Integrated Final Examination

Pulmonary Pathology, Pathophysiology and Pharmacology

October 21, 2003

Total of 117 Questions

36 Pathology Questions
Point as indicated for each question
Total of 110 points

31 Pharmacology Questions
Each question is of equal value
Total of 100 points

"Blank" 50 Pathophysiology Questions
Each question is of equal value
Total of 100 points
Case 1

A 67 year-old woman is seen in the office of her primary care physician for medical clearance for an elective hysterectomy scheduled in 3 weeks for fibroid uterus. She has no other documented medical problems and has not seen her primary care physician for the past 5 years. During the review of systems, she complains of shortness of breath and cough. Upon further questioning, she admits to dyspnea on exertion starting about 3 years ago. She has attributed the symptom to aging and did not seek medical help. She was otherwise asymptomatic until 10 months ago when she developed a non-productive cough. She was seen in an urgent care facility and was treated with antibiotic and inhaled bronchodilators without improvement. Since then, her shortness of breath has worsened and now she gets dyspneic climbing one flight of stairs. Her review of system was other negative.

Physical examination is only significant for crackles heard over the lower third of the posterior lung fields. Laboratory evaluations are essentially normal.

Chest x-ray shows small lung volumes and reticular densities that are most prominent in the lower lung zones. Pulmonary function tests reveal the following:

- TLC = 3.12 L (72% of predicted)
- FRC = 1.73L (68% of predicted)
- RV = 1.00 L (65% of predicted)

- DLCO = 13.31 ml/min.torr (54% of predicted)

- FVC = 1.77 L (61% of predicted)
- FEV1 = 1.41 L (58% of predicted)
- FEV1/FVC = 80%

(1) Which one of the following interpretations of the PFT is INCORRECT?

- a) The lung volumes indicate a restrictive dysfunction
- b) The reduction in TLC is most likely due to a change in the pressure volume relationship of the respiratory system
- c) The spirometry does not show evidence of obstructive dysfunction
- d) The dysfunction is most likely due to a process extrinsic to the lung

The hysterectomy is postponed and patient undergoes a thoracoscopic lung biopsy which reveals changes consistent with idiopathic pulmonary fibrosis.
(2) Changes in lung physiology as a result of the underlying pathology in this disorder include all the following EXCEPT

a) Pulmonary HTN
b) Abnormal small airway function
c) Increased elastic recoil of the lung
d) Impaired diffusion
e) Increased lung compliance

(3) The major mechanism of hypoxemia in this disorder is

a) Hypoventilation
b) V/Q mismatch
c) Shunt
d) Diffusion abnormality

(4) The pathogenesis of this disorder include all the following EXCEPT

a) Release of proteolytic enzyme
b) Activation of inflammatory cell
c) Inactivation of antiproteases
d) Replication of fibroblasts
e) Degradation of connective tissue components

Case 2

A 46 year-old male with history of AIDS presents to his physician with complaint of cough. He had been feeling ill for about a month. He felt fatigued and had experienced night sweats. His cough started about 3 weeks ago with white sputum production. On exam, he had a temperature of 38.6°C and the lung was clear to auscultation. His chest X-ray showed bilateral infiltrates in the apices with possible cavitation on the left side. His pulse oximetry showed O2 saturation of 96% on room air. His sputum smear was positive for acid-fast bacilli.

(5) Which one of the following statements is INCORRECT

a) This patient most likely had reactivation tuberculosis
b) Reactivation tuberculosis is more common in the apices of the lung because these regions receive better lymphatic drainage than the rest of the lung
c) *Mycobacterium tuberculosis* is a slow growing organism so the identification and drug sensitivity may not be available for up to 6 weeks
d) This patient’s oxygenation is relatively preserved because ventilation and perfusion are destroyed simultaneously in the affected lung regions
e) Caseating granulomas are typically seen in active TB
(6) Indicate which of the drug treatments for tuberculosis requires pyridoxine to avoid the side effect of peripheral neuritis:

a) Cycloserine  
b) Rifampin  
c) Isoniazid  
d) Pyrazinamide  
e) Streptomycin

(7) A tubercular patient is started on therapy with rifampin and isoniazid. Culture results come back indicating resistance to rifampin. The most appropriate course of action at this point:

a) Continue with rifampin and isoniazid, but increase the dosage of rifampin  
b) Drop the rifampin and add pyrazinamide and ethambutol  
c) Go drug-free for one month, then restart the rifampin plus isoniazid  
d) Drop the rifampin and continue with the isoniazid  
e) Switch to a combination of cycloserine plus aminosalicylic acid

(8) Rifampin is bactericidal against Mycobacterium tuberculosis because of its ability to inhibit:

a) Mycolic acid synthesis  
b) ATP production  
c) Folate biosynthesis  
d) DNA-dependent RNA polymerase  
e) Cell wall synthesis involving D-alanine

(9) An anti-tubercular drug that inhibits the metabolism of the anti-epileptic drug, phenytoin:

a) Isoniazid  
b) Rifampin  
c) Pyrazinamide  
d) Cycloserine  
e) Aminosalicylic acid
(10) Indicate which of the following statements concerning tuberculosis are **CORRECT**:

a) Drug resistance will often develop if only one drug is used as therapy  
b) Directly observed therapy (DOT) is used in Rhode Island  
c) Drug treatment typically lasts for at least 6 months  
d) A and B  
e) A, B and C

**Case 3**

A 56 year-old office worker presented to his primary care physician with complaint of shortness of breath with physical activity over the past 6 months. He reported occasional coughs at night but denied any history of wheezing. He smoked half a pack of cigarettes a day since age 32. He was referred to the local pulmonary function laboratory and the following pulmonary function tests were obtained:

\[
\begin{align*}
\text{TLC} &= 6.30 \text{ L (108\% of predicted)} \\
\text{FRC} &= 2.47 \text{ L (97\% of predicted)} \\
\text{RV} &= 1.83 \text{ L (101\% of predicted)} \\
\text{FVC} &= 4.04 \text{ L (102\% of predicted)} \\
\text{FEV1} &= 3.21 \text{ L (96\% of predicted)} \\
\text{FEV1/FVC} &= 80\%
\end{align*}
\]

Patient then underwent a methacholine challenge and had 35\% reduction in FEV1 after 16 cumulative units of methacholine. However, he did not show up for his appointment with a pulmonologist as instructed. Today he was brought in by rescue to the emergency room for acute respiratory distress. He had headache and running nose for the past 4 days and experienced an acute episode of shortness of breath while running to one of his meetings this morning. He was tachypneic on arrival to the emergency room and had diffuse wheezing noted on examination. A bedside spirometry was performed which showed FVC = 2.57 L (65\% of predicted), FEV1 = 1.41 L (42\% of predicted), FEV1/FVC = 55\%.

