Find the preimage of a function

Determining the Inverse Image of A Set Examples Recall, given a set H that is a subset of the codomain B, the inverse image of the set H denoted $f^{-1} (H)$ is defined as follows: Definition: If $f : A \to B$ is a function where $H \subseteq B$ then the inverse image of H under the function f is defined to be the set $f^{-1}(H) = \{ x \in A : f(x) \in H \}$ containing elements $x \in A$ such that $f(x) \in H$. We will now look at some examples of determining the inverse image of a set. Example 1 Let $f : \mathbb{R} \to \mathbb{R}$ be defined by the equation $f(x) = 3x$. If $H \subseteq B = \mathbb{R}$ and $H := \{ y \in \mathbb{R} : 3 ≤ y ≤ 6 \}$, then determine the inverse image $f^{-1} (H)$. To find the inverse image of the set H, $f^{-1} (H)$, we need to find $x \in A$ such that $f(x) \in H$. We note that if $x = 1$ then $f(1) = 3$ and similarly if $x = 2$ then $f(2) = 6$. So on the interval $1 ≤ x ≤ 2$ we have that $3 ≤ f(x) = 3x ≤ 6$. This is the only interval where this is true, so $f^{-1} (H) = \{ x \in \mathbb{R} : 1 ≤ x ≤ 2$. We should note that if we take the inequality $3 ≤ 3x ≤ 6$ and divide each part by 3 we obtain an interval to which x is restricted for our inverse image. Example 2 Let $f : \mathbb{R} \to \mathbb{R}$ be defined by the equation $f(x) = x^2 + 1$. Let $H \subseteq B = \mathbb{R}$ and $H := \{ y \in \mathbb{R} : 5 ≤ y ≤ 10 \}$, then determine the inverse image $f^{-1} (H)$. We want to find values of x such that $5 ≤ x^2 + 1 ≤ 10$. Subtracting 1 from each part of this inequality we get that $4 ≤ x^2 ≤ 9$ But this only happens if $-3 ≤ x ≤ -2$ or $2 ≤ x ≤ 3$. So we get that $f^{-1} (H) = \{ x \in \mathbb{R} : -3 ≤ x ≤ -2 \: \mathrm{or} \: 2 ≤ x ≤ 3 \}$. Example 3 Let $p : \mathbb{R} \to \mathbb{R}$ be defined by the equation $p(x) = x^2 + x$. Let $H \subseteq B = \mathbb{R}$ and $H := \{ y \in \mathbb{R} : 6 ≤ y ≤ 12 \}$, the determine the inverse image $p^{-1} (H)$. We need to find values of x such that $6 ≤ x^2 + x ≤ 12$. We note that $p(2) = 6$ and $p(3) = 12$. On the interval $2 ≤ x ≤ 3$, the absolute minimum is $p(2) = 6$ and the absolute maximum is $p(3) = 12$. So we have found one interval in the inverse image $p^{-1} (H)$. Now since p is a parabola we suspect that there are two sets of intervals such that $6 ≤ y ≤ 12$. We note that $6 = p(x) = x^2 + x$ if $x = 2$ (as we have verified) or $x = -3$. Similarly we note that $12 = p(x) = x^2 + x$ if $x = 3$ (as we have verified) or $x = -4$. Therefore on the interval $-4 ≤ x ≤ -3$, $6 ≤ x^2 + x ≤ 12$ and so then $f^{-1} (H) = \{ x \in \mathbb{R} : -4 ≤ x ≤ -3 \: \mathrm{or} \: 2 ≤ x ≤ 3 \}$. What comes first image or Preimage? What is a relation in math? What does Injective mean? What is the image in geometry? What is a function in math? What is image linear algebra? How do you find the domain of a function? The image T(V) is defined as the set {k | k=T(v) for some v in V}. So x=T(y) where y is an element of T^-1(S). The preimage of S is the set {m | T(m) is in S}. Thus T(y) is in S, so since x=T(y), we have that x is in S.Click to see full answer. Thereof, what is the Preimage in geometry?The rigid transformations are translations, reflections, and rotations. The new figure created by a transformation is called the image. The original figure is called the preimage. A translation is a transformation that moves every point in a figure the same distance in the same direction.Subsequently, question is, is Preimage the same as domain? is that domain is a geographic area owned or controlled by a single person or organization while preimage is (mathematics) the set containing exactly every