

GIVEN THAT (1,-8) IS ON THE GRAPH OF F(x), FIND THE CORRESPONDING POINT FOR THE FUNCTION 1/2 F(x)

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INTRODUCTION

UNDERSTANDING HOW TRANSFORMATIONS AFFECT A FUNCTION'S GRAPH IS FUNDAMENTAL IN ALGEBRA AND CALCULUS. WHEN A POINT LIES ON A GRAPH OF A FUNCTION, APPLYING TRANSFORMATIONS SUCH AS SCALING VERTICALLY OR HORIZONTALLY ALTERS THE POSITION OF THE POINTS ON THE GRAPH. IN THIS ARTICLE, WE WILL EXPLORE HOW TO DETERMINE THE CORRESPONDING POINT FOR THE FUNCTION $\left(\frac{1}{2} F(x)\right)$ GIVEN A SPECIFIC POINT ON $(F(x))$. SPECIFICALLY, IF THE POINT (1, -8) LIES ON THE GRAPH OF $(F(x))$, WHAT POINT CORRESPONDS TO THIS ON THE GRAPH OF $\left(\frac{1}{2} F(x)\right)$?

UNDERSTANDING THE GIVEN POINT AND FUNCTION

THE KNOWN POINT: (1, -8)

THE POINT (1, -8) ON THE GRAPH OF $(F(x))$ INDICATES THAT:

$$\begin{aligned} & \left[\right. \\ & F(1) = -8 \\ & \left. \right] \end{aligned}$$

THIS MEANS, WHEN THE INPUT $(x = 1)$, THE OUTPUT OF THE FUNCTION $(F(x))$ IS -8.

THE TRANSFORMATION: $\left(\frac{1}{2} F(x)\right)$

THE TRANSFORMATION INVOLVES MULTIPLYING THE ORIGINAL FUNCTION $(F(x))$ BY $\left(\frac{1}{2}\right)$. THIS IS A VERTICAL COMPRESSION OF THE GRAPH BY A FACTOR OF 2.

MATHEMATICALLY:

$$\begin{aligned} & \left[\right. \\ & g(x) = \frac{1}{2} F(x) \\ & \left. \right] \end{aligned}$$

FOR ALL (x) .

EFFECT OF THE TRANSFORMATION ON THE GRAPH

VERTICAL SCALING AND COMPRESSION

MULTIPLYING THE FUNCTION BY $\left(\frac{1}{2}\right)$ REDUCES THE OUTPUT VALUES OF THE FUNCTION BY HALF. THIS TRANSFORMATION:

- DOES NOT AFFECT THE (x) -COORDINATE OF POINTS ON THE GRAPH.
- MULTIPLIES THE (y) -COORDINATE OF EACH POINT BY $\left(\frac{1}{2}\right)$.

IMPLICATIONS FOR THE KNOWN POINT

SINCE THE ORIGINAL POINT IS $(1, -8)$:

$$\begin{aligned} & \left[\right. \\ & F(1) = -8 \\ & \left. \right] \end{aligned}$$

THE CORRESPONDING POINT ON $\left(g(x) = \frac{1}{2} F(x)\right)$ WILL BE:

$$\begin{aligned} & \left[\right. \\ & g(1) = \frac{1}{2} \times F(1) = \frac{1}{2} \times (-8) = -4 \\ & \left. \right] \end{aligned}$$

THUS, THE POINT ON $\left(g(x)\right)$ CORRESPONDING TO $(1, -8)$ ON $\left(F(x)\right)$ IS $(1, -4)$.

STEP-BY-STEP SOLUTION PROCESS

STEP 1: IDENTIFY THE KNOWN POINT ON $\left(F(x)\right)$

- THE POINT IS $\left((x, y) = (1, -8)\right)$, WITH $\left(y = F(1)\right)$.