(11) The change in patient’s PFT from his baseline could be due to all the following **EXCEPT**:

a) Mucosal edema of the airway walls  
b) Acute bronchoconstriction from smooth muscle contraction  
c) Mucus plugging of the airways  
d) Loss of alveolar attachments that maintain the patency of small airways  
e) Inflammatory cell infiltration of the airway walls
(12) Which of the following statements about his disease is CORRECT

a) Eosinophils and neutrophils are the major inflammatory cells in this disease
b) Small airways are involved
c) During an attack, patients usually have greater difficulty with airflow on inspiration than on expiration
d) Airway remodeling is not involved because the pulmonary function returns to normal between attacks
e) Airway smooth muscles cells become hypertrophied but the airway epithelial cells are usually intact

(13) The mechanism of hypoxemia during an asthmatic attack is

a) Hypoventilation
b) V/Q mismatch
c) Shunt
d) Diffusion abnormality
e) Increased dead space

(14) Risk factors for this disease include all of the following EXCEPT

a) Atopy with high serum IgE level
b) Male gender after age 40
c) Bronchial hyperresponsiveness
d) Exposure to indoor allergens
e) Passive smoke exposure in early life

His condition improved significantly after 2 weeks of therapy. A month later he was seen by his physician for follow up. He still had occasional shortness of breath and wheezing about 3 to 4 times a week, mostly with exercise/exertion. He slept well at night overall, however, he woke up coughing or wheezing about once a week. In the office, his spirometry revealed

\[
\text{FVC} = 3.88 \text{ L (98\% of predicted)} \\
\text{FEV1} = 3.08 \text{ L (92\% of predicted)} \\
\text{FEV1/FVC} = 80\% 
\]
(15) Appropriate management of this patient should include the following maintenance medications EXCEPT

a) A regularly scheduled short-acting beta2-adrenergic agent to prevent episodic wheezing
b) A long-acting beta2-adrenergic agonist for his nocturnal symptoms
c) An inhaled corticosteroid to reduce airway inflammation
d) A leukotriene-modifying agent can be considered for better control of the exercise-induced component of his asthma

(16) Which of the following statements about the airways in general is INCORRECT

a) Goblet cells in the mucosa produce the majority of mucus in the airways
b) Pseudostratified columnar epithelial cells have cilia on their luminal surfaces
c) Bronchial smooth muscles tone is determined by the autonomic nervous system
d) Basal cells are capable of differentiating into columnar cells
e) Mediators released by mast cells can increase bronchial smooth muscle tone

(17) Which of the following anti-asthmatic drugs would be the LEAST appropriate to treat an acute asthmatic attack:

a) Albuterol
b) Salmeterol
c) Pirbuterol
d) Terbutaline
e) Epinephrine

(18) Zafirlukast is used in the treatment of asthma because of its ability to:

a) Block leukotriene receptors
b) Inhibit release of bronchoconstrictors from the mast cell
c) Block adenosine receptors
d) Inhibit leukotriene synthesis
e) Block muscarinic receptors

(19) All of the following statements concerning beclomethasone treatment for asthma are correct EXCEPT:

a) It can be administered via a metered dose inhaler
b) It reduces the need for "rescue" β-agonist administration
c) It produces an inhibition of glucocorticoid synthesis
d) It stimulates the formation of arachidonic acid
e) It can produce a manic mood
(20) A drug contraindicated (not to be used) in an asthmatic patient:

a) Theophylline
b) Oral prednisone
c) Propranolol
d) Inhaled fumaride
e) Nedocromil

(21) The Giganto Drug Company has just announced that it has developed a new anti-asthmatic drug that is completely selective for stimulating \( \beta_2 \) receptors. They claim that because of its receptor selectivity it will not produce any unwanted side effects. However, since you are astute pharmacology students, you should be able to indicate which of the following side effects could still occur even if the drug were completely selective for just \( \beta_2 \) receptors:

a) Increased blood pressure via stimulation of vascular smooth muscle \( \beta_2 \) receptors
b) Cardiac palpitations via stimulation of cardiac \( \beta_2 \) receptors
c) Tremors via stimulation of skeletal muscle \( \beta_2 \) receptors
d) A and B
e) B and C

Case 4

A 54 year-old male was brought in to the emergency room after a single car accident on Route 95. He was the driver of the car which went off the road and hit a tree. He remembered slowing down to take the exit and next thing he knew he had hit a tree near the entrance of the exit ramp. He thought he must have fallen asleep briefly at the wheels. His physical examination was unremarkable except for some bruises on his chest. He is neurologically intact. Upon further questioning, he admitted to feeling tired all the time and falling asleep frequently during the day. He snores loudly when he sleeps according to his wife. He is mildly obese with a wide neck. You are concerned that he may have obstructive sleep apnea.

(22) Which of the following statements about obstructive sleep apnea is INCORRECT

a) The apnea is caused by upper airway obstruction
b) Continuous positive airway pressure (CPAP) is an effective therapy
c) There is increased pharyngeal dilator muscle function during sleep leading to obstruction
d) It is more common than central sleep apnea
e) Anatomically small upper airway contributes to this disorder
(23) Obstructive sleep apnea may be associated with all of the following EXCEPT

a) Decreased neurocognitive function
b) Pulmonary vasodilation
c) Systemic hypertension
d) Increased prevalence of stroke
e) Alveolar hypoxia

Case 5

A 78-year old male was brought to the emergency room by his family for shortness of breath. Patient had baseline dementia and was unable to give any history. According to the family, patient had decreased appetite over the last 2 days and appeared tired. No history of fever but patient had intermittent coughs for the past 5 days. On arrival to the emergency department patient was found to be febrile with temperature of 38.9°C, hypotensive with BP = 78/52 and tachypneic with respiratory rate of 32. His chest X-ray showed bilateral infiltrates. His arterial blood gas showed pH = 7.19, PCO2 = 24 mmHg, PO2 = 51 mmHg on room air. His blood chemistry was significant for HCO3 of 10 and an elevated anion gap. Because of the low PCO2, you concluded that this patient had increased minute ventilation.

