SECTION A. Answer each question in this section by writing the letter corresponding to the best answer on the line provided (2 points each; 50 points total)

1. The drug illustrated below:

   ![Chemical Structure]

   I  Irreversibly inhibits cyclooxygenase
   II Undergoes metabolic hydrolysis to salicylic acid
   III Is an organic acid that can irritate the stomach

   a) I only
   b) III only
   c) I and II only
   d) II and III only
   e) I, II, and III

   Answer  

2. The drug illustrated below is:

   ![Chemical Structure]

   I  Can readily enter the CNS because it is non-polar
   II Is used primarily as an analgesic during childbirth
   III Is administered with atropine for control of diarrhea

   a) I only
   b) III only
   c) I and II only
   d) II and III only
   e) I, II, and III

   Answer  

3. The drug illustrated below:

   ![Chemical Structure]

   I  Has good antitussive activity
   II Can undergo metabolic conversion into morphine
   III Has no affinity for μ-receptors because of the 7,8-double bond

   a) I only
   b) III only
   c) I and II only
   d) II and III only
   e) I, II, and III

   Answer  

   1
4. The drug illustrated below:

- I Is susceptible to environmental oxidation at the amino group and should be stored under nitrogen
- II Is metabolized rapidly by ester hydrolysis
- III Is usually administered together with atropine to reduce its abuse potential

a) I only
b) III only
c) I and II only
d) II and III only
e) I, II, and III

Answer ______

5. The drug illustrated below:

- I Is likely to cause methemoglobinemia in susceptible patients
- II Is a salicylate NSAID
- III Is used to treat mild to moderate pain

a) I only
b) III only
c) I and II only
d) II and III only
e) I, II, and III

Answer ______

6. The drug illustrated below:

- I Is a cis-1,2-disubstituted cyclohexane derivative
- II Contains the necessary pharmacophore for a μ-agonist and is used to treat pain
- III Is a trans-1,2-disubstituted cyclohexane derivative

a) I only
b) III only
c) I and II only
d) II and III only
e) I, II, and III

Answer ______

7. The drug illustrated below:

- I Is a salt of citric acid
- II Is an extremely potent analgesic
- III Can be used to induce and maintain anesthesia during surgery

a) I only
b) III only
c) I and II only
d) II and III only
e) I, II, and III

Answer ______
8. **The drug illustrated below:**

|   | I Can be used at high doses as an antidote to cyanide poisoning  
|   | II Is used at high doses for treating methemoglobinemia  
|   | III Is used to treat an overdose of acetaminophen  
|---|---|---|---|
| a) | I only  
| b) | III only  
| c) | I and II only  
| d) | II and III only  
| e) | I, II, and III  

**Answer**

9. **The drug illustrated below:**

|   | I Is naproxen  
|   | II Must be metabolically converted into 6-methoxy-2-naphthaleneacetic acid before it can function as an anti-inflammatory agent  
|   | III Produces very little stomach upset because it is not acidic  
|---|---|---|---|
| a) | I only  
| b) | III only  
| c) | I and II only  
| d) | II and III only  
| e) | I, II, and III  

**Answer**

10. **The drug illustrated below:**

|   | I Is a prodrug that must be metabolized to salicylic acid before becoming active  
|   | II Is a potent antipyretic agent used to reduce fever  
|   | III Is used primarily for treating pain and arthritis  
|---|---|---|---|
| a) | I only  
| b) | III only  
| c) | I and II only  
| d) | II and III only  
| e) | I, II, and III  

**Answer**

11. **The drug illustrated below:**

|   | I Is used to treat cough  
|   | II Has little affinity for μ-receptors  
|   | III Is a potent μ-antagonist  
|---|---|---|---|
| a) | I only  
| b) | III only  
| c) | I and II only  
| d) | II and III only  
| e) | I, II, and III  

