MEDICINAL CHEMISTRY I
EXAM #1
October 2, 2009

Name ________________________________

There are Thirteen pages in this exam

Section A. Questions 1-37: ANSWER EACH QUESTION IN THIS SECTION BY ON THE SCANTRON PROVIDED (2 POINTS EACH; 74 POINTS TOTAL)

1. The compound shown below:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>Is 2-oxazoline</td>
<td>Has both oxygens, the nitrogen, and the carbonyl carbon all in the same plane</td>
<td>Is oxazolidine-2-one</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 compound illustrated below:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>Is 7-benzylquinoline</td>
<td>Has a strongly basic (pKb = 5) amino group</td>
<td>Is 7-benzoylquinoline</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 _______

3. The compound illustrated below:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>5-Aminopurine</td>
<td>Has two aromatic rings</td>
<td>2-Aminopurine</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 _______
4. **The compound illustrated below:**

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Is correctly named 4-pyrazoline</td>
<td>Has two nitrogens that can act as bases</td>
<td>Is correctly named 3-pyrazoline</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**

5. **The compound illustrated below:**

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Is a derivative of 1,4-benzodiazepine</td>
<td>Has a conjugate base with pK_b = 2</td>
<td>Has a conjugate acid with pK_a = 4</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**

6. **The compound shown below:**

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Is the lowest energy conformation of ( \text{cis} )-3-allyl-5-methylpiperidine</td>
<td>Is ( \text{cis} )-3-methyl-5-vinylpiperidine</td>
<td>Is the lowest energy conformation of ( \text{trans} )-3-allyl-5-methylpiperidine</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**

7. **The compound illustrated below:**

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Has one lone pair of electrons on the oxygen that is in the plane of the ring</td>
<td>Has a nitrogen that behaves as a base</td>
<td>Has a nitrogen that is not basic because the lone pair is used to make the ring aromatic</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**
8. **Consider the two structure shown below:**

<table>
<thead>
<tr>
<th>Structure</th>
<th>Description</th>
</tr>
</thead>
</table>
| ![Structure](image1) | I  The compound is an ester of formic acid  
II  There is one ester and two ether groups  
III  The compound is phenoxymethyl phenoxyacetate |

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

**Answer**

9. **The compound illustrated below:**

<table>
<thead>
<tr>
<th>Structure</th>
<th>Description</th>
</tr>
</thead>
</table>
| ![Structure](image2) | I  Has a conjugate acid with pKₐ = 2  
II  Contains a sulfide  
III  Is isothiazole |

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

**Answer**

10. **The compound shown below:**

<table>
<thead>
<tr>
<th>Structure</th>
<th>Description</th>
</tr>
</thead>
</table>
| ![Structure](image3) | I  Is 1-hydroxy-5-methylphenanthrene  
II  Is acidic  
III  Is 4-hydroxy-10-methylphenanthrene |

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

**Answer**

11. **The compound illustrated below:**

<table>
<thead>
<tr>
<th>Structure</th>
<th>Description</th>
</tr>
</thead>
</table>
| ![Structure](image4) | I  Has only one aromatic ring  
II  Is 1H-indole  
III  Has two aromatic rings |

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

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

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Is 1H-6,7-dihydroindene</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Is planar</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Is 1,6,7-trihydroindene</td>
<td></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. **For the compound illustrated below:**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>The methoxy group is at the 2-position and the chloro is at the 5-position</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>The 10-position is basic with pK_b = 12</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>The methoxy group is at the 2-position and the chloro is at the 6-position</td>
<td></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 compound illustrated below:**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Is 4-methylmorpholine</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Is planar</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Is 1-methylmorpholine</td>
<td></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 compound illustrated below:**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Is (Z)-3-bromo-6-chloro-9-ethylidene-9H-xanthene</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Has three aromatic rings</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Is (Z)-3-bromo-7-chloro-9-ethylidene-9H-xanthene</td>
<td></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 is:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>An $\alpha_1$-agonist.</td>
<td>Causes vascular constriction.</td>
<td>Formulated as eye drops, it is used for relieving redness due to minor eye irritation.</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**

17. The drug illustrated below is:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A potent vasoconstrictor.</td>
<td>Primarily selective for $\beta_2$-receptors.</td>
<td>Is not a substrate for catechol O-methyl transferase.</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**

18. The drug illustrated below:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>May cause muddled-headness and confusion</td>
<td>Is used as an adjunctive therapy in the treatment of Parkinson’s disease.</td>
<td>Devoid of CNS side effects and is used as an antispasmodic in the GI tract</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**
19. The drug illustrated below is:

| I | Causes miosis. |
| II | Used to treat open-angle glaucoma. |
| III | An indirect-acting cholinergic agent. |

- 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:

| I | Is used to improve cognition in Alzheimer’s patients. |
| II | Is commonly associated with liver toxicity. |
| III | Carbamates acetylcholinesterase and slows its reactivation. |

- 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 | Block the enzyme acetylcholinesterase. |
| II | Is commonly used to treat over active bladder and urinary incontinence. |
| III | Blocks cholinergic receptors. |

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

Answer: 

22. The compound illustrated below:

| I | Can cross the BBB and gains entry into the CNS. |
| II | Causes reversible enzyme inhibition. |
| III | Is used to improve cognition in Alzheimer’s patients. |

