1. You may use an 8.5x11 page of notes and a calculator.
2. Tear off this sheet and use it to keep your answers covered at all times. If you need more scratch paper, I have some.
3. Write your name on the back of the test by the staple to facilitate returning the exams. Do not write your name on the front of the exam.
4. No question is meant to have a syntax error. If it does, fix it or ask me how I want the error resolved.
5. You are graded not only on the correct answer, but also the best answer.
6. Look at the number of points a problem is worth in deciding how much time to spend answering it. A question with five points probably doesn't warrant three pages of proof (unless you have finished answering everything else).
7. The amount of space provided is an indication of how much room I needed to answer the question.
Multiple Choice (3 points) Pick the single best answer.

1. A risk averse agent is given the following choices for deals.

   Deal 1: $49 guaranteed  
   Deal 2: $100 with probability .5 and 0 otherwise  
   Deal 3: $75 with probability .7, 16 otherwise  
   Deal 4: $200 with probability .2 and 0 otherwise

Which would he select
(a) Deal 1  
(b) Deal 2  
(c) Deal 3  
(d) Deal 4  
(e) There is no clear winner

2. A risk seeking agent is given the following choices for deals.

   Deal 1: $49 guaranteed  
   Deal 2: $100 with probability .5 and 0 otherwise  
   Deal 3: $75 with probability .7, 16 otherwise  
   Deal 4: $200 with probability .2 and 0 otherwise

Which would he select
(a) Deal 1  
(b) Deal 2  
(c) Deal 3  
(d) Deal 4  
(e) There is no clear winner

3. Consider the following preferences functions in a Borda voting protocol. The function A>B means A is preferred to B.

   Agent 1:  A > B > C  
   Agent 2:  B > C > A  
   Agent 3:  C > A > B  
   Agent 4:  A > C > B  
   Agent 5:  B > A > C  
   Agent 6:  B > A > C

How can agent 6 lie about his preference to get an advantage?

a) He votes B > C > A  
   b) He votes A > C > B  
   c) He vote A > B > C  
   d) There is no reason for him to lie.
4. Given the utilities of the following coalitions, what is a core solution?

<table>
<thead>
<tr>
<th>Coalition</th>
<th>Utility</th>
</tr>
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<tbody>
<tr>
<td>{1,2}</td>
<td>6</td>
</tr>
<tr>
<td>{1,3}</td>
<td>11</td>
</tr>
<tr>
<td>{1,4}</td>
<td>6</td>
</tr>
<tr>
<td>{2,3,4}</td>
<td>8</td>
</tr>
<tr>
<td>{1,2,3,4}</td>
<td>14</td>
</tr>
</tbody>
</table>

a) There is no core solution
b) (5,1,6,1) (payment for agents 1,2,3,4, respectively)
c) (5,1,6,2) (payment for agents 1,2,3,4, respectively)
d) none of the above

5. Given the utilities of the following coalitions, what is a core solution?

<table>
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<tr>
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<tbody>
<tr>
<td>{1,2}</td>
<td>5</td>
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<td>{1,3}</td>
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<tr>
<td>{1,4}</td>
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<tr>
<td>{2,3,4}</td>
<td>6</td>
</tr>
<tr>
<td>{1,2,3,4}</td>
<td>8</td>
</tr>
</tbody>
</table>

a) There is no core solution
b) (2,2,2,2) (payment for agents 1,2,3,4, respectively)
c) (3,2,1,2) (payment for agents 1,2,3,4, respectively)
d) none of the above

6. Which of the following graphs represent the utility of a risk averse bidder?

7. Which of the following graphs represent the utility of a risk neutral bidder?
8. Which of the following represents a modular task oriented domain?

<table>
<thead>
<tr>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
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</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram A" /></td>
<td><img src="image2" alt="Diagram B" /></td>
<td><img src="image3" alt="Diagram C" /></td>
<td>None of the others</td>
</tr>
</tbody>
</table>

9. If we do not have to return to the post office, which represents a sub-additive domain?

<table>
<thead>
<tr>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image4" alt="Diagram A" /></td>
<td><img src="image5" alt="Diagram B" /></td>
<td><img src="image6" alt="Diagram C" /></td>
<td>None of the others</td>
</tr>
</tbody>
</table>

10. Where does the term pareto optimal come from?
   a. A term derived from paring the excess
   b. It is the last name of the researcher who invented the concept
   c. A term from psychology
   d. none of the above

11. In the task oriented domain, the conflict deal is:
   a) the initial allocation.
   b) the deal where no one does anything.
   c) the deal where one agent does everything.
   d) a payment of 0 to every agent.
   e) none of the above

12. Under multiple issue negotiation, what concern emerges which is **not** found in single issue negotiation?
   a) It is not clear which a true concession is.
   b) It may not be clear what is up for negotiation.
   c) Exploring the solution space can be huge.
   d) All of the above are concerns that emerge
13. Consider the following negotiation where player 1 is the buyer and player 2 is the seller:
   Player1: 0
   Player2: 50
   Player1: 15
   Player2: 45
   What is the risk for player 2
   (a) .45
   (b) .86
   (c) .66
   (d) none of the above

**Short Answer:**

1. (7 points) The Zeuthen strategy for negotiation answers two questions that must be answered on any given round of negotiation: *who should concede?* and *how much should they concede?*
   Explain the answers that the Zeuthen strategy provides to these questions.

2. (10 points) You are one of three bidders in a First Price Sealed Bid auction. The others each value a painting at between 500 and 1000 dollars. (Assume a uniform distribution of their valuations.) You value it at 1000. What should you bid to maximize your expected profit?
3. (8 points) Consider the following diagram in which Agent 1 delivers to \{b,d\}. Agent 2 delivers to \{b,a\}. Agents must return to the post office. If we are restricted to all-or-nothing deals, what deal would be struck?

4. (7 points). In the previous problem, if we are restricted to pure deals, would a decoy lie at \{e\} for agent 1 improve his utility? If so, what is the distance \(Y\) that would make the lie beneficial? If not, explain why not.

5. (5 points) In a Vickrey auction, Liz says, “I am always going to bid very high. It saves a lot of effort in deciding what to bid. Since the others are bidding their true valuation, I get a reasonable price, yet I always win.” Analyze the advantages and disadvantages of her strategy.
6. (5 points) In an auction, suppose every bidder knows its own valuation of an item, and every other bidder’s valuation. Which auction type generates the most revenue for the auctioneer? Explain.

7. (5 points) Is it possible for an auction item to have a common, yet unknown, value? If so, give a specific example. If no, explain why not.

8. (6 points) In a Japanese auction, bidding is like an English auction except at every price level a bidder must indicate their willingness to stay in the auction (and would pay the current price if they win the bid). What is the advantage of such a requirement? What difference does it make in bidding strategies and expected revenue?
9. (15 points) The Shapley value has been used for cost sharing. Suppose the three owners of airplanes want to build a runway together. The planes require 2, 2, and 4 miles to land. Thus, a runway of 4 miles must be built, but how much should each pay?

a) How can the Shapley value be used to determine who should pay what?

b) What part of the cost should each owner pay?