STEP 2: UNDERSTAND THE TRANSFORMATION $\left(y \text{ TO } \frac{1}{2} y\right)$

- FOR THE SAME $\left(x\right)$, THE NEW $\left(y\right)$ -VALUE WILL BE:

$$\begin{aligned} & \left[\right. \\ & y' = \frac{1}{2} \times y \\ & \left. \right] \end{aligned}$$

STEP 3: CALCULATE THE NEW $\left(y\right)$ -VALUE

- SUBSTITUTE $\left(y = -8\right)$:

$$y' = \frac{1}{2} \times (-8) = -4$$

STEP 4: WRITE THE NEW POINT

- THE CORRESPONDING POINT ON $(g(x) = \frac{1}{2} f(x))$:

$$(1, -4)$$

GENERALIZING THE TRANSFORMATION

THE PROCESS DESCRIBED IS SPECIFIC TO THE GIVEN POINT, BUT IT ALSO ILLUSTRATES A GENERAL PRINCIPLE:

- FOR A FUNCTION $(y = f(x))$, IF A POINT $((x, y))$ LIES ON ITS GRAPH, THEN FOR THE TRANSFORMED FUNCTION $(y = k \times f(x))$:

$$\text{Corresponding Point} = (x, k \times y)$$

- IN OUR CASE, $(k = \frac{1}{2})$.

THEREFORE:

$$\text{If } (x, y) \text{ is in the graph of } f(x), \text{ then } (x, \frac{1}{2} y) \text{ is in the graph of } \frac{1}{2} f(x).$$

ADDITIONAL EXAMPLES AND PRACTICE

EXAMPLE 1: ORIGINAL POINT (2, 10)

- FOR $(f(2) = 10)$, THE CORRESPONDING POINT ON $(\frac{1}{2} f(x))$:

$$(2, \frac{1}{2} \times 10) = (2, 5)$$

EXAMPLE 2: ORIGINAL POINT (-3, 6)

- For $(F(-3) = 6)$, THE CORRESPONDING POINT:

$$(-3, \frac{1}{2} \times 6) = (-3, 3)$$

PRACTICE EXERCISE

- If $(F(4) = -12)$, WHAT IS THE CORRESPONDING POINT ON $(\frac{1}{2} F(x))$?

SOLUTION:

$$(4, \frac{1}{2} \times -12) = (4, -6)$$

GRAPHICAL INTERPRETATION

UNDERSTANDING THE EFFECT OF THE TRANSFORMATION GRAPHICALLY ENHANCES COMPREHENSION. WHEN YOU GRAPH $(F(x))$, POINTS ARE PLOTTED WITH THEIR RESPECTIVE (y) -VALUES. APPLYING $(\frac{1}{2} F(x))$ COMPRESSES THE GRAPH VERTICALLY, BRINGING ALL POINTS CLOSER TO THE (x) -AXIS BY HALF. THIS RESULTS IN:

- THE SAME (x) -COORDINATES AS BEFORE.
- (y) -COORDINATES SCALED BY $(\frac{1}{2})$.

THIS TRANSFORMATION DOES NOT ALTER THE (x) -INTERCEPTS, BUT IT REDUCES THE MAGNITUDE OF THE (y) -VALUES, MAKING THE GRAPH APPEAR “SQUISHED” VERTICALLY.

CONCLUSION

IN SUMMARY, GIVEN A POINT ON THE GRAPH OF A FUNCTION $(F(x))$, FINDING THE CORRESPONDING POINT ON $(\frac{1}{2} F(x))$ INVOLVES:

1. KEEPING THE SAME (x) -COORDINATE.
2. MULTIPLYING THE ORIGINAL (y) -VALUE BY $(\frac{1}{2})$.

APPLYING THIS PROCESS TO THE KNOWN POINT $(1, -8)$, THE CORRESPONDING POINT ON $(\frac{1}{2} F(x))$ IS $(1, -4)$.