(24) All the following mechanisms may be responsible for this patient’s increased minute ventilation EXCEPT

a) Stimulation of the carotid body by the decreased arterial pH
b) Stimulation of the central receptor in the medulla by the decreased PCO2
c) Stimulation of carotid body by the decreased PO2
d) Stimulation of the central receptor in the medulla by the increase in [H+]

Patient was intubated and placed on mechanical ventilation. His sputum and blood cultures were positive for Streptococcus pneumoniae. He stabilized initially with improvement in his acid-base status. However, 2 days into his hospitalization, his respiratory condition deteriorated and he required 100% FiO2 on mechanical ventilation. His chest X-ray showed worsened bilateral infiltrates. His ABG showed a pH of 7.32, PaCO2 of 40 mmHg and PaO2 of 60 mmHg with O2 saturation of 90%. A pulmonary artery catheter was placed and the pulmonary capillary wedge pressure was 16 mmHg. His mixed venous blood showed pH of 7.28, PvCO2 of 40 mmHg, PvO2 of 40 mmHg with O2 saturation of 60%. His hemoglobin was 10 g/dl.
(25) The pathogenesis of this patient’s pulmonary dysfunction include all of the following EXCEPT

a) Increased vascular permeability leading to fluid influx into alveolar space
b) Cytokine secretion by activated macrophages
c) Endothelial cell injury leading to loss of surfactant
d) Release of oxidants into the tissues
e) Decreased epithelial water removal

(26) What was this patient’s shunt fraction?

a) 12%
b) 27%
c) 44%
d) 52%

Patient was placed on high level of PEEP and over time his respiratory status improved.

(27) All of the following may be expected in the lung repair process in this disorder EXCEPT

a) Interstitial fibroblast proliferation
b) Surfactant regeneration
c) Type I cell hyperplasia
d) Increased collagen deposition in interstitium
e) Regression of fibroproliferative phase

Case 6

A 61 year-old female presented with complaint of acute onset of pleuritic chest pain and dyspnea. She had history of hypertension but is otherwise in good health. One week ago she took a car trip to Georgia for a family reunion. Since her return two days ago she had noticed some tenderness in her left calf. This morning she woke up with pleuritic chest pain and shortness of breath. On physical exam, her temperature was 37.8°C, pulse 118/min, respiratory rate 28/min and blood pressure was 154/92 mmHg. Her breath sounds were normal and there was no murmur or gallop on heart exam. Her left calf was slightly swollen but no cords were palpable. An arterial blood gas on room air showed pH = 7.48, PCO2 = 29 mmHg, PO2 = 56 mmHg, O2 saturation of 88%. The rest of her laboratory evaluation was normal.
It was suspected that patient had deep venous thrombosis (DVT) and pulmonary embolism (PE) and further work-up was ordered.

(28) Which of the following statements about diagnostic tests of PE is CORRECT

a) The definitive diagnostic test for PE is magnetic resonance angiography
b) The most common CXR finding in PE is pleural effusion
c) A low probability V/Q scan rules out the diagnosis of PE
d) The most common ABG finding in PE is respiratory acidosis with increased A-a gradient
e) A D-dimer level less than 500 ng/ml makes the diagnosis of PE unlikely

Her chest X-ray showed right base atelectasis. Lower leg Doppler ultrasound was positive for left leg deep venous thrombosis and a ventilation-perfusion scan (V/Q scan) showed multiple unmatched perfusion defects which was high probability for PE.

(29) What are the potential mechanisms of hypoxemia in this patient

a) Hypoventilation and V/Q mismatch
b) V/Q mismatch and shunt
c) Shunt and hypoventilation
d) Shunt and increased dead space
e) Increased dead space and V/Q mismatch

(30) Which of the following statements about pulmonary embolism is CORRECT

a) Mediators released by the thrombus leads to bronchoconstriction of the central and small airways
b) Increased pulmonary vascular resistance leads to increased right ventricular output
c) Increased dead space leads to increased alveolar ventilation
d) Mediator released by the thrombus leads to vasoconstriction and increased pulmonary vascular resistance
e) Compromised surfactant production leads to atelectasis which leads to hypoxemia through V/Q mismatch
The lesion illustrated above might have occurred in this patient. Indicate whether each of the following statements are true (a) or false (b) (2 points each)

(31) Pulmonary infarcts are usually pale because pulmonary arteries are likely to have reduced lumen size after pulmonary emboli.

(32) The above lesion is atypical because of its wedge shape and its peripheral location.

(33) Pulmonary embolism in otherwise healthy young persons does not result in pulmonary infarction in the majority of cases.

(34) The list of hypercoagulable states which increase the risk of pulmonary embolism includes pregnancy.

(35) Devastating effects secondary to amniotic fluid embolism and fat embolism are due not only to obstruction but also to chemical effects resulting in alveolar damage.
Case 7

A 74 year-old man from nursing home was brought to the hospital for urinary tract infection. On arrival to the emergency room, patient was found to be hypotensive and tachypneic. He was intubated in the emergency room and his arterial blood gas on FiO2 of 80% shows pH = 7.26, PCO2 = 34, PO2 = 63. His chest x-ray was significant for bilateral infiltrates. He was admitted to the intensive care unit and started on antibiotic therapy. A pulmonary artery catheter was placed and the pulmonary capillary wedge pressure was 13 mmHg. Both his urine and blood cultures came back positive for E. coli within 24 hours.

(36) Patient’s arterial blood gas is consistent with which type of acidosis:

   a) Respiratory acidosis
   b) Metabolic acidosis
   c) Combined respiratory and metabolic acidosis
   d) Unable to decide without the value of serum HCO3

(37) Which one of the following statements about this patient’s condition is INCORRECT:

   a) This patient’s clinical presentation met all the criteria for the diagnosis of acute respiratory distress syndrome
   b) The bilateral infiltrates were results of pulmonary edema from increased vascular permeability
   c) Loss of surfactant can lead to areas of atelectasis
   d) The lung injury was homogeneous with diffuse alveolar damage
   e) Both endothelial and epithelial cells were injured leading to edema in the alveolar spaces

(38) Which of the following pathophysiologic abnormalities associated with this clinical condition is CORRECT

   a) Intra-alveolar water accumulation causing left-to-right shunt
   b) Decreased work of breathing
   c) Abnormal surfactant leading to decreased lung recoil
   d) The edema fluid in the alveolar space leading to increased lung volumes
   e) Bronchoconstriction leading to V/Q mismatch
Positive end-expiratory pressure (PEEP) was added to the patient's mechanical ventilator setting in order to improve oxygenation. On PEEP of 10 cm H2O and FiO2 of 50%, patient's arterial blood gas showed pH = 7.32, PCO2 = 28, PO2 = 60 and O2 saturation was 90%. His hemoglobin was 10 g/dL. With this ventilator setting, the pulmonary capillary wedge pressure was 18 with the cardiac output of 5.0 liters/min.

