Composite functions worksheet higher maths

GCSE 4 - 5GCSE 6 - 7AQAEdexcelOCRWJECAQA November 2022Edexcel November 2022WJEC November 2022FoundationHigher Level 4-5 GCSE Evaluating functions involves putting numbers into the function to get the result. Example: A function is given by f(x) = 3x+1, Find f(10) All this requires is to replace x with 10 and calculate the result. When we input 10 into this function that would look like: f(\textcolor{red}{10}) = 3\times \textcolor{red}{10} + 1 = 31. Level 6-7 GCSE Level 6-7 GCSE A composite function is the result of one function being applied immediately after the other. Example: Let f(x)=\textcolor{red}{2x-3} and g(x)=\textcolor{blue}{x+1}, find fg(x) To find fg(x) we replace x in f(x) with g(x) fg(x) = f(g(x)) = \textcolor{red}{2(}\textcolor{blue}{x+1}\textcolor{red}{) - 3} Next we can expand the brackets and simplify if required. \textcolor{red}{2(}\textcolor{blue}{x+1}\textcolor{red}{) - 3} = 2x+2-3 = 2x-1 Level 8-9 GCSE An inverse function is a function acting in reverse. The inverse function of f(x) is given by f^{-1}(x), and it tells us how to go from an output of f(x) back to its input. Example: Given that f(x) = \dfrac{x+8}{3}, find f^{-1}(x) Step 1: Write the equation in the form x = f(y) For this we need to replace all the x's in the equation with y's and set the equation equal to x f(x) = \dfrac{x+8}{3} becomes x= \dfrac{y+8}{3} Step 2: Rearrange the equation to make y the subject. \begin{aligned}x&= \dfrac{y+8}{3} \\ 3x&= y+8 \\ 3x-8 &= y \end{aligned} Step 3: Replace y with f^{-1}(x) \begin{aligned}y & = 3x-8 \\ f^{-1}(x) & = 3x-8\end{aligned} Level 8-9 GCSE Level 6-7 GCSE Let f(x)=x-3 and g(x)=x^2 [4 marks] Find: a) fg(10) – we must find g(10) then apply f(x) to the answer. g(10) = 10^2 = 100 so fg(10) = f(100) = 100 - 3 = 97. b) gf(-4) – we must find f(-4) then apply g(x) to the answer. f(-4) = -4-3 = -7 so gf(-4) = g(-7) = (-7)^2 = 49 c) an expression for fg(x) – we need to input g(x) into f(x). So, we get fg(x) = f\left(g(x)\right) = g(x) - 3 = x^2 - 3 Level 8-9 GCSE Given that f(x) = 3x - 9, find f^{-1}(x) [3 marks] Step 1: Write the equation in the form x = f(y) f(x) = 3x- 9 becomes x = 3y-9 Step 2: Rearrange to make y the subject \begin{aligned}x &= 3y-9 \\ x+9 &= 3y \\ \dfrac{x+9}{3} &=y\end{aligned} Step 3: Replace ywith f^{-1}(x) \begin{aligned} \dfrac{x+9}{3} & = y \\ f^{-1}(x) & = \dfrac{x+9}{3}\end{aligned} Level 8-9 GCSE Example Questions a) Substituting x=10 into f(x), we find, f(10) = \dfrac{10}{3(10)-5} = \dfrac{10}{25}= \dfrac{2}{5}=0.4 b) Substituting x=2 into f(x), we find, f(10) = \dfrac{10}{3(2)-5} = \dfrac{10}{1}= 10 c) Substituting x=-1 into f(x), we find, f(10) = \dfrac{10}{3(-1)-5} = \dfrac{10}{-8}=-\dfrac{5}{4} =1.25 a) Substituting x=4 into g(x), then substituting the result into f(x), g(4) = (2\times 4) - 5 = 8 - 5 = 3 fg(4) = f(3) = \dfrac{15}{3} = 5 b) For gf(-30) we must first find f(-30) and then substitute the result into g(x), f(-30) = \dfrac{15}{-30} = -\dfrac{1}{2} gf(-30) = g(-\dfrac{1}{2}) = 2(-\dfrac{1}{2}) - 5 = -1 - 5 = -6 c) To find an expression for gf(x), substitute f(x) in for every instance of x in g(x), gf(x) = 2(f(x)) - 5 = 2\times(\dfrac{15}{x}) - 5 = \dfrac{30}{x} - 5 So, we need to write the function as y=\frac{5}{x-4} and rearrange this equation to make x the subject. Then, we will swap every y with an x – and vice versa. We won't be able to get x on its own whilst it's in the denominator, so our first step will be multiplying both sides by (x-4): y(x-4)=5 Then, divide both sides by y: x-4=\dfrac{5}{y} Finally, add 4 to both sides to make x the subject: x=\dfrac{5}{y}+4 Now, swap each x with a y and vice versa to get f^{-1}(x)=\dfrac{5}{x}+4 So, we need to write the function as g=\frac{4}{x}+3 and rearrange this equation to make x the subject. Then, we will swap every g with an x – and vice versa. The first step is to subtract 3 from both sides, g-3=\dfrac{4}{x}+\cancel{3}-\cancel{3} Then, multiply both sides by x: x(g-3)=4 Finally, divide both sides by (g-3) to make x the subject: x=\dfrac{4}{g-3} Now, simply swap each x with a g and vice versa to get, g^{-1}(x)=\dfrac{4}{x-3} Related Topics Worksheet and Example Questions Drill Questions You May Also Like... 