Answer all questions. If you don’t explain (= show your work for) your answers you will get no credit.

NAME:___________________________________ University ID:___________________

IRCLE THE NAME OF YOUR TA:  Kalyani Chauduri  or  Hyunseo Park

If you don’t know the name of your TA, then write your Section Number: ______________

- By writing your name on this exam you certify that you have not violated the University’s Code of Academic Contact (for example, you have not copied from the work of another student and you have not knowingly facilitated cheating by another student).

- If you submit the exam without writing your name and ID, you will get a score of 0 for this exam.

- If you do not stop writing when told so (at the end), a penalty of 10 points will be deducted from your score.
1. [20 points] Consider the following game with von Neumann-Morgenstern payoffs.

<table>
<thead>
<tr>
<th></th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Player 1</td>
<td>A</td>
<td>4,2</td>
<td>1,1</td>
<td>2,0</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>1,4</td>
<td>2,2</td>
<td>5,1</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>3,1</td>
<td>0,2</td>
<td>1,8</td>
</tr>
</tbody>
</table>

(a) [4 points] Are there any the pure-strategy Nash equilibria? If Yes, list them all.

(b) (b.1) [10 points] Find the mixed-strategy Nash equilibrium.

(b.2) [6 points] Calculate the payoffs of the two players at the Nash equilibrium.
2. [50 points] Consider the following game, where the payoffs are von Neumann-Morgenstern payoffs (note that Player 2 makes the first move and note the order in which payoffs are written):

(a) [4 points] How many strategies does Player 2 have?

(b) [4 points] Write all the strategies of Player 1.

(c) [6 points] How many proper subgames does the game have?
(d) [36 points] Find all the pure-strategy subgame-perfect equilibria. [This question is reproduced in the next 3 pages, so you have 3 pages to answer it.]
Continue part (d) here if you need more space (find three subgame-perfect equilibria and specify the payoffs at those equilibria).
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3. [30 points] Consider the following two-player game-frame. Rudy is a fugitive and it is common knowledge between him and the Chief of Police that (1) there are only three locations, A, B and C, where Rudy could go and (2) Rudy has an ankle bracelet with a GPS that sends its location to a scanner at the police station, but Rudy knows how to turn it off. Rudy makes two consecutive decisions: first whether to leave the GPS on or turn it off and then where to go (to location A or to location B or to location C). The next day, the police chief, not knowing any of the above decisions by Rudy, after consulting the tracking device and checking whether or not there is a signal from the GPS and -- if there is -- where it is coming from, decides whether to storm location A or location B or location C.

(a) [14 points] Draw an extensive-form game-frame to represent this situation.
(b) [3 points] How many information sets does the **police chief** have?

(c) [5 points] How many strategies does the **police chief** have?

(d) [3 points] How many information sets does the **Rudy** have?

(e) [5 points] How many strategies does **Rudy** have?