(39) All of the following statements about PEEP are correct EXCEPT:

a) It can lead to pneumothorax from barotrauma  
b) It increases functional residual capacity (FRC)  
c) It increases lung compliance  
d) It increases cardiac output  
e) It decreases oxygen toxicity

(40) The oxygen delivery for this patient is

a) 482 ml/min  
b) 560 ml/min  
c) 612 ml/min  
d) 724 ml/min  
e) 856 ml/min

Case 8

A 72 year-old male with history of coronary artery disease and congestive heart failure presented with 2-week history of dyspnea and fatigue. On physical exam he was noted to have rales at the left base and diminished breath sounds at the right base. Chest x-ray showed mild vascular congestion and right-sided pleural effusion. There was a rounded density in the right lower lung field and widened mediastinum. A chest CT showed a mass in the right lower lobe with enlarged hilar lymph nodes and the right pleural effusion. There were also several lesions noted in the liver. Bronchoscopy revealed an endobronchial lesion in the right lower lobe bronchus and the biopsy is showed below.

A thoracentesis was performed for the right pleural effusion with the following results:

Pleural fluid protein = 2.8 g/dL, Serum protein = 6.2 g/dL  
Pleural fluid LDH = 161 U/L, Serum LDH = 218 U/L  
(The upper limit of normal serum LDH is 280 U/L)
(41) The pleural fluid results are consistent with

a) Transudative effusion
b) Exudative effusion

(42) What is the most likely mechanism of pleural effusion in this patient?

a) Altered permeability from his lung cancer
b) Altered permeability from his congestive heart failure
c) Increased hydrostatic pressure from his lung cancer
d) Increased hydrostatic pressure from his congestive heart failure

Patient was started on therapy for his lung cancer. Two months after he presented with fever, cough and worsened dyspnea. On physical exam, he was acutely ill with a fever of 38.8°C and his Chest x-ray showed right lower lobe consolidation consistent with pneumonia.

(43) Which one of the following statements about defense of the lung is CORRECT

a) Polymorphonuclear leukocytes and lymphocytes are the major cells for phagocytosis in bacterial pneumonia
b) T-lymphocytes with the ability to produce antibodies are responsible for the humoral immune responses
c) Alveolar macrophages are capable of phagocytosis
d) Viral infection can lead to T lymphocyte dysfunction
e) Corticosteroids can lead to B lymphocyte dysfunction

Case 9

A 42-year old female presented with complaint of progressive shortness of breath and fatigue. Her exam was significant for clear lungs on auscultation and a holosystolic murmur over the right sternal border. An echocardiogram was obtained which showed right ventricular enlargement with severe tricuspid regurgitation. Her estimated mean pulmonary artery pressure was 60 mmHg. Her chest X-ray revealed enlarged pulmonary arteries with clear lung fields. Her pulmonary function tests did not reveal any obstructive or restrictive defects. Subsequent work up pointed to the diagnosis of primary pulmonary hypertension.
(44) Which of the following statements about circulation of the respiratory system is CORRECT

a) The pulmonary circulation is a high pressure system  
b) The bronchial circulation carries a high percentage of total cardiac output  
c) The airways are supplied by pulmonary circulation  
d) The distribution of pulmonary blood flow depends on hydrostatic pressure  
e) Recruitment of vessels lead to high pulmonary vascular resistance

(45) All of the following hemodynamic features are seen in primary pulmonary hypertension EXCEPT

a) Normal pulmonary capillary wedge pressure (PCWP) 
b) Increased pulmonary vascular resistance (PVR) 
c) Elevated pulmonary artery pressure  
d) Elevated right atrial pressure  
e) High cardiac output

(46) The treatment of primary pulmonary hypertension include all of the following EXCEPT

a) Anticoagulation  
b) Bronchodilator therapy  
c) Vasodilator therapy  
d) Supplemental Oxygen for hypoxemia  
e) Diuretic for right heart failure

Case 10

An 81-year old female was sent to the Pulmonary Function Laboratory for testing because of complaint of dyspnea associated with exertion.

(47) Which one of the following changes in her pulmonary function will be expected given her advanced age

a) Decreased FRC from early closure of small airways  
b) Increased in RV leading to increased TLC  
c) Decreased lung compliance due to increased elastic recoil of the lung  
d) Decreased airway resistance because of increased airway size  
e) Decreased DLCO because of increased collagen content in the alveolar walls
(48) Which of the following statement is CORRECT about lung diseases in the elderly

a) Elderly patients have increased incidence of TB because as many as 20-25% of patients with positive PPD will reactivate
b) Although elderly patients are more likely to get pneumonia, age is not an independent risk factor for pneumonia mortality
c) The prevalence of allergic asthma is lower in elderly than in the younger population
d) Most elderly asthmatics have long-standing asthma; new onset of asthma in this group is rare
e) Medication is an uncommon cause of chronic cough in elderly

**Case 11**

(49) The above photo is of a cross-section of a muscular pulmonary artery in a case of Down syndrome with common AV canal resulting in secondary pulmonary hypertension. Which of the features of the vascular changes which can be seen in pulmonary hypertension is present in this section? (5 points)

a) A plexiform lesion
b) Intimal fibrosis
c) Medial hypertrophy
d) Necrotizing arteritis
e) Intimal and medial fibrosis
Case 12

A 67-year-old woman is brought in by rescue to the emergency room after experiencing severe dyspnea at home. She is cyanotic and unable to speak in full sentences. Her daughter who accompanies her to the emergency room states that patient has had increasing dyspnea and productive cough for the past week. In the emergency room, a CXR is obtained which shows hyperinflated lungs without infiltrates. An arterial blood gas is done and it shows pH = 7.15, PCO2 = 68, PO2 = 46 on room air.

