Part I. 80 Points (40 Questions; 2 Points Each)
Select the BEST answer for each of the following. If none of the answers are correct, do
not fill in the Scantron for that particular question and write “NONE” on your exam.

1. Which of the comments are valid-

<table>
<thead>
<tr>
<th>Low-molecular weight heparins (LMWHs)</th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cannot be administered orally.</td>
<td>can be used to prevent deep vein thrombosis.</td>
<td>are associated with a lower risk for heparin-induced thrombocytopenia syndrome (HIT syndrome).</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

2. The drug illustrated below has:

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:

A. I only  
B. III only  
C. I and II only  
D. II and III only  
E. I, II, and III  

Answer
4. The drug illustrated below:

I can stimulate appetite and can cause weight gain.
II is available OTC.
III is non-sedating H₁-receptor antagonist.

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 inhibits the ADP binding to receptors on platelets by causing a reversible modification.
II reduces platelets by limiting the maturation of megakaryocytes into platelets.
III is administered orally.

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 approved for the treatment of duodenal ulcers.
II is effective in lowering stomach pH.
III can be used in individuals with chronic renal failure.

R = SO₃[(Al)₂(OH)ₓ(H₂O)ᵧ]

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 frequently causes heparin-induced thrombocytopenia (HIT).
II has the same mechanism of action as heparin.
III is a direct thrombin inhibitor.

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 is the most potent of the H₂-receptor antagonists.
II causes an increase in gastric pH.
III inhibits hepatic enzymes.

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 is:

I is used to inactivate heparin.
II is a glycoprotein.
III is a direct thrombin inhibitor that is cleared via the kidneys.

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 binds to antithrombin III.
II accelerates the inactivation of several clotting factors.
III activates prothrombin.

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:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>binds to GPIIB/IIIA receptors blocking access by fibrinogen.</td>
</tr>
<tr>
<td>II</td>
<td>accelerates the degradation of fibrin clots.</td>
</tr>
<tr>
<td>III</td>
<td>unlike eptifibatide, is 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**

12. The drug illustrated below:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>is an antidepressant.</td>
</tr>
<tr>
<td>II</td>
<td>can be administered topically to the eye.</td>
</tr>
<tr>
<td>III</td>
<td>is used to treat allergic conjunctivitis.</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 is:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>a H₁-receptor agonist.</td>
</tr>
<tr>
<td>II</td>
<td>among the less sedating of the first-generation antihistamines.</td>
</tr>
<tr>
<td>III</td>
<td>available OTC.</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. Which of the comments are valid:

<table>
<thead>
<tr>
<th>Urokinase</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>is a serine protease.</td>
</tr>
<tr>
<td>II</td>
<td>is isolated from human kidney tissue cultures.</td>
</tr>
<tr>
<td>III</td>
<td>is an enzyme inhibitor.</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:

![Drug Structure](image)

- I is metabolically-transformed to an electrophile
- II is manufactured as an enteric-coated tablet.
- III is used not only for the treatment of duodenal ulcers, but also gastroesophageal reflux disease, GERD.

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:

![Drug Structure](image)

- I activates antithrombin III.  
- II inhibits Vitamin K epoxide reductase.  
- III inhibits the synthesis of Factor X, the Stuart-Prower factor.

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:

![Drug Structure](image)

- I is selective for peripheral H1-receptors.  
- II is a h-ERG channel inhibitor.  
- III is used to prevent motion sickness.

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 is:

\[
\begin{array}{c}
\text{O} \\
\text{N} \\
\text{N} \\
\text{CH}_2\text{Cl} \\
\text{N} \\
\text{CH}_3 \\
\text{CH}_2\text{-} \\
\text{Cl}
\end{array}
\]

I an antihistamine that is administered as a nasal spray.
II is used topically as an opthalmic.
III is non-sedating.

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:

\[
\begin{array}{c}
\text{CO}_2\text{H} \\
\text{OCCH}_3 \\
\text{O} \\
\end{array}
\]

I irreversibly inhibits cyclooxygenase in platelets.
II inhibits the formation of thromoxane A\textsubscript{2} (TXA\textsubscript{2}) in platelets.
III can limit mucus formation associated with the lining of the stomach.

