

Unit 3 *Linear Programming*

Text Answers

3.1 Formation of Linear Programming Problems

1. (a) If
- x
- = no. of blouses and
- y
- = no. of skirts,

$$\text{maximise } P = 8x + 6y$$

$$\text{subject to } x + y \leq 7$$

$$x + \frac{1}{2}y \leq 5$$

$$x \geq 0 \text{ and } y \geq 0$$

- (b) Possible solutions:

(i) $x = 3, y = 4$

(ii) $x = 2, y = 5$

(iii) $x = 1, y = 6$

2. If
- x
- = no. of large vans, and
- y
- = no. of small vans,

$$\text{minimise } C = 40x + 20y$$

$$\text{subject to } 5x + 2y \geq 30$$

$$2x + y \leq 15$$

$$x \leq y$$

$$x \geq 0 \text{ and } y \geq 0$$

3. If
- x
- = no. of boxes of wood screws, and

$$y = \text{no. of boxes of metal screws,}$$

$$\text{maximise } P = 10x + 17y$$

$$\text{subject to } 3x + 2y \leq 3600$$

$$2x + 8y \leq 3600 \text{ (or } x + 4y \leq 1800)$$

$$x \geq 0 \text{ and } y \geq 0$$

4. If
- x
- = no. of unskilled workers and

$$y = \text{no. of skilled workers,}$$

$$x + 2y < 180$$

$$x + y \geq 110$$

$$y \geq 40$$

$$y \geq \frac{1}{2}x$$

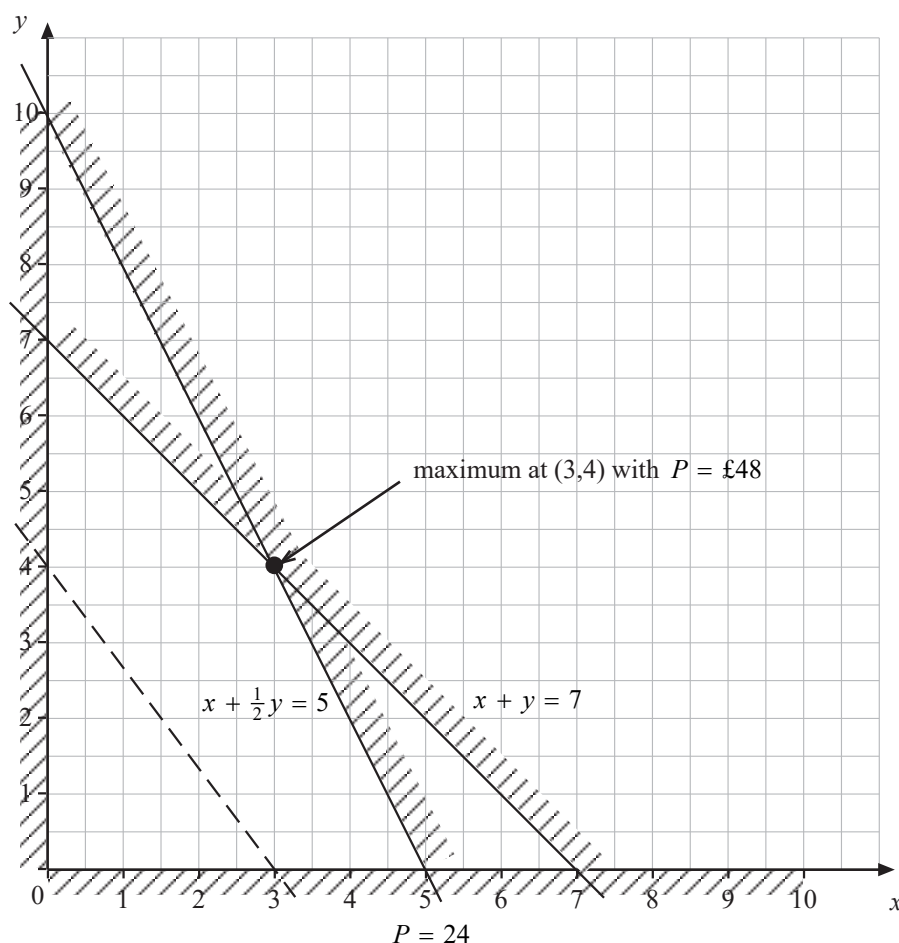
$$x \geq 0$$

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3.2 Graphical Solution

1. $x = 3$, $y = 4$ and $P = £48$ See graph below.