**Answer**
12. **The drug illustrated below:**

<table>
<thead>
<tr>
<th><strong>I</strong></th>
<th>Has a short duration of action, but a rapid onset</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>II</strong></td>
<td>Is used as an analgesic during labor</td>
</tr>
<tr>
<td><strong>III</strong></td>
<td>Is an agonist at both μ- and κ-receptors</td>
</tr>
</tbody>
</table>

- a) I only
- b) III only
- c) I and II only
- d) II and III only
- e) I, II, and III

**Answer** ______

13. **The drug illustrated below:**

<table>
<thead>
<tr>
<th><strong>I</strong></th>
<th>Is metabolized more rapidly by amide hydrolysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>II</strong></td>
<td>Is an injectible local anesthetic used in dentistry</td>
</tr>
<tr>
<td><strong>III</strong></td>
<td>Is metabolized more rapidly by ester hydrolysis</td>
</tr>
</tbody>
</table>

- a) I only
- b) III only
- c) I and II only
- d) II and III only
- e) I, II, and III

**Answer** ______

14. **The drug illustrated below:**

<table>
<thead>
<tr>
<th><strong>I</strong></th>
<th>Is a derivative of the amino acid cysteine</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>II</strong></td>
<td>Is used to deactivate toxic electrophilic metabolites of acetaminophen when natural glutathione has been depleted</td>
</tr>
<tr>
<td><strong>III</strong></td>
<td>Possesses a thiol functional group that behaves as a nucleophile</td>
</tr>
</tbody>
</table>

- a) I only
- b) III only
- c) I and II only
- d) II and III only
- e) I, II, and III

**Answer** ______

15. **The drug illustrated below:**

<table>
<thead>
<tr>
<th><strong>I</strong></th>
<th>Is a highly addicting μ-agonist used to treat severe pain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>II</strong></td>
<td>Is used to reverse respiratory depression caused by an overdose of opioids</td>
</tr>
<tr>
<td><strong>III</strong></td>
<td>Is ineffective when administered orally</td>
</tr>
</tbody>
</table>

- a) I only
- b) III only
- c) I and II only
- d) II and III only
- e) I, II, and III

**Answer** ______
16. **The drug illustrated below:**

![Chemical Structure]

- I Is used as a local anesthetic in over the counter formulations such as lozenges for treating sore throats
- II Is 100% ionized at all pH values
- III Is used as a local anesthetic in the eyes during cataract surgery

a) I only  

b) III only  

c) I and II only  

d) II and III only  

e) I, II, and III

**Answer**

17. **The drug illustrated below:**

![Chemical Structure]

- I Can undergo metabolism by keto-reductases to give a secondary alcohol
- II Is an aryl acetic acid NSAID
- III Is used to treat arthritis

a) I only  

b) III only  

c) I and II only  

d) II and III only  

e) I, II, and III

**Answer**

18. **The drug illustrated below:**

![Chemical Structure]

- I Is an opiate
- II Belongs to the lidocaine class of local anesthetics
- III Is used to treat severe pain in cancer patients

a) I only  

b) III only  

c) I and II only  

d) II and III only  

e) I, II, and III

**Answer**

19. **The drug illustrated below:**

![Chemical Structure]

- I Is not a μ-agonist because it lacks the 4,5-epoxy function on the morphinan system
- II Is used over the counter as a cough suppressant
- III Is a potent μ-agonist used to treat severe pain

a) I only  

b) III only  

c) I and II only  

d) II and III only  

e) I, II, and III

**Answer**
20. **The drug illustrated below:**

![Drug Image]

- I Is used to treat inflammation in the eyes following cataract extractions
- II Is an inhibitor of cyclooxygenase
- III Is a uricosuric agent used to treat chronic gout

a) I only  
b) III only  
c) I and II only  
d) II and III only  
e) I, II, and III  

**Answer** _____

---

21. **The compound illustrated below:**

![Compound Image]

- I Is released from phospholipids as needed by the action of phospholipase A2
- II Is a substrate for cyclooxygenase
- III Is converted in the body into leukotrienes by the action of 5-lipoxygenase

a) I only  
b) III only  
c) I and II only  
d) II and III only  
e) I, II, and III  

