ACID Base Practice test #2

① $HCN_{(aq)} + H_2O \leftrightarrow H_3O^+_{(aq)} + CN^-_{(aq)}$

weak acid — base — conj acid — conjugate base

TRICKY! They aren't asking to just identify pairs. They want the function of the eq. in the direction written | ANSWER: B

HCN : CN^-
Acid conjugate base

② Bronsted-Lowry = accepts a H^+

A) $NH_3 \rightarrow NH_4^+$ ✓
B) $NH_4^+ \rightarrow NH_5^{2+}$ X no! | ANSWER: B
C) $O^{2-} \rightarrow OH^-$ ✓
d) $H_2O \rightarrow H_3O^+$ ✓
e) $OH^- \rightarrow H_2O$ ✓

③ need to be one H^+ apart, more H^+ : one less H^+

A) $NH_3 : NH_2^-$ ✓
B) $OH^- : O^{2-}$ ✓
C) $NH_4^+ : NH_3$ ✓
d) $HCN : HOCN$ X no!
e) $H_3PO_4 : H_2PO_4^-$ ✓

| ANSWER: D

④ Strongest acid = largest Ka | ANSWER: E

⑤ Weak electrolyte → weak acid or base | ANSWER: A

⑥ HBr = strong acid $pH = -\log(4.2 \times 10^{-4}) = 3.38$ | ANSWER B

⑦ Conjugate base = one less H^+ $H_2O \rightarrow OH^-$ | ANSWER: E

⑧ $pH = -\log(1.34 \times 10^{-4}) = 3.87$ | ANSWER: C

⑨ pH 12.8 vs Scale of 1-14, | ANSWER: E
I would say very basic. I think slight basic would be closer to 7

(10) $HNO_2 + H_2O \rightarrow NO_2^- + H_3O^+$ $K_a = 5.0 \times 10^{-4}$

So if we want the Rxn of NO_2^- acting as a base we actually want the K_b of HNO_2

$K_W = K_a * K_B$ $\quad 1 \times 10^{-14} = (5 \times 10^{-4})(K_b)$

$K_b = 2 \times 10^{-11}$ | Answer: A |

(11) Lewis = about e^- donors / Recievers

Bronsted-Lowry → donating a H^+ = acid (e^- deficient)

taking H^+ = base (e^- rich)

∴ Lewis base donates e^- pair | Answer: D |

(12) $HCN + HS^- \leftrightarrow CN^- + H_2S$

weaker, stays together more

↑ Stronger acid, more likely to dissociate

← lies to left

∴ | Answer: A |

(13) $HA \rightarrow H^+ + A^-$

0.2 $\quad$ Ø $\quad$ Ø

$-x$ $\quad +x \quad +x$

↓

$pH = 3.82$

$[H^+] = 10^{-3.82}$

$= 1.51 \times 10^{-4}$

$= x$

$K_a = \dfrac{[H^+][A^-]}{[HA]}$

$= \dfrac{(1.51 \times 10^{-4})(1.51 \times 10^{-4})}{(0.2 - 1.51 \times 10^{-4})}$

$= 1.15 \times 10^{-7}$

| Answer: C |

(14) $H_2S \rightarrow H^+ + HS^-$ $K_{a1} = 1.0 \times 10^{-7}$

$HS^- \rightarrow H^+ + S^-$ $K_{a2} = 1.3 \times 10^{-13}$

$H_2S \rightarrow$	$H^+ +$	HS^-
0.1	∅	∅
$-x$	$+x$	$+x$

$K = \frac{[H^+][HS^-]}{[H_2S]}$

$1.0 \times 10^{-7} = \frac{(x)(x)}{(0.1-x)} \approx \frac{x^2}{0.1}$ $x = 1 \times 10^{-4}$

Common ion effect for the 2nd dissociation!

$HS^- \rightarrow$	$H^+ +$	S^-
(1×10^{-4})	(1×10^{-4})	∅
$-x$	$+x$	$+x$

$1.3 \times 10^{-13} = \frac{(1.0 \times 10^{-4} + x)(x)}{(1 \times 10^{-4} - x)}$

$= (x)(x)/(1 \times 10^{-4})$

$x = 3.61 \times 10^{-9}$

$\Downarrow$

$(1 \times 10^{-4} + 3.61 \times 10^{-9})$

$= 1.0 \times 10^{-4}$ ⟹ See how the 2nd dissociation was so small we can't even see the effect w/ our sig figs taken into account?! Could have ignored it! Just done 1st dissociation & $-\log(1.0 \times 10^{-4})$ @ that point?

