Check Your Understanding

Linear Optimization

The table below identifies the key concepts from this unit.
1. Check your understanding by completing these questions.
2. Check your answers in the key provided.
3. In the table below, highlight the questions you got correct.
4. Ask peers/Dr. James about concepts where you can improve.

Key Concepts	Basic Questions	Intermediate Questions	Advanced Questions
Words to Inequalities	1	2	3
Linear Optimization	4	5, 6, 7	8

1. Convert the following statements into inequalities:

a) Students are holding a bake sale. They sell cookies and cupcakes. They sell at least 25 cookies.

b) Students are holding a bake sale. They sell cookies and cupcakes. They sell no fewer than 20 cupcakes.

2. Convert the following statements into inequalities:

a) A company sells road bikes and mountain bikes. The number of road bikes they sell is not greater than three times the number of mountain bikes.

b) Students are selling bracelets and necklaces as a fundraiser. They sell at most 30 pieces of jewelry total.

c) A school is selling strawberry plants and tomato plants as a fundraiser. They sell a maximum of twice as many tomato plants as strawberry plans.

3. Conver the following statement into an inequality:

 Students are holding a fundraiser washing cars and trucks. They wash no less than 10 more trucks than cars.

4. A small local dairy produces milk to sell at their small shop. They sell regular milk and chocolate milk. The amount of each type of milk the dairy can produce each week must adhere to the following constraints:

- The dairy produces no more than 500L of regular milk
- The dairy produces at most 300L of chocolate milk
- The dairy produces a maximum of 700L of milk total
- The dairy produces a minimum of 500L of milk total

Given x is the number of litres of regular milk sold and y is the number of litres of chocolate milk sold, the polygon of constraints is shown below.
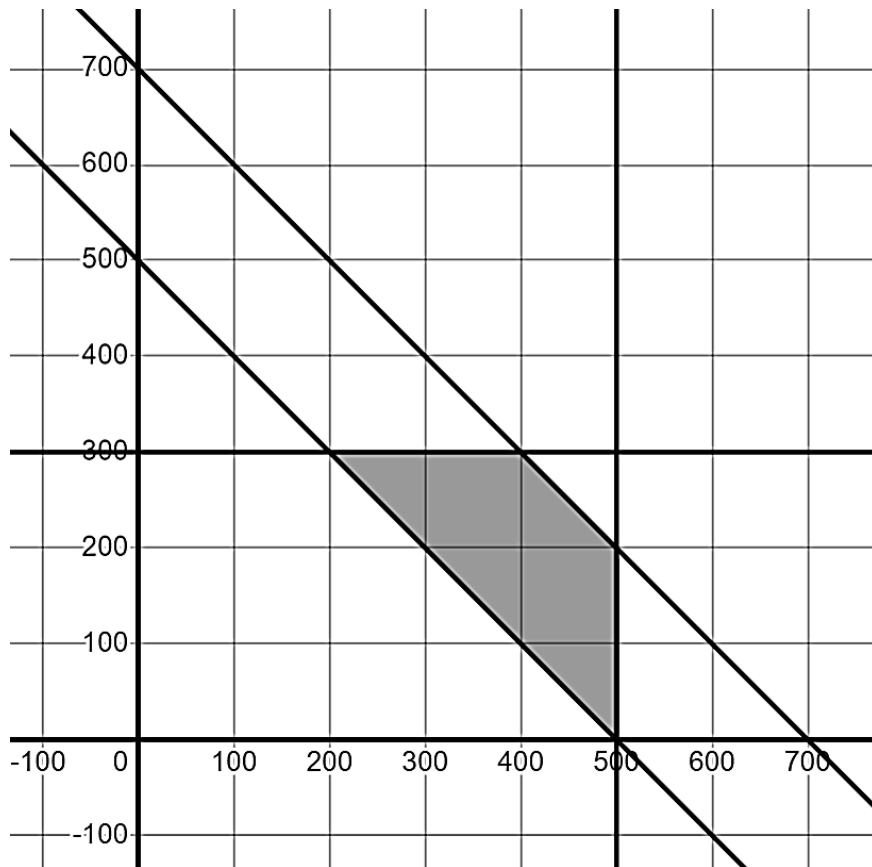

The dairy charges $2 per litre for regular milk and $2.50 per litre for chocolate milk.

What is the maximum revenue the dairy can make each week?