THIS PRINCIPLE IS FUNDAMENTAL IN UNDERSTANDING HOW SCALAR TRANSFORMATIONS AFFECT THE GRAPH OF A FUNCTION AND IS A STEPPING STONE TO MORE COMPLEX TRANSFORMATIONS INVOLVING SHIFTS, REFLECTIONS, AND STRETCHES. MASTERY OF THESE CONCEPTS ENABLES STUDENTS TO ANALYZE AND SKETCH TRANSFORMED FUNCTIONS WITH CONFIDENCE.

FREQUENTLY ASKED QUESTIONS

IF THE POINT $(1, -8)$ LIES ON THE GRAPH OF $f(x)$, WHAT IS THE CORRESPONDING POINT ON THE GRAPH OF $(1/2)f(x)$?

THE CORRESPONDING POINT ON $(1/2)f(x)$ IS $(1, -4)$, BECAUSE MULTIPLYING THE Y-VALUE BY $1/2$ GIVES $-8 \cdot 1/2 = -4$.

HOW DO YOU FIND THE POINT ON $(1/2)f(x)$ WHEN GIVEN A POINT ON $f(x)$?

TO FIND THE POINT ON $(1/2)f(x)$, KEEP THE SAME X-COORDINATE AND MULTIPLY THE Y-VALUE OF THE ORIGINAL POINT BY $1/2$. SO, FOR $(1, -8)$, IT BECOMES $(1, -4)$.

WHAT IS THE EFFECT OF MULTIPLYING $f(x)$ BY $1/2$ ON THE GRAPH?

MULTIPLYING $f(x)$ BY $1/2$ COMPRESSES THE GRAPH VERTICALLY TOWARD THE X-AXIS BY A FACTOR OF 2, REDUCING ALL Y-VALUES BY HALF.

GIVEN A POINT (a, b) ON $f(x)$, WHAT IS THE CORRESPONDING POINT ON $(1/2)f(x)$?

THE CORRESPONDING POINT IS $(a, b/2)$. FOR EXAMPLE, IF $(1, -8)$ IS ON $f(x)$, THEN ON $(1/2)f(x)$, IT IS $(1, -4)$.

IF THE ORIGINAL POINT ON $f(x)$ IS $(1, -8)$, WHAT WOULD BE THE X AND Y COORDINATES OF THE POINT ON $(1/2)f(x)$?

THE X-COORDINATE REMAINS THE SAME AT 1, AND THE Y-COORDINATE BECOMES -4 AFTER HALVING, SO THE POINT IS $(1, -4)$.

ADDITIONAL RESOURCES

GIVEN THAT $(1, -8)$ IS ON THE GRAPH OF $f(x)$, FIND THE CORRESPONDING POINT FOR THE FUNCTION $1/2 f(x)$

UNDERSTANDING HOW TO MANIPULATE FUNCTIONS AND INTERPRET THEIR POINTS IS A FUNDAMENTAL SKILL IN ALGEBRA AND CALCULUS. WHEN YOU ARE TOLD "GIVEN THAT $(1, -8)$ IS ON THE GRAPH OF $f(x)$," IT SETS THE STAGE FOR EXPLORING HOW THE FUNCTION BEHAVES AND HOW TRANSFORMATIONS AFFECT ITS GRAPH. IN PARTICULAR, CALCULATING THE CORRESPONDING POINT ON $(1/2) f(x)$ INVOLVES UNDERSTANDING WHAT HAPPENS WHEN THE ORIGINAL FUNCTION IS SCALED VERTICALLY BY A FACTOR OF $1/2$. THIS GUIDE WILL WALK YOU THROUGH THE PROCESS STEP-BY-STEP, PROVIDING CLARITY ON THE CONCEPTS INVOLVED AND PRACTICAL TIPS FOR SOLVING SIMILAR PROBLEMS.