$pH = -\log(1.0 \times 10^{-4})$

$= 4$

Answer: C

(15) Oxyacid strength

more oxygens, more acidic proton. comparing Cl to I, more electronegative draws e^- density away from the O–H bond (I)–O–H ← vs (Cl)–O–H ←

∴ Iodines first then Chlorines

$HIO_2 < HIO_3 < HClO_2 < HClO_3$ **Answer: A**

(16) pH 3.18 $10^{-3.18} = [H^+] = 6.61 \times 10^{-4}$

$HA \rightarrow H^+ + A^-$

1.0 ∅ ∅

−x +x +x

$K_a = \frac{[H^+][A^-]}{[HA]} = \frac{(x)(x)}{(1.0-x)} = \approx x^2/1.0$

$= \frac{(6.61 \times 10^{-4})^2}{1.0}$

$= 4.37 \times 10^{-7}$

Answer: A

(17) pH 0.054 NaOH

$pOH = -\log(0.054) = 1.27$ $pH = 14 - pOH$

$= 14 - 1.27 = 12.7$

Answer: d

(18) salt solution

$NaF \rightarrow Na^+ + F^-$

came from: NaOH HF

∴ Na^+ ∴ F^-

weak A strong B ⇒ hydrolysis!

$B + H_2O \rightarrow BH^+ + OH^-$

$F^- + H_2O \rightarrow HF + OH^-$

0.144 ∅ ∅

−x −x −x

$pOH = -\log(1.42 \times 10^{-6})$

$= 5.85$

$pH = 14 - 5.85 = 8.15$

K_a HF $= 7.1 \times 10^{-4}$

BUT now I need K_b For F^-

$K_w = K_a \times K_b$

$1.0 \times 10^{-14} = (7.1 \times 10^{-4})(K_b)$

$K_b = 1.41 \times 10^{-11}$

BH^+

$K_b = \frac{[HF][OH^-]}{[F^-]}$

$1.41 \times 10^{-11} = \frac{(x)(x)}{(0.144-x)} \approx \frac{x^2}{0.144}$

$x = 1.42 \times 10^{-6}$

Answer: d

(19) lowest pH = most acidic Answer: A

NH_4Cl	$KC_2H_3O_2$	KBr	$NaNO_2$	NaCl
↓ ↓	↓ ↓	↓ ↓	↓ ↓	↓ ↓
WB NH_3 HCl SA	KOH HAC	KOH HBr	NaOH HNO_2	NaOH HCl
	SB WA	SB SA	SB WA	SB SA
∴ SA WB	∴ WA SB	∴ WA ∴ WB	∴ WA ∴ SB	∴ WA ∴ WB
* ACIDIC *	Basic	neutral	Basic	neutral

(20) $HCN \rightarrow H^+ + CN^-$

0.2	∅	∅
−x	+x	+x

$K_a = \frac{[H^+][CN^-]}{[HCN]}$

$4.0 \times 10^{-10} = \frac{(x)(x)}{(0.2-x)} \approx \frac{x^2}{0.2}$ $\quad x = 8.94 \times 10^{-6}$

$pH = -\log(8.94 \times 10^{-6}) = 5.05$

Answer: B

(21) not change pH = neutral salt

$NaHCO_3$	$NaHSO_4$	$NaCN$	NH_4NO_3	$NaBr$
↓ ↓	↓	↓	↓ ↓	HBr
NaOH H_2CO_3	H_2SO_4	HCN	NH_3 HNO_3	SA
SB WA	SA	WA	WB SA	↓
↓ ↓	BUT	↓	↓ ↓	WB
$\therefore Na^+$ HCO_3^-	WA HSO_4^-	WA (SB)	(SA) WB	WA
WA (SB)	is a weak acid!	Basic	Acidic	* neutral *
Basic	Super tricky!			

$HSO_4^- \rightarrow H^+ + SO_4^{2-}$

Answer: E

(22)

$H_2S \rightarrow H^+ + HS^-$

0.1	∅	∅
−x	+x	+x

$K_{a_1} = \frac{[H^+][HS^-]}{[H_2S]} = \frac{(x)(x)}{(0.1-x)} = 1 \times 10^{-7}$

$\approx x^2/0.1$ $\quad x = 1 \times 10^{-4}$

$HS^- \rightarrow H^+ + S^-$

(1×10^{-4})	(1×10^{-4})	∅
−x	+x	+x

$K_{a_2} = \frac{[H^+][S^-]}{[HS^-]} = \frac{(1 \times 10^{-4} + x)(x)}{(1 \times 10^{-4} - x)} = 1.3 \times 10^{-13}$

$\approx \frac{(1 \times 10^{-4})(x)}{(1 \times 10^{-4})}$

$x = 1.3 \times 10^{-13}$

H_2SO_4	HSO_4^-	SO_4^{2-}
Strong acid	weak acid	Strong Base

* if we didn't use 5% rule we would see $[S^{2-}]$ is a little different but remember, they won't ask us to use Quadratic!

Answer: C