5. A children's toy manufacturer has focused manufacturing on its two best selling toys: toy cars and action figures. The manufacturing plant has been set up so that both toys can be produced each day, and the numbers of each toy produced must follow the constraints below:

- They make no fewer than half as many action figures as toy cars
- They make at most 150 toys each day
- They make a minimum of 40 toy cars each day
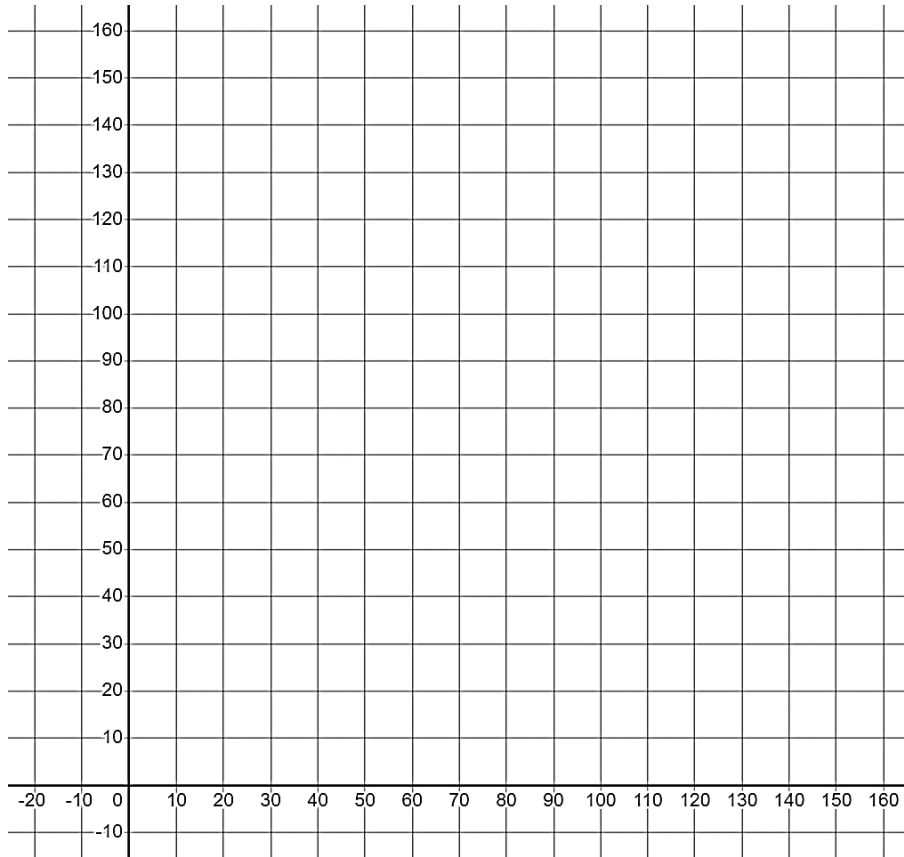
The company makes a profit of $3 for every toy car and $1.50 for each action figure.

What is the maximum profit the company can earn each day?

6. A carpentry student is learning how to make furniture. The student is practicing making tables and chairs. Each month the student wants to get in as much practice as possible, but is limited in the number of pieces they can make, given by the constraints below:
- The student must make at most 5 tables
- The student must make a minimum of 2 chairs
- The student must make no more than twice as many tables as chairs
- The student must make at most 6 chairs
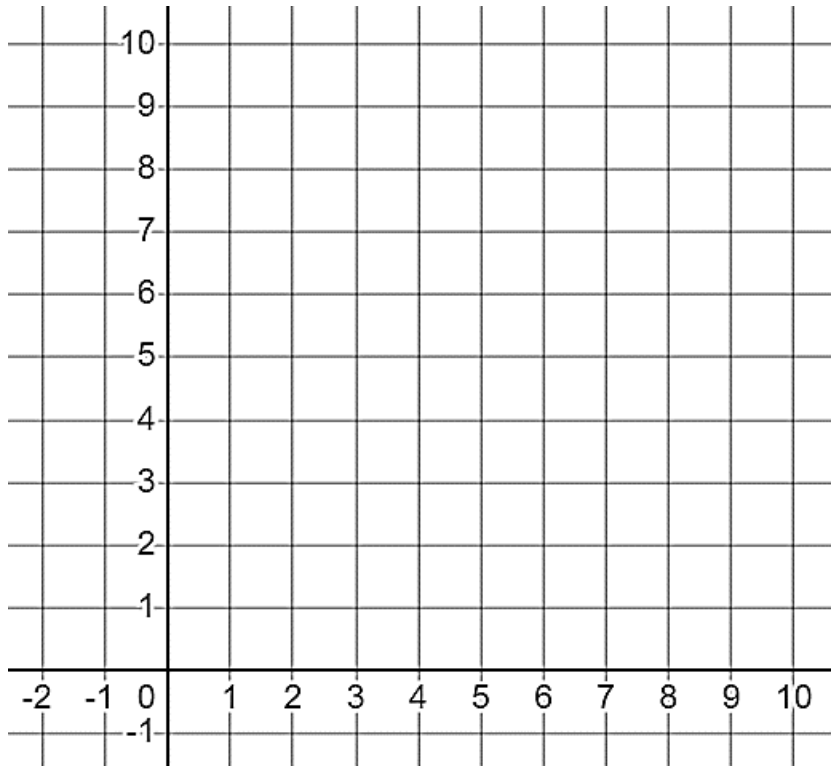
In addition to the time spent practicing, the student must pay for supplies. Each table costs the student $40 to make, and each chair costs the student $15 to make.

