Linear models and optimisation - Practice test 3

Name: _____ Date: _____

10 questions | 49 marks | 70 minutes

Whole-number planning, competing limits and justified decisions.

A scientific calculator may be used.

1. The total cost of 4 display boards is AUD 104; the total for 9 boards is AUD 189. Assume a linear rule. [4 marks]

(a) Find the variable cost and fixed cost. [3 marks]

(b) Find the cost of 12 boards. [1 mark]

2. Adult and concession tickets total 35. Adult tickets cost AUD 14 and concessions AUD 9; total revenue is AUD 390. [5 marks]

(a) Form and solve simultaneous equations. [4 marks]

(b) Check the answer in context. [1 mark]

3. A subscription costs AUD 120 and AUD 2 per visit. Casual visits cost AUD 8 each. [4 marks]

(a) Find the equal-cost number of visits. [2 marks]

(b) Find the first whole-number visit count at which the subscription is cheaper. [2 marks]

4. Solve $4(3 - x) \geq 2x - 6$. [4 marks]

(a) Find the solution set. [3 marks]

(b) Explain whether the boundary is included. [1 mark]

5. A workshop makes x stands and y shelves. Each stand needs 3 planks and each shelf 2. At most 31 planks are available, and no more than 8 shelves can be sold. [4 marks]

(a) Write all restrictions, including the nature of the variables. [3 marks]

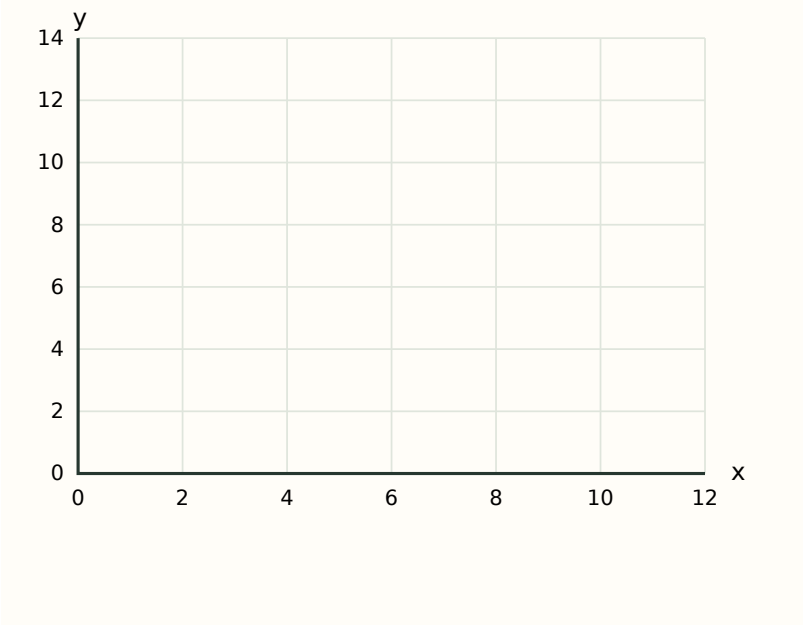
(b) Test 5 stands and 8 shelves. [1 mark]

6. A feasible polygon has vertices $(0, 0), (10, 0), (6, 6), (0, 9)$. The objective is $P = 6x + 4y$. [5 marks]

(a) Evaluate P and identify every optimal vertex. [3 marks]

(b) Describe all continuous optima, not just vertices. [2 marks]

7. A printer produces x posters and y banners. There are 20 sheet-units and 24 machine-units. A poster uses 2 sheet-units and 1 machine-unit; a banner uses 1 and 2. Profits are AUD 5 and AUD 6. Counts must be whole numbers. [8 marks]



(a) State the model, including variable restrictions. [3 marks]

(b) Find and justify the optimal decision. Give the objective value. [5 marks]

8. A food stall needs at least 70 servings. A small tray holds 12 servings and costs AUD 18; a large tray holds 20 and costs AUD 27. Only 5 trays fit in the warmer. [7 marks]

(a) Form a minimum-cost integer model. [3 marks]

(b) Find the least cost and check all possible large-tray counts. [4 marks]

9. A continuous solver recommends $(4.5, 2.5)$ for indivisible products. A student proposes $(5, 3)$ without checking. [4 marks]

(a) Explain why the rounded recommendation is not justified. [2 marks]

(b) Describe a systematic method for a small bounded model. [2 marks]

10. A model maximises profit using only material constraints. One product also requires specialist staff available for 6 hours. [4 marks]

(a) Explain the missing information needed to add a staffing constraint. [2 marks]

(b) Would adding a staffing restriction ever increase the maximum profit, with all other data fixed? [2 marks]