member of the domain of a function such that the member is mapped by the function onto an element of a given subset of the codomain of the function formally, of a Beside this, what is Preimage in function? preimage (plural preimages) (mathematics) For a given function, the set of all elements of the domain that are mapped into a given subset of the codomain; (formally) given a function ƒ : X → Y and a subset B ⊆ Y, the set ƒ−1(B) = {x ∈ X : ƒ(x) ∈ B}. The preimage of under the function is the set .What is the image in geometry? Definition Of Image The new position of a point, a line, a line segment, or a figure after a transformation is called its image. Professional Answer Expert Verified. The image is the result of performing a transformation, and the preimage is the original that you perform the transformation. To tell them apart, they will usually be defined separately. For example, the square ABCD, when translated four units right becomes square A'B'C'D'. Professional Inverse Image of a Set Definition: If is a function where then the inverse image of under the function is defined to be the set $f^{-1}(H) = { x in A : f(x) in H }$ containing elements such that . For example, consider the function defined by and suppose that where $H = { y : y ≥ 8 }$. Explainer In the coordinate plane we can draw the translation if we know the direction and how far the figure should be moved. To translate the point P(x,y) , a units right and b units up, use P'(x+a,y+b) . Explainer Isometry. An isometry of the plane is a linear transformation which preserves length. Isometries include rotation, translation, reflection, glides, and the identity map. Two geometric figures related by an isometry are said to be geometrically congruent (Coxeter and Greitzer 1967, p. 80). Explainer Congruent. Angles are congruent when they are the same size (in degrees or radians). Sides are congruent when they are the same length. Pundit The four types of transformations which you will encounter during this topic are: Rotation. Reflection. Translation. Enlargement/Re-sizing. Pundit In mathematics, a function is a relation between sets that associates to every element of a first set exactly one element of the second set. The symbol that is used for representing the input is the variable of the function (one often says that f is a function of the variable x). Pundit In a translation, every point of the object must be moved in the same direction and for the same distance. Pundit In geometry, a reflection is a type of rigid transformation in which the preimage is flipped across a line of reflection to create the image. Each point of the image is the same distance from the line as the preimage is, just on the opposite side of the line. Pundit Definition of a vector. A vector is an object that has both a magnitude and a direction. Geometrically, we can picture a vector as a directed line segment, whose length is the magnitude of the vector and with an arrow indicating the direction. Two examples of vectors are those that represent force and velocity. Teacher Find the points of the verticals on the graph and connect the points one by one until you can get one shape. - Second step: Add the transformation values X and Y coordinates of each point. You can get some new transformation values, if you like. - Third step: Then draw with those values. Teacher In geometry, transformation refers to the movement of objects in the coordinate plane. This lesson will define and give examples of each of the four common transformations and end with a quiz to make sure you are moving in the right direction. Supporter More modern books, if they use the word "range" at all, generally use it to mean what is now called the image. For this function, the codomain and the image are the same (the function is a surjection), so the word range is unambiguous; it is the set of all real numbers. Beginner line of reflection. • a line midway between something, called a pre-image, and its mirror reflection. Beginner A function is an equation that has only one answer for y for every x. A function assigns exactly one output to each input of a specified type. It is common to name a function either f(x) or g(x) instead of y. f(2) means that we should find the value of our function when x equals 2. Beginner In mathematics, an origin is a starting point on a grid. It is the point (0,0), where the x-axis and y-axis intercept. The origin is used to determine the coordinates for every other point on the graph. Beginner To find the excluded value in the domain of the function, equate the denominator to zero and solve for x . So, the domain of the function is set of real numbers except −3 . The range of the function is same as the domain of the inverse function. So, to find the range define the inverse of the function. exercise \(\PageIndex{1}\label{ex:ontofcn-01}\) Determine which of the following are onto functions. \(f :{\mathbb{Z}}\to{\mathbb{Z}}\); \(f(n)=n^3+1\) \(g :{\mathbb{Q}}\to{\mathbb{Q}}\); \(g(x)=n^2\) \(h :{\mathbb{R}}\to{\mathbb{R}}\); \(h(x)=x^3-x\) \(k :{\mathbb{R}}\to{\mathbb{R}}\); \(k(x)=5^x\) Solution (a) Not onto (b) Not onto (c) Onto (d) Not onto . exercise \(\PageIndex{2}\label{ex:ontofcn-02}\) Determine which of the following are onto functions. \(p :{\mathscr{P}(\{1,2,3,\ldots,n\})}\to{\{0,1,2,\ldots,n\}}\); \(p(S)=|S|\) \(q :{\mathscr{P}(\{1,2,3,\ldots,n\})}\to{\mathscr{P}(\{1,2,3,\ldots,n\})}\); \(q(S)=\overline{S}\) exercise \(\PageIndex{3}\label{ex:ontofcn-03}\) Determine which of the following functions are onto. \(f_1:\{1,2,3,4,5\}\to\{a,b,c,d\}\); \(f_1(1)=b\), \(f_1(2)=c\), \(f_1(3)=a\), \(f_1(4)=a\), \(f_1(5)=c\) \({f_2}:{\{1,2,3,4\}}\to{\{a,b,c,d,e\}}\); \(f_2(1)=c\), \(f_2(2)=b\), \(f_2(3)=a\), \(f_2(4)=d\) \({f_3}:{\mathbb{Z}}\to{\mathbb{Z}}\); \(f_3(n)=-n\) Solution \(f_1\) and \(f_2\) are not onto, \(f_3\) is onto. exercise \(\PageIndex{4}\label{ex:ontofcn-04}\) Determine which of the following functions are onto. \({g_1}:{\{1,2,3,4,5\}}\to{\{a,b,c,d,e\}}\); \(g_1(1)=b\), \(g_1(2)=b\), \(g_1(3)=b\), \(g_1(4)=a\), \(g_1(5)=d\) \({g_2}:{\{1,2,3,4,5\}}\to{\{a,b,c,d,e\}}\); \(g_2(1)=d\), \(g_2(2)=b\), \(g_2(3)=e\), \(g_2(4)=a\), \(g_2(5)=c\) Exercise \(\PageIndex{5}\) Is it possible for a function from \(\{1,2\}\) to \(\{a,b,c,d\}\) to be onto? Explain. Answer No, because we have at most two distinct images, but the codomain has four elements. exercise \(\PageIndex{6}\label{ex:ontofcn-6}\) List all the onto functions from \(\{1,2,3,4\}\) to \(\{a,b\}\)? Hint List the images of each function. exercise \(\PageIndex{7}\label{ex:ontofcn-7}\) Determine which of the following functions are onto. \(f :{\mathbb{Z}_{10}}\to{\mathbb{Z}_{10}}\); \(h(n)\equiv 3n\) (mod 10). \(g :{\mathbb{Z}_{10}}\to{\mathbb{Z}_{10}}\); \(g(n)\equiv 5n\) (mod 10). \(h :{\mathbb{Z}_{36}}\to{\mathbb{Z}_{36}}\); \(h(n)\equiv 3n\) (mod 36). Solution (a) Onto (b) Not onto (c) Not onto exercise \(\PageIndex{8}\label{ex:ontofcn-8}\) Determine which of the following functions are onto. \(r:{\mathbb{Z}_{36}}\to{\mathbb{Z}_{36}}\); \(r(n)\equiv 5n\) (mod 36). \(s :{\mathbb{Z}_{10}}\to{\mathbb{Z}_{10}}\); \(s(n)\equiv n+5\) (mod 10). \(t :{\mathbb{Z}_{10}}\to{\mathbb{Z}_{10}}\); \(t(n)\equiv 3n+5\) (mod 10). exercise \(\PageIndex{9}\label{ex:ontofcn-9}\) Given a function \(f :{A}\to{B}\), and \(C\subset A\), since \(f(C)\) is a subset of \(B\), the preimage of this subset is indicated by the notation \(f^{-1}(f(C))\). Consider the function \(f :{\mathbb{Z}}\to{\mathbb{Z}}\) defined by \(f(x)=x^2\), and \(C=\{0,1,2,3\}\). (a) Find \(f(C)\). (b) Find \(f^{-1}(f(C))\). Solution (a) \(f(C)=\{0,2,4,9\}\). (b) \(f^{-1}(f(C))=\{-3,-2,-1,0,1,2,3\}\). exercise \(\PageIndex{10}\label{ex:ontofcn-10}\) Give an example of a function \(f :\mathbb{N}\to \mathbb{N}\) that is neither one-to-one nor onto one-to-one but not onto onto but not one-to-one both one-to-one and onto Exercise \(\PageIndex{11}\) For each of the following functions, find the image of \(C\), and the preimage of \(D\). (a) \({f_1}:{\{1,2,3,4,5\}}\to{\{a,b,c,d\}}\); \(f_1(1)=b\), \(f_1(2)=c\), \(f_1(3)=a\), \(f_1(4)=a\), \(f_1(5)=c\); \(C=\{1,3\}\), \(D=\{a,c\}\). (b) \({f_2}:{\{1,2,3,4\}}\to{\{a,b,c,d,e\}}\); \(f_2(1)=c\), \(f_2(2)=b\), \(f_2(3)=a\), \(f_2(4)=d\);\(C=\{1,3\}\), \(D=\{b,d\}\). (c) \({f_3}:{\{1,2,3,4,5\}}\to{\{a,b,c,d,e\}}\); \(f_3(1)=b\), \(f_3(2)=b\), \(f_3(3)=b\), \(f_3(4)=a\), \(f_3(5)=d\); \(C=\{1,3,5\}\), \(D=\{c\}\). (d) \({f_4}:{\{1,2,3,4,5\}}\to{\{a,b,c,d,e\}}\); \(f_4(1)=d\), \(f_4(2)=b\), \(f_4(3)=e\), \(f_4(4)=a\), \(f_4(5)=c\); \(C=\{3\}\), \(D=\{c\}\). Solution (a) \(f_1(C)=\{a,b\}\) ; \(f_1^{-1}(D)=\{2,3,4,5\}\) (b) \(f_2(C)=\{a,c\}\) ; \(f_2^{-1}(D)=\{2,4\}\) (c) \(f_3(C)=\{b,d\}\) ; \(f_3^{-1}(D)=\emptyset\) (d) \(f_4(C)=\{e\}\) ; \(f_4^{-1}(D)=\{5\}\) Exercise \(\PageIndex{12}\) Define the \(r :{\mathbb{Z}\times\mathbb{Z}}\to{\mathbb{Q}}\) according to \(r(m,n) = 3^m 5^n\). Find \(r(\{1,2,3\}\times\{-1,0,1\})\). Find \(r^{-1}\big(\big\{\frac{25}{27}\big\}\big)\). Find \(r^{-1}(D)\), where \(D=\{3,9,27,81,\ldots\,\}\). Exercise \(\PageIndex{13}\) The function \(u :{\mathbb{R}}\to{\mathbb{R}}\) is defined as \(u(x)=3x+11\), and the function \(v :{\mathbb{Z}}\to{\mathbb{R}}\) is defined as \(v(x)=3x+11\). Find \(u([\,3,5))\) and \(v(\{3,4,5\})\). Find \(u^{-1}((2,7\,])\) and \(v^{-1}((2,7\,])\). Solution (a) \(u([\,3,5))=[\,20,26]\) and \(v(\{3,4,5\})=\{20,23,26\}\). (b) \(u^{-1}((2,7\,])=(-3,-\frac{4}{3}]\) and \(v^{-1}((2,7\,]=\{-2\}\). Exercise \(\PageIndex{14}\) Is the function \(h :{\mathbb{Z}}\to{\mathbb{Z}}\) defined by \[h(n) = \cases{ 2n & if $n\geq0$ \cr -n & if $n < 0$ \cr}\] one-to-one? Is it onto? Exercise \(\PageIndex{15}\) The function \(f :\mathbb{R} \times \mathbb{R} \to\mathbb{R} \times \mathbb{R}\) is defined as \(f(x,y)=(x+y,3y)\). (a) Find \(f(3,4)\), \(f(-2,5)\), \(f(2,0)\). (b) Is \(f\) onto? (c) Is \(f\) one-to-one? Answer (a) \(f(3,4)=(7,12)\), \(f(-2,5)=(3,15)\), \(f(2,0)=(2,0)\). (b) Consider any \((a,b)\) in the codomain. Let \((x,y)=(a-\frac{b}{3} ,\frac{b}{3})\). Since \(\mathbb{R}\) is closed under subtraction and non-zero division, \(a-\frac{b}{3} \in \mathbb{R}\) and \(\frac{b}{3} \in \mathbb{R}\) , thus \((x,y) \in \mathbb{R} \times \mathbb{R}\). Then \(f(x,y)=f(a-\frac{b}{3} ,\frac{b}{3})=(a,b)\). So, every element in the codomain has a preimage in the domain and thus \(f\) is onto. (c) Yes, if \(f(x_1,y_1)=f(x_2,y_2) \mbox{ then } (x_1+y_1,3y_1)=(x_2+y_2,3y_2).\) This means \(3y_1=3y_2\) and (dividing by 3) \(y_1=y_2.\) Now, since \(x_1+y_1=x_2+y_2,\) subtract equals, \(y_1\) and \(y_2\) from both sides to get \(x_1=x_2.\) Because \(x_1=x_2\) and \(y_1=y_2\), we have \((x_1,y_1)=(x_2,y_2).\) \(f(x_1,y_1)=f(x_2,y_2) \rightarrow (x_1,y_1)=(x_2,y_2),\) so \(f\) is one-to-one.

finding the preimage of a function. how do you find the image and preimage of a function. what is the preimage of a function

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