This exam consists of 50 questions, each of equal value. Choose the single most appropriate lettered answer for entry onto the Pharmacology Exam #4 Answer Sheet.

1. Effects associated with activation of opiate mu receptors:
   A. Inhibition of resting potential potassium permeability
   B. Inhibition of adenylyl cyclase activity
   C. Inhibition of voltage-gated calcium permeability
   D. A and B
   E. B and C

2. Indicate which of the following statements concerning morphine are CORRECT:
   A. It produces analgesia via action in both the brain and the spinal cord
   B. If a patient is tolerant to the analgesic effects of meperidine, the patient will also be tolerant to the analgesic effects of morphine
   C. After intravenous administration, morphine gets into the brain faster and to a higher concentration compared to an equal dose of heroin
   D. A and B
   E. B and C

3. Indicate which pairings below are CORRECT:
   A. Chlorothiazide: A potassium-sparing diuretic
   B. Furosemide: A diuretic with an efficacy of greater than 15% for inhibiting sodium reabsorption
   C. Acetazolamide: A diuretic with a main site of action in the collecting duct
   D. A and B
   E. B and C

4. Indicate which of the diuretics below has the greatest efficacy for inhibiting sodium reabsorption:
   A. Triamterene
   B. Metolazone
   C. Bumetanide
   D. Spironolactone
   E. Amiloride
5. Indicate which of these anesthetic agents is most likely to cause sensitization of the heart to the action of catecholamines:

A. Halothane  
B. Enflurane  
C. Thiopental  
D. Nitrous Oxide  
E. Isoflurane

6. Indicate which stage of anesthesia corresponds to the following description:
   Spontaneous movements cease; regular respiration; loss of eyelash reflex:

A. Stage 1  
B. Stage 2  
C. Stage 3  
D. Stage 4  
E. Stage 5

7. All of the following statements concerning hypertension are correct EXCEPT:

A. Ganglionic blockers such as hexamethonium can lower blood pressure in hypertensive patients  
B. Blood pressure will increase if peripheral resistance doesn’t change but cardiac output increases  
C. Non-drug regimens such as exercise and weight loss can produce a reduction in blood pressure in hypertensive patients  
D. The first approach in initiating drug therapy for hypertension is to start with the use of a single anti-hypertensive drug  
E. The great majority (about 90%) of cases of hypertension are due to a known causative condition

8. Minoxidil can lower blood pressure because it:

A. Stimulates adrenergic β2-receptors  
B. Increases potassium permeability  
C. Blocks Ca++ channels  
D. Produces nitric oxide  
E. Blocks adrenergic α1 receptors
9. All of the following can occur following administration of furosemide EXCEPT:

A. Reduction of renal excretion of salicylates
B. Enhancement of ototoxicity of gentamicin
C. Reduction of renal clearance of lithium
D. Augmentation of pressor action of norepinephrine
E. Hyperuricemia

10. Diuretic agents that indirectly cause an increased binding of digoxin to cardiac tissue sodium-potassium-ATPase include all of the following EXCEPT:

A. Amiloride
B. Hydrochlorothiazide
C. Torsemide
D. Indapamide
E. Ethacrynic acid

#11-17. Match-up the numbered anti-hypertensive agents below with the single most appropriate lettered description describing the antihypertensive mechanism of action. Each lettered description may be used once, more than once, or not at all.

11. Clonidine
12. Prazosin
13. Reserpine
14. α-Methyldopa
15. Enalapril
16. α-Methyltyrosine
17. Atenolol

A. Inhibition of catecholamine uptake into synaptic vesicles
B. Inhibition of angiotensin converting enzyme (ACE)
C. Stimulation of α2 receptors in the central nervous system
D. Inhibition of tyrosine hydroxylase
E. Inhibition of α2 receptors in the peripheral nervous system
F. Inhibition of β1 receptors
G. Inhibition of α1 receptors

18. The main mechanism of action for local anesthetics such as procaine (Novacain):

A. Activation of GABA_A receptors
B. Activation of voltage-gated potassium channels
C. Inhibition of glutamate receptors
D. Inhibition of voltage-gated calcium channels
E. Inhibition of voltage-gated sodium channels
19. Intravenous anesthetic X has a MAC (minimum alveolar concentration) of 2%. The lowest concentration in the inspired air mixture that you could use of anesthetic X to produce anesthesia in greater than 99% of patients is:

A. 2.6 %
B. 4.4 %
C. 6.6 %
D. 8 %
E. 10 %

20. An example of an opiate used to induce anesthesia:

A. Codeine
B. Thiopental
C. Fentanyl
D. A and B
E. B and C

21. Nitrous oxide is not used as a sole anesthetic because:

A. Its MAC value is too high
B. It is too soluble in the plasma
C. It takes too long to produce anesthesia
D. A and B
E. A, B and C

22. A patient is brought into the emergency room in a coma due to a heroin overdose. To reverse this coma, you could administer:

A. Oxycodone
B. Naltrexone
C. Fentanyl
D. A and B
E. B and C

23. The blood gas partition coefficient for diethyl ether is higher than is the coefficient for halothane. From this we can conclude:

A. Ether will take longer than halothane to produce anesthesia
B. Ether will take longer than halothane to lose its anesthetic effect upon discontinuation of anesthetic administration
C. Ether is more likely to produce hepatotoxicity compared to halothane
D. A and B
E. A, B and C
24-28. Match-up the numbered diuretic below with the most relevant single lettered site in the kidney where this drug works to produce diuresis. Each lettered choice may be used once, more than once, or not at all. Sites are identified in the drawing above.

24. Hydrochlorothiazide
25. Triamterene
26. Acetazolamide
27. Spironolactone
28. Furosemide
   A. Proximal Convoluted Tubule
   B. Descending loop of Henle
   C. Ascending loop of Henle
   D. Distal convoluted tubule
   E. Collecting Duct

29. Indicate which of the diuretics below would be the first choice to use in treating a hypertensive patient with normal renal function:

   A. Furosemide
   B. Hydrochlorothiazide
   C. Acetazolamide
   D. Amiloride
   E. Mannitol
30. An antihypertensive agent that blocks both $\alpha_1$ and $\beta_1$ receptors:

A. Losartan  
B. Clonidine  
C. Phentolamine  
D. Labetalol  
E. $\alpha$-Methyldopamine

31. R.G. is a 53-year-old male who is being treated with propranolol for hypertension. A decision is made to augment this treatment by adding a calcium channel blocker. Why might nifedipine be chosen over verapamil as the calcium channel blocker to add?

A. Verapamil inhibits propranolol metabolism  
B. Verapamil displaces propranolol from plasma protein binding sites  
C. Verapamil produces greater cardiac depression compared to nifedipine  
D. Verapamil blocks propranolol binding to cardiac $\beta$-receptors  
E. Verapamil inhibits propranolol absorption from the GI tract

32. Which of the following statements concerning morphine are CORRECT?:

A. Only the L-isomer is analgesic  
B. It has good affinity for mu receptors  
C. It is a peptide  
D. A and B  
E. A, B and C

33. In 1846 William Morton provided the first successful demonstration of a general anesthetic at Mass. General Hospital utilizing:

A. Chloroform  
B. Cyclopropane  
C. Thiopental  
D. Halothane  
E. Ether

34. The minimum alveolar concentration (MAC) is defined as:

A. The amount of anesthetic needed to eliminate movements in 50% of patients challenged with a standardized skin incision  
B. The amount of anesthetic needed to produce a 50% reduction in pain sensation  
C. The amount of anesthetic needed to produce a 50% reduction in movement in patients challenged with a standardized skin incision  
D. The amount of anesthetic needed to produce a 100% reduction in pain sensation  
E. The amount of anesthetic needed to produce a measurable reduction in pain sensation
35. All of the following are examples of acute side effects of opiates EXCEPT:

A. Constriction of the pupils  
B. Respiratory depression  
C. Histamine release from mast cells  
D. Diarrhea  
E. Emesis (vomiting)

36. In order to delay absorption of a local anesthetic into the general circulation, administration of the local anesthetic can be combined with administration of:

A. Epinephrine  
B. Phenylephrine  
C. Phentolamine  
D. A and B  
E. A, B and C

37. Which of the following statements concerning local anesthetics are CORRECT?:

A. Most local anesthetics exhibit use-dependent neuronal blockade  
B. Small diameter pain fibers are more sensitive to blockade compared to motor neurons  
C. At the therapeutic dosages used, motor neurons are blocked by local anesthetics  
D. A and B  
E. A, B and C

