Linear models and optimisation - Practice test 1

Name: _____ Date: _____

10 questions | 48 marks | 70 minutes

A balanced paper building from equations and comparisons to constrained decisions.

A scientific calculator may be used.

1. A display company charges AUD 65 for setup and AUD 18 per stand. [3 marks]

(a) Define variables and write a linear cost rule. [2 marks]

(b) Find the cost of 9 stands. [1 mark]

2. Solve the simultaneous equations $2x + 3y = 24$ and $x + y = 9$. [4 marks]

(a) Find x and y. [3 marks]

(b) Verify both equations. [1 mark]

3. Plan A costs $A = 48 + 2n$ and plan B costs $B = 18 + 5n$, in dollars. [4 marks]

(a) Find their equal-cost point. [2 marks]

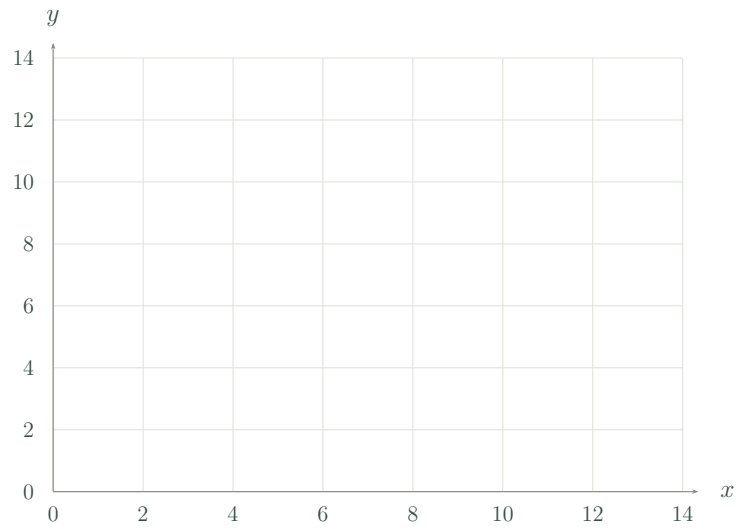
(b) Which plan is cheaper for 15 uses, and by how much? [2 marks]

4. A maker can spend at most 42 hours. A small unit uses 2 hours and a large unit 5 hours. [3 marks]

(a) Write the time restriction for x small and y large units. [2 marks]

(b) Does $(6, 6)$ meet this restriction? [1 mark]

5. Use $x, y \geq 0$, $x + y \leq 12$ and $x \leq 8$. [4 marks]



(a) Sketch the feasible region and list all its vertices. [3 marks]

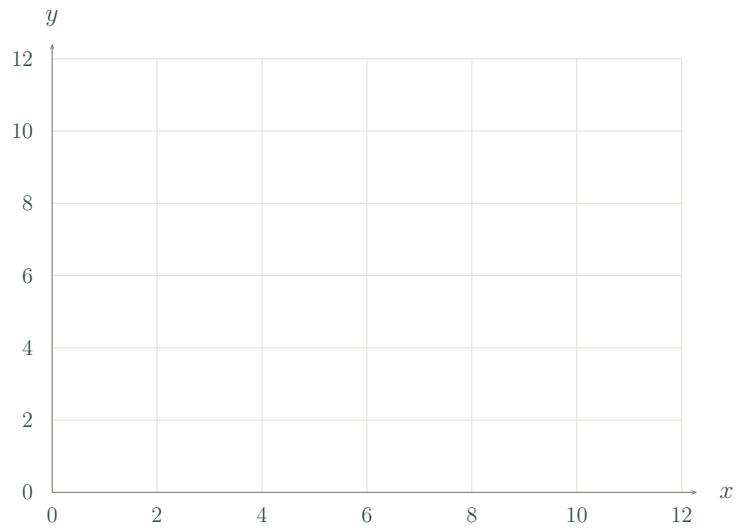
(b) Explain why $(10, 1)$ is excluded even though its sum is below 12. [1 mark]

6. A shop makes AUD 14 profit on A and AUD 9 on B. The feasible vertices are $(0,0), (6,0), (4,5), (0,7)$. [4 marks]

(a) Write and evaluate the objective at the vertices. [3 marks]

(b) State the best decision and profit. [1 mark]

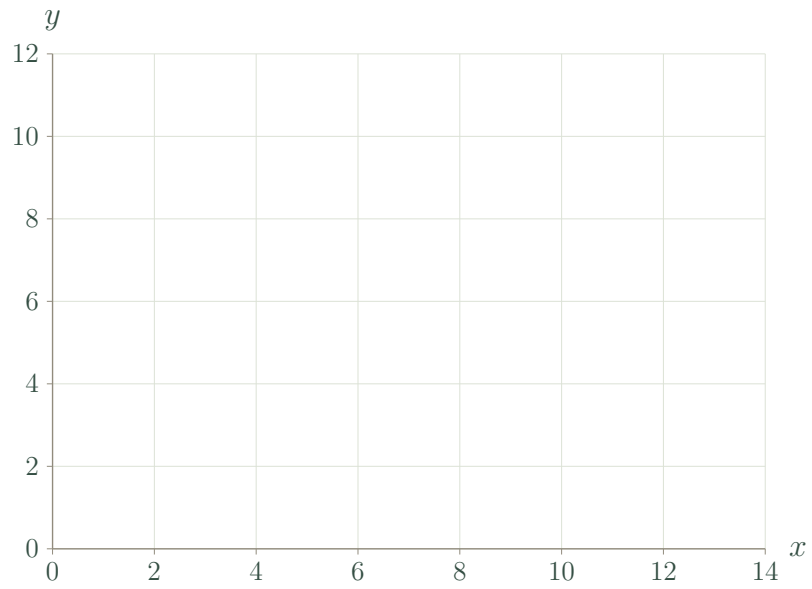
7. A workshop makes x small boxes and y large boxes. Each uses one sheet; a small box needs 2 assembly units and a large one 1. There are 10 sheets and 14 assembly units. Unit profits are AUD 5 and AUD 3. [8 marks]



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

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

8. A blend uses x litres of A and y litres of B. It must total at least 8 litres and supply at least 12 nutrient units; A has 1 unit/litre and B has 2. Costs are AUD 3 and AUD 4 per litre. [8 marks]



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

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

9. For integer x, y, maximise $P = 3x + 4y$ subject to $2x + y \leq 7$, $x + 2y \leq 7$ and non-negativity. [6 marks]

(a) Show why rounding the continuous corner up to $(3, 3)$ fails. [2 marks]

(b) Find the integer optimum using a table. [4 marks]

10. A linear model recommends producing 60 gift packs, assuming all packs sell and each uses the same labour time. [4 marks]

(a) State two assumptions that should be checked in practice. [2 marks]

(b) Orders cap gift-pack demand at 45. Explain the required model change. [2 marks]