2. $x = 4$, $y = 5$ and $P = £260$ See graph on page 3.

3. $x =$ no. of caravans

$y =$ no. of tents

Maximise $P = 2x + y$ subject to

$$x \leq 6$$

$$4x + 3y \leq 48$$

$$200x + 90y \leq 1800 \quad (\Rightarrow 20x + 9y \leq 180)$$

$$x, y \geq 0$$

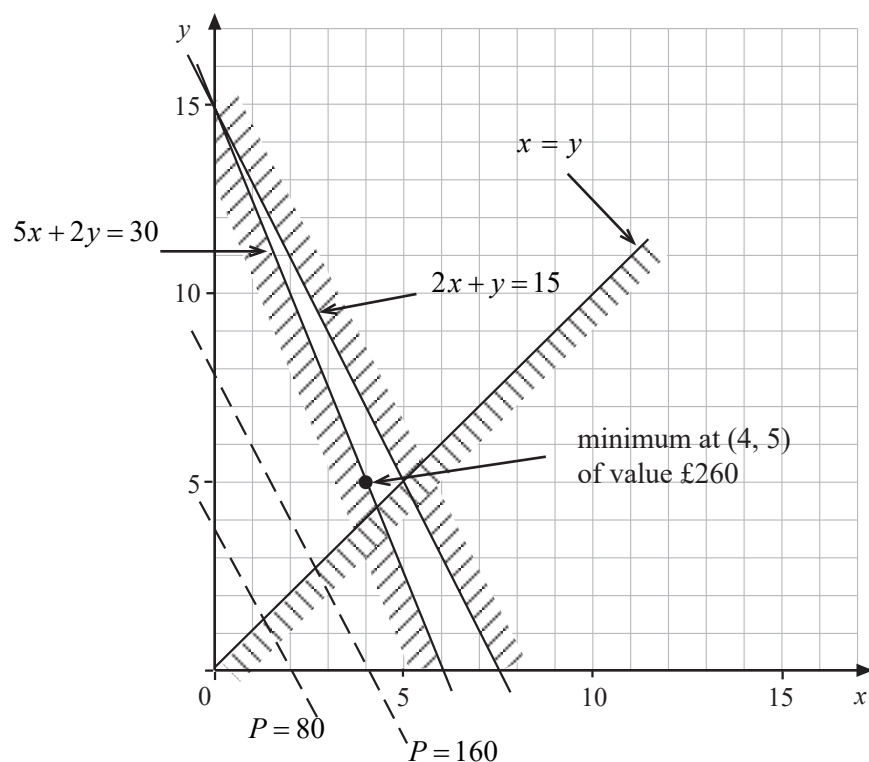
See graph on page 3.