- 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 is:

![Drug Structure]

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>An adrenergic agonist selective for α₁-receptors.</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Is associated with orthostatic hypertension as a side effect.</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Is used to treat hypertension.</td>
<td></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

24. The drug illustrated below is:

![Drug Structure]

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>A cholinergic antagonist.</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Contraindicated for individuals with glaucoma.</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Used to treat urinary frequency and incontinence.</td>
<td></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

25. The drug illustrated below:

![Drug Structure]

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Inhibits the action of acetylcholinesterase.</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Is an irreversible neuromuscular blocking agent</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Is a non-depolarizing neuromuscular blocking agent.</td>
<td></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

26. The drug illustrated below:

![Drug Structure]

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Is an adrenergic agonist.</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Is readily absorbed from the GI tract.</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Readily crosses the blood brain barrier into the CNS.</td>
<td></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
27. The drug illustrated below:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Would be contraindicated for individuals with hypertension.</td>
<td>Could be used to treat nasal congestion.</td>
<td>Can cause CNS stimulation and wakefulness.</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 drug illustrated below:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Is used to reverse the effects of a depolarizing neuromuscular blocking agent.</td>
<td>Could be used to treat Alzheimer’s disease.</td>
<td>Is used to reverse the effects of a non-depolarizing neuromuscular blocking agent.</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></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Is phenylephrine.</td>
<td>Has replaced pseudoephedrine in some OTC products.</td>
<td>Is both a direct adrenergic agonist and a norepinephrine releaser.</td>
</tr>
</tbody>
</table>

a. I only  
b. III only  
c. II only  
d. II and III only  
e. I and III only  

Answer ______

30. The drug illustrated below:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Is a β₂-selective adrenergic agonist</td>
<td>Is used to treat asthma.</td>
<td>Would be contraindicated for individuals with hypertension.</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 ______
31. The drug illustrated below:

<table>
<thead>
<tr>
<th>Structure</th>
<th>Properties</th>
</tr>
</thead>
</table>
| ![Molecule](image1) | I Is a carbamate.  
II Is a depolarizing neuromuscular blocking agent.  
III Has a relatively short duration of action (≈ 20 minutes). |

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:

<table>
<thead>
<tr>
<th>Structure</th>
<th>Properties</th>
</tr>
</thead>
</table>
| ![Molecule](image2) | I Is used to treat overactive bladder and urinary incontinence.  
II Is a direct-acting cholinergic antagonist.  
III Can be used in stimulate the GI tract. |

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:

<table>
<thead>
<tr>
<th>Structure</th>
<th>Properties</th>
</tr>
</thead>
</table>
| ![Molecule](image3) | I Has CNS side effects including muddled-headedness, confusion, and drowsiness.  
II Can be used as a transdermal patch.  
III Is used in the treatment of asthma. |

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 is:

<table>
<thead>
<tr>
<th>Structure</th>
<th>Properties</th>
</tr>
</thead>
</table>
| ![Molecule](image4) | I Used to treat peripheral vascular disease.  
II Is a direct adrenergic agonist.  
III Is not a substrate for catechol-O-methyl transferase. |

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:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inhibits acetylcholinesterase by blocking its binding to its endogenous substrate, acetylcholine.</td>
<td>Is used to improve cognition in Alzheimer’s patients.</td>
<td>Is an irreversible indirect-acting cholinergic agents.</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 ______

36. The drug illustrated below:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Is used as an inhalant to treat acute asthma attacks.</td>
<td>Is used to treat individual with congestive obstructive pulmonary disease</td>
<td>Is effective orally as well as by inhalation.</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:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Can be used to improve cognition.</td>
<td>Can be used to prevent motion sickness.</td>
<td>Can be used as an antisialagogue.</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 ______
Section B

Questions 51 and 52. Answer each question in this section by indication on the reverse side (Page 2 of the scantron) the correct letter below each given structure that corresponds to the generic name provided. (1 Point each; 6 Points total)

51. Solifenacin  
52. Tacrine

Questions 53 and 54. Answer each question in this section by indication on the reverse side (Page 2 of the scantron) the correct letter below each given structure that corresponds to the generic name provided. (1 point each; 6 points total)

53. Neostigmine  
54. Oxybutynin
Questions 55 and 56. Answer each question in this section by INDICATION ON THE REVERSE SIDE (PAGE 2 OF THE SCANTRON) the correct letter below each given STRUCTURE THAT CORRESPONDS TO THE GENERIC NAME PROVIDED. (1 point each; 6 points total)

55  Pirbuterol  
56  Midodrine

SECTION D. 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 as C, and for having too many bonds to an atom. (20 Points).

1. 5H-Thiazolo[3,2-a]pyrazine, 8-(4-methoxybenzoyl)-2-(2,2,2-trifluoroethyl)-

2. 3,3-Dimethyl-8-oxa-1,5-dithiaspiro[5.6]dodec-11-ene
3. 7-Hydroxy-9-methyl-3,9-diazabicyclo[3.3.1]nonan-2-one, exo-, hydrobromide

4. 3-(1H-Indol-3-yl)propanamine, γ-ethyl-N,α,α-trimethyl-

5. 3-Methylcyclopentyl 3,3-bis(3,4-dimethoxyphenyl)propionate, (cis)-