Linear models and optimisation - Practice test 2

Name: _____ Date: _____

10 questions | 47 marks | 70 minutes

Graphs, minimum requirements and the meaning of linear comparisons.

A scientific calculator may be used.

1. A water reservoir contains 720 litres and loses 24 litres per minute at a constant rate. [5 marks]

(a) Write volume V after t minutes and state the useful domain. [3 marks]

(b) When does the volume reach 240 litres? [2 marks]

2. A graphing tool displays an intersection near $(2.5, 4.5)$ for $3x + y = 12$ and $x - y = -2$. [4 marks]

(a) Find the exact intersection algebraically. [3 marks]

(b) Explain why graph coordinates should be checked. [1 mark]

3. Two hire plans cost $A = 80 + 6d$ and $B = 35 + 9d$, with d in days. [4 marks]

(a) Find the equal-cost duration and cost. [2 marks]

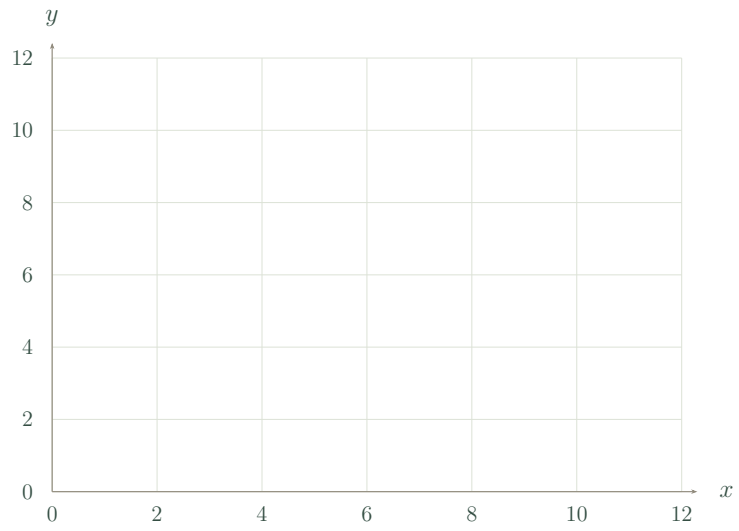
(b) Choose the cheaper plan for 8 days. [2 marks]

4. Solve and interpret $36 - 3x < 15$. [3 marks]

(a) Find the solution interval. [2 marks]

(b) If x counts whole boxes, find the least permitted x. [1 mark]

5. The feasible set is $x, y \geq 0,\ x + y \geq 6,\ y \leq 5$. [4 marks]



(a) List its finite corner points and explain why the set is unbounded. [3 marks]

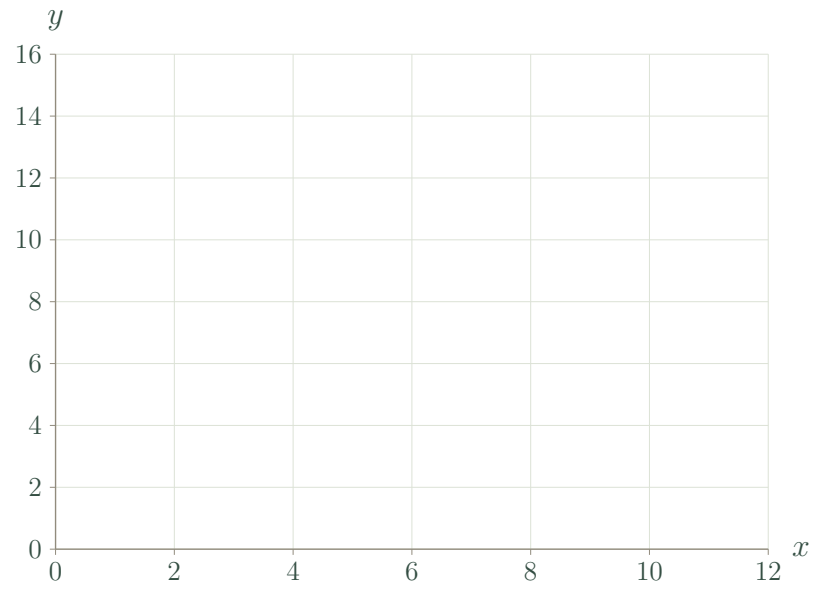
(b) Does unboundedness itself prove that no minimum cost exists? [1 mark]

6. On a feasible edge, $x+y=10$ with x,y non-negative. The objective is $P=6x+6y$. [3 marks]

(a) Find P anywhere on the edge. [1 mark]

(b) If this is the greatest feasible value, describe the full set of optima. [2 marks]

7. A farm mixes x tonnes of feed A and y tonnes of feed B. At least 10 tonnes are needed. A supplies 2 nutrient units/tonne and B 1; at least 14 units are required. A costs AUD 4 per tonne and B costs AUD 3 per tonne. [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 manufacturer has constraints $x + y \leq 14$ and $3x + y \leq 24$, with x, y non-negative. Profit is $P = 7x + 4y$. [6 marks]

(a) Find the feasible vertices. [3 marks]

(b) Find maximum profit and identify unused resources there. [3 marks]

9. A class needs at least 58 seats. A small vehicle provides 10 seats for AUD 90 and a large vehicle 18 seats for AUD 140. At most 5 vehicles may be hired. [7 marks]

(a) Write an integer model minimising cost. [3 marks]

(b) Find the least-cost plan. [4 marks]

10. A solution at $(5, 9)$ uses all 24 available assembly hours. Next week only 22 hours are available. [3 marks]

(a) Explain why the current solution cannot simply be reused. [1 mark]

(b) Describe how to update the model and report. [2 marks]