# 3.9 - Solving Linear Systems by Graphing

A **linear system** is a group of linear relations (lines).

The **solution** of a linear system is where the lines cross - their **point of intersection**. This can be useful when comparing the prices between different products/services!

Example 1: Listen-Now offers audiobooks at $5 each with no monthly fees. Ear-Reader offers audiobooks at $2.50 each, but charges a $10 monthly fee. The relations are graphed below.

Listen-Now

Ear-Reader

Number of audiobooks bought per month
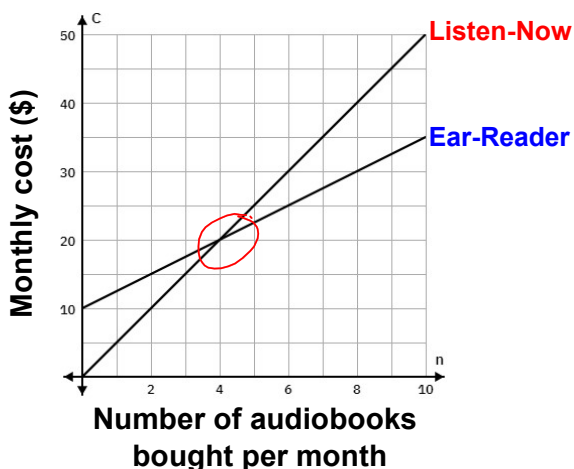
a) What is the solution to this linear system?

At 4 books, cost is $20

$(4, 20)$

b) What does the solution represent in this situation?

The cost of $20 is the same if downloading 4 books

c) When should you choose Ear-Reader to buy audiobooks?

You want Ear-reader if buying more than 4 books

Note: We can also write solutions as an **ordered pair** or **coordinate!** The solution to the system above can be written as (4 , 20).

Example 2: Below are the fees of two banks for using your debit card with their chequing account. Answer the following questions.

	Monthly Fee	Cost per debit transaction ($)
UBank	$5.00	$0.25
BankFree	$0	$0.50

Let "C" be the total monthly cost, and "n" be your number of debit transactions.

a) Determine the equation representing the cost of using each bank.

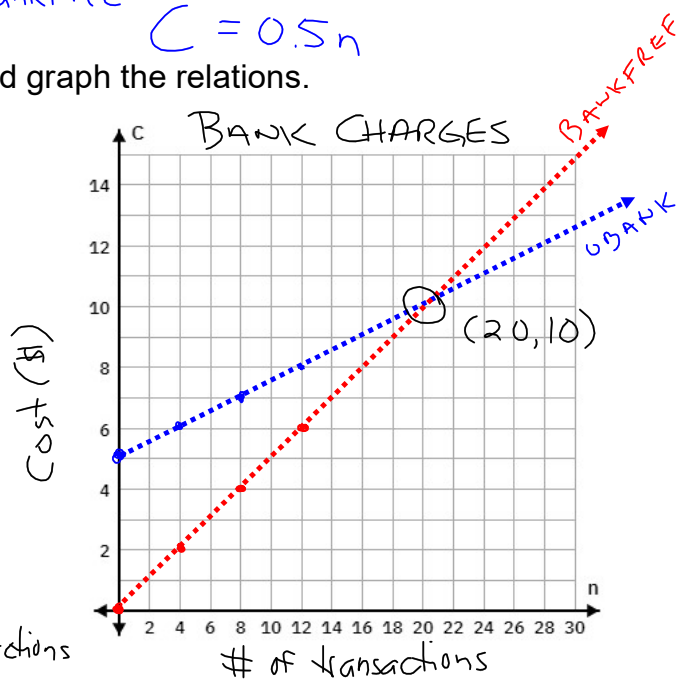UBANK

$$C = 0.25n + 5$$

BankFree

$$C = 0.5n$$

b) Fill out the tables of values below and graph the relations.

UBank

n	C
0	5
4	6
8	7
12	8
16	9
20	10
24	11

BankFree

n	C
0	0
4	2
8	4
12	6
16	8
20	10
24	12

SAME

DASHED LINE!
CAN'T HAVE ½ transactions

BANK CHARGES

BANKFREE

UBANK

(20,10)

Cost ($)

# of transactions

c) What is the solution? What does it represent?

(20,10)   At 20 transactions they both cost $10

d) When should you choose BankFree? UBank?

Use BankFree when under 20 transactions
Use UBank when more than 20 transactions

Example 3: You are trying to decide between two restaurants to host a small event. Fig Newton's charges a fixed cost of $70 and then charges $5 per person for food and drink. Hypatia's Diner has no fixed cost, but charges $12 per person for food and drink.

a) Write out the equations for each restaurant (include a let statement).

Fig

$$C = 5n + 70$$

Hyp

$$C = 12n$$

Let C represent the cost
Let n represent # of people

b) Use your equation (or a pattern) to fill out a table of values.

Fig Newton's

n	C
0	70
2	80
4	90
6	100
8	110
10	120
12	130

Hypatia's

n	C
0	0
2	24
4	48
6	72
8	96
10	120
12	144

DASHED → can't have $\frac{1}{2}$ of a person

c) Graph the two relations.

Restaurant Costs

Cost ($) / # of people
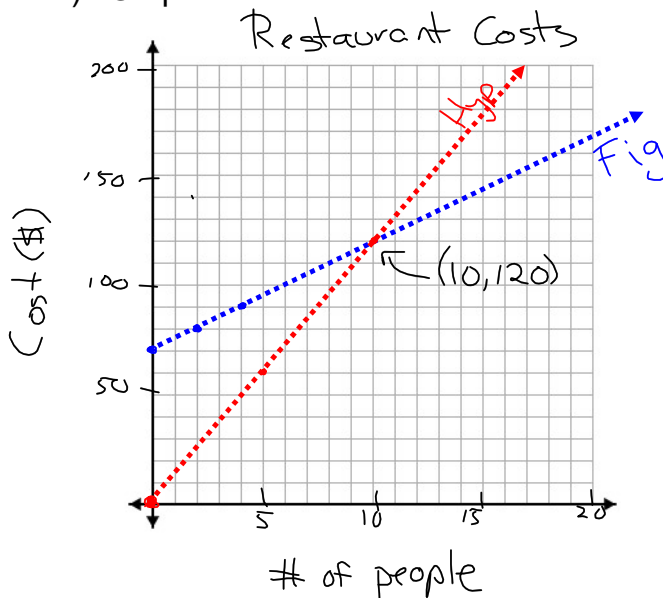
(10, 120)

d) What is the solution to this linear system? What does it represent?

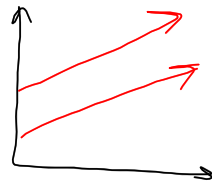(10, 120)   At 10 people, both cost $120

e) Explain under what conditions you would choose Hypatia's Diner? Fig Newton's?

Under 10 people, choose Hypatia
More than 10 people, choose Fig Newton's

Think!

Is it possible for a linear system to have **no solutions**?
If so, how could this happen?

Parallel lines!

- Same rate of change
- Different starting points

Is it possible for a linear system to have **more than one solution**? If so, how could this happen?

L_1, L_2

Same line

Infinite # of solutions

- Same starting point
- Same rate of change