What is the minimum amount of money the student can spend on supplies each month, while still getting in the necessary practice? How many chairs and tables will the student make if they spend the minimum amount of money on supplies?

7. Kayla has decided to make some extra money by selling handmade jewelry. Kayla makes necklaces and earrings. The numbers of necklaces and earrings Kayla can make each month are limited by the constraints below:

- Kayla can make no more than 21 pieces of jewelry
- Kayla can make at least half as many necklaces as earrings
- Kayla can make no fewer than 9 pieces of jewelry
- Kayla can make a maximum of twice as many necklaces as earrings
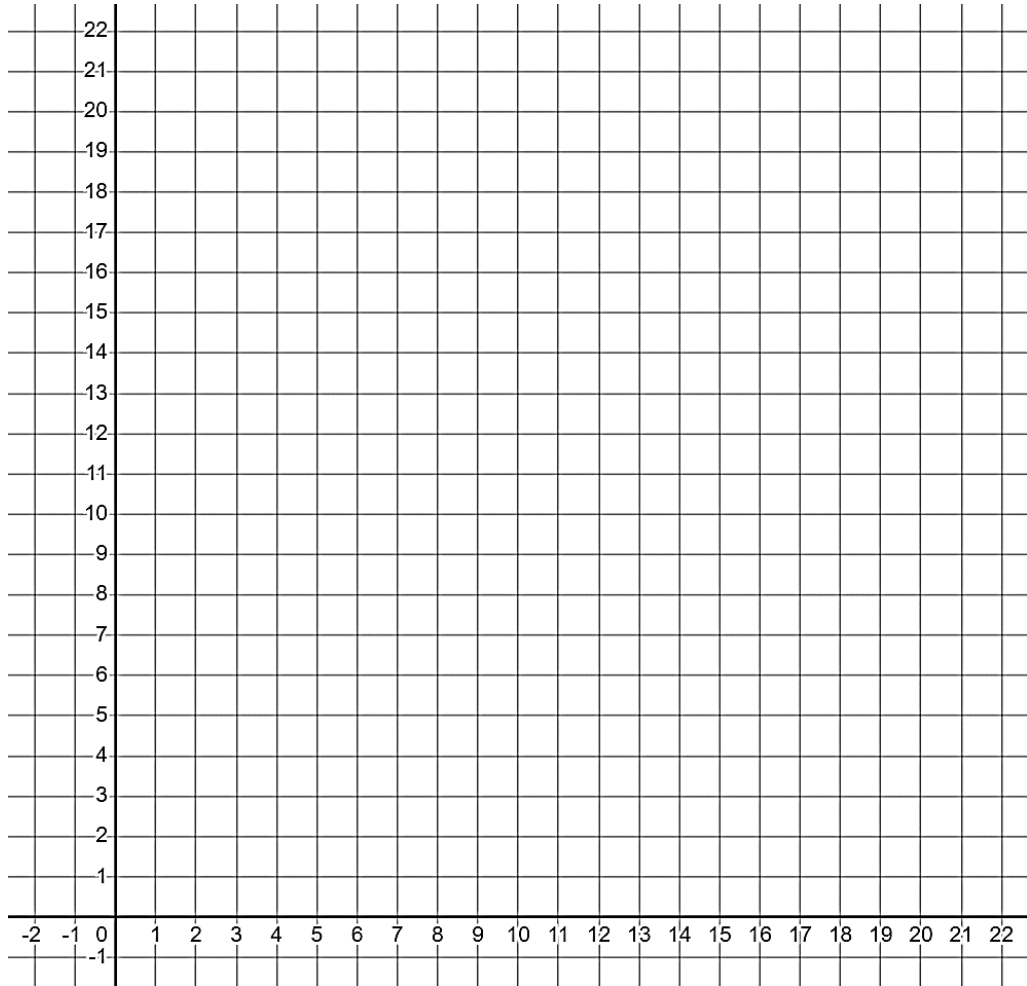
Kayla sells each necklace for $18 and each pair of earrings for $22.

