Acid-Base Worksheet

PARAMETER	Case 1	Case 2	Case 3	Case4	Case5
1.pH					
2. HCO_3/BE					
3. Expected $PaCO_2$ (1.5 (HCO_3) + 8)					
4. AG and AG_{corr}					
5. Delta-delta					
6. Urinary AG (Na+K-Cl)					
7. Osmolar gap (2[Na] + [Glucose]/18 + [BUN]/2.8)					

Table 1. Secondary ("Compensatory") Responses in Acid–Base Disorders as Indicated by Standard Base Excess (SBE) or Bicarbonate (HCO_3^-) Level.*

Condition	$Paco_2$ or SBE Secondary Response	$Paco_2$ or HCO_3^- Secondary Response
Acute respiratory acidosis (pH decreased, $Paco_2$ increased, SBE = 0±2 mmol/liter)	SBE = 0±2 mmol/liter	Increase of 1 mmol/liter in HCO_3^- for each 10 mm Hg increase in $Paco_2$ above 40 mm Hg
Acute respiratory alkalosis (pH increased, $Paco_2$ decreased, SBE = 0±2 mmol/liter)	SBE = 0±2 mmol/liter	Decrease of 2 mmol/liter in HCO_3^- for each 10 mm Hg decrease in $Paco_2$ below 40 mm Hg
Chronic respiratory acidosis (pH decreased, $Paco_2$ increased, SBE increased)	SBE = 0.4 × ($Paco_2$ − 40)	Increase of 4–5 mmol/liter in HCO_3^- for each 10 mm Hg increase in $Paco_2$ above 40 mm Hg
Chronic respiratory alkalosis (pH increased, $Paco_2$ decreased, SBE decreased)	SBE = 0.4 × ($Paco_2$ − 40)	Decrease of 4–5 mmol/liter in HCO_3^- for each 10 mm Hg decrease in $Paco_2$ below 40 mm Hg
Metabolic acidosis (pH decreased, $Paco_2$ decreased, SBE decreased)	$\Delta Paco_2$ = SBE	Expected $Paco_2 = 1.5 \times [HCO_3^-] + 8 \pm 2$ mm Hg
Metabolic alkalosis (pH increased, $Paco_2$ increased, SBE increased)	$\Delta Paco_2 = 0.6 \times$ SBE	Expected $Paco_2 = 0.7 \times ([HCO_3^-] - 24) + 40 \pm 2$ mm Hg

(Berend K. NEJM 2018)

Table 1. Primary Acid–Base Disturbances with a Secondary ("Compensatory") Response.*

Metabolic acidosis

pH <7.38 and bicarbonate [HCO_3^-] <22 mmol per liter

Secondary (respiratory) response: $Paco_2 = 1.5 \times [HCO_3^-] + 8 \pm 2$ mm Hg† or $[HCO_3^-] + 15$ mm Hg‡

Complete secondary adaptive response within 12–24 hr

Superimposed respiratory acidosis or alkalosis may be diagnosed if the calculated $Paco_2$ is greater or less than predicted

Metabolic alkalosis

pH >7.42 and [HCO_3^-] >26 mmol per liter

Secondary (respiratory) response: $Paco_2 = 0.7 \times ([HCO_3^-] - 24) + 40 \pm 2$ mm Hg or $[HCO_3^-] + 15$ mm Hg‡ or $0.7 \times [HCO_3^-] + 20$ mm Hg§

Complete secondary adaptive response within 24–36 hr

Superimposed respiratory acidosis or alkalosis may be diagnosed if the calculated $Paco_2$ is greater or less than predicted

Respiratory acidosis

pH <7.38 and $Paco_2$ >42 mm Hg

Secondary (metabolic) response

Acute: [HCO_3^-] is increased by 1 mmol/liter for each $Paco_2$ increase of 10 mm Hg above 40 mm Hg

Chronic: generally [HCO_3^-] is increased by 4–5 mmol/liter for each $Paco_2$ increase of 10 mm Hg above 40 mm Hg

Complete secondary adaptive response within 2–5 days

Superimposed metabolic alkalosis or acidosis may be diagnosed if the calculated [HCO_3^-] is greater or less than predicted

Respiratory alkalosis

pH >7.42 and $Paco_2$ <38 mm Hg

Secondary (metabolic) response

Acute: [HCO_3^-] is decreased by 2 mmol/liter for each $Paco_2$ decrease of 10 mm Hg below 40 mm Hg

Chronic: [HCO_3^-] is decreased by 4–5 mmol/liter for each $Paco_2$ decrease of 10 mm Hg below 40 mm Hg

Complete secondary adaptive response in 2–5 days

Superimposed metabolic alkalosis or acidosis may be diagnosed if the calculated [HCO_3^-] is greater or less than predicted

(Berend K, et al. NEJM 2014)