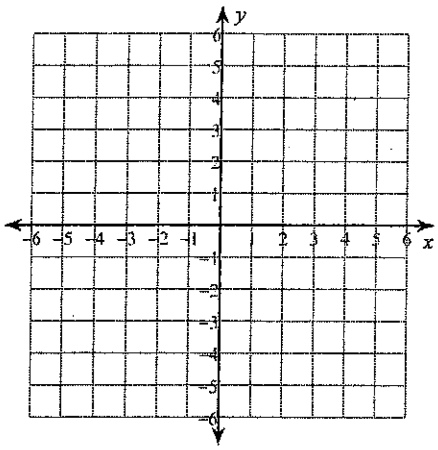
Algebra 2 Name______________________________ ID: 1

Graphing Review for Linear Programming

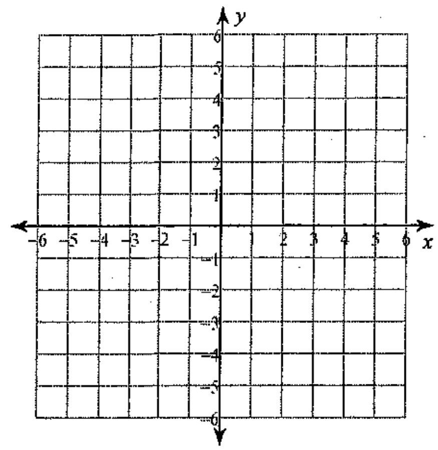
Date________________ Period____

Sketch the graph of each line.

1) $7x - 2y = -4$

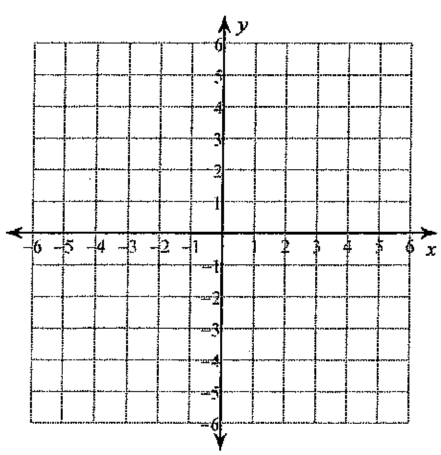


2) $7x + 4y = -8$

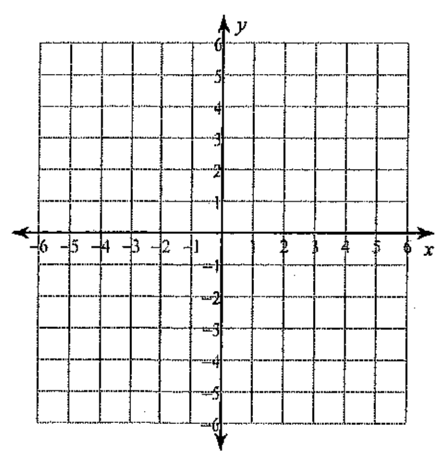


Sketch the graph of each linear inequality.

3) $x - 5y < -20$

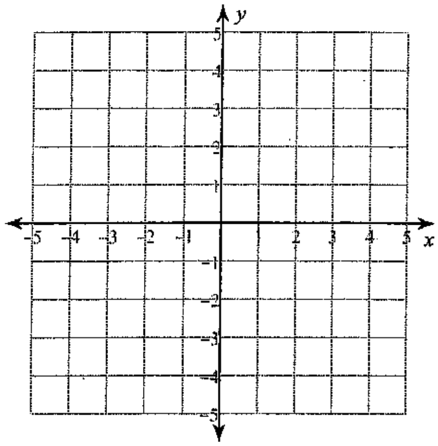


4) $x > -3$

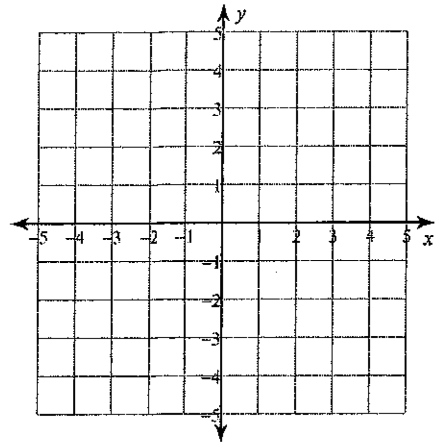


Sketch the solution to each system of inequalities.

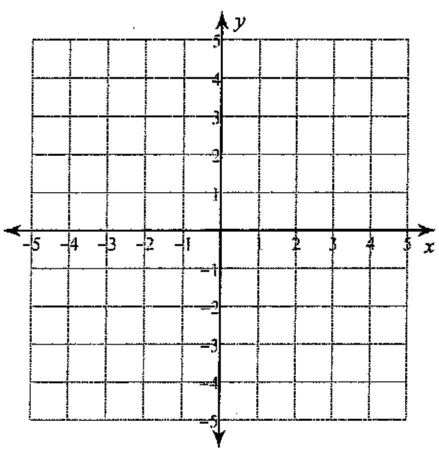
5) $x + 3y > -9$
$x - y > -1$



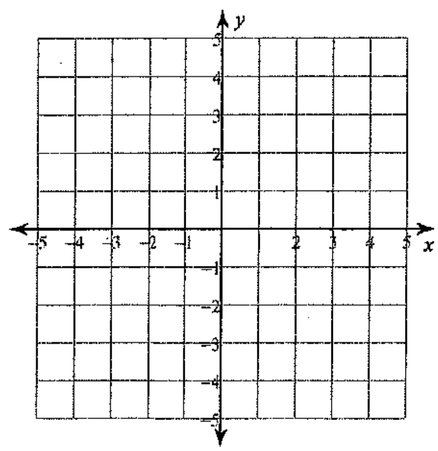
6) $x - 2y > -6$
$x + 2y \geq 2$



7) $3x - 2y \leq -4$
$x + y > -3$



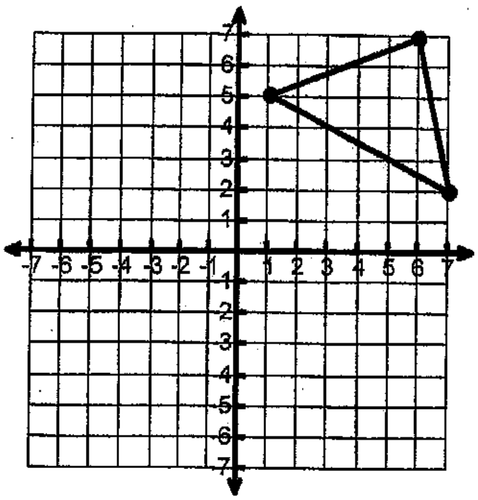
8) $2x - y \leq 3$
$y \geq 1$



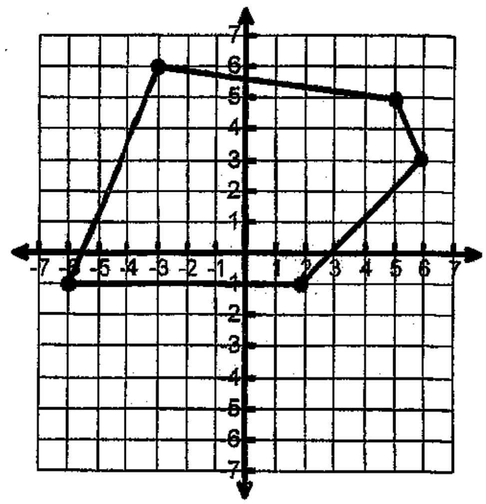
Advanced Algebra
Unit 4 Day 3 WS – Linear Programming Practice
Name:________________