INTRODUCTION TO FUNCTIONS AND POINTS

BEFORE DIVING INTO THE PROBLEM, IT'S ESSENTIAL TO UNDERSTAND SOME BASIC CONCEPTS:

- FUNCTION POINT: A POINT (x, y) IS ON THE GRAPH OF A FUNCTION $f(x)$ IF, WHEN YOU SUBSTITUTE x INTO THE FUNCTION, YOU GET y .
- TRANSFORMATION OF FUNCTIONS: MODIFYING A FUNCTION OFTEN INVOLVES CHANGING ITS GRAPH THROUGH SHIFTS, STRETCHES, COMPRESSIONS, OR REFLECTIONS.

IN OUR SPECIFIC CASE, WE ARE GIVEN A POINT ON THE ORIGINAL FUNCTION, AND WE NEED TO FIND THE CORRESPONDING POINT ON A TRANSFORMED FUNCTION.

THE GIVEN DATA AND ITS SIGNIFICANCE

GIVEN: $(1, -8)$ IS ON THE GRAPH OF $f(x)$.

THIS MEANS:

- WHEN $x = 1$, $F(1) = -8$.

THIS IS OUR STARTING POINT. THE PROBLEM ASKS US TO FIND THE POINT ON THE GRAPH OF $(1/2)F(x)$ CORRESPONDING TO THE SAME x -VALUE, I.E., $x = 1$.

UNDERSTANDING THE TRANSFORMATION: FROM $F(x)$ TO $(1/2)F(x)$

THE TRANSFORMATION FROM $F(x)$ TO $(1/2)F(x)$ INVOLVES MULTIPLYING THE ORIGINAL FUNCTION'S OUTPUT BY $1/2$. THIS IS A VERTICAL COMPRESSION OR SCALING OF THE GRAPH.

WHAT DOES MULTIPLYING BY $1/2$ DO?

- IT SCALES THE y -VALUES OF THE ORIGINAL FUNCTION BY A FACTOR OF $1/2$.
- IF $F(x)$ PRODUCES A CERTAIN y -VALUE, THEN $(1/2)F(x)$ PRODUCES A y -VALUE THAT IS HALF AS LARGE.

VISUALIZING THE TRANSFORMATION

IMAGINE THE ORIGINAL GRAPH OF $F(x)$. AT THE POINT $(1, -8)$, THE GRAPH DIPS DOWN TO -8 AT $x=1$. WHEN YOU APPLY THE TRANSFORMATION TO GET $(1/2)F(x)$:

- THE POINT AT $x=1$ WILL HAVE A y -VALUE OF $(1/2)(-8) = -4$.

THIS RESULTS IN A VERTICAL COMPRESSION OF THE GRAPH TOWARDS THE x -AXIS.

STEP-BY-STEP SOLUTION

STEP 1: RECOGNIZE THE KNOWN POINT

FROM THE PROBLEM:

- ORIGINAL POINT: $(1, -8)$
- FUNCTION VALUE AT $x=1$: $F(1) = -8$

STEP 2: APPLY THE TRANSFORMATION

FOR ANY x , THE TRANSFORMED FUNCTION IS:

- $G(x) = (1/2)F(x)$

GIVEN THAT AT $x=1$:

- $F(1) = -8$

THEREFORE,

- $G(1) = (1/2)F(1) = (1/2)(-8) = -4$

STEP 3: WRITE THE CORRESPONDING POINT

THE CORRESPONDING POINT ON $G(x)$ (WHICH IS $(1/2)F(x)$) IS:

- $(1, -4)$

THIS IS BECAUSE THE x -COORDINATE REMAINS THE SAME, BUT THE y -COORDINATE IS SCALED BY $1/2$.