(50) Which of the following best describes patient’s hypercapnic respiratory failure

- a) Acute hypercapnic respiratory failure
- b) Chronic hypercapnic respiratory failure
- c) Acute on chronic hypercapnic respiratory failure

(51) This patient’s alveolar-arterial oxygen difference (A-a gradient) is

- a) 10 mmHg
- b) 13 mmHg
- c) 19 mmHg
- d) 27 mmHg
- e) 31 mmHg

She has been followed by a pulmonologist for the past 5 years and a call to the pulmonologist’s office provides the following pulmonary function test done a month ago:

- TLC = 5.87 L (136% predicted)
- FRC = 3.83 L (151% predicted)
- RV= 2.75 L (180% predicted)

- DLCO = 9.36 ml/min.torr (38% predicted)

- FVC = 1.65 L (57% of predicted)
- FEV1 = 0.77 L (32% of predicted)
- FEV1/FVC = 47%

(52) Which of the following best described the pulmonary dysfunction

- a) Restriction with diffusion abnormality
- b) Obstruction with diffusion abnormality
- c) Combined restriction and obstruction with diffusion abnormality
- d) Obstruction without diffusion abnormality
- e) Restriction without diffusion abnormality
A pulse oximetry was obtained on room air at rest at that time which showed an oxygen saturation of 86%.

(53) Patient’s hypoxemia at rest was most likely due to which of the following mechanisms
   
a) Hypoventilation  
b) V/Q mismatch  
c) Shunt  
d) Diffusion abnormality  
e) Increased dead space

(54) Which of the following statement about this patient’s disease is CORRECT
   
a) Airway hyperresponsiveness may be associated with this disorder  
b) Neutrophils, eosinophils and T lymphocytes are the major cell types responsible for the inflammation in this disease  
c) Central airways are the major site of airway obstruction  
d) Increased elastic recoil contributes to the airflow limitation  
e) Alveolar anatomy is generally intact in this disease

(55) Compared to a patient with idiopathic pulmonary fibrosis, this patient has
   
a) Increased respiratory system compliance  
b) Decreased respiratory system compliance  
c) Normal respiratory system compliance  
d) No consistent findings regarding pulmonary compliance distinguish this patient’s pulmonary disorder from those with IPF

(56) The use of ipratropium in chronic obstructive pulmonary disease (COPD) is due to its ability to:
   
a) Inhibit leukotriene release from mast cells  
b) Stimulate the production of lipocortin  
c) Inhibit the metabolism of cyclic AMP  
d) Stimulate epinephrine secretion from the adrenal medulla  
e) Block muscarinic receptors
(57) All of the statements about the type of emphysema in the diagram above are true EXCEPT: (5 points)

a) It is the most common clinically significant type
b) It is the type associated with deficiency of alpha 1-antitrypsin
c) A synonym for this type is proximal acinar emphysema
d) Lesions are most severe in the apex
e) This type is frequently seen in patients with coal workers pneumoconiosis

Case 13

A 38 year-old female working as a nurse’s aide in a long-term care facility was found to have a positive tuberculin skin test during a routine screening. Patient had a negative test a year ago. She does not remember ever been exposed to anyone with active TB. She denies any fatigue, weight loss, fever, night sweat, cough or hemoptysis. Her chest X-ray is normal.

(58) Which one of the following statements is CORRECT

a) The conversion from negative to positive tuberculin skin test indicates a reactivation of tuberculosis
b) Since the patient is asymptomatic and has a negative chest x-ray, it indicates that the host defense mechanism has been able to completely eliminate the tubercle bacilli
c) The patient most likely had the exposure to the tubercle bacilli within the past week
d) The positive tuberculin skin test is the manifestation of the host’s cellular immune response to the exposure
e) This patient is considers infectious and should not return to work until she is adequately treated
Case 14

A 68 year-old female was brought to the emergency room after she was found unresponsive at home by her husband. Her medical history according to her husband was significant for hypertension, diet-controlled diabetes, COPD and depression. She was in her usual state of health when he left the house this morning. When he returned 6 hours later he found her in bed and was unable to arouse her. She was only responsive to deep pain on arrival to the emergency department and had shallow breathing on exam. An arterial blood gas was obtained which showed pH = 7.14, PCO2 = 80 mmHg, PO2 = 46 mmHg on room air.

(59) What is the acid-base disorder

a) Acute metabolic acidosis
b) Acute respiratory acidosis
c) Acute respiratory alkalosis
d) Chronic respiratory acidosis
e) Acute on chronic respiratory acidosis

(60) What is the most likely mechanism of this patient’s hypoxemia

a) Hypoventilation
b) Diffusion abnormality
c) V/Q mismatch
d) Shunt
e) Increased dead space
(61) All of the following statements regarding the histopathological findings in chronic bronchitis are true EXCEPT: (5 points)

a) The mucosa is hyperemic and swollen
b) There are abundant mucinous and mucopurulent secretions
c) The Reid index, an attempt to quantitate thickening of the layer of mucus glands, is determined by relating the thickness of the mucus glands to the thickness of the cartilage
d) Squamous metaplasia of the bronchial epithelium may be present
e) Bronchiolar lumens are narrowed
A neonate was delivered prematurely at 30 weeks gestation in 1955. He was treated with oxygen at high concentrations for the entire 8 weeks of his life. At 2 days of life his chest x-ray revealed a diffuse “white-out”. At the time of his death he continued to show “oxygen dependence and abnormal chest radiographic findings”. The above photo represents a section of his lungs at autopsy. The section shows thickening of the septa due to fibrosis. Grossly the lungs would show a cobblestone pattern.

True (a) or false (b) regarding this disorder: (2 points each)

(62) The entity from which this patient suffered on day 2 was hyaline membrane disease.
(a) True (b) False

(63) The primary cause of alveolar damage in this setting is “shock lung”.
(a) True (b) False

(64) Hyaline membranes are seen only in the setting of surfactant deficiency.
(a) True (b) False

(65) Patients such as this are also at risk for retinopathy of prematurity (retrolental fibroplasia)
(a) True (b) False

(66) The pathological picture illustrated above was due to co-existing congenital cystic adenomatoid malformation of the lung (CCAM)
(a) True (b) False
Case 16

A 68 year-old female presents to her primary care physician for follow up after an emergency room visit for chest pain. A myocardial infarction was ruled out at that time. She subsequently had an echocardiogram done as an outpatient. The echocardiogram revealed normal left ventricular ejection and moderate tricuspid regurgitation. The estimated systolic pulmonary artery pressure was 56 mmHg. She smokes 2 packs of cigarettes a day and has been smoking since she was 21. She has chronic dyspnea and a Pulmonary Function Test done 4 months ago showed the following:

- \( \text{TLC} = 5.72 \text{ L (134\% of predicted)} \)
- \( \text{FRC} = 3.56 \text{ L (140\% of predicted)} \)
- \( \text{RV} = 2.86 \text{ L (186\% of predicted)} \)

- \( \text{DLCO} = 9.12 \text{ ml/min/torr (37\% of predicted)} \)

- \( \text{FVC} = 1.62 \text{ L (54\% of predicted)} \)
- \( \text{FEV1} = 0.68 \text{ L (28\% of predicted)} \)
- \( \text{FEV1/FVC} = 41\% \)

Laboratory results from her emergency room visit revealed an elevated hemoglobin of 18 g/dL and an arterial blood gas showing \( \text{pH} = 7.37, \text{PCO2} = 36 \text{ mmHg, PO2} = 52 \text{ mmHg, O2 saturation} = 86\% \) on room air.

(67) All of the following statements about this patient’s disorder are correct EXCEPT

a) V/Q mismatch is the major mechanism of hypoxemia
b) Airway remodeling leading to irreversible airway obstruction
c) Smooth muscle contraction leading to reversible airway obstruction
d) Increased elastic recoil leading to premature airway closure
e) Expiratory flow limitation is the hallmark of this disorder

(68) The causes of this patient’s pulmonary hypertension may include all the following EXCEPT

a) Increased blood viscosity from polycythemia
b) Loss of blood vessels from destruction of lung parenchyma
c) Chronic hypoxia causing medial hypertrophy
d) Lung hyperinflation causing mechanical constriction of arteries
e) Increased pulmonary venous pressure
(69) Which of the following statements about the pulmonary circulation is INCORRECT

a) Blood viscosity is one of the normal determinants of pulmonary arterial pressure  
b) Pulmonary circulation is a high pressure/low flow system  
c) There is paucity of medial vascular smooth muscles in pulmonary arteries  
d) Chronic hypoxia can lead to vessel wall remodeling  
e) Acute hypoxia leads to vasoconstriction

(70) All of the following can increase pulmonary arterial pressure EXCEPT

a) Increased right atrial pressure  
b) Increased pulmonary blood flow  
c) Decreased pulmonary arterial lumen areas  
d) Increased pulmonary venous pressure  
e) Increased blood viscosity

(71) Treatment for this patient’s pulmonary hypertension should include all of the following EXCEPT

a) Phlebotomy  
b) Supplemental oxygen  
c) Smoking cessation  
d) Vasodilator therapy  
e) Bronchodilator therapy

Case 17

A 63-year old male presented to his primary care physician with complaint of progressive dyspnea over the past 4 days. His denied any cough or sputum production. His past medical history was significant for coronary artery disease, congestive heart failure and chronic renal insufficiency. He had a 30 pack-year smoking history but stopped smoking 10 years ago. His lung exam was remarkable for decreased breath sounds at the bases. CXR showed bilateral pleural effusions. Pulmonary function testing ordered by his physician revealed the following

\[
\begin{align*}
\text{TLC} &= 3.78 \text{ L (73\% predicted)}  
\text{FRC} &= 1.91 \text{ L (71\% predicted)} 
\text{RV} &= 1.22 \text{ L (68\% predicted)} 
\text{DLCO} &= 25.04 \text{ ml/min/torr (88\% predicted)} 
\text{FVC} &= 2.25 \text{ L (64\% of predicted)} 
\text{FEV1} &= 1.57 \text{ L (54\% of predicted)} 
\text{FEV1/FVC} &= 70\% 
\end{align*}
\]
(72) Which of the following best described the pulmonary dysfunction

a) Restriction with diffusion abnormality  
b) Restriction without diffusion abnormality  
c) Obstruction with diffusion abnormality  
d) Obstruction without diffusion abnormality  
e) Combined restriction and obstruction without diffusion abnormality

(73) Which of the following statements about lung mechanics and pulmonary function testing is CORRECT

a) Total lung capacity (TLC) is set by the balance between recoil of the chest wall and the recoil of the lung  
b) Vital capacity (VC) is the difference between TLC and functional residual capacity (FRC)  
c) Functional residual capacity (FRC) is set by the balance between the recoil of the respiratory system and the strength of the inspiratory muscles  
d) Residual volume (RV) is set by the balance between the recoil of the respiratory system and airway closure  
e) Reduction in FEV1 defines the presence of obstruction

A diagnostic thoracentesis was performed and the pleural fluid was consistent with transudate.

(74) All of the following diseases may cause transudative pleural effusion except

a) Tuberculosis  
b) Nephrotic syndrome  
c) Congestive heart failure  
d) Myxedema  
e) Liver cirrhosis
(75) Succinylcholine is used for surgical anesthesia to produce a state of:

a) Unconsciousness  
b) Amnesia  
c) Analgesia  
d) Neuromuscular blockade  
e) Inhibited bronchial secretions

(76) A dopamine pathway in the brain associated with reward:

a) Ventral tegmentum to nucleus accumbens  
b) Septum to hippocampus  
c) Substantia nigra to striatum  
d) Striatum to cerebral cortex  
e) Septum to cerebellum

(77) Parkinsonian side effects produced by neuroleptic treatment can be reduced by concurrent treatment with:

a) Physostigmine  
b) Propranolol  
c) Benztropine  
d) Reserpine  
e) Haloperidol

(78) Drug A has the concentrations indicated below in the blood following intravenous administration. From these data we can conclude that the half-life (t₁/₂) of drug A is:

<table>
<thead>
<tr>
<th>Time after intravenous administration</th>
<th>µg/ml of drug A in the blood</th>
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<td>8 hours</td>
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a) 4 hours  
b) 6 hours  
c) 8 hours  
d) 12 hours  
e) 16 hours
(79) Isoflurane has a minimum alveolar concentration (MAC) of 1.15%. Of the values below, what is the lowest % of isoflurane in the inhaled gas that would be necessary for isoflurane to prevent a pain response in essentially 100% of patients?

a) 1.27%
b) 1.53%
c) 2.30%
d) 3.45%
e) Cannot achieve this goal with isoflurane alone, since its MAC is above 1%