Find the Maximum and Minimum values of the objective function for the given feasible region

1. $C = 5x + 2y$



2. $C = x - 3y$



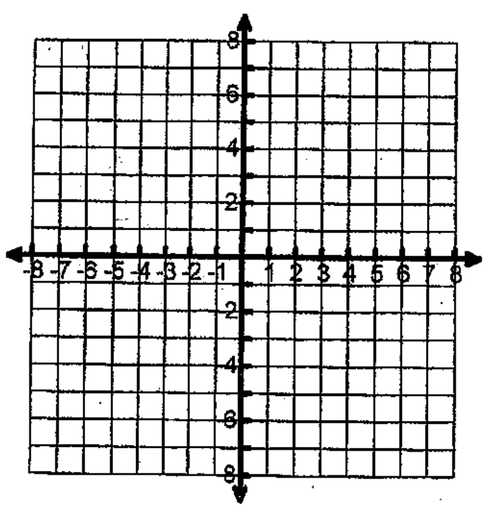
3. $C = 5x + y$

Constraints:

$x \geq 0$

$y \geq 0$

$x + 2y \leq 6$



4. $C = 3x + 5y$

Constraints:

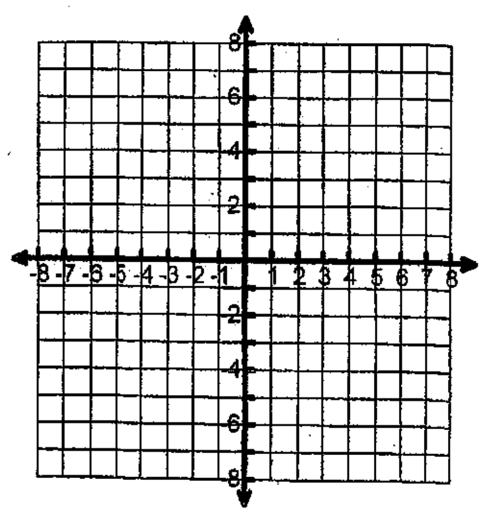
$x \geq 2$

$x \leq 6$

$2x - y \geq 3$

$x + y \leq 6$

$y \geq 0$

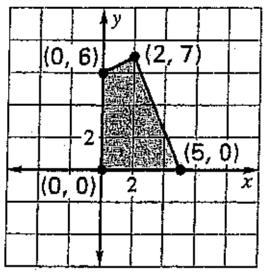


3.4

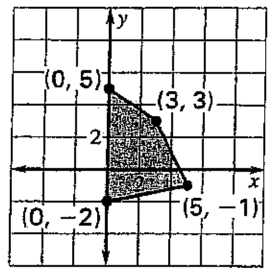
Step-By-Step Linear Programming

A. Practice plugging in the vertices to the objective function to find the maximum and minimum values.

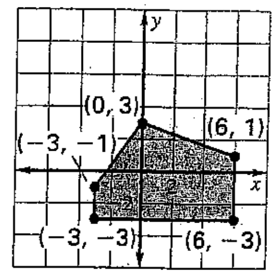
1. $C = x - y$



2. $C = x + 2y$



3. $C = -2x + y$



B. Practice graphing the constraints and finding the vertices of the feasible region. Then find the maximum and minimum values of the objective function.

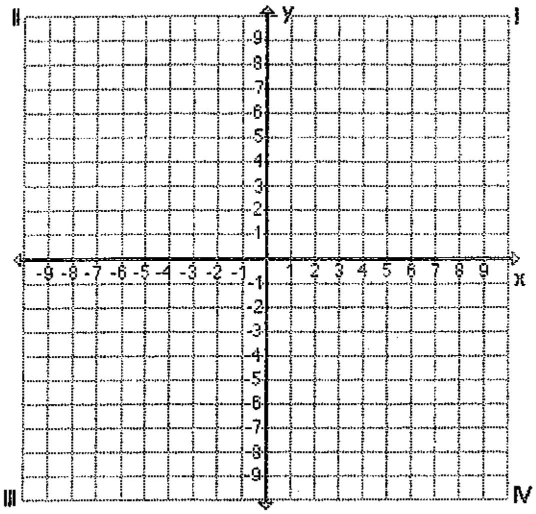
1. Objective function: $C = 2x - 3y$
   Constraints: $x \geq 0$
   $y \geq 0$
   $x + y \leq 4$

2. Objective function: $P = x + 3y$
   Constraints: $x - y \geq 0$
   $x + 2y \leq 12$
   $y \geq 1$

3. Objective function: $C = 3y + x$
   Constraints: $x + y \geq 2$
   $2y \geq 3x - 6$
   $-x + 4y \leq 8$

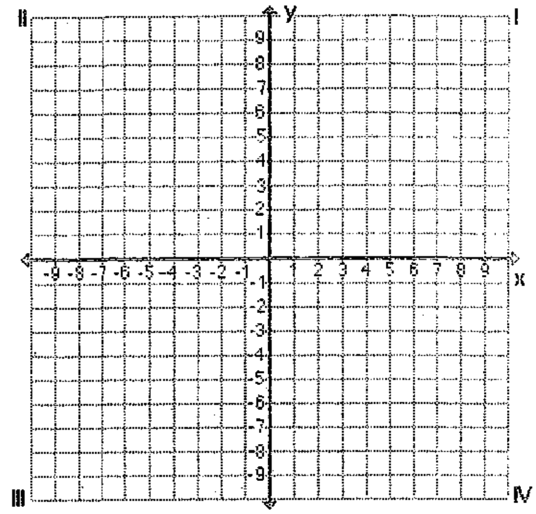
4. Objective function: $S = 2x - 5y$
   Constraints: $y \geq -x + 6$
   $y \leq x + 4$
   $y \leq 7$
   $x \leq 5$

(1)



y
x
I
II
III
IV
-9 -8 -7 -6 -5 -4 -3 -2 -1 1 2 3 4 5 6 7 8 9

(2)



y
x
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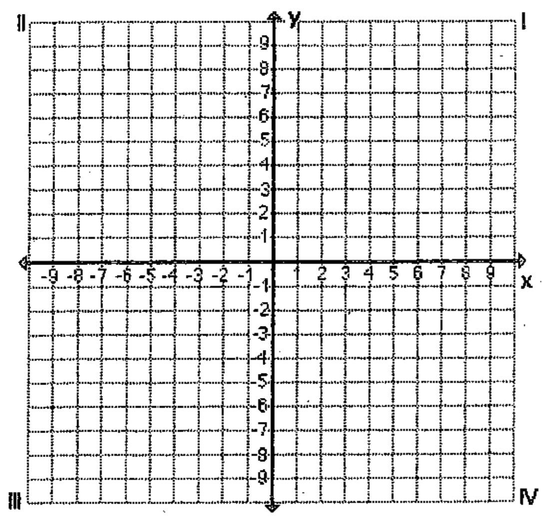
II
III
IV
-9 -8 -7 -6 -5 -4 -3 -2 -1 1 2 3 4 5 6 7 8 9

