**Section One**

1. Medical student draws ABG and put it in her pocket for 6 hours. Then she sends it to the lab.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.26 |
| 40 | pCO2 | 61 |
|   |   |  |
| 140 | Na | 138 |
| 4 | K | 3.8 |
| 100 | Cl | 100 |
| 24 | HCO3 | 31 |
| 8-16 | BUN | 17 |
| 0.6-1.4 | Cr | 1.2 |
| 12 | Anion Gap |  |

1. 36 year old man with history of depression found down in his garage

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.28 |
| 40 | pCO2 | 26 |
|   |   |  |
| 140 | Na | 140 |
| 4 | K | 3.9 |
| 100 | Cl | 103 |
| 24 | HCO3 | 12 |
| 8-16 | BUN | 10 |
| 0.6-1.4 | Cr | 0.8 |
| 12 | Anion Gap |  |

1. 68 year old man with stable COPD in for routine PFT’s

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.34 |
| 40 | pCO2 | 60 |
|   |   |  |
| 140 | Na | 140 |
| 4 | K | 3.9 |
| 100 | Cl | 98 |
| 24 | HCO3 | 32 |
| 8-16 | BUN | 20 |
| 0.6-1.4 | Cr | 1.2 |
| 12 | Anion Gap |  |

1. 22 year old G2P1 woman in the 33rd week of pregnancy

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.46 |
| 40 | pCO2 | 29 |
|   |   |  |
| 140 | Na | 138 |
| 4 | K | 3.7 |
| 100 | Cl | 108 |
| 24 | HCO3 | 20 |
| 8-16 | BUN | 6 |
| 0.6-1.4 | Cr | 0.5 |
| 12 | Anion Gap |  |

1. 18 year old wrester with recent rapid weight loss

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.50 |
| 40 | pCO2 | 48 |
|   |   |  |
| 140 | Na | 137 |
| 4 | K | 3.2 |
| 100 | Cl | 92 |
| 24 | HCO3 | 38 |
| 8-16 | BUN | 23 |
| 0.6-1.4 | Cr | 1.0 |
| 12 | Anion Gap |  |

1. In a man undergoing surgery, it was necessary to aspirate the contents of the upper gastro-intestinal tract.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.50 |
| 40 | pCO2 | 52 |
|   |   |  |
| 140 | Na | 140 |
| 4 | K | 3.0 |
| 100 | Cl | 90 |
| 24 | HCO3 | 40 |
| 8-16 | BUN | 22 |
| 0.6-1.4 | Cr | 1.4 |
| 12 | Anion Gap |  |

1. A person was admitted to hospital in a coma.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.10 |
| 40 | pCO2 | 16 |
|   |   |  |
| 140 | Na | 138 |
| 4 | K | 3.7 |
| 100 | Cl | 100 |
| 24 | HCO3 | 5 |
| 8-16 | BUN | 36 |
| 0.6-1.4 | Cr | 0.5 |
| 12 | Anion Gap |  |

1. 39 year old man with heartburn

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.50 |
| 40 | pCO2 | 50 |
|   |   |  |
| 140 | Na | 141 |
| 4 | K | 3.5 |
| 100 | Cl | 92 |
| 24 | HCO3 | 37 |
| 8-16 | BUN | 10 |
| 0.6-1.4 | Cr | 0.8 |
| 12 | Anion Gap |  |

1. Nurse gets blood gas because patient has been breathing hard for the past 3 hours.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.46 |
| 40 | pCO2 | 30 |
|   |   |  |
| 140 | Na | 134 |
| 4 | K | 4.1 |
| 100 | Cl | 100 |
| 24 | HCO3 | 22 |
| 8-16 | BUN | 22 |
| 0.6-1.4 | Cr | 1.4 |
| 12 | Anion Gap |  |

1. A 44 year old moderately dehydrated man was admitted with a two day history of acute severe diarrhea.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.31 |
| 40 | pCO2 | 33 |
|   |   |  |
| 140 | Na | 134 |
| 4 | K | 2.9 |
| 100 | Cl | 108 |
| 24 | HCO3 | 16 |
| 8-16 | BUN | 31 |
| 0.6-1.4 | Cr | 1.5 |
| 12 | Anion Gap |  |