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:

\[
\begin{array}{c}
\text{CH}_2\text{CH}_2\text{CH}_2\text{O} \\
\text{N} \\
\text{N} \\
\text{N} \\
\text{N} \\
\text{N} \\
\text{N} \\
\text{N} \\
\text{H} \\
\text{N} \\
\text{O} \\
\end{array}
\]

I blocks ADP receptors.
II inhibits platelet aggregation.
III specifically inhibits phosphodiesterase type 3 (PDE 3)

A. I only
B. III only
C. I and II only
D. II and III only
E. I, II, and III

Answer
21. The drug illustrated below

I. is a prodrug of caffeine.
II. is weakly basic.
III. is used to treat infant apnea.

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

23. is extensively metabolized.
24. is metabolized through oxidative reactions.
25. is resistant to hydrolysis.

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

I. is weakly acidic.
II. is not metabolized through oxidative phase I reactions.
III. is used to treat neurological conditions characterized by excessive daytime sleepiness.

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

| I. | is used as an appetite suppressant. |
| II. | is just as likely to lead to abuse as amphetamine. |
| III. | has one chiral center and thus two stereoisomers with the S-enantiomer being more active. |

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

| I. | is used along with diet and exercise for the short-term treatment of obesity. |
| II. | is metabolized through oxidative N-demethylation. |
| III. | has two chiral centers and four stereoisomers. |

A. I only  
B. III only  
C. I and II only  
D. II and III only  
E. I, II, and III

Answer __________

26. The drug illustrated below

| I. | is used as an anorexient. |
| II. | has a phenyl ring with reduced metabolic liability. |
| III. | is metabolized through N-demethylation to give two inactive amine metabolites. |

A. I only  
B. III only  
C. I and II only  
D. II and III only  
E. I, II, and III

Answer __________
27. **The drug illustrated below**

<table>
<thead>
<tr>
<th>I.</th>
<th>II.</th>
<th>III.</th>
</tr>
</thead>
<tbody>
<tr>
<td>reversibly inhibits pancreatic lipase.</td>
<td>is synthetic analog of natural product called lipstatin.</td>
<td>contains a lactone functional group.</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**

---

28. **The two structures illustrated below**

<table>
<thead>
<tr>
<th>I.</th>
<th>II.</th>
<th>III.</th>
</tr>
</thead>
<tbody>
<tr>
<td>are enantiomers.</td>
<td>are both erythro isomers.</td>
<td>A is the more active isomer marketed as dexamethylphenidate for ADHD.</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**

---

29. **The drug illustrated below**

<table>
<thead>
<tr>
<th>I.</th>
<th>II.</th>
<th>III.</th>
</tr>
</thead>
<tbody>
<tr>
<td>contains amino acid leucine.</td>
<td>is a prodrug used for ADHD in 6-12-year-olds.</td>
<td>is metabolized to release the active drug through 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**
30. The drug illustrated below

I. is an SSRI used as an antidepressant.
II. is mainly metabolized through reductive pathways.
III. is orally active.

A. I only
B. III only
C. I and II only
D. II and III only
E. I, II, and III

Answer

31. The drug illustrated below

I. is a mechanism-based MAO inhibitor used to treat depression.
II. is a reversible inhibitor.
III. has one chiral center and thus two stereoisomers.

A. I only
B. III only
C. I and II only
D. II and III only
E. I, II, and III

Answer

32. The drug illustrated below

I. is an antidepressant that can be used to treat enuresis.
II. is metabolized through aromatic hydroxylation followed by conjugation reactions to inactive metabolites.
III. is metabolized to secondary and primary amine metabolites that are inactive.

