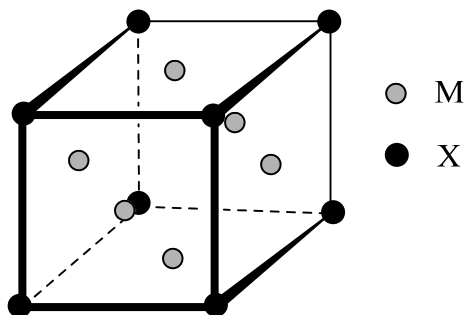
4. Alongside H_2O , what are the major species present in a 1.0 M solution of NaCN ?

- a) $\text{NaCN}(\text{aq})$
 b) $\text{HCN}(\text{aq})$, $\text{Na}^+(\text{aq})$ and $\text{CN}^-(\text{aq})$
 c) $\text{HCN}(\text{aq})$, $\text{OH}^-(\text{aq})$, $\text{Na}^+(\text{aq})$ and $\text{CN}^-(\text{aq})$
 d) $\text{Na}^+(\text{aq})$ and $\text{CN}^-(\text{aq})$
 e) $\text{CN}^-(\text{aq})$, $\text{H}_3\text{O}^+(\text{aq})$, $\text{OH}^-(\text{aq})$ and $\text{Na}^+(\text{aq})$

5. Which one of the following statements concerning crystal structures is correct?
- The arrangement of layers in the cubic close-packed structure (ccp) is abcabcabc....
 - The coordination number in a body-centred cubic unit cell of iron is 6.
 - The primitive cubic unit cell of polonium contains 2 atoms per unit cell.
 - The packing efficiency of the primitive cubic unit cell of polonium is 68%.
 - The packing efficiency of magnesium, which has hexagonal close-packed structure, is 68%.

6. The unit cell below has anions (X) at the corners and cations (M) in the centre of each face. What is the formula of the compound?

- MX
- MX₂
- M₃X
- M₂X
- M₂X₃



7. The K_{sp} for barium sulfate is 1.1×10^{-10} at 25 °C. What is the solubility of barium sulfate (in mol L⁻¹) in 0.1 M iron(III) sulfate solution?

- 1.1×10^{-10}
- 2.2×10^{-10}
- 3.7×10^{-10}
- 5.5×10^{-10}
- 1.0×10^{-5}

Questions 8 & 9 refer to the solubility of iron(II) phosphate, Fe₃(PO₄)₂:



8. The K_{sp} for Fe₃(PO₄)₂(s) is 1.0×10^{-36} at 25 °C. What is the solubility of Fe₃(PO₄)₂ in mol L⁻¹?

- 2.5×10^{-8}
- 3.1×10^{-8}
- 6.3×10^{-8}
- 1.0×10^{-7}
- 4.0×10^{-7}

9. If 25.0 mL of 2.0×10^{-5} M FeSO₄ is added to 25.0 mL of a solution of 1.0×10^{-10} M K₃PO₄, which statement is correct?

- The ionic product is 8.0×10^{-35} and Fe₃(PO₄)₂(s) precipitates.
- The ionic product is 2.5×10^{-36} and Fe₃(PO₄)₂(s) precipitates.
- The ionic product is 8.0×10^{-35} and Fe₃(PO₄)₂(s) does not precipitate.
- The ionic product is 2.5×10^{-36} and Fe₃(PO₄)₂(s) does not precipitate.
- none of the above

10. How many different stereoisomers (*i.e.* geometrical and optical isomers) of the complex [Co(en)BrCl(CN)F]⁻ are possible? en = ethylenediamine = NH₂CH₂CH₂NH₂

- 4
- 6
- 8
- 12
- 16

Correct answers: 1E, 2E, 3D, 4D, 5A, 6C, 7C, 8A, 9B, 10D