(80) The finding that phencyclidine (PCP) can produce schizophrenic symptoms has led to the suggestion that schizophrenia may be related to brain:

a) Hypoactivity with regard to GABA receptor function
b) Hypoactivity with regard to NMDA receptor function
c) Hyperactivity with regard to GABA receptor function
d) Hyperactivity with regard to NMDA receptor function
e) Hyperactivity with regard to enkephalin receptor function

(81) A dose of 5 mg of drug X is administered to a patient. Determination of the C₀ (concentration at time zero) reveals a value of 125 μg/liter in the plasma. What is the volume of distribution (Vₐ) of drug X?

a) 4 liters
b) 6.25 liters
c) 25 liters
d) 40 liters
e) 250 liters

(82) Indicate which of the drugs below could hasten recovery from tubocurarine-induced neuromuscular blockade:

a) Neostigmine
b) Atropine
c) Epinephrine
d) Fentanyl
e) Midazolam
(83) The most appropriate treatment for a patient in a heroin-induced coma:

a) Morphine
b) Amphetamine
c) Naloxone
d) Haloperidol
e) Lofexidine

(84) When given alone, 98% of Drug A is bound to plasma albumin. When Drug B is added to the patient treatment, it displaces Drug A so that now 80% of Drug A is bound to plasma albumin. What effect will this have on the free Drug A concentration?

a) A barely perceptible change (<5%)
b) An 18% increase
c) An 80% increase
d) A 200% increase (2-fold higher)
e) A 1000% increase (10-fold higher)

(85) Inhalation anesthetic A has a blood:gas partition coefficient of 12, and inhalation anesthetic B has a blood:gas partition coefficient of 0.5. Indicate which of the following conclusions can be CORRECTLY drawn from these facts:

a) Drug B will have a quicker onset of anesthesia compared to drug A
b) Drug B will have a quicker recovery from anesthesia compared to drug A
c) Drug B will produce fewer side effects compared to drug A
d) A and B
e) A, B and C

(86) Indicate which of the following statements concerning nicotine are CORRECT:

a) Activation of presynaptic nicotinic receptors in the brain augments transmitter release
b) Rats will not self-administer nicotine
c) Nicotinic receptors are G-protein coupled receptors
d) A and B
e) A, B and C
(87) All of the following are produced by morphine EXCEPT:
   
   a) Depression of cough reflex  
   b) Dilated pupils  
   c) Histamine release  
   d) Analgesia  
   c) Inhibition of GI motility

(88) Indicate which of the following pharmacokinetic statements are CORRECT:
   
   a) A drug administered intravenously will have a bioavailability of 1 (100%)  
   b) The AUC (area under the curve) is generated by plotting drug plasma concentration on the y-axis vs. time on the x-axis  
   c) First-pass metabolism refers to the drug metabolism that occurs within all tissues of the body during the first circulation of the drug around the body  
   d) A and B  
   e) A, B and C

(89) All of the following statements concerning amphetamine are correct EXCEPT:
   
   a) It inhibits locomotor activity in rodents  
   b) It can produce schizophrenic symptoms  
   c) It stimulates dopamine release in the brain  
   d) It stimulates norepinephrine release in the autonomic nervous system  
   e) It is used in the treatment of narcolepsy

(90) Drug X has a half-life ($t_{1/2}$) of 14 hours, and is being given by constant intravenous infusion. Indicate the shortest time point that is required for the drug to reach greater than 90% of its final steady-state concentration in the blood.
   
   a) 14 hours  
   b) 28 hours  
   c) 42 hours  
   d) 56 hours  
   e) 70 hours
(91) Drug X is being administered orally as a 20 mg pill every 12 hours. If the half-life \( (t_{1/2}) \) of the drug is 12 hours, which of the following pairs of values best expresses the maximum and minimum amounts of drug in the body after a steady state is achieved?

a) Minimum of 10 mg: Maximum of 20 mg  
b) Minimum of 15 mg: Maximum of 30 mg  
c) Minimum of 20 mg: Maximum of 40 mg  
d) Minimum of 30 mg: Maximum of 60 mg  
e) Minimum of 40 mg: Maximum of 80 mg

(92) Olanzapine differs from haloperidol in that:

a) Olanzapine produces a lower incidence of Parkinsonian symptoms  
b) Olanzapine produces a lower incidence of tardive dyskinesia  
c) Olanzapine doesn’t block dopamine receptors in the brain  
d) A and B  
e) A, B and C

(93) All of the following statements concerning thiopental are correct EXCEPT:

a) It can be given intravenously to produce rapid unconsciousness  
b) It doesn’t produce respiratory depression  
c) It doesn’t sensitize the heart to catecholamines  
d) It doesn’t stimulate airway secretions  
e) It can decrease cardiac contractility

(94) Indicate the CORRECT drug: mechanism of action pairings for drugs used to treat allergic rhinitis:

a) Diphenhydramine: Blockade of \( H_2 \) receptors  
b) Phenylephrine: Blockade of \( \alpha_1 \)-adrenergic receptors  
c) Loratadine: Blockade of \( H_1 \) receptors  
d) A and B  
e) B and C
(95) The following statements are true about lung development EXCEPT: (5 points)

a) Oligohydramnios is associated with lung hypoplasia
b) At gestational age of 30 weeks lung development is complete and all alveoli are in place
c) The canalicular stage of lung development is from 17-28 weeks, a time of development of the vascular bed and acinar framework
d) Production of surfactant is delayed in the fetus of a mother with poorly-controlled diabetes mellitus
e) The lungs are formed from an outpouching from the foregut early in embryonal life

(96) Select the CORRECT statement about viral pneumonia: (5 points)

a) It is usually an interstitial pneumonia
b) The infiltrate usually consists of equal portions of neutrophils and lymphocytes
c) In all cases, the cause can never be determined unless viral cultures are performed or DNA techniques are utilized
d) The presence of viral infection protects against superimposed bacterial infection
e) For unknown reasons, the HIV positive patient is less susceptible to viral pneumonia

(97) Select the CORRECT statement about the pathogenesis of emphysema (5 points)

a) Damage to the alveolar wall results from an imbalance between amylase and antiproteases
b) The principal antielastase factor is alpha1-antitrypsin
c) Elastase is supplied primarily by lymphocytes and eosinophils
d) Patients with hereditary alpha1-antitrypsin deficiency are prone to develop centrilobular emphysema
e) Smoking causes increased antielastase activity