A. I only
B. III only
C. I and II only
D. II and III only
E. I, II, and III

Answer
33. **The drug illustrated below**

<p>| | | |</p>
<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
</table>
| ![Drug](image1.png) | I. is used for the relief of symptoms of depression.  
II. has antipsychotic properties due to its D<sub>2</sub> receptor blocking activity.  
III. Chlorine substitution makes the benzene ring on the right more susceptible to metabolic hydroxylation. | A. I only  
B. III only  
C. I and II only  
D. II and III only  
E. I, II, and III |

**Answer**

34. **The drug illustrated below**

<p>| | | |</p>
<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
</table>
| ![Drug](image2.png) | I. is a strong H<sub>1</sub> antagonist leading to sedative side effects.  
II. is an antagonist leading to increased adrenergic and serotonergic transmission.  
III. is an agonist at 5-HT<sub>2A</sub>, 5-HT<sub>2C</sub>, and 5-HT<sub>3</sub>. | A. I only  
B. III only  
C. I and II only  
D. II and III only  
E. I, II, and III |

**Answer**

35. **The drug illustrated below**

<p>| | | |</p>
<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
</table>
| ![Drug](image3.png) | I. induces enzymes responsible for its own metabolism leading to a shorter half life after long-term use.  
II. is extensively metabolized through demethylation resulting in an active metabolite.  
III. is an SSRI that can be used to treat alcoholism. | A. I only  
B. III only  
C. I and II only  
D. II and III only  
E. I, II, and III |

**Answer**
36. **The drug illustrated below**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>is an SSRI that can be used to treat OCD.</td>
</tr>
<tr>
<td>II.</td>
<td>is extensively metabolized to hydroxyl-containing metabolites and their conjugates.</td>
</tr>
<tr>
<td>III.</td>
<td>is orally inactive and has to be administered through injection.</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**  

37. **The drug illustrated below**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>has a metabolite with the t-butyl group removed through oxidative dealkylation.</td>
</tr>
<tr>
<td>II.</td>
<td>is metabolically reduced to a primary alcohol.</td>
</tr>
<tr>
<td>III.</td>
<td>is used for smoking cessation.</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**  

38. **The drug illustrated below**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>can be viewed as a conformationally restricted analog of sumatriptan.</td>
</tr>
<tr>
<td>II.</td>
<td>has a short half life just like most other triptans.</td>
</tr>
<tr>
<td>III.</td>
<td>is a 5-HT1 receptor antagonist indicated for migraine headache.</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**
39. **The drug illustrated below**

![Drug Illustration]

I. is a 5-HT$_1$ receptor agonist.
II. is effective against vomiting and nausea.
III. has a pharmacophore consisted of a basic center and an aromatic ring linked through a carbonyl-containing linker.

A. I only  
B. III only  
C. I and II only  
D. II and III only  
E. I, II, and III

**Answer**

40. **The drug illustrated below**

![Drug Illustration]

I. is used for the prevention of nausea and vomiting in combination with other antiemetics.
II. is a substance P antagonist on NK1 receptor.
III. The F and CF$_3$ help deactivate the aromatic rings and increase metabolic stability.

A. I only  
B. III only  
C. I and II only  
D. II and III only  
E. I, II, and III

**Answer**

**Part II * Points (4 Questions , 1 Point each)**

51. and 52. Match a structure provided below to the generic name

![Structures A, B, C, D, E]

A. Desipramine  
B.  
C.  
D.  
E.  

51. Desipramine
52. Match a structure provided below to the generic name

Sertraline

53. Match a structure provided below to the generic name

Eptifibatide
54. Match a structure provided below to the generic name

![Structures](image)

54. **Emedastine**

**Part III. (16 Points)** Complete the structures of the FOUR following compounds

**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 (see below for examples).

**Examples:**

Incorrect:

- Incorrect chemical symbol (-1 point each)
- Hydrogen missing from nitrogen (-1 point)
- 5 bonds to carbon (-2 points)
- Hydrogens missing from carbon chain (-1 point)

Correct:

1. 1-Piperazineacetamide, N-(2-methyl-4-(imidazol-1-yl)phenyl)-4-[2-hydroxy-3-(2-ethoxyphenoxy)propyl]- dihydrochloride

3. (R)-3-(Dimethylamino)-N-(cyclopropyl)-2,3,4,9-tetrahydro-1H-carbazol-6-methylsulfonamide

4. Ethanamine, 2-[(4-chlorophenyl)-2-pyridinylmethoxy]-N-phenyl-N-(2-pyridyl)

There are Twelve pages in this exam!

<table>
<thead>
<tr>
<th>Part</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part I</td>
<td>80</td>
</tr>
<tr>
<td>Part II</td>
<td>4</td>
</tr>
<tr>
<td>Part III</td>
<td>16</td>
</tr>
</tbody>
</table>