GENERALIZATION: HOW TO FIND CORRESPONDING POINTS FOR SIMILAR TRANSFORMATIONS

THIS PROBLEM IS REPRESENTATIVE OF A BROADER CLASS OF FUNCTION TRANSFORMATIONS. HERE ARE SOME COMMON TYPES AND HOW TO HANDLE THEM:

1. VERTICAL SCALING

- TRANSFORMATION: $y = A F(x)$
- EFFECT: SCALES THE GRAPH VERTICALLY BY A FACTOR OF $|A|$.
- If $|A| > 1$: VERTICAL STRETCH.
- If $0 < |A| < 1$: VERTICAL COMPRESSION.
- CORRESPONDING POINT: $(x, A F(x))$.

2. HORIZONTAL SCALING

- TRANSFORMATION: $y = F(Bx)$
- EFFECT: COMPRESSES OR STRETCHES THE GRAPH HORIZONTALLY.
- CORRESPONDING POINT: $(x, F(Bx))$.

3. TRANSLATIONS

- VERTICAL SHIFT: $y = F(x) + c$ SHIFTS THE GRAPH UP OR DOWN.
- HORIZONTAL SHIFT: $y = F(x - h)$ SHIFTS THE GRAPH LEFT OR RIGHT.

ADDITIONAL PRACTICE PROBLEMS

TO DEEPEN UNDERSTANDING, CONSIDER THESE PRACTICE SCENARIOS:

- If $(2, 5)$ is on $F(x)$, FIND THE POINT ON $3 F(x)$ AT $x=2$.
- If $(-1, 7)$ is on $F(x)$, FIND THE POINT ON $F(x) + 4$ AT $x=-1$.
- If $(0, -3)$ is on $F(x)$, FIND THE POINT ON $F(2x)$ AT $x=0.5$.

SUMMARY OF KEY CONCEPTS

- GIVEN A POINT (x, y) ON $F(x)$, THE POINT ON $k F(x)$ AT THE SAME x -VALUE IS $(x, k y)$.
- WHEN SCALING VERTICALLY BY A FACTOR OF $1/2$, THE y -VALUE IS MULTIPLIED BY $1/2$.
- THE x -VALUE REMAINS UNCHANGED DURING VERTICAL SCALING.
- RECOGNIZING THE EFFECT OF TRANSFORMATIONS ON THE GRAPH HELPS IN QUICKLY IDENTIFYING CORRESPONDING POINTS.

FINAL THOUGHTS

UNDERSTANDING HOW TRANSFORMATIONS AFFECT FUNCTIONS AND THEIR POINTS IS A CORNERSTONE OF GRAPH ANALYSIS. IN THIS SPECIFIC PROBLEM, RECOGNIZING THAT MULTIPLYING THE ENTIRE FUNCTION BY $1/2$ CAUSES A VERTICAL COMPRESSION SIMPLIFIES THE PROCESS OF FINDING CORRESPONDING POINTS. REMEMBER TO ALWAYS ANALYZE THE TYPE OF TRANSFORMATION INVOLVED, DETERMINE HOW IT AFFECTS THE FUNCTION'S OUTPUT, AND THEN APPLY THAT UNDERSTANDING TO FIND THE NEW POINTS. WITH PRACTICE, THESE CONCEPTS BECOME INTUITIVE, ENABLING QUICK AND ACCURATE GRAPH ANALYSIS IN VARIOUS MATHEMATICAL CONTEXTS.

IN CONCLUSION, GIVEN THAT $(1, -8)$ IS ON THE GRAPH OF $F(x)$, THE CORRESPONDING POINT ON THE GRAPH OF $(1/2) F(x)$ AT $x=1$ IS $(1, -4)$. THIS STRAIGHTFORWARD APPLICATION OF SCALING PRINCIPLES CAN BE EXTENDED TO MORE COMPLEX TRANSFORMATIONS, FORMING A FUNDAMENTAL PART OF YOUR ALGEBRAIC TOOLKIT.

Given That 1 8 Is On The Graph Of F X Find The Corresponding Point For The Function 1 2 F X

Given That 1 8 Is On The Graph Of F X Find The Corresponding Point For The Function 1 2 F X

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