1. A 22 year old female with type I DM, presents to the emergency department with a 1 day history of nausea, vomiting, polyuria, polydypsia and vague abdominal pain. Exam noted for deep sighing breathing, orthostatic hypotension, and dry mucous membranes

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.27 |
| 40 | pCO2 | 23 |
|   |   |  |
| 140 | Na | 132 |
| 4 | K | 6.0 |
| 100 | Cl | 93 |
| 24 | HCO3 | 11 |
| 8-16 | BUN | 38 |
| 0.6-1.4 | Cr | 2.6 |
| 12 | Anion Gap |  |

1. A previously well 55 year old woman is admitted with a complaint of severe vomiting for 5 days. Physical examination reveals postural hypotension, tachycardia, and diminished skin turgor. The laboratory finding include the following.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.23 |
| 40 | pCO2 | 22 |
|   |   |  |
| 140 | Na | 140 |
| 4 | K | 3.4 |
| 100 | Cl | 77 |
| 24 | HCO3 | 9 |
| 8-16 | BUN | 48 |
| 0.6-1.4 | Cr | 2.1 |
| 12 | Anion Gap |  |

1. A 70 year old man with history of CHF presents with 6 days of shortness of breath and leg swelling.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.30 |
| 40 | pCO2 | 60 |
|   |   |  |
| 140 | Na | 140 |
| 4 | K | 4.0 |
| 100 | Cl | 101 |
| 24 | HCO3 | 30 |
| 8-16 | BUN | 21 |
| 0.6-1.4 | Cr | 1.0 |
| 12 | Anion Gap |  |

1. A 50 year old insulin dependent diabetic woman was brought to the ED by ambulance. She was semi-comatose and had been ill for several days.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.41 |
| 40 | pCO2 | 32 |
|   |   |  |
| 140 | Na | 132 |
| 4 | K | 2.7 |
| 100 | Cl | 79 |
| 24 | HCO3 | 19 |
| 8-16 | BUN | 30 |
| 0.6-1.4 | Cr | 2.1 |
| 12 | Anion Gap |  |

1. A 19 year old pregnant insulin dependent diabetic patient was admitted with a history of polyuria and thirst. She now felt ill and presented to hospital.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.39 |
| 40 | pCO2 | 16 |
|   |   |  |
| 140 | Na | 136 |
| 4 | K | 4.8 |
| 100 | Cl | 101 |
| 24 | HCO3 | 10 |
| 8-16 | BUN | 28 |
| 0.6-1.4 | Cr | 2.2 |
| 12 | Anion Gap |  |

1. 72 year old woman taking oil of wintergreen, Bayer and ECASA for pain, fever, and heart.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.38 |
| 40 | pCO2 | 26 |
|   |   |  |
| 140 | Na | 141 |
| 4 | K | 4.0 |
| 100 | Cl | 101 |
| 24 | HCO3 | 15 |
| 8-16 | BUN | 17 |
| 0.6-1.4 | Cr | 0.8 |
| 12 | Anion Gap |  |

1. 43 year old male with cirrhosis, gangrene of the foot, and hypotension

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.41 |
| 40 | pCO2 | 21 |
|   |   |  |
| 140 | Na | 139 |
| 4 | K | 3.0 |
| 100 | Cl | 105 |
| 24 | HCO3 | 13 |
| 8-16 | BUN | 6 |
| 0.6-1.4 | Cr | 0.6 |
| 12 | Anion Gap |  |

1. 81 year old male with renal insufficiency and longstanding COPD presenting with respiratory difficulty.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.19 |
| 40 | pCO2 | 50 |
|   |   |  |
| 140 | Na | 137 |
| 4 | K | 5.2 |
| 100 | Cl | 100 |
| 24 | HCO3 | 18 |
| 8-16 | BUN | 68 |
| 0.6-1.4 | Cr | 4.3 |
| 12 | Anion Gap |  |

