

Acidity of ionic and molecular compounds worksheet

If one ion in an ionic compound is pH-neutral, the compound will have the acid-base properties of the active ion. Predict whether the following ionic compounds are acidic, basic, or pH neutral. If acidic or basic, write the active ion and its K_a or K_b value.

Compound	Acidic/Basic/pH-Neut	Active ion	K_a or K_b
1. KCl	pH-neutral		
2. NaF	basic	F^-	$K_b = K_w / K_a(HF) = 2.9E-11$
3. $Zn(NO_3)_2$	acidic	Zn^{2+}	-----
4. NH_4ClO_4	acidic	NH_4^+	$K_a = K_w / K_b(NH_3) = 5.68E-10$
5. KCN	basic	CN^-	$K_b = K_w / K_a(HCN) = 2.0E-5$
6. $CaSO_4$	basic	SO_4^{2-}	$K_b = K_w / K_a(HSO_4^-) = 8.3E-13$
7. $C_6H_5NH_3NO_3$	acidic	$C_6H_5NH_3^+$	$K_a = K_w / K_b(C_6H_5NH_2) = 2.6E-5$
8. $NaCHO_2$	basic	CHO_2^-	$K_b = K_w / K_a(HCHO_2) = 5.6E-11$
9. $LiC_2H_3O_2$	basic	$C_2H_3O_2^-$	$K_b = K_w / K_a(HC_2H_3O_2) = 5.6E-10$
10. Na_2CO_3	basic	CO_3^{2-}	$K_b = K_w / K_a(HCO_3^-) = 1.8E-4$

Determine whether the following substances are molecular or ionic. Predict whether the compounds are acidic, basic, or pH neutral. If acidic or basic, write its K_a or K_b value. If ionic, write its active ion.

Compound	Molecular/Ionic	Acidic/Basic/pH-Neut	(Active ion)	K_a or K_b
11. H_2CO_3	molecular	acidic	--	$4.3E-7$
12. C_5H_5N	molecular	basic	--	$1.7E-9$
13. Na_3PO_4	ionic	basic	PO_4^{3-}	$K_b = K_w / K_a(HPO_4^{2-}) = 2.4E-2$
14. $Al(NO_3)_3$	ionic	acidic	Al^{3+}	-----
15. $LiOCN$	ionic	basic	OCN^-	$K_b = K_w / K_a(HOCN) = 5E-11$
16. KNO_2	ionic	basic	NO_2^-	$K_b = K_w / K_a(HNO_2) = 2.2E-11$
17. $HClO_2$	molecular	acidic	--	$1.1E-2$
18. $H_2C_6H_6O_6$	molecular	acidic	--	$8.0E-5$
19. $K_3C_6H_5O_7$	ionic	basic	$C_6H_5O_7^{3-}$	$K_b = K_w / K_a(HC_6H_5O_7^{2-}) = 2.5E-8$
20. HNO_3	molecular	acidic	--	strong acid

Calculate the pH of a 0.10 M solution of each of the previous compounds 1-20.

1. pH = 7.00
2. $\text{F}^- + \text{H}_2\text{O} \rightleftharpoons \text{HF} + \text{OH}^-$; $K_b = 2.9\text{E-}11 \cong x^2/.10$; $x = 1.7\text{E-}6 = [\text{OH}^-]$; pOH = 5.77; pH = 8.23
3. Calculation not covered in this course.
4. $\text{NH}_4^+ + \text{H}_2\text{O} \rightleftharpoons \text{NH}_3 + \text{H}_3\text{O}^+$; $K_a = 5.68\text{E-}10 \cong x^2/.10$; $x = 7.5\text{E-}6 = [\text{H}_3\text{O}^+]$; pH = 5.12
5. 11.15
6. 7.00
7. 2.79
8. 8.37
9. 8.87
10. 11.63
11. 3.68
12. 9.11
13. x is not small – use quadratic equation: pH = 1.41
14. Calculation not covered in this course.
15. 8.35
16. 8.17
17. x is not small – use quadratic equation: pH = 1.55
18. 2.55
19. 9.70
20. $[\text{H}_3\text{O}^+] = 0.10 \text{ M}$; pH = 1.00