Key

Math 1 Name____________________

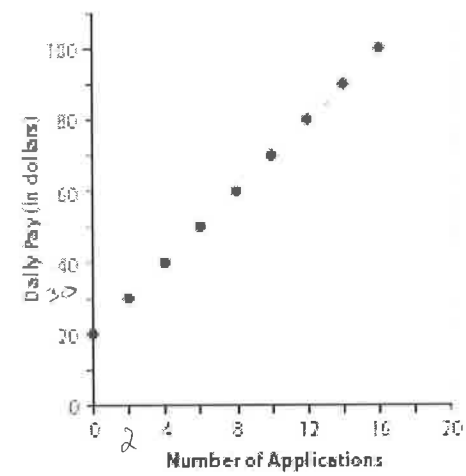
2-4 Writing Linear Functions Date________

- *I can correctly choose which formula best models a given situation.*
- *I can define and calculate the average rate of change of a function and explain the connection between average rate of change and slope.*
- *I can identify and graph a linear function in a variety of forms including, but not limited to: slope-intercept.*
- *I can write explicit/recursive equations to describe a real-world problem.*

Previously, you studied a variety of relationships between variables. Among the most common were linear functions – those with straight-line graphs, data patterns showing a constant rate of change and rules like $y = mx + b$.

For example, Barry works for a credit card company on college campuses. He entices students with free gifts (hats, water bottles, and t-shirts) to complete a credit card application. The graph below shows the relationship between Barry's daily pay and the number of credit card applications he collects.

Pay for Soliciting Credit Card Customers



a. How does Barry's daily pay change as the number of applications he collects increases? How is this shown in the graph?

He gets $5 per application collected. The graph is linear (constant rate of change).

b. If the linear patterns shown by the graph holds for other *(number of applications, daily pay)* pairs, how much would you expect Barry to earn for a day during which he collects:

i. 1 application: $25

ii. 13 applications: $85

iii. 25 applications: $25 \cdot 5 + 20 = \boxed{\$145}$

c. What information from the graph might you use to write a rule showing how to calculate daily pay for any number of applications?

pay per application (slope) + y-intercept

1. For collecting credit card applications, Barry's daily pay (B) is related to the number of applications he collects (n) by the function $B(n) = 20 + 5n$.

a. Use the function rule to complete this table of sample (n, B) values:

$20+5(10)$ $20+5(50)$

# of Applications	0	1	2	3	4	5	10	20	50
Daily Pay ($)	20	25	30	35	40	45	70	120	270

b. Compare the pattern of change shown in your table with that shown in the graph on the preceding page.

Constant rate of change → increases by $5 for each app. collected.

c. Barry will earn $ 20 if he does not collect any credit card applications. This information

is seen in the rule $B(n) = 20 + 5n$ because the 20 is by itself (constant term)

It can be seen in the table of sample $(n, B(n))$ because (0,20).

It can be seen on the graph because the y-intercept is (0,20).

d. Barry earns $ 5 extra for each application he collects. This information

is seen in the rule $B(n) = 20 + 5n$ because it is the rate of change multiplied by n.

It can be seen in the table of sample $(n, B(n))$ because increases by $5 each app.

It can be seen on the graph because slope is 5.

e. Write a **recursive equation** showing how Barry's daily pay changes with each new credit card application he collects. Put your answer on the line.

$$\begin{cases} a_0 = 20 \\ a_n = a_{n-1} + 5 \end{cases}$$

Example: $\begin{cases} a_0 = \_\_\_\_ \\ a_n = a_{n-1} \pm \_\_\_\_ \end{cases}$

☆ f. What is the practical domain of the function?

x-values that make sense: Any positive #s; $x \geq 0$.

What is the practical range of the function?

y-values that make sense: $y \geq 20$ → He can never make less than $20.

2. Cheri also works for the credit card company. She calls existing customers to sell them additional services for their account. The next table shows how much Cheri earns for selling selected numbers of additional services.

Number of Services Sold	10	20	30	40	50
Daily Pay (in dollars)	60	80	100	120	140

a. Does Cheri's daily pay appear to be a linear function of the number of services sold? Explain.