1. 72 year old female with CHF on diuretics. FEV1 = 1.30.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.37 |
| 40 | pCO2 | 64 |
|   |   |  |
| 140 | Na | 139 |
| 4 | K | 3.4 |
| 100 | Cl | 93 |
| 24 | HCO3 | 36 |
| 8-16 | BUN | 25 |
| 0.6-1.4 | Cr | 1.3 |
| 12 | Anion Gap |  |

1. 25 year old type I diabetic patient presents feeling poorly. FSBS is 650. He is given 10 units of IV insulin, then the following labs are drawn

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.40 |
| 40 | pCO2 | 40 |
|   |   |  |
| 140 | Na | 140 |
| 4 | K | 5.1 |
| 100 | Cl | 90 |
| 24 | HCO3 | 25 |
| 8-16 | BUN | 25 |
| 0.6-1.4 | Cr | 0.8 |
| 12 | Anion Gap |  |

1. 39 year old type I diabetic with ESRD has nausea and vomiting for three days. Still taking all of her meds, but little food or fluid. Receives lorazepam in ED for agitation.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.51 |
| 40 | pCO2 | 46 |
|   |   |  |
| 140 | Na | 142 |
| 4 | K | 5.1 |
| 100 | Cl | 89 |
| 24 | HCO3 | 36 |
| 8-16 | BUN | 67 |
| 0.6-1.4 | Cr | 7.8 |
| 12 | Anion Gap |  |

1. 79 year old female with a history of pancreatic cancer status post Whipple procedure, admitted for seizure and mental status change.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.14 |
| 40 | pCO2 | 47 |
|   |   |  |
| 140 | Na | 139 |
| 4 | K | 5.7 |
| 100 | Cl | 112 |
| 24 | HCO3 | 13 |
| 8-16 | BUN | 38 |
| 0.6-1.4 | Cr | 2.8 |
| 12 | Anion Gap |  |

**Section 2**

1. 68 year old male with dilated cardiomyopathy presents with hypotension and pulmonary edema on CXR

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.39 |
| 40 | pCO2 | 25 |
|   |   |  |
| 140 | Na | 123 |
| 4 | K | 5.1 |
| 100 | Cl | 85 |
| 24 | HCO3 | 15 |
| 8-16 | BUN | 42 |
| 0.6-1.4 | Cr | 2.1 |
| 12 | Anion Gap |  |

The patient above is given 2 liters of normal saline and promptly goes into respiratory distress. He is paralyzed and intubated. The ventilator is set at AC, RR = 10. TV = 500, FIO2 = 100%. His next blood gas is:

pH = 7.20

pCO2 = 40

pO2 = 320

What do you do now?

1. 18 year old male with asthma attack. Three hours of dyspnea. Respiratory rate = 36.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.52 |
| 40 | pCO2 | 25 |
|   |   |  |
| 140 | Na | 140 |
| 4 | K | 4.0 |
| 100 | Cl | 105 |
| 24 | HCO3 | 27 |
| 8-16 | BUN | 10 |
| 0.6-1.4 | Cr | 1.0 |
| 12 | Anion Gap |  |

Forty-five minutes later, after O2 and nebulizers his respiratory rate is 38. His ABG is now

pH = 7.40, pCO2 = 40, pO2 = 180. What do you do?

What is the most likely acid-base disorder(s) in the following examples? Give a clinical example that could cause the disturbance.

25.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.47 |
| 40 | pCO2 | 29 |
|   |   |  |
| 140 | Na | 140 |
| 4 | K | 4.0 |
| 100 | Cl | 106 |
| 24 | HCO3 | 22 |
| 12 | Anion Gap |  |

26.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.42 |
| 40 | pCO2 | 29 |
|   |   |  |
| 140 | Na | 140 |
| 4 | K | 4.0 |
| 100 | Cl | 110 |
| 24 | HCO3 | 19 |
| 12 | Anion Gap |  |

27.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.26 |
| 40 | pCO2 | 60 |
|   |   |  |
| 140 | Na | 140 |
| 4 | K | 4.0 |
| 100 | Cl | 104 |
| 24 | HCO3 | 26 |
| 12 | Anion Gap |  |

