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S1.5 The Inverse Function and Its Properties

The inverse of a function is the reverse of the original function. In essence, if x was an input and $f(x)$ was the output; then when the inverse $f^{-1}(x)$ is applied, x is the output while $f(x)$ is the input. Algebraically, the x and $f(x)$ simply switch positions.

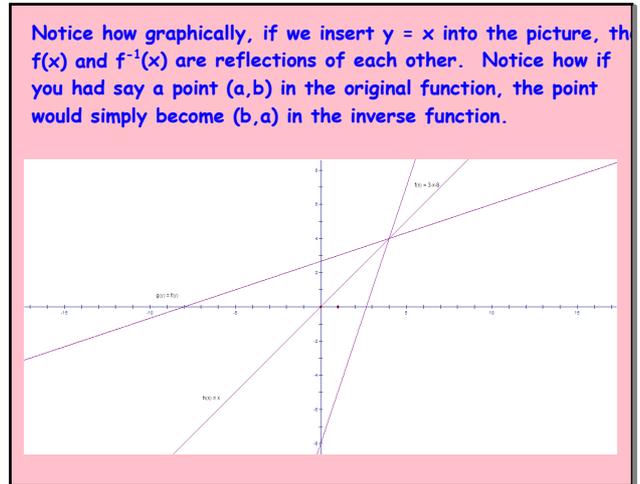
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Example: Given $f(x) = 3x - 8$ write the equation of the inverse function.

Since $f(x) = 3x - 8$ then $f^{-1}(x)$ yields $x = 3f(x) - 8$

We temporarily let $f(x) = y$ to get:
 $x = 3y - 8$
 Now we solve for y :
 $3y - 8 = x$
 $3y - 8 + 8 = x + 8$
 $3y = x + 8$
 $\frac{3y}{3} = \frac{x + 8}{3}$ Change y back to $f^{-1}(x)$
 $f^{-1}(x) = \frac{x + 8}{3}$

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Example: The Temperature below the Earth's surface can be expressed using the function: $T(d) = 11 + 0.015d$, d is the depth in m and $T(d)$ is that Temperature at that depth.

- State the domain and range of $T(d)$.
- Determine the inverse of this function.
- State the domain and range of $T^{-1}(d)$.
- Explain what the inverse represents.

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Solution: a) State the domain and range of $T(d)$. Since $T(d) = 11 + 0.015d$ is related to the temperature of the Earth's surface, we will view positive depth as negative altitude. Since the surface of the Earth begins at 0 m we will begin the domain there and end it at 5000m since that is where the Magma begins. Hence, $\{d \in \mathbb{R} | 0 \leq x \leq 5000\}$. Since this is linear, we need only evaluate both $T(0)=11$ and then $T(5000)=86$. Hence $\{T(d) \in \mathbb{R} | 11 \leq x \leq 86\}$.

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Solution b) Determine the inverse of this function.
 let $T(d) = y$ so that $y = 11 + 0.015d$. Now let's inverse to get:
 $d = 11 + 0.015y$
 $11 + 0.015y = d$
 $11 - 11 + 0.015y = d - 11$
 $0.015y = d - 11$
 $\frac{0.015y}{0.015} = \frac{d - 11}{0.015}$

$$y = \frac{d - 11}{0.015}$$

$$T^{-1}(d) = \frac{d - 11}{0.015} \quad \text{or we can also say:}$$

$$d(T) = \frac{T - 11}{0.015}$$

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Solution c) State the domain and range of $T^{-1}(d)$.
 Since the inverse will simply create a mirror image, we can say that the domain is the range of the original and that the range is the domain of the original.

Hence the domain is $\{T \in \mathbb{R} | 11 \leq x \leq 86\}$ and the range is $\{d(T) \in \mathbb{R} | 0 \leq x \leq 5000\}$.

Solution d) Explain what the inverse represents.

The inverse of this function simply makes the depth the dependent variable and the Temperature the independent variable.

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Now get into groups and start the reflective task on page 41 and 42 A-O.

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HOMEWORK: §1.5 #1, 2ace, 3, 4, 6ef, 7ef, 9-12.

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