first name **last name** **id#**

$(2+3)+(2+1+2+1)+(2+2)$ **marks** **50 min** **closed book** **no devices** **3 pages**

1. Rose (row player) and Colin (column player) play each of these games. Give their minimax strategies: show your work.

a)
```
5 3 4
2 0 6
```

b)
```
2 1 3
1 1 0
4 3 7
```

2. For each of these games g:

   if g is equal to a number of the form $m/2^t$ where m is an odd integer and t is a positive integer, give the simplest such number it is equivalent to; if g is not equal to a number, say why.

```
{ 1/2, 1/4 | 5/4, 2, 3 }

{ 7/4 | 3/4 }

{ 3/8 | 1/2 }
```

3. For this 0-sum matrix game,

$$\begin{matrix} 2 & -1 \\ 1 & 2 \end{matrix}$$

Rose plays mixed strategy `(row 1, row 2)` with probabilities $(2/5, 3/5)$ and

Colin plays mixed strategy `(row 1, row 2)` with probabilities $(1/5, 4/5)$.

a) For Rose's (2/5, 3/5) strategy, what is her guaranteed expected payoff (she will always get at least this much) against **any possible** strategy by Colin.

b) Against Rose's (2/5, 3/5) strategy, give a Colin strategy that is best for Rose (worst for Colin).

c) For Colin's (1/5, 4/5) strategy, what is his guaranteed expected payoff (he will always pay Rose no more than this much) against **any possible** strategy by Rose.

d) Against Colin's (1/5, 4/5) strategy, give a Rose strategy that is best for Colin (worst for Rose).

4. Blotto and Baloney are opposing battle commanders. There are three locations valued 1, 2, 3. Each commander has two military units to deploy (both to the same location or one each to two different locations). If a commander sends more units to a location than the other, they capture the location and win its value. If both commanders send the same number of units to a location, it is not captured and nothing is won at this location.

   Give the payoff matrix for Blotto for this game.

5. Give the dyadic rational equivalent to this hackenbush game. Show your work.