## Linear programming


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By shading the unwanted regions of the grid, find and label the region R which satisfies the following four inequalities.

$$
y \geqslant 0 \quad x \geqslant 4 \quad 2 y \leqslant x \quad 2 y+x \leqslant 12
$$

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The region $\boldsymbol{R}$ contains points which satisfy the inequalities

$$
y \leqslant \frac{1}{2} x+4, \quad y \geqslant 3 \quad \text { and } \quad x+y \geqslant 6
$$

On the grid, label with the letter $\boldsymbol{R}$ the region which satisfies these inequalities.
You must shade the unwanted regions.


Find the three inequalities that define the unshaded region, R.


Write down the 3 inequalities which define the unshaded region.

> Answer
$\qquad$
$\qquad$


Find four inequalities that define the region, R , on the grid.
$\qquad$
$\qquad$
$\qquad$


Write down the three inequalities that define the unshaded region, $R$.


The region $R$ satisfies these inequalities.

$$
y \leqslant 2 x \quad 3 x+4 y \geqslant 12 \quad x \leqslant 3
$$

On the grid, draw and label the region $R$ that satisfies these inequalities. Shade the unwanted regions.

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(a) Find the equations of the lines $L_{1}, L_{2}$ and $L_{3}$.

Answer(a) $L_{1}$ $\qquad$
$L_{2}$ $\qquad$
$L_{3}$
(b) Write down the three inequalities that define the shaded region, $R$.

Answer(b) $\qquad$
$\qquad$
$\qquad$
(c) A gardener buys $x$ bushes and $y$ trees.

The cost of a bush is $\$ 30$ and the cost of a tree is $\$ 200$.
The shaded region $R$ shows the only possible numbers of bushes and trees the gardener can buy.
(i) Find the number of bushes and the number of trees when the total cost is $\$ 720$.
Answer(c)(i)

$\qquad$
bushes
$\qquad$ trees [2]
(ii) Find the number of bushes and the number of trees which give the greatest possible total cost. Write down this greatest possible total cost.
Answer(c)(ii)

$\qquad$
bushes
$\qquad$ trees

4 Ali buys $x$ rose bushes and $y$ lavender bushes.
He buys:

- at least 5 rose bushes
- at most 8 lavender bushes
- at most 15 bushes in total
- more lavender bushes than rose bushes.
(a) (i) Write down four inequalities, in terms of $x$ and/or $y$, to show this information.
Answer(a)(i)
$\qquad$
$\qquad$
$\qquad$
(ii) On the grid, show the information in part (a)(i) by drawing four straight lines. Label the region R where all four inequalities are true.

(b) Rose bushes cost $\$ 6$ each and lavender bushes cost $\$ 4.50$ each.

What is the greatest amount of money Ali could spend?
(b) A bag of sweets contains $x$ orange sweets and $y$ lemon sweets.

Each orange sweet costs 2 cents and each lemon sweet costs 3 cents.
The cost of a bag of sweets is less than 24 cents.
There are at least 9 sweets in each bag.
There are at least 2 lemon sweets in each bag.
(i) One of the inequalities that shows this information is $2 x+3 y<24$.

Write down the other two inequalities.
$\qquad$
$\qquad$
(ii) On the grid, by shading the unwanted regions, show the region which satisfies the three inequalities.

(iii) Find the lowest cost of a bag of sweets.

Write down the value of $x$ and the value of $y$ that give this cost.
$\qquad$ cents

$$
x=
$$

$$
\begin{equation*}
y= \tag{3}
\end{equation*}
$$

8 Sima sells $x$ biscuits and $y$ cakes.
(a) (i) She sells at least 100 biscuits.

Write down an inequality in $x$.
Answer(a)(i)
(ii) She sells at least 120 cakes.

Write down an inequality in $y$.

> Answer(a)(ii)
(iii) She sells a maximum of 300 biscuits and cakes altogether.

Write down an inequality in $x$ and $y$.

Answer(a)(iii)
(iv) Sima makes a profit of 40 cents on each biscuit and 80 cents on each cake. Her total profit is at least $\$ 160$.

Show that $x+2 y \geqslant 400$.
Answer(a)(iv)
(b) On the grid, draw four lines to show the four inequalities and shade the unwanted regions.

(c) Calculate Sima's maximum profit.

Give your answer in dollars.

3 (a) Luk wants to buy $x$ goats and $y$ sheep.
(i) He wants to buy at least 5 goats.

Write down an inequality in $x$ to represent this condition.
Answer(a)(i)
[1]
(ii) He wants to buy at least 11 sheep.

Write down an inequality in $y$ to represent this condition.
Answer(a)(ii)
(iii) He wants to buy at least 20 animals.

Write down an inequality in $x$ and $y$ to represent this condition.
Answer(a)(iii) ............................................. [1]
(b) Goats cost $\$ 4$ and sheep cost $\$ 8$.

The maximum Luk can spend is $\$ 160$.
Write down an inequality in $x$ and $y$ and show that it simplifies to $x+2 y \leqslant 40$.
Answer (b)
(c) (i) On the grid below, draw four lines to show the four inequalities and shade the unwanted regions.

[7]
(ii) Work out the maximum number of animals that Luk can buy.

3 Pablo plants $x$ lemon trees and $y$ orange trees.
(a) (i) He plants at least 4 lemon trees.

Write down an inequality in $x$ to show this information.

> Answer(a)(i)
(ii) Pablo plants at least 9 orange trees.

Write down an inequality in $y$ to show this information.

> Answer(a)(ii)
(iii) The greatest possible number of trees he can plant is 20 .

Write down an inequality in $x$ and $y$ to show this information.

> Answer(a)(iii)
(b) Lemon trees cost $\$ 5$ each and orange trees cost $\$ 10$ each.

The maximum Pablo can spend is $\$ 170$.
Write down an inequality in $x$ and $y$ and show that it simplifies to $x+2 y \leqslant 34$.
Answer (b)
(c) (i) On the grid opposite, draw four lines to show the four inequalities and shade the unwanted region.

[7]
(ii) Calculate the smallest cost when Pablo buys a total of 20 trees.