What is the maximum amount of money Kayla can earn each month by selling jewelry?

8. Izzy is a talented artist and has decided to earn money to pay for CEGEP by selling handmade cards and sketches online. The number of cards and sketches Izzy can sell each month must follow the constraints given below:

- Izzy sells a minimum of 6 sketches
- Izzy sells at least 1 card
- Izzy sells no more than 12 items in total
- Izzy sells no more than 6 more than twice as many sketches as cards
- Izzy sells a maximum of half as many cards as sketches
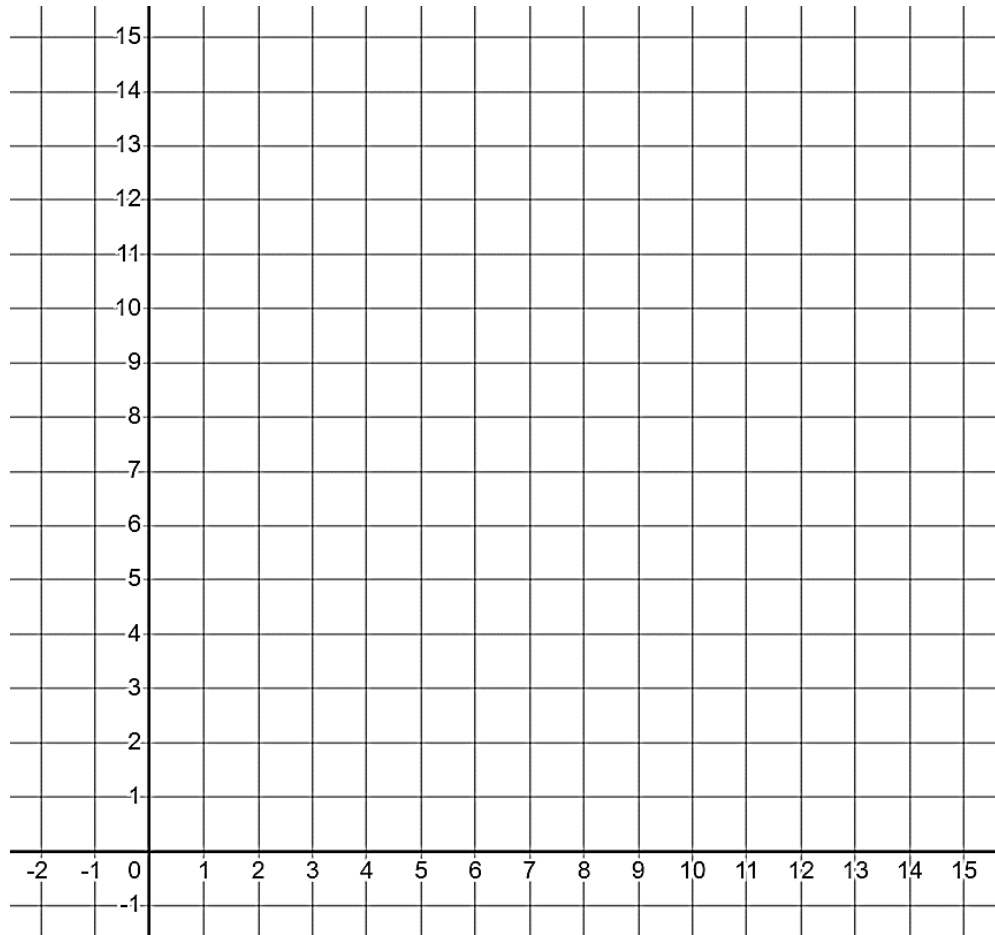
Izzy charges $7 for each card and $30 for each sketch.

What is the maximum amount of money Izzy can earn each month by selling cards and sketches?

Answers

1. Let x be the number of cookies sold. Let y be the number of cupcakes sold

   a. $x \geq 25$

   b. $y \geq 20$

2. a. Let x be the number of road bikes sold. Let y be the number of mountain bikes sold.

   $x \leq 3y$

   b. Let x be the number of bracelets sold. Let y be the number of necklaces sold.

   $x + y \leq 30$

   c. Let x be the number of strawberry plants sold. Ley y be the number of tomato plants sold.

   $y \leq 2x$

3. Let x be the number of cars washed. Let y be the number of trucks washed.

$$y \geq x + 10$$

4. The dairy can make a maximum revenue of $1550 per week.

5. The maximum profit the toy company can make each day is $375

6. The minimum amount of money the student can spend on supplies each month is $30 by making 0 tables and 2 chairs.

7. Kayla can make a maximum of $434 each month by selling jewelry.

8. Izzy can make a maximum of $314 each month by selling cards and sketches.