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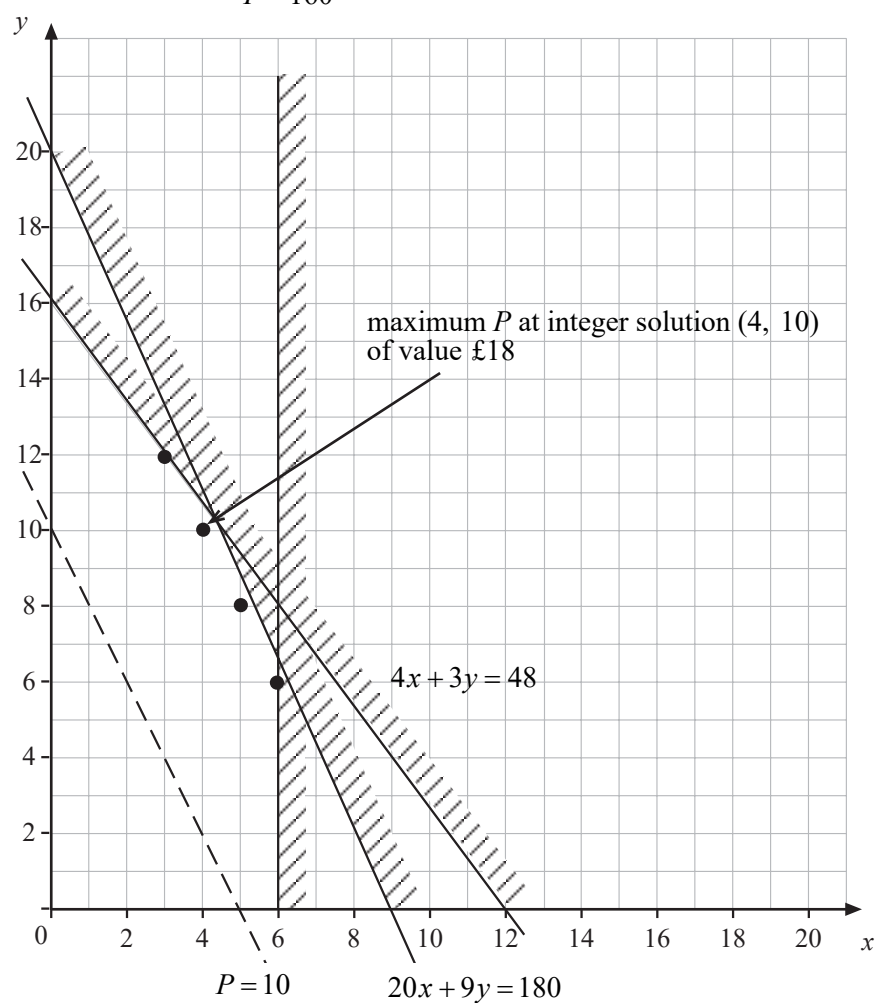
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3.2

2.



3.