**Answer** _____

---

22. **The drug illustrated below:**

![Drug Image]

- I Is a potent analgesic with diminished potential for causing respiratory depression
- II Is an agonist at κ-receptors and a partial antagonist at μ-receptors
- III Would be expected to be most effective when administered orally

a) I only  
b) III only  
c) I and II only  
d) II and III only  
e) I, II, and III  

**Answer** _____
23. **The drug illustrated below:**

![Drug structure](image)

I  Is an aryl acetic acid NSAID  
II  Undergoes rapid metabolism by amide hydrolysis  
III  Is used as a topical local anesthetic  

a) I only  
b) III only  
c) I and II only  
d) II and III only  
e) I, II, and III  

**Answer**

24. **The drug illustrated below:**

![Drug structure](image)

I  Is a pro-drug  
II  Is metabolized by bacteria in the colon to two molecules of 5-aminosalicyclic acid  
III  Has no known activity due to the charged carboxylate groups  

a) I only  
b) III only  
c) I and II only  
d) II and III only  
e) I, II, and III  

**Answer**

25. **The drug illustrated below:**

![Drug structure](image)

I  Is rapidly metabolized to an inactive ketone at the 16-position  
II  Is an analog of PGE\textsubscript{2}  
III  Is used to prevent against gastric ulcers  

a) I only  
b) III only  
c) I and II only  
d) II and III only  
e) I, II, and III  

**Answer**
Section B. On the line to the right of each of the following structures write the letter corresponding to its generic name (shown at bottom of page). (10 Points).

A. Salsalate
B. Acetaminophen
C. Chloroprocaine
D. Oxycodone
E. Colchicine
F. Pentazocine
G. Indomethacin
H. Bupivacaine
I. Antipyrine
J. Oxymorphone
K. Balsalazide
L. Ropivacaine
M. Choline Salicylate
N. Sulindac
O. Sulfasalazine
Section C. For each of the following answer the questions pertaining to the metabolism of the drugs shown in the boxes. You will be awarded 1 point for each correct metabolite and will lose 1 point for each incorrect metabolite. (10 Points).

1. On the line, write the letter(s) corresponding to all likely phase I metabolic pathways for the drug shown in the box below. ____________________
2. On the line, write the letter(s) corresponding to all likely phase I metabolic pathways for the drug shown in the box below.
3. On the line, write the letter(s) corresponding to all likely phase I metabolic pathways for the drug shown in the box below.

Section D. For each of the following drugs write on the appropriate lines the principal medicinal use and the mechanism of action associated with that use. (10 Points).

1.
2. [Chemical structure of compound 2]
   
   **Medicinal Use:**
   
   **Mechanism:**

3. [Chemical structure of compound 3]
   
   **Medicinal Use:**
   
   **Mechanism:**

4. [Chemical structure of compound 4]
   
   **Medicinal Use:**
   
   **Mechanism:**

5. [Chemical structure of compound 5]
   
   **Medicinal Use:**
   
   **Mechanism:**
Section E. For each of the following systematic names, **draw the correct chemical structure, including stereochemistry** wherever indicated. Partial credit will be given but you will lose points for incorrect chemical symbols, hydrogens missing from heteroatoms, hydrogens missing from carbons labeled C, and for having too many bonds to an atom. (20 Points).

1. N-(2-Chloro-6-methylphenyl)-3-[2,3,4,4a,5,6,7,7a-octahydro-1H-cyclopenta[b]pyridine-1-yl]propanamide, *trans-*

2. Morphinan-6-one, 7,8-didehydro-4,5-epoxy-3-hydroxy-17-methyl-14-(pentylamino)-, (5α)-

3. 4-Piperidinecarboxylic acid, 3-methyl-4-[(1-oxopropyl)phenylamino]-1-(2-phenylethyl)-, methyl ester, *cis-*

4. 2H-Thieno[2,3-e][1,2]thiazine-3-carboxamide, 6-chloro-4-hydroxy-2-methyl-N-2-pyridinyl-, 1,1-dioxide