

**Math 140 - Direct Variation**

Kids Inc. sells a style of T-shirt for \$5. If a customer orders online, the price remains \$5, but the company adds a \$4 shipping and handling fee for each mail order.

1) Complete the tables below:

**IN STORE**

Number of shirts purchased	0	1	2	3	7	10	s
Total Cost before taxes							

**ONLINE**

Number of shirts purchased	--	1	2	3	7	10	s
Total Cost before taxes							

2) Look at the relationship between the two rows of each table.

A) If you had not known how to determine the total cost of an order in the store, could you easily guess how to do it from the numbers in the table?

B) If you had not known how to determine the total cost of an order online, could you easily guess how to do it from the numbers in the table?

3) "The total cost depends on the number of shirts purchased." describes a relationship between two quantities.

A) What is the dependent (output) quantity for this relationship?

B) What is the independent (input) quantity for this relationship?

4) A) For each additional shirt after the first shirt purchased in store, the total cost increases by \_\_\_\_\_.

B) For each additional shirt after the first shirt purchased online, the total cost increases by \_\_\_\_\_.

5) Complete the tables by computing the indicated ratios. Be sure to include units.

**IN STORE**

Number of Shirts	1	2	3	7	10	s
Total Cost of order	\$5	\$10	\$15	\$35	\$50	\$5s
$\frac{\text{Total Cost}}{\text{No. of Shirts}}$						

**ONLINE**

Number of Shirts	1	2	3	7	10	s
Total Cost of order	\$9	\$14	\$19	\$39	\$54	\$5s + \$4
$\frac{\text{Total Cost}}{\text{No. of Shirts}}$						

6) A) What do you notice about the in store ratio of total cost to number of shirts purchased?

B) What do you notice about the online ratio of total cost to number of shirts purchased?

C) Can we say "In the store, the actual cost of each shirt is \$5"?

D) Can we say "Online, the actual cost of each shirt is \$5"?

7) To graph each relationship, consider answers to the following questions:

A) What quantity should be represented on the vertical axis? Why?

B) How should we scale each axis? Why?

Horizontal:

Vertical:

8) Graph each relationship by plotting the appropriate points below.

9) Did you connect the points with a line? Should you have connected the points?  
Why or why not?

10) Notice that a line through the “in store” points goes through the origin, but a line through the “online” points does not go through the origin. Write a sentence or two (in context with the problem) to explain why this is happening.

The major difference between purchasing in the store and purchasing online is that there are no added charges in the store. In the store, the ratio of total cost to number of shirts is always the same: \$5 per shirt. This fact can be written two ways:

$$1) \frac{\text{Total Cost}}{\text{No. of Shirts}} = \frac{\$5}{\text{Shirt}} \text{ or } \frac{C}{S} = \frac{\$5}{\text{Shirt}} \quad 2) \text{ Total Cost} = \$5 \text{ per shirt} \times (\text{number of shirts}) \text{ or } C = \$5S$$

When the ratio of two quantities is constant, we say that the quantities are proportional. The quantity in the numerator is the dependent quantity, and the quantity in the denominator is the independent quantity. We say that the dependent quantity **is directly proportional to** the independent quantity; or that the dependent quantity **varies directly with** the independent quantity. The constant ratio is called the **constant of proportionality, k**. (In your book, the constant of proportionality is called m.)

$$\frac{\text{dependent quantity}}{\text{independent quantity}} = \frac{\text{output quantity}}{\text{input quantity}} = k$$

The origin, (0, 0), is a point on the graph of a relationship which is a direct proportion.

**Example 1:** Shemika has two credit cards. For the National Credit Card, the minimum payment is one-tenth of the outstanding balance. For the Capital Credit Card, the minimum payment is \$20 plus one-tenth of the outstanding balance.

1) Complete the tables below:

**NATIONAL**

Outstanding Balance (\$)	0	50	51	100	200	475	b
Minimum Payment (\$)							

**CAPITAL**

Outstanding Balance (\$)	--	50	51	100	200	475	b
Minimum Payment (\$)							

2) Look at the relationship between the two rows of each table.

- A) If you had not known how to determine the minimum payment on the National account, could you easily guess how to do it from the numbers in the table?
- B) If you had not known how to determine the minimum payment on the Capital account, could you easily guess how to do it from the numbers in the table?

3) “The minimum payment is one-tenth of the outstanding balance.” describes a relationship between two quantities.

- A) What is the dependent (output) quantity for this relationship?
- B) What is the independent (input) quantity for this relationship?

4) A) For each additional dollar after the first dollar on National's outstanding balance, the minimum payment increases by \_\_\_\_\_.

B) For each additional dollar after the first dollar on Capital's outstanding balance, the minimum payment increases by \_\_\_\_\_.

5) Complete the tables by computing the indicated ratios. Be sure to include units.

**NATIONAL**

Outstanding Balance (\$)	50	51	100	200	475	b
Minimum Payment (\$)						
<u>Minimum Payment</u> Outstanding Balance						

**CAPITAL**

Outstanding Balance (\$)	50	51	100	200	475	b
Minimum Payment (\$)						
<u>Minimum Payment</u> Outstanding Balance						

6) A) Is the ratio of minimum payment to outstanding balance constant for the National credit card?  
 B) Is the minimum payment directly proportional to the outstanding balance for the National card?  
 C) If so, what is the constant of proportionality?

7) A) Is the ratio of minimum payment to outstanding balance constant for the Capital credit card?  
 B) Is the minimum payment directly proportional to the outstanding balance for the Capital card?  
 C) If so, what is the constant of proportionality?

8) Choose an appropriate scale, and then graph each relationship by plotting the points below.

9) Did you connect the points with a line?                      Should you have connected the points?  
 Why or why not?

10) Notice that a line through the "National" points goes through the origin, but a line through the "Capital" points does not go through the origin. Write a sentence or two (in context with the problem) to explain why this is happening.

11) For the National Credit Card, the minimum payment \_\_\_\_\_ to the outstanding balance.

12) Write two different equations to represent the relationship between minimum payment and outstanding balance for the National Credit Card.