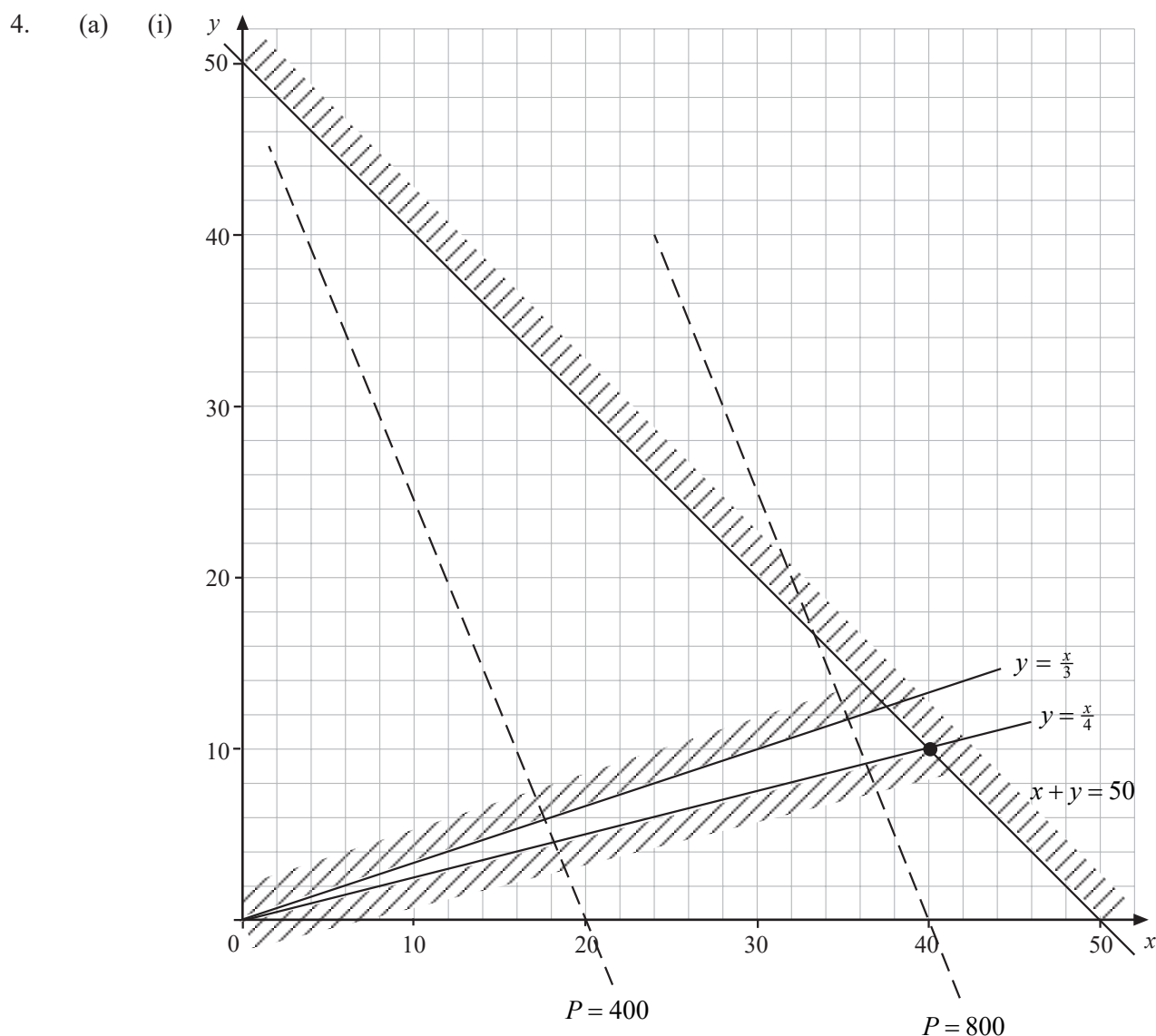


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3.2

3. (a) $P = £18$ at $(4, 10)$ but also at $(3, 12)$, $(5, 8)$ and $(6, 6)$
 (b) (i) 6 caravans, 6 tents (ii) 3 caravans, 12 tents



Let x = no. of adults, y = no. of juniors.

Maximise $P = 20x + 8y$

subject to $x + y \leq 50$

$$\frac{x}{4} \leq y \leq \frac{x}{3}$$

$$x \leq 4y, 3y \leq x$$

$$x \geq 0, y \geq 0$$

(ii) Maximum subscription when $x = 40, y = 10$ (giving $P = £880$)

