# Inequalities

### What you should know
What an inequality such as $2x + y \leq 6$ means.
How to draw a graph to show the inequality $2x + y \leq 6$.

### New idea
If you have a number of inequalities representing real situations you can draw them on a graph and shade the areas you *don't* want. The unshaded area will then be the set of solutions to the inequalities, known as the **feasible region**.

## Task: Linear programming
A company makes two types of garden shed, standard and luxury. Use $x$ to represent the number of standard sheds and $y$ to represent the number of luxury sheds.

| Type | Standard ($x$) | Luxury ($y$) | Total available (per day) |
|---|---|---|---|
| **Machine time** | 2 | 3 | 30 |
| **Craftsman time** | 5 | 5 | 60 |
| **Profit** | £60 | £84 | $P$ |

- The inequalities that represent this are $2x + 3y \leq 30$, $5x + 5y \leq 60$, $x \geq 0$ and $y \geq 0$. Explain in words related to the problem what these inequalities represent.

- Draw the inequalities $2x + 3y \leq 30$ and $5x + 5y \leq 60$ on a graph. Shade the areas you *don't* want. Also shade the area to the left of the $y$-axis and below the $x$-axis (to represent $x \geq 0$ and $y \geq 0$).

- The feasible region should have four vertices: $(0, 0)$, $(12, 0)$, $(0, 10)$ and the point where $2x + 3y = 30$ and $5x + 5y = 60$ intersect. Find where these lines intersect.

- Enter these values for $x$ and $y$ into a copy of the table and complete the final row.

| $x$ | 0 | 12 | 0 | |
|---|---|---|---|---|
| $y$ | 0 | 0 | 10 | |
| $P (= 60x + 84y)$ | | | | |

- Why does $60x + 84y$ represent the profit? How many sheds of each type should the company make? What will the profit be?

### Take it further
- Investigate how changing the amount of machine time or craftsman time alters the solution.

- The company decide the sheds need to be painted. Standard sheds take 1 hour to paint; luxury sheds takes 2 hours to paint. The company has 14 hours of painter time available each day. Investigate how adding this extra constraint into the original problem affects the solution.

### Where this goes next
At A level this process, known as **linear programming** is studied in detail in Decision Mathematics.