(98) The following statements about the pathogenesis of bronchial asthma are true EXCEPT: (5 points)

a) Upon re-exposure to the allergen, mast cells on the mucosal surface are stimulated to release chemical mediators
b) During sensitization, Th2-type cells are stimulated to release cytokines which promote the production of IgE by B cells
c) The immediate phase includes bronchoconstriction, edema, and mucus secretion
d) The late phase is set by mast cells releasing cytokines which recruit eosinophils, neutrophils, monocytes, lymphocytes, and basophils
e) Histamine has been proven to be a powerful mediator, very important in the pathogenesis of extrinsic asthma
(99) Select the **CORRECT** statement about coal workers pneumoconiosis (CWP):
(5 points)

a) Progressive massive fibrosis (PMF) is a likely occurrence in pipe-smoking coal workers
b) CWP is secondary to exposure to the amorphous form of silicon dioxide
c) Simple CWP is represented histologically by 1-2 mm nodules of carbon-laden macrophages, with little fibrosis, adjacent to respiratory bronchioles
d) The presence of numerous carbon-laden macrophages in the lung and hilar lymph nodes of a cigarette smoking city-dweller who died at age seventy due to non-lung-related disease and had no respiratory complaints indicates that the patient was a stoic who suffered from respiratory insufficiency
e) Even if a patient with CWP develops PMF the heart will remain unaffected

(100) Select the **CORRECT** statement about staging of neoplasms: (5 points)

a) The classification system takes into account the extent of the tumor (T), the presence or absence of regional lymph node metastases, and the presence or absence of distant metastases
b) Prognosis can be stated with great accuracy based on staging
c) The size of the primary tumor is really not of much value in determining prognosis
d) Because of the diversity of tumor types, lung tumors cannot be staged
e) Staging of lung tumors takes into account the patient’s smoking history

(101) Which of the following lung tumors is **NOT** (or extremely rarely) associated with neuroendocrine granules: (5 points)

a) Tumorlets
b) Bronchioloalveolar carcinoma
c) Carcinoids
d) Atypical carcinoids
e) Small cell carcinoma
True (a) or False (b)

(102) In lobar sequestration the involved tissue lacks normal connections to the proximal airways and to pulmonary arteries (2 points)

(103) As a result of decrease in pulmonary vascular resistance after birth, pressure in the left atrium becomes greater than pressure in the right atrium and the foramen ovale functionally closes (2 points)

(104) Primary pulmonary hypertension of the newborn, also known as persistent fetal circulation, is characterized by persistent left to right shunting through the foramen ovale and ductus arteriosus, and by failure of the ductus venosus to close (2 points)

(105) Miliary tuberculosis is possible only with reactivation and is never seen with primary tuberculosis (2 points)

(106) When a lung abscess or a tuberculous cavity communicates with a bronchus and with the pleural cavity, the lesion is referred to as a bronchopleural fistula (2 points)

(107) The Charcot-Leyden crystal is seen in chronic bronchitis and represents a breakdown product of the immature neutrophil (2 points)

(108) The histology of bronchiolitis obliterans – organizing pneumonia (BOOP) is characterized by fibrous plugs in large bronchi and fibrosis in the lung periphery and pleura (2 points)

(109) The type of lung cancer most clearly associated with cigarette smoking is adenocarcinoma (2 points)
Fill in the blanks

(110) In congestive failure, what does the finding of alveolar hemosiderin-laden macrophages indicate about the amount of time the condition has been present (one word or several words) (3 points) ____________________________

(111) Indicate a microscopic finding in the alveoli which is seen in adult respiratory distress syndrome (ARDS) and in respiratory distress of the premature infant with surfactant deficiency (3 points) ____________________________

(112) In ARDS, capillary leak with interstitial and alveolar edema and fibrin exudation results from damage to the alveolar epithelium and -- (2 words preferred but more accepted if meaning is conveyed) (3 points) ________________ ________________

(113) Describe in one sentence the most significant gross feature which distinguishes lobar pneumonia and bronchopneumonia (3 points) ____________________________

(114) The prototypic interstitial pneumonia, characterized by the insidious onset of dyspnea in a middle-aged person and histologically showing heterogeneous localization and timing of fibrosis in the interstitium, is called __________ interstitial pneumonia (3 points)

(115) The type of lung cancer clearly related to smoking, arising from the bronchus in a central location, and, if well-differentiated, showing keratinization and intercellular bridges is (3 points) ________ ______ __________
(116) The patient had "a chronic relapsing inflammatory disorder characterized by hyperreactive airways, leading to episodic, reversible bronchoconstriction, owing to increased responsiveness of the tracheobronchial tree to various stimuli". The disease entity from which the patient suffered was ___________ _________ (3 points)

(117) As illustrated, the basement membrane is thickened and the predominant inflammatory cell in this disorder is the _______________ (3 points)
<p>|   | ANSWER_KEY 1 |   | ANSWER_KEY 2 |   | ANSWER_KEY 3 |   | ANSWER_KEY 4 |   | ANSWER_KEY 5 |   | ANSWER_KEY 6 |   | ANSWER_KEY 7 |   | ANSWER_KEY 8 |   | ANSWER_KEY 9 |   | ANSWER_KEY 10 |   | ANSWER_KEY 11 |   | ANSWER_KEY 12 |   | ANSWER_KEY 13 |   | ANSWER_KEY 14 |   | ANSWER_KEY 15 |   | ANSWER_KEY 16 |   | ANSWER_KEY 17 |   | ANSWER_KEY 18 |   | ANSWER_KEY 19 |   | ANSWER_KEY 20 |   | ANSWER_KEY 21 |   | ANSWER_KEY 22 |   | ANSWER_KEY 23 |   | ANSWER_KEY 24 |   | ANSWER_KEY 25 |   | ANSWER_KEY 26 |   | ANSWER_KEY 27 |   | ANSWER_KEY 28 |   | ANSWER_KEY 29 |   | ANSWER_KEY 30 |   | ANSWER_KEY 31 |   | ANSWER_KEY 32 |   | ANSWER_KEY 33 |   | ANSWER_KEY 34 |   | ANSWER_KEY 35 |   | ANSWER_KEY 36 |   | ANSWER_KEY 37 |   | ANSWER_KEY 38 |   | ANSWER_KEY 39 |   | ANSWER_KEY 40 |   | ANSWER_KEY 41 |   | ANSWER_KEY 42 |   | ANSWER_KEY 43 |   | ANSWER_KEY 44 |   | ANSWER_KEY 45 |   | ANSWER_KEY 46 |   |
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SECTION 1 (74 items)  50.00