(b) $x = 36, y = 10$ i.e. 46 members

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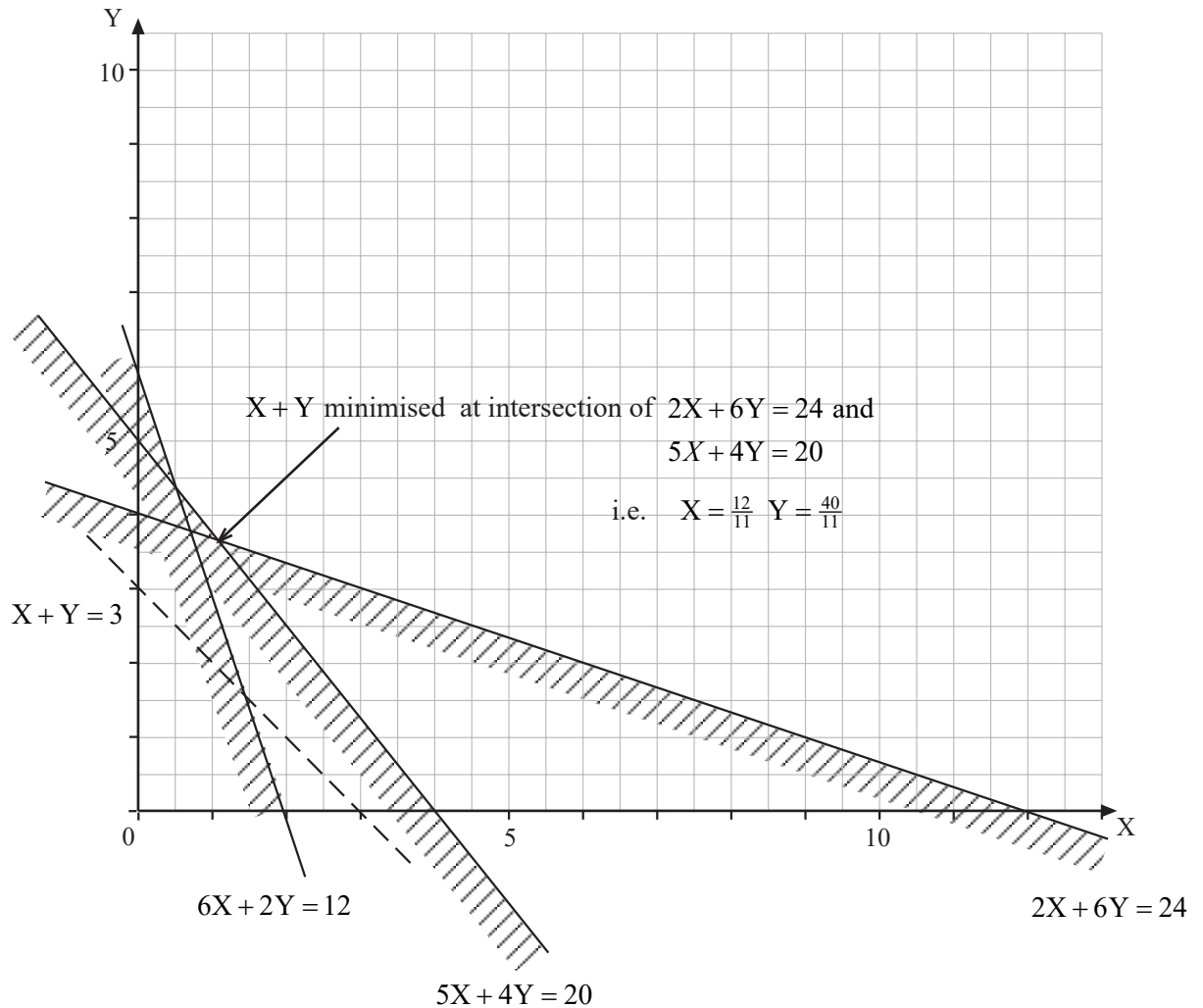
3.2

5. (a) Minimise
- $X + Y$
- subject to:

$$5X + 4Y \geq 20$$

$$2X + 6Y \geq 24$$

$$6X + 2Y \geq 12$$



- (b) Minimise
- $P = X + 3Y$
- : this gives any point on the line

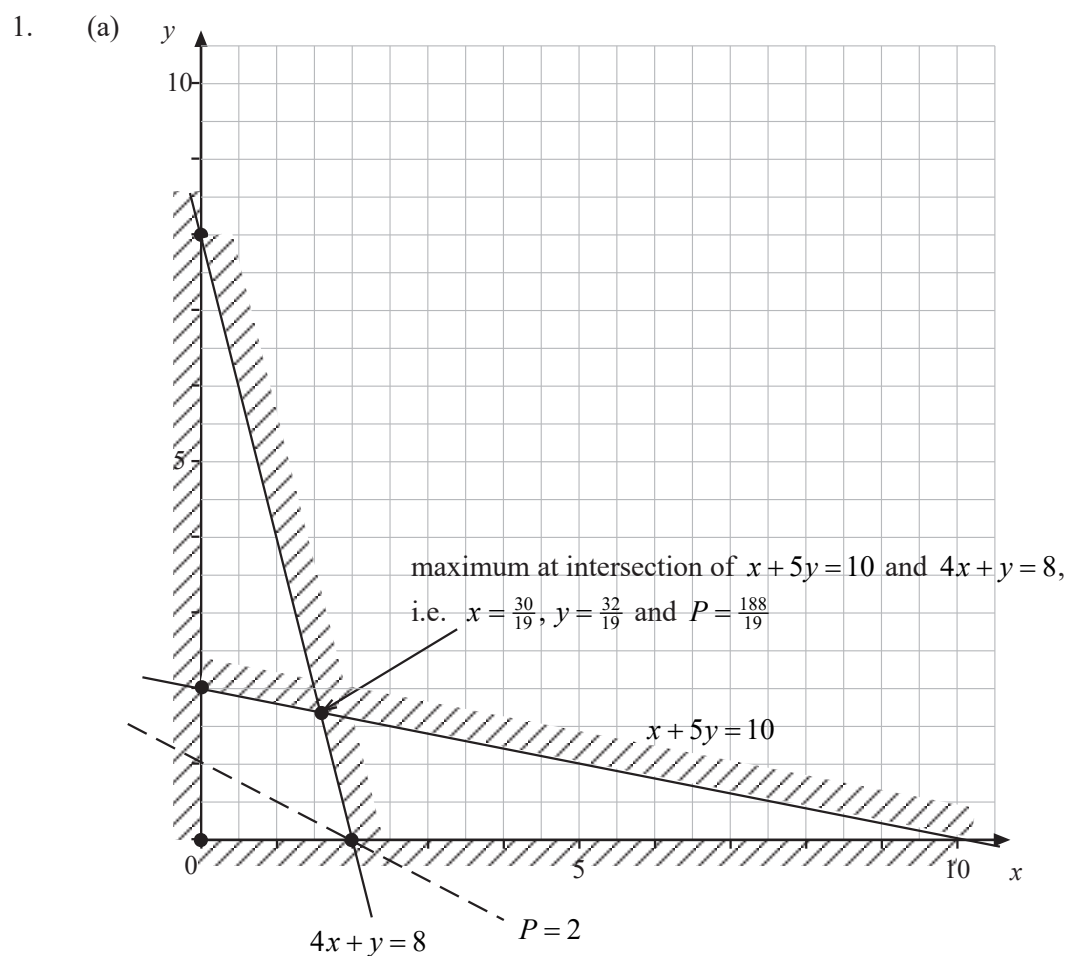
$$2X + 6Y = 24 \text{ from } \left(\frac{12}{11}, \frac{40}{11}\right) \text{ to } (12, 0)$$

6. Type A = 819, Type B = 162 with profit of £376.20 (best integer solution).
7. 19; no. of skilled workers = 11; no. of apprentices = 10.
8. No. of small spaces = 48 and no. of large spaces = 24 giving a total 72.
9. 1270 tonnes when 12 Type A and 13 Type B are used.
10. 25 trees; 11 trees
11. Upper seam = $\frac{36}{7}h$, and lower seam = $\frac{5}{7}h$

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3.3 Simplex Method



- (b) Define $r = 10 - x - 5y$, $s = 8 - 4x - y$
and evaluate P at the vertices $x = y = 0$, $x = s = 0$

$$r = s = 0 \text{ and } y = r = 0$$

2. (a) See graph on page 7.

(b) $P = \frac{43}{11}$ at $x = \frac{28}{11}$, $y = \frac{15}{11}$

3. $P = 56$ at $x = 2$, $y = \frac{12}{5}$

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3.3

2.