(3)



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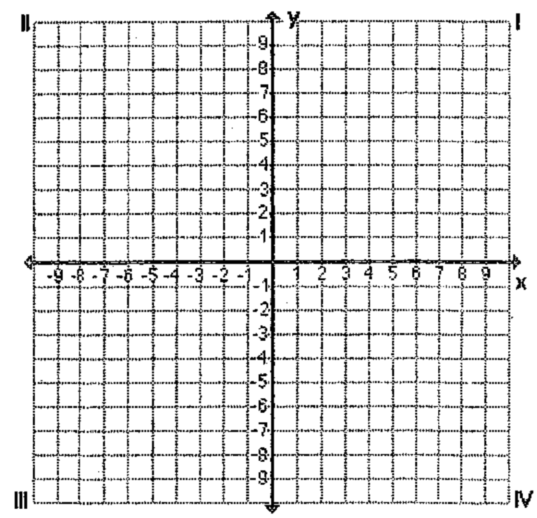
(4)



y
x
I
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-9 -8 -7 -6 -5 -4 -3 -2 -1 1 2 3 4 5 6 7 8 9

Making Money

In general, businesses want to make a profit. Not only do they want to make a profit; they want to make the maximum profit possible given their resources.

For instance, Phillip has a delivery service with a fleet of trucks. He largely delivers appliances. Each of his trucks can carry 3500 lbs. and 400 cubic feet of merchandise. A small refrigerator weighs 35 lbs. and occupies 3 cubic feet of space; a 21-inch television set weighs 25 lbs. and occupies 5 cubic feet of space. Phillip charges $10 for each refrigerator and $8 for each television he delivers. How many of each appliance should he load into a truck to maximize his income?

1. Look first to see what Phillip wants to maximize. Write an equation expressing Phillip's income. Be sure to define your variables.

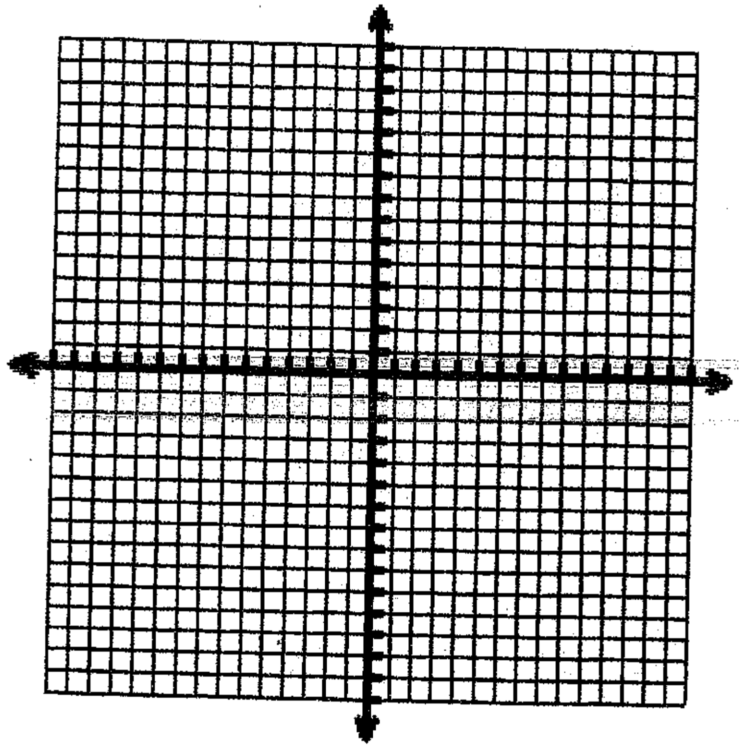
2. What are the limitations of Phillip's trucks?

3. Write an equation to express the weight of the items Phillip is carrying in his truck.

4. Write an equation to express the cubic feet of merchandise he is carrying in his truck.

5. The first equation you wrote (problem 1) is called an objective function. It represents what you are trying to maximize (or minimize). The other two equations are called constraints. They represent the limits of your resources. One other limit you should always consider is this – should your variables be restricted to non-negative numbers. In this case, can you have a negative number of televisions that you are carrying? Can you have a negative number of refrigerators that you are carrying? How can you express that with an equation?

6. Graph all of your constraints. Be sure to shade appropriately.



7. The shaded region in the graph above is called the feasible region. All of the values within the region are possible combinations of refrigerators and televisions. The values that will cause the biggest and smallest income will occur at the vertices. List the vertices of your feasible region.

8. Go back to your objective function (problem 1). Using that equation, evaluate your equation at each vertex (plug the vertices into the equation).

9. Which vertex gives you the highest income?

10. How many refrigerators and televisions should Phillip load onto his truck?

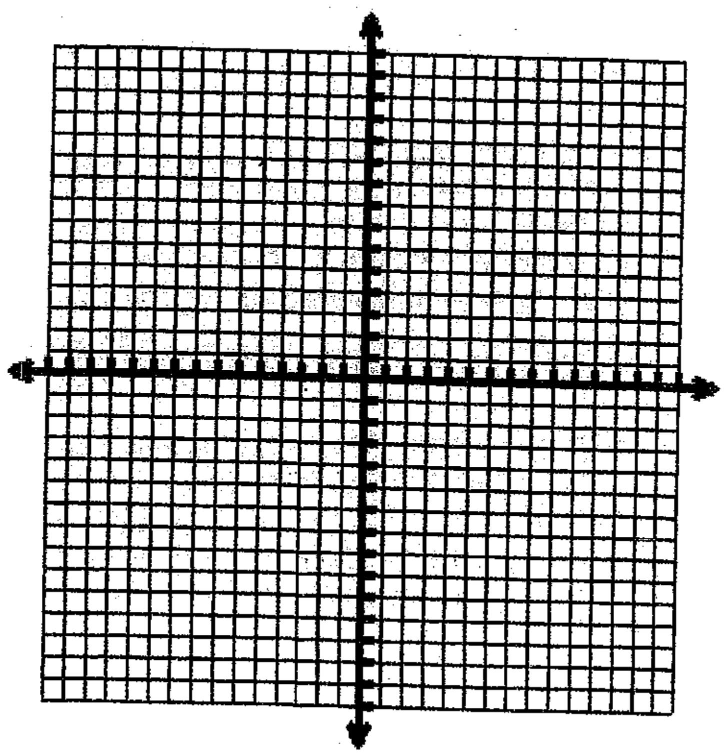
Now, follow the same process to solve this problem.

A manufacturer makes two types of picnic tables, deluxe and standard. The deluxe table takes 6 hours to build and 1 hour to finish. The standard table takes 4 hours to build and 2 hours to finish. The manufacturer can devote at most 120 hours per week to building and 40 hours per week to finishing. The profit on each deluxe table is $30 and on each standard table the profit is $36. How many of each type of table should be produced to maximize the profit?

1. What are you maximizing or minimizing? Write the objective function.

2. What are your limitations? Write the constraints.

3. Graph the constraints.



4. What are the values where the maximums and minimums will occur? List the vertices of the shaded region.

5. What are the maximum and minimum profits? Plug the vertices into the objective function.

6. How many of each table should be produced to provide the maximum profit?

Additional problems.

