Pearson Edexcel AS Further Mathematics 8FM0

Decision 2 – 3 Game Theory

Time allowed: 45 **minutes**

School: www.CasperYC.club

Name:

Teacher:

Question	Points	Score
1	12	
2	15	
3	14	
4	15	
Total:	56	

How I can achieve better:

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Last updated: February 3, 2026

1. (a) In the context of game theory, explain what the term "play safe strategy" means. [2]

A two person zero–sum game is represented by the following pay–off matrix for player A.

	B plays 1	B plays 2
A plays 1	-4	3
A plays 2	4	-2
A plays 3	2	-1

(b) Verify that there is no stable solution for this game. [2]

(c) i. Find the best strategy for player B, defining any variables you use. [8]

ii. Find the value of the game to player A.

Total: 12

(Q1 continued . . .)

2. (a) Explain what the term 'zero–sum game' means. [1]

Two teams, A and B, are to face each other as part of a quiz. There will be several rounds to the quiz with 10 points available in each round.

For each round, the two teams will each choose a team member and these two people will compete against each other until all 10 points have been awarded. The number of points that Team A can expect to gain in each round is shown in the table below.

		Team B		
		Paul	Qaasim	Rashid
	Mischa	5	6	3
Team A	Noel	4	1	7
	Olive	4	5	8

The teams are each trying to maximise their number of points.

(b) State the number of points that Team B will expect to gain each round if Team A chooses Noel and Team B chooses Rashid. [1]

(c) Explain why subtracting 5 from each value in the table will model this situation as a zerosum game. [1]

(d) i. Find the play–safe strategies for the zero–sum game. [4]

ii. Explain how you know that the game is not stable.

At the last minute, Olive becomes unavailable for selection by Team A. Team A decides to choose its player for each round so that the probability of choosing Mischa is p and the probability of choosing Noel is $1 - p$.

(e) Use a graphical method to find the optimal value of p for Team A and hence find the best strategy for Team A. [6]

For this value of p,

(f) i. find the expected number of points awarded, per round, to Team A, [2]

ii. find the expected number of points awarded, per round, to Team B.

Total: 15

(Q2 continued . . .)

3. Two teams, A and B, each have three team members. One member of Team A will compete against one member of Team B for 10 rounds of a competition. None of the rounds can end in a draw. Table below shows, for each pairing, the expected number of rounds that the member of Team A will win minus the expected number of rounds that the member of Team B will win. These numbers are the scores awarded to Team A. This competition between Teams A and B is a zero–sum game. Each team must choose one member to play. Each team wants to choose the member who will maximise its score.

		Team B		
		Paul	Qaasim	Rashid
Team A	Mischa	4	- 6	2
	Noel	0	- 2	6
	Olive	- 6	2	0

(a) i. Find the number of rounds that Team A expects to win if Team A chooses Mischa and Team B chooses Paul. [2]

ii. Find the number of rounds that Team B expects to win if Team A chooses Noel and Team B chooses Qaasim.

Table above models this zero–sum game.

(b) i. Find the play - safe strategies for the game. [4]

ii. Explain how you know that the game is not stable.

(c) Determine which team member Team B should choose if Team B thinks that Team A will play safe. Give a reason for your answer. [1]

At the last minute, Rashid is ill and is therefore unavailable for selection by Team B.

(d) Find the best strategy for Team B, defining any variables you use. [7]

Total: 14

(Q3 continued . . .)

4. The table below gives the pay–off matrix for a zero–sum game between two players, Aljaz and Brendan. The values in the table show the pay–offs for Aljaz.

		Brendan		
		Option X	Option Y	Option Z
	Option P	- 6	- 1	2
Aljaz	Option Q	5	4	- 7
	Option R	5	6	3

(a) i. Show that this game is stable. [3]

ii. State the value of this game to Brendan.

Option R is removed from Aljaz's choices and the reduced game, with option R removed, is no longer stable.

(b) Find the best strategy for Aljaz in this reduced game, defining any variable you use. [7]

(c) Explain why Brendan should never play option Y. [1]

Let Brendan play option X with probability q.

(d) i. Explain why q satisfies the equation $6q - 2(1 - q) = 1.6$. [4]

ii. Hence find the best strategy for Brendan in this reduced game.

Total: 15

(Q4 continued . . .)