38. The rationale for using tubocurarine together with an inhalation anesthetic:

A. Tubocurarine plus inhalation anesthetic will produce a greater analgesic effect than inhalation anesthetic alone  
B. Tubocurarine will allow neuromuscular blockade to be achieved while using a lower concentration of inhalation anesthetic  
C. Tubocurarine will hasten the recovery from inhalation anesthetic effects once the inhalation anesthetic administration is stopped  
D. Tubocurarine will reduce the incidence of nausea produced by inhalation anesthetics  
E. Tubocurarine will reduce the incidence of hepatotoxicity produced by inhalation anesthetics

39. Nitroprusside can be used in a hypertensive emergency because it:

A. Inhibits voltage-gated calcium channels  
B. Stimulates adenyl cyclase activity  
C. Produces nitric oxide  
D. Desensitizes α1 receptors  
E. Inhibits inositol triphosphate (IP3) production
40. Your patient is a 23-year-old male with a pheochromocytoma (adrenal medullary tumor), blood pressure of 190/120, and normal pulmonary and renal function. His catecholamines are elevated and he has a well-defined abdominal tumor on MRI. He has been scheduled for surgical removal of the tumor. Of the agents listed below, indicate which drug is the LEAST suitable for inclusion in his anesthesia protocol:

A. Halothane
B. Midazolam
C. Nitrous oxide
D. Thiopental
E. Isoflurane

41. Which of the following antihypertensive drugs is most likely to lower blood sugar levels?

A. Enalapril
B. Nifedipine
C. Prazosin
D. Propranolol
E. Hydralazine

42. All of the following produce a significant decrease in peripheral resistance EXCEPT:

A. Clonidine
B. Hydralazine
C. Chronic diuretic treatment
D. Enalapril
E. Atenolol

43. Which of the following diuretics would be contraindicated in a patient experiencing hyperkalemia?

A. Furosemide
B. Amiloride
C. Chlorothiazide
D. Acetazolamide
E. Bumetanide

44. An osmotic diuretic that can be used to maintain urine flow during acute renal failure:

A. Spironolactone
B. Bumetanide
C. Mannitol
D. A and B
E. B and C
45. Your patient has a blood pressure of 90/62, a heart rate of 150 beats/minute, and complains of feeling faint. Indicate which of the following drugs represents the most appropriate treatment for this patient:

A. Dobutamine  
B. Nitroglycerin  
C. Norepinephrine  
D. Epinephrine  
E. Amphetamine

46. The most efficacious diuretics (greatest increase in sodium excretion) are those that work in the:

A. Collecting Duct  
B. Distal Tubule  
C. Ascending loop of Henle  
D. Descending loop of Henle  
E. Proximal tubule

47. Indicate which of the following statements concerning the dorsal horn of the spinal cord are CORRECT:

A. It contains interneurons that use enkephalin as a transmitter  
B. It contains pre-synaptic receptors on the terminals of primary afferent pain neurons which, when activated by enkephalin, inhibit release of the primary afferent neuron transmitters  
C. It contains pre-synaptic receptors on the terminals of primary afferent pain neurons which, when activated by morphine, inhibit release of the primary afferent neuron transmitters  
D. A and B  
E. A, B and C

48. Examples of calcium channel antagonists that are more selective for blocking calcium channels in smooth muscle compared to calcium channels in the heart, and therefore find clinical usage as antihypertensive agents:

A. Nifedipine  
B. Nicardipine  
C. Verapamil  
D. A and B  
E. B and C
49. Indicate which of the following statements concerning *midazolam* and *diazepam* are **CORRECT**:

A. Both cause significant respiratory depression  
B. Both are used as anesthetic inducing agents  
C. Diazepam has a shorter half-life compared to midazolam  
D. A and B  
E. B and C

50. Which of the following drugs is **LEAST** appropriate for treating a patient with Stage 1 (mild) hypertension and asthma?

A. Enalapril  
B. Losartan  
C. Propranolol  
D. Diltiazem  
E. Atenolol

END OF PHARMACOLOGY EXAM #4
TIME TO ENJOY THE HOLIDAYS!