Yes, pay increases by $20 for every 10 services sold.

b. Calculate the missing entries to Cheri's table below.

50 1

# of Applications	0	10	15	20	25	30	40	50	100	101
Daily Pay ($)	40	60	70	80	90	100	120	140	240	242

100 2

c. *Calculate Cheri's average rate of change in pay from the following:*

i. 10 applications to 20 applications:

$(10, 60)$ $(20, 80)$

$\frac{Y_2 - Y_1}{X_2 - X_1}$

$\frac{80-60}{20-10} = \frac{20}{10} = \boxed{\$2 \text{ per service}}$

ii. 20 applications to 25 applications:

$(20, 80)$ $(25, 90)$

$\frac{90-80}{25-20} = \frac{10}{5} = \boxed{2}$

iii. 25 applications to 40 applications:

$(25, 90)$ $(40, 120)$

$\frac{120-90}{40-25} = \frac{30}{15} = \boxed{2}$

iv. 50 applications to 100 applications:

$(50, 140)$ $(100, 240)$

$\frac{240-140}{100-50} = \frac{100}{50} = \boxed{2}$

d. Write a recursive equation showing how Cheri's pay changes with each additional service sold.

$\begin{cases} C_0 = 40 \\ C_n = C_{n-1} + 2 \end{cases}$

ei. The function that shows how to calculate Cheri's daily pay C for any number of services n she sells is $C(n) =$ 40 + 2n. I know this because... \$40 no matter what & \$2 per service

eii. What do the numbers in the function you wrote down above (part ei) tell you about Cheri's daily pay?

Same as

f. What is the practical domain of the function?

$x \geq 0$ (positive #s)

What is the practical range of the function?

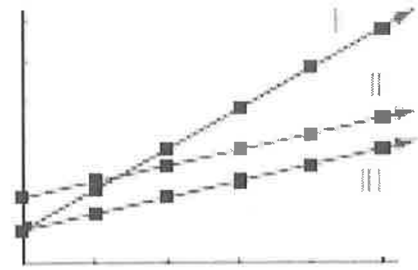
$y \geq 40$ → she will never make less than \$40.

3. **The diagram to the right shows graphs of pay plans offered by three different banks to employees who collect card applications.**

Atlantic Bank: $A(n) = 20 + 2n$

Boston Bank: $B(n) = 20 + 5n$

Consumers Bank: $C(n) = 40 + 2n$



a. Atlantic Bank matches with graph III. I know this because it has a smaller y-int + smaller slope.

Boston Bank matches with graph I. I know this because it has same y-int as Atlantic, but larger slope.

Consumers Bank matches with graph II. I know this because it is the only equation with larger y-intercept.

b. The numbers in the rule for the pay plan at Atlantic Bank tell me . . .

You make \$20 no matter what + \$2 per application collected.

4. Emily purchased a television for \$480 using an Electric Avenue store credit card. Suppose she pays the minimum monthly payment of \$20 each month for the first 12 months. *(This store offers 0% interest for 12 months).*

a. Complete the table of *(number of monthly payments, account balance)* values for the first 6 months.

# of Monthly Payments	0	1	2	3	4	5	6
Account Balance (\$)	480	460	440	420	400	380	360

b. Emily will not (*will or will not*) pay off her balance in 12 months. I know this because. . .

20 × 12 is only \$240. She needs to pay off \$480.

c. Write a recursive equation to help you calculate the change in Emily's account balance after each monthly payment.

$$\begin{cases} e_0 = 480 \\ e_n = e_{n-1} - 20 \end{cases}$$

d. Multiple Choice: Which of the following function rules gives Emily's account balance *E* after *m* monthly payments have been made?

A.) *E(m) = 20m – 480* B.) *E(m)=m – 20* C.) *E(m)=-20m + 480*

D.) *E(m) = 480 – 20m* E.) *E(m) = 480 + 20m*

e. The rate of change **(including units)** in the account balance from 0 to 2 months is -\$20 per month.