28.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.34 |
| 40 | pCO2 | 60 |
|   |   |  |
| 140 | Na | 140 |
| 4 | K | 4.0 |
| 100 | Cl | 100 |
| 24 | HCO3 | 30 |
| 12 | Anion Gap |  |

29.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.44 |
| 40 | pCO2 | 60 |
|   |   |  |
| 140 | Na | 140 |
| 4 | K | 4.0 |
| 100 | Cl | 95 |
| 24 | HCO3 | 38 |
| 12 | Anion Gap |  |

Two patients present with the following data

H+ = 61

PCO2 = 24

Patient A

|  |  |  |
| --- | --- | --- |
| 140 | Na | 140 |
| 4 | K | 5.0 |
| 100 | Cl | 96 |
| 24 | HCO3 | 9 |

Patient B

|  |  |  |
| --- | --- | --- |
| 140 | Na | 140 |
| 4 | K | 5.0 |
| 100 | Cl | 121 |
| 24 | HCO3 | 9 |

30. Based on the data presented for patient A, which one of the following diagnoses would most likely explain the lab findings?

A. Diarrhea

B. Respiratory acidosis

C. Ketosis

31. Based on the data presented for patient B, which one of the following diagnoses would most likely explain the lab findings?

A. Diarrhea

B. Respiratory acidosis

C. Ketosis

32. A 60 year old homeless man presents with nausea, vomiting and poor oral intake 2 days prior to admission. The patient reports a 3 day history of binge drinking prior to symptoms.

Labs : Serum chemistry: Na 139, K 5.0, Cl 104, HCO3- 16 , BUN 25, Cr 1.3, Glu 75
ABG: pH 7.30, PCO2 29, HCO3- 16, PO2 92
Serum albumin 1.0

Does the patient have an abnormal anion gap?

What calculation do you need to perform?

33. A 28 year old female with history of Sjogren’s syndrome presents to her PCP for a checkup visit. She is doing well. Physical examination is unremarkable. She is noted to have the following serum chemistry:

Na 138, K 4.2, Cl 108, HCO3- 18

Because of her history, the physician decides to check her urine electrolytes.

Urine chemistry: K 30, Na 75, Cl 105

What is the most likely diagnosis?

34. A 58 year old male is admitted with a 2 day history of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Na 138, K 3.2, Cl 108, HCO3- 18

Because of her history, the physician decides to check her urine electrolytes.

Urine chemistry: K 30, Na 100, Cl 200

What is the most likely diagnosis?

35. A suicidal auto mechanic presents with mental status changes. He has the following lab values.

|  |  |  |
| --- | --- | --- |
| Normal | Values | Case |
| 7.35-7.45 | pH | 7.28 |
| 40 | pCO2 | 26 |
|   |   |  |
| 140 | Na | 140 |
| 4 | K | 3.9 |
| 100 | Cl | 103 |
| 24 | HCO3 | 12 |
| 8-16 | BUN | 10 |
| 80-100 | GLUCOSE | 104 |
| 12 | Anion Gap |  |

What test should you order next?

36. 21-year-old type I diabetic discontinues insulin because of sore throat and difficulty swallowing. Which of the following is the most likely acid-base disorder to develop?

a) metabolic acidosis, normal anion gap

b) metabolic acidosis, increased anion gap

c) acute respiratory alkalosis

d) no acid-base disorder is likely to develop

37. 24-year-old asthmatic has acute onset of wheezing and nonproductive cough. Which of the following is the most likely acid-base disorder to develop?

a) chronic respiratory alkalosis

b) acute respiratory acidosis

c) acute respiratory alkalosis

d) no acid-base disorder is likely to develop

38. 22-year-old morbidly obese patient adheres to 600 calorie diet, 2000ml water intake daily for 10 consecutive days. Which of the following is the most likely acid-base disorder to develop?

a) metabolic acidosis, normal anion gap

b) metabolic acidosis, increased anion gap

c) acute respiratory alkalosis

d) no acid-base disorder is likely to develop

39. 57-year-old male with COPD, home oxygen dependence, daily chronic sputum production, is treated with several types of metered dose inhalers. No other medications. He is in his usual state. Which of the following is the most likely acid-base disorder to be present?