1. A carpentry shop makes end tables and coffee tables. Each week the shop must complete at least 9 end tables and 13 coffee tables to be shipped to furniture stores. The shop can produce at most 30 end tables and coffee tables combined each week. The shop sells end tables for $120 and coffee tables for $150, how many of each item should be produced for a maximum weekly profit?

2. Sally's woodworking shop produces 2 sizes of bookcases: large and small. Each week, her staff must produce at least 23 large bookcases and 40 small bookcases to meet demand, but can produce a combined total of only 75 bookcases due to the availability of materials. The cost to produce a small bookcase is $72, while the cost to produce a large bookcase is $104. If the selling price for a small size is $125 and the selling price for the large size is $159, how many of each type should Sally produce each week to maximize her profit? What is the maximum profit?

3. Farmer Fortney raises only pigs and goats. She plans to raise no more than 16 animals with no more than 12 goats. It costs $5 to raise a pig and $2 to raise a goat, and she has only $50 to use for this purpose. If Farmer Fortney can make a profit of $7.50 per goat and $4.75 per pig, how many of each should she raise to maximize her profit? What is the maximum profit?

3.4 Introduction to Linear Programming

- What is linear programming & when is it used?

Key Vocabulary Words

Objective Function	
Constraints	
Feasible Region	
Vertices	

<u>Steps for Solving a Linear Programming Problem:</u>

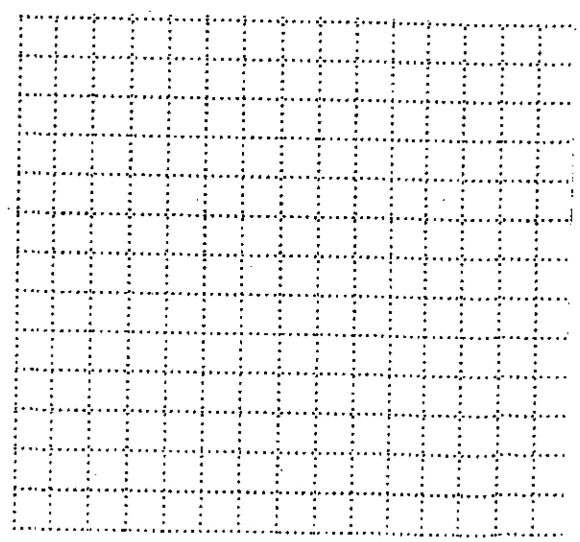
1. Write an equation to represent the objective function.
2. Write a system of inequalities for the problem's constraints.
3. Graph the system of inequalities.
4. Find the vertices of the feasible region.
5. Substitute each vertex into the objective function to find out which set of ordered pairs gives you the maximum and minimum values.
6. Write a statement that answers the problem.

<u>Example</u>: Your class plans to raise money by selling t-shirts and hats. The plan is to buy the t-shirts for \$8 and sell them for \$12 and to buy the hats for \$4 and to sell them for \$7. The planning committee estimates that you will not sell more than 120 items. Your class can afford to spend as much as \$800 to purchase the articles. What combination of hats and t-shirts will give you the maximum profit? What is the maximum profit?

Define the variables:

Objective function:

Constraints:



Linear Programming Name:

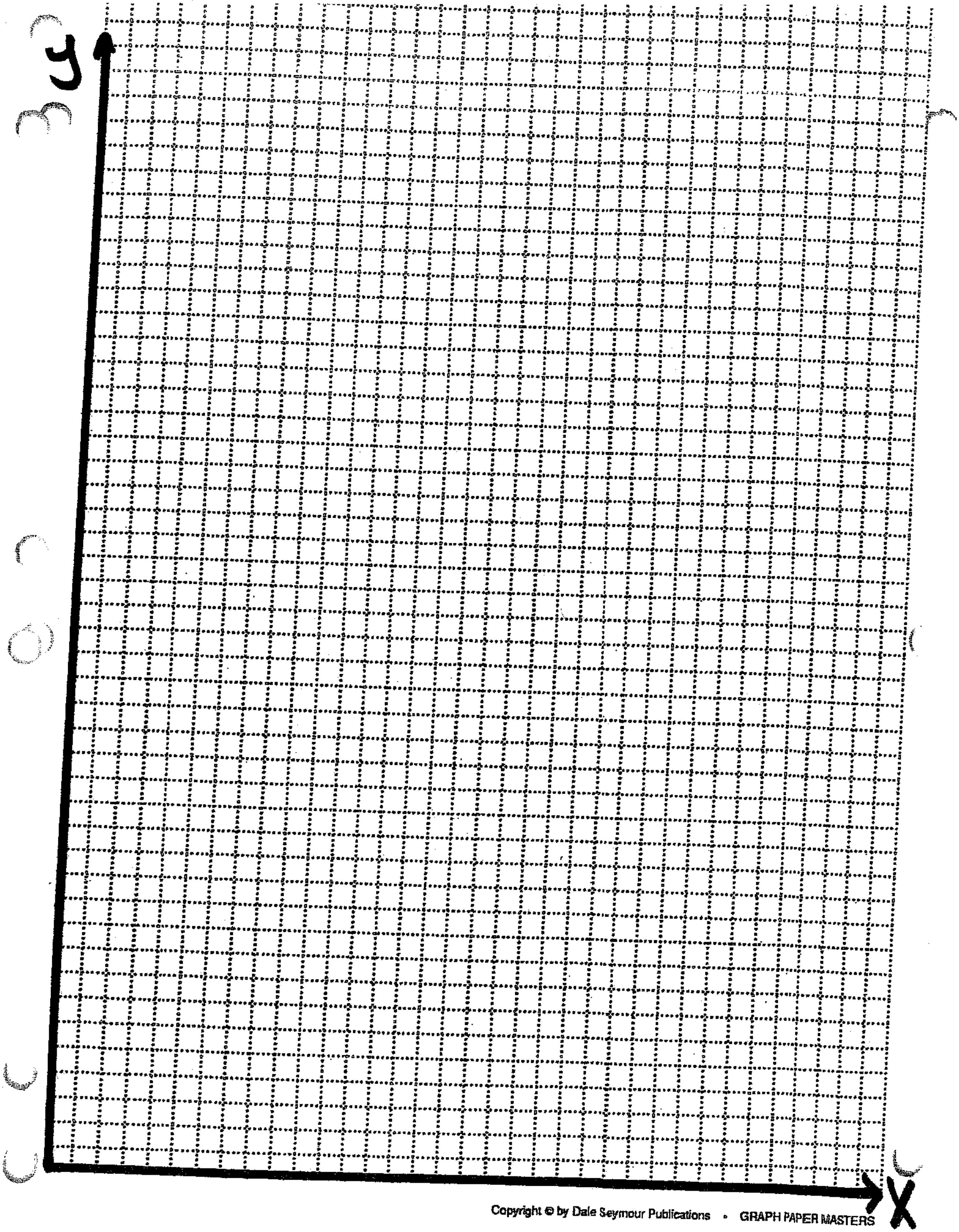
1. You are about to take a test that contains questions of type A worth 10 points and of type B worth 25 points. You must answer at least 3 of type A, but time restricts answering more than 12. You must answer at least 4 questions of type B, but time restricts answering more than 15. In total, you can answer no more than 20. How many of each type of question must you answer, assuming all of your answers are correct, to maximize your score? What is the maximum score? (1 block = 1)