Show work below!

$$\frac{440-480}{2-0} = \frac{-40}{2} = \boxed{-20}$$

The rate of change **(including units)** in the account balance from 2 to 3 months is $-\$20$/month.
Show work below!

$$\frac{420-440}{3-2}=\frac{-20}{1}$$

The rate of change **(including units)** in the account balance from 3 to 6 months is $-\$20$/mo.
Show work below!

$$\frac{360-420}{6-3}=\frac{-60}{3}=-20$$

ei. How does the rate of change reflect the fact that the account balance *decreases* as the number of monthly payments increases? It is a negative rate of change.

eii. How can the rate of change be seen in the:

Table (from part a): Pay decreases by \$20 each month.

Functions rule (part d): -20 next to independent variable.

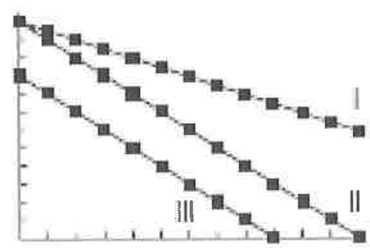
f. How can the starting account balance be seen in the:

Table (part a): (0,480) entry

Function rule (part d): the 480 is the constant term

5. The diagram to the right shows graphs of account balance functions for three Electric Avenue customers.

Emily: $E(m) = 480 - 20m$
Darryl: $D(m) = 480 - 40m$
Felicia: $F(m) = 360 - 40m$



a. Emily matches with graph I. I know this because higher y-intercept & smaller (less negative) slope.

Darryl matches with graph II. I know this because same y-int as I but more negative slope

Felicia matches with graph III. I know this because it is the only equation with a smaller y-int.

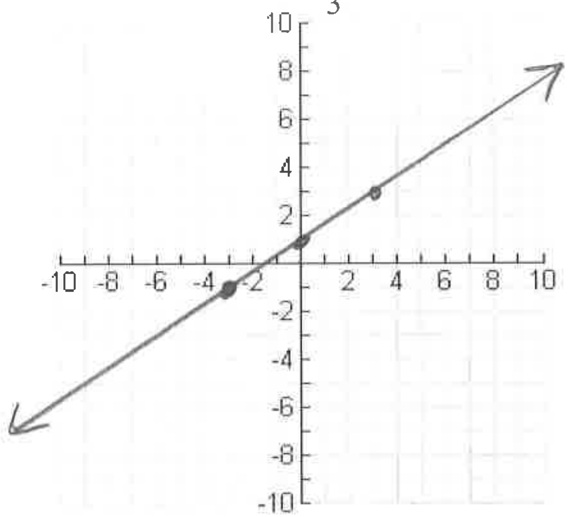
b. From Darryl's equation I know that his starting balance is 480 and his monthly payment is \$40.

From Felicia's rule I know. . .
starting balance of \$360 & monthly payment of \$40

6. *Graph the following functions.*

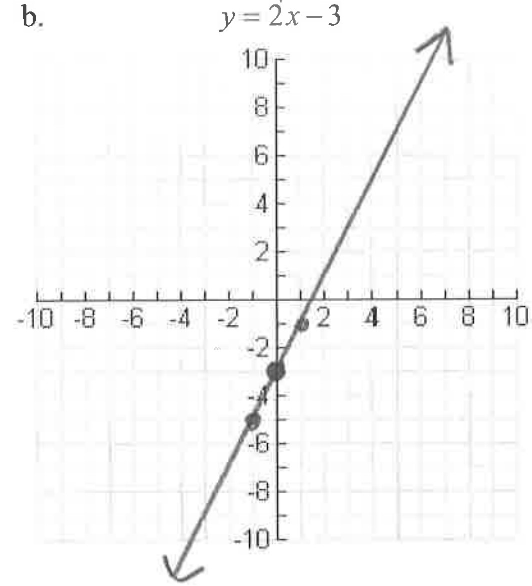
$\frac{\text{Rise}}{\text{Run}}$

a. $y = 1 + \frac{2}{3}x$



$\frac{2}{1}$

b. $y = 2x - 3$



For the equation in part (a) explain how the numbers in the symbolic rule relate to the graph.

- 1 is the y-intercept
- $\frac{2}{3}$ is the slope or rate of change