a) chronic respiratory alkalosis

b) acute respiratory acidosis

c) chronic respiratory acidosis

d) no acid-base disorder is likely to develop

40. The patient described in problem 39 develops worsening respiratory failure and requires mechanical ventilation. He is placed on a ventilator with tidal volume 800 cc, 100 percent FIO2, and rate of 24/min. Arterial blood gas is performed after 30 minutes of these ventilator settings. Which of the following is the most likely acid-base disorder to be present at this time?

a) acute respiratory alkalosis and metabolic alkalosis

b) acute respiratory alkalosis and metabolic acidosis

c) chronic respiratory acidosis

d) acute respiratory alkalosis

e) no acid-base disorder is likely to develop

41. 55-year-old male with ischemic cardiomyopathy, ejection fraction 25 percent receives outpatient treatment including lisinopril, digoxin, low-salt diet, furosemide 80 mg twice daily, and potassium supplement. Blood pressure is 110/ 70. He has one plus ankle edema and feels well. Serum creatinine concentration is 0.9 mg/dl. Which of the following is most likely to be present?

a) chronic respiratory alkalosis related to impaired cardiac output

b) metabolic alkalosis

c) respiratory acidosis and metabolic acidosis related to impaired cardiac output

**Section 3**

42. A 26 year old man with unknown past medical history is brought in to the ER by ambulance, after friends found him unresponsive in his apartment. He had last been seen at a party four hours prior.

ABG: pH 7.25 Chem 7: Na+ 137

 PCO2 60 K+ 4.5

 HCO3- 26 Cl- 100

 PO2 55 HCO3-  25

43. A 67 year old man with diabetes and early diabetic nephropathy (without overt renal failure) presents for a routine clinic visit. He is currently asymptomatic. Because of some abnormalities on his routine blood chemistries, you elect to send him for an ABG.

ABG: pH 7.33 Chem 7: Na+ 135

 PCO2 34 K+ 5.1

 HCO3- 18 Cl- 110

 PO2 92 HCO3- 16

 Cr 1.4

44. A 68 year old woman with metastatic colon cancer presents to the ER with 1 hour of chest pain and shortness of breath. She has no known previous cardiac or pulmonary problems.

ABG: pH 7.49 Chem 7: Na+ 133

 PCO2 28 K+ 3.9

 HCO3-  21 Cl- 102

 PO2 52 HCO3- 22

45. A 6 year old girl with severe gastroenteritis is admitted to the hospital for fluid rehydration, and is noted to have a high [HCO3-] on hospital day #2. An ABG is ordered:

 ABG: pH 7.47 Chem 7: Na+ 130

 PCO2 46 K+ 3.2

 HCO3- 32 Cl- 86

 PO2 96 HCO3- 33

46. A 75 year old man with morbid obesity is sent to the ER by his skilled nursing facility after he developed a fever of 103° and rigors 2 hours ago. In the ER he is lucid and states that he feels “terrible”, but offers no localizing symptoms. His ER vitals include a heart rate of 115, and a blood pressure of 84/46.

ABG: pH 7.12 Chem 7: Na+ 138

 PCO2 50 K+ 4.2

 HCO3- 13 Cl- 99

 PO2 52 HCO3- 15

47. A 25 year old man with type I diabetes presents to the ER with 24 hours of severe nausea, vomiting, and abdominal pain.

ABG: pH 7.15 Chem 7: Na+ 138

 PCO2 30 K+ 5.6

 HCO3- 10 Cl- 88

 PO2 88 HCO3- 11

 Cr 1.1

48. A 62 year old woman with severe COPD comes to the ER complaining of increased cough and shortness of breath for the past 12 hours. There are no baseline ABGs to compare to, however, her HCO3- measured during a routine clinic visit 3 months ago was 34 mEq/L.

ABG: pH 7.21 Chem 7: Na+ 135

 PCO2 85 K+ 4.0

 HCO3- 33 Cl- 90

 PO2 47 HCO3- 34