2. You are stenciling wooden boxes to sell at a fair. It takes you 2 hours to stencil a small box and 3 hours to stencil a large box. You make a profit of $10 for a small box and $20 for a large box. If you have no more than 30 hours available to stencil and want to have at least 12 boxes to sell, how many of each size box should you stencil to maximize your profit? (Use a unit scale of 1 block = 1)

3. Wheels, Inc. makes mopeds and bicycles. Experience shows that each month they must produce at least 10 mopeds and at least 20 bicycles to meet demand. The factory can produce at most 60 mopeds and at most 120 bicycles in month. They can make at most 160 vehicles combined. The profit on a moped is $134 and on a bicycle is $30. How many of each should be made each month to maximize a monthly profit? What is the maximum profit? (Use a unit scale of 1 block = 10)

4. The area of a parking lot is 600 square meters. A car requires 6 square meters to park and a bus requires 30 square meters to park. The attendant can handle only 60 vehicles. If a car is charged $3 and a bus is charged $8, find how many of each type of vehicle should be accepted to maximize profit for the parking lot? (Use a unit scale of 1 block = 10)

5. A snack bar cooks and sells hamburgers and hotdogs during football games. To stay in business, it must sell at least 10 hamburgers but cannot cook more than 40. It must sell at least 30 hotdogs but cannot cook more than 70. The snack bar cannot cook more than 90 items total. The profit on a hamburger is $.33 and on a hotdog is $.21. How many of each should the snack bar sell to make a maximum profit? What is the maximum profit? (Use a unit scale of 1 block = 10)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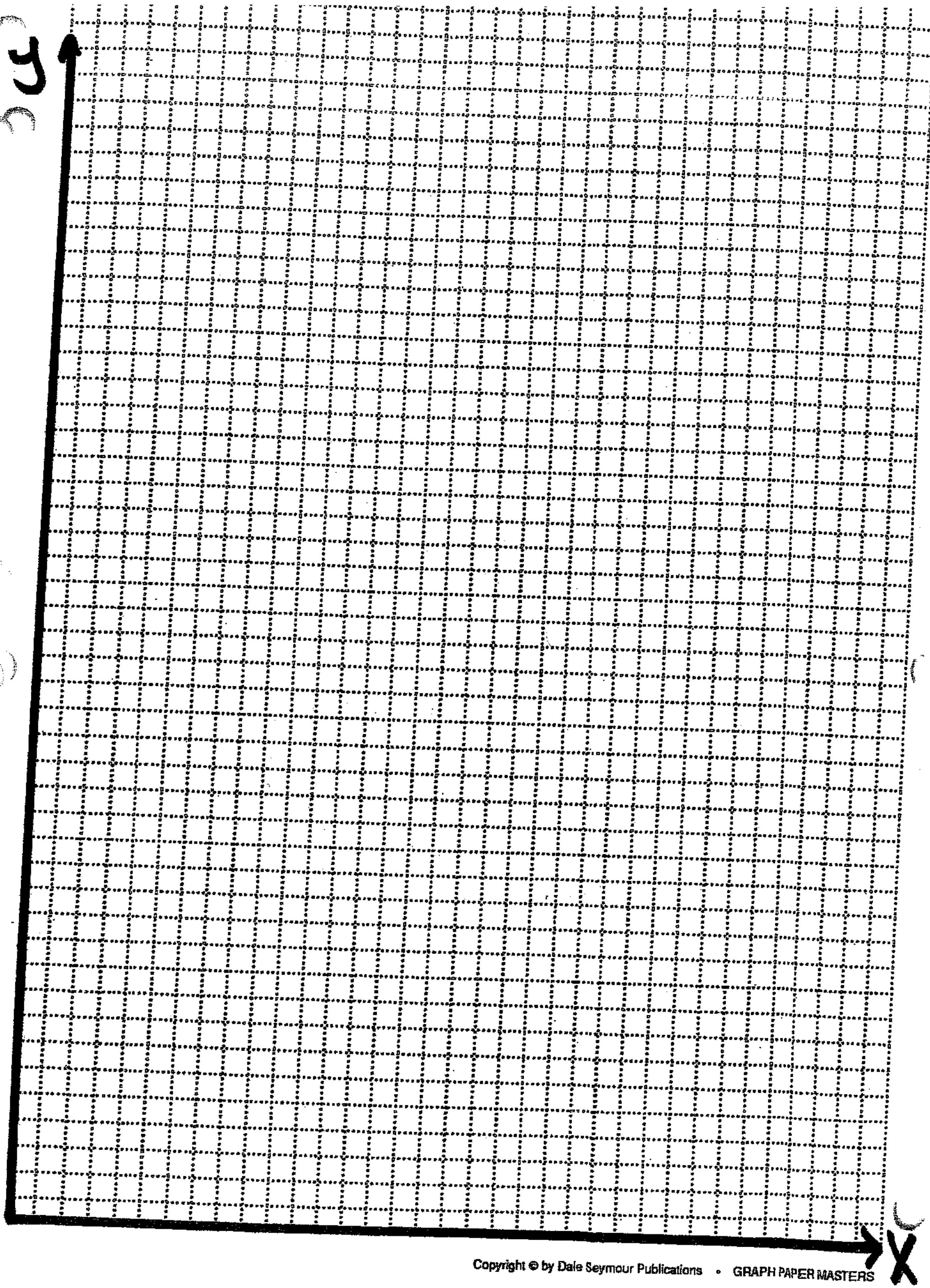
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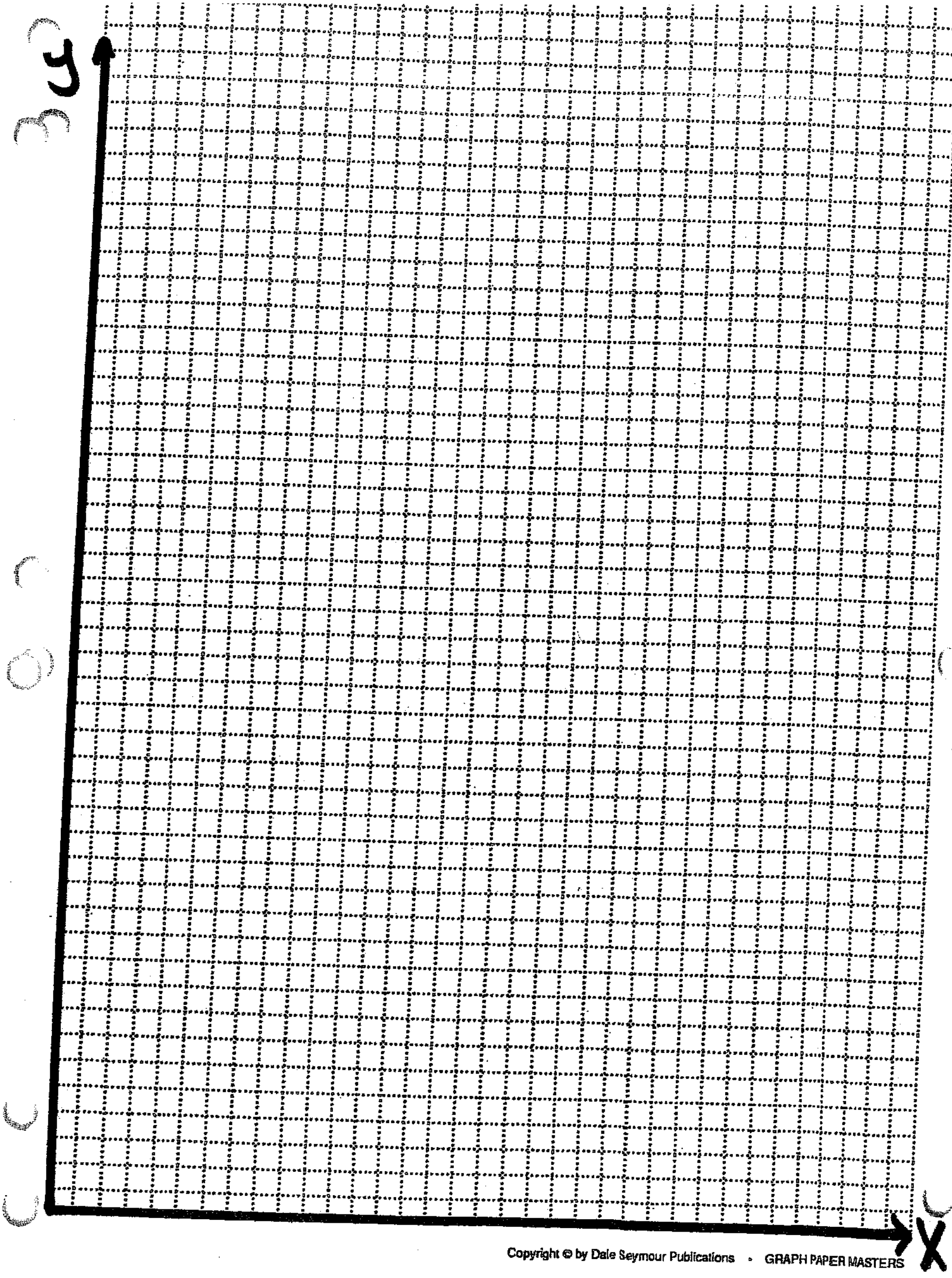
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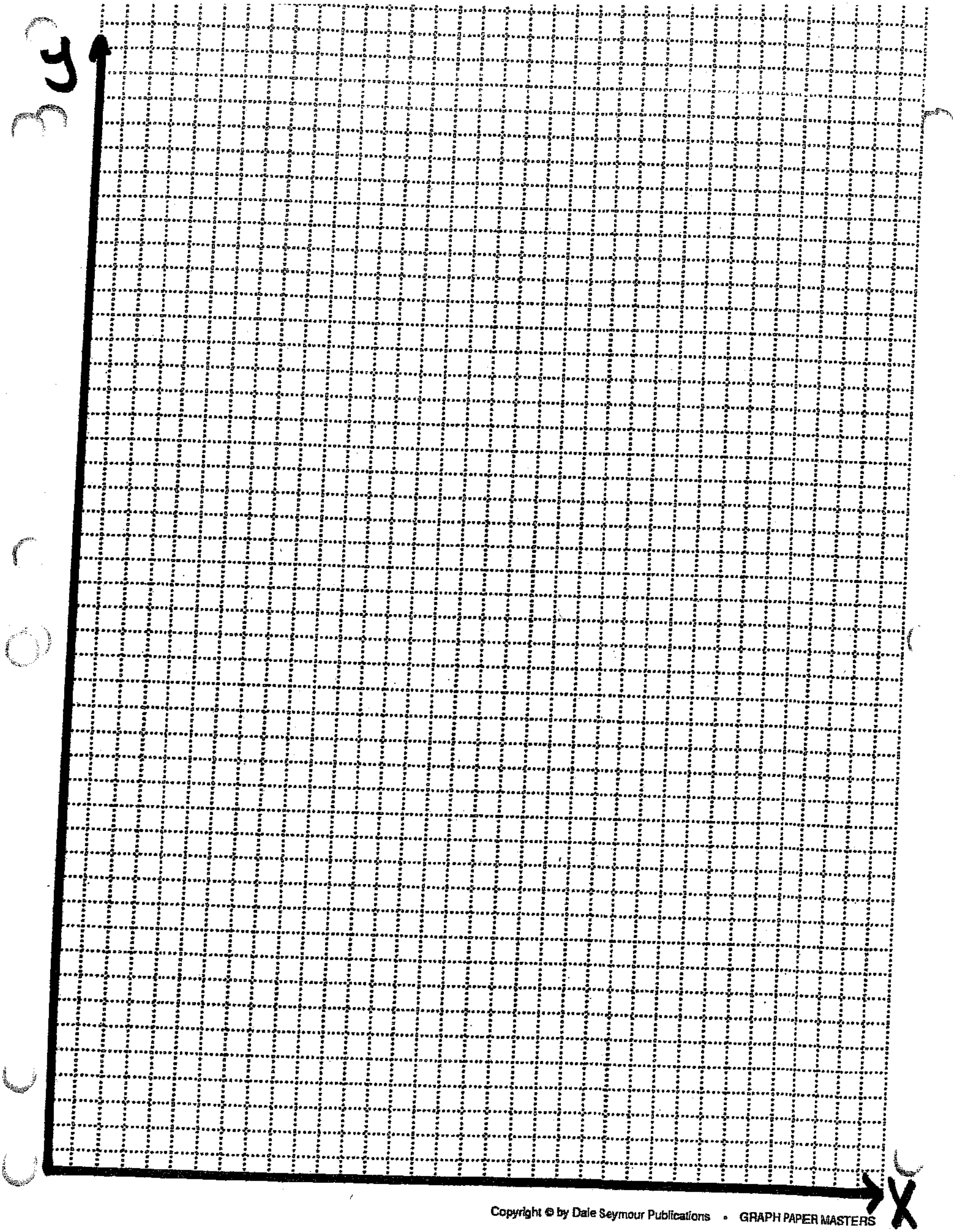
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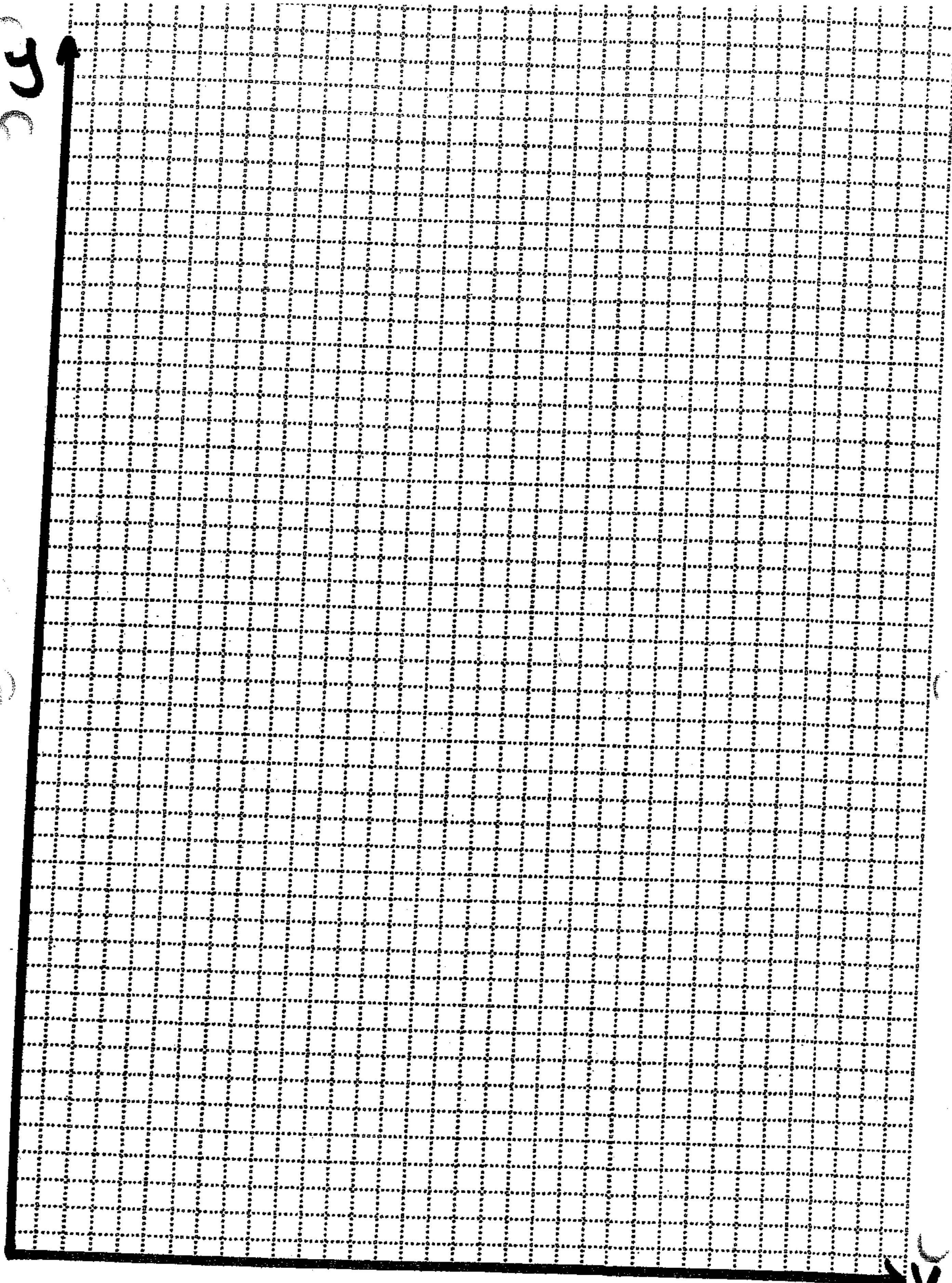
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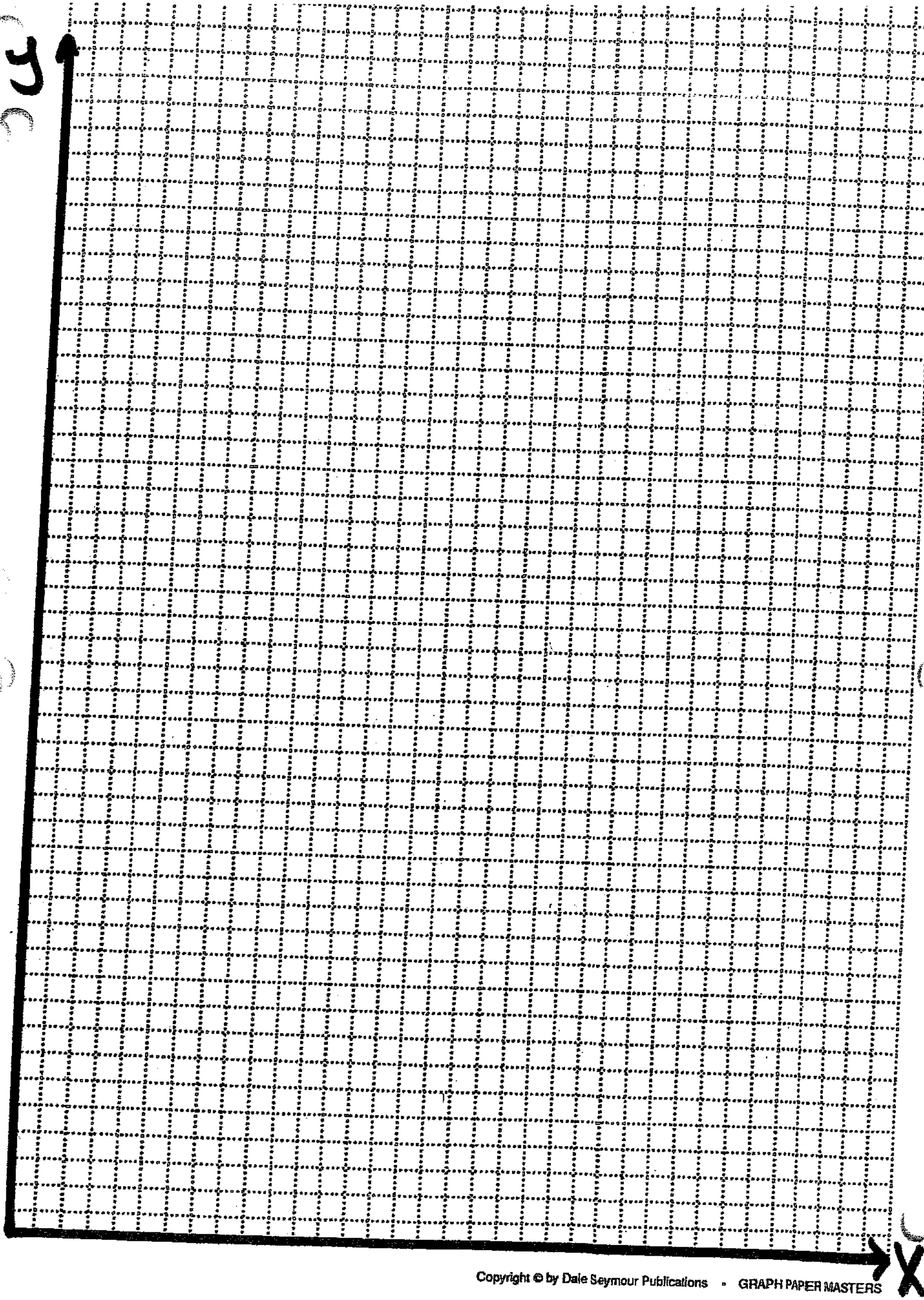
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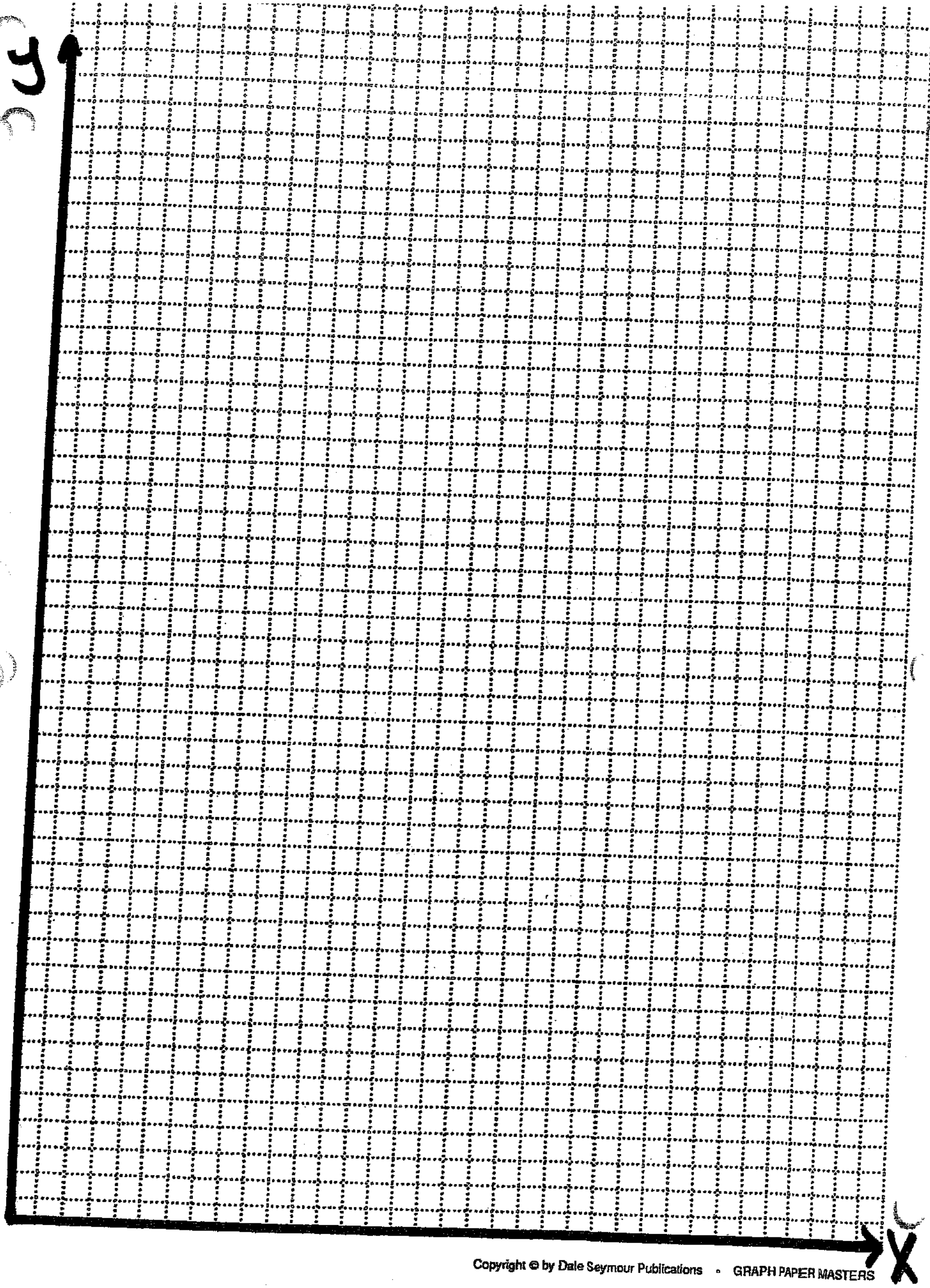
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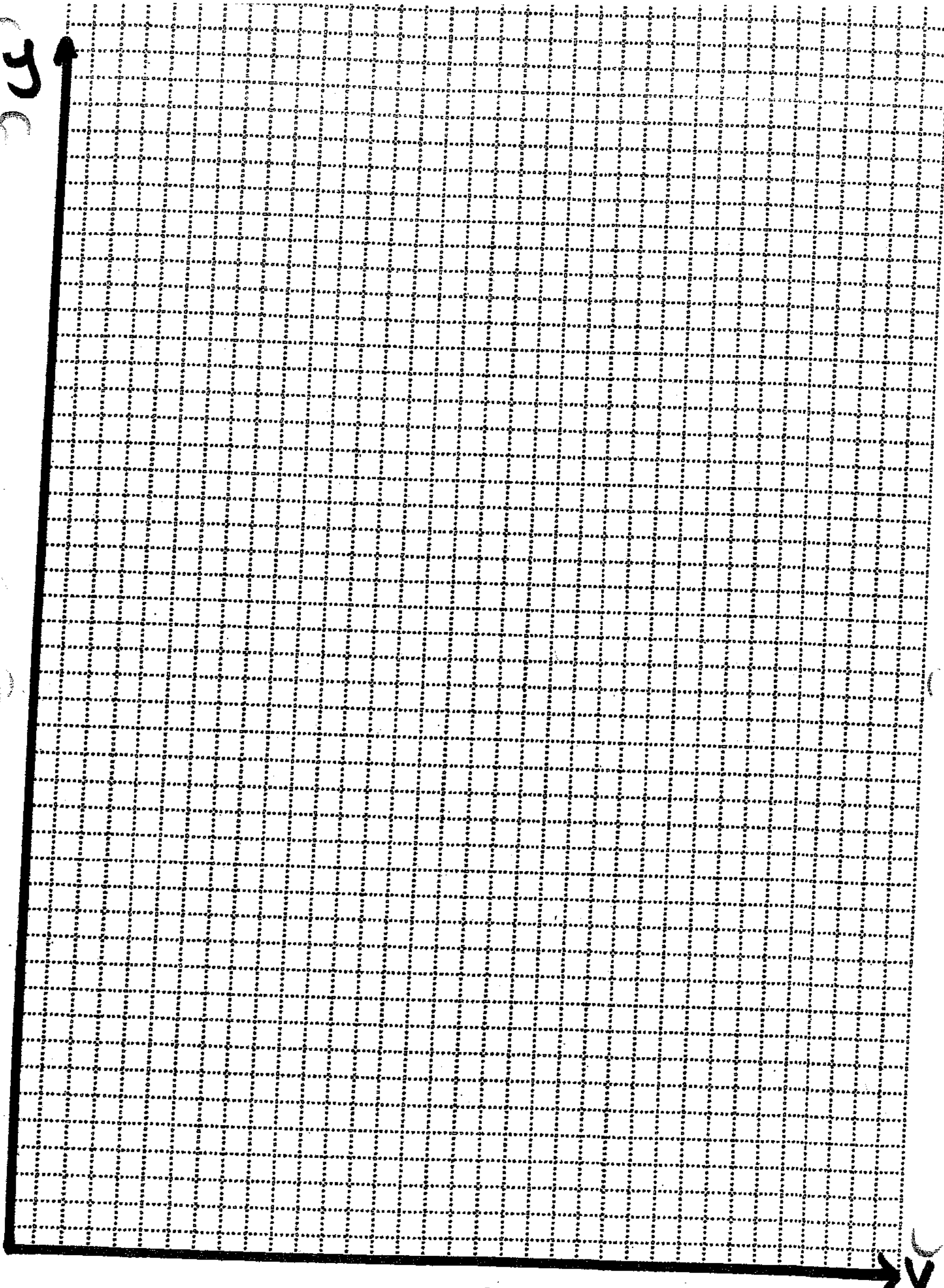
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