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There are also composite functions worksheets based on Edexcel, AQA and OCR exam questions, along with further guidance on where to go next if you're still stuck. Composite functions are when the output of one function is used as the input of another. If we have a function f and another function g , the function fg(x) , said as " f of g of x ", or " fg of x ", is the composition of the two functions. The order of how the functions are applied is important. We are finding a function of a function, and if we have two or more functions, there could be many different permutations of those functions leading to many different composite functions. fg(x) could be written as f[g(x)] which shows that the inner function must be applied before the outer function. We can evaluate composite functions for numerical values or find the algebraic expression for the new function. To evaluate a composition of functions for a numerical value we can just substitute the value into the inside function and then use the result of that function to substitute into the outside function. E.g.Here the function h is described by h(x)=x^2 and the function f by f(x)=x-5 . We can find hf(2) by finding f(2) , which gives us −3 , and then finding h(−3) which gives us 9. If we want to find the expression for the function fh(x) , we can replace the x in the expression for f(x) with the expression for h(x) . There are other types of notation that can be used for composite functions. E.g.The composition of functions f and g can be written using a small circle, (f ∘ g)(x)=fg(x) . In A level mathematics we look at composite functions in more depth by finding the derivatives of composite functions using a process called the chain rule. The derivative of a function gives us an expression for the function's gradient at any point. In order to evaluate composite functions: Use the number to be evaluated as the input for the inner function and substitute it into the expression.Find the output for the inner function and substitute it into the expression for the outer function.Find the output for the outer function and repeat the process if there are any further outer functions. Get your free composite functions worksheet of 20+ questions and answers. Includes reasoning and applied questions. DOWNLOAD FREE x Get your free composite functions worksheet of 20+ questions and answers. Includes reasoning and applied questions. DOWNLOAD FREE If f(x)=4x and g(x)=x^2-1 , find fg(4) : Use the number to be evaluated as the input for the inner function and substitute it into the expression. g\left(4 \right)={{\left(4 \right)}^{2}}-1 2Find the output for the inner function and substitute it into the expression for the outer function. \begin{aligned} & g\left(4 \right)=15 \\ \\ & f\left(15 \right)=4\left(15 \right) \end{aligned} 3Find the output for the outer function and repeat the process if there are any further outer functions. f(15)=60, \text{ so } fg(4)=60 If f(x)=2x+1 find ff(3) : Use the number to be evaluated as the input for the inner function and substitute it into the expression. f\left(3 \right)=2\left(3 \right)+1 Find the output for the inner function and substitute it into the expression for the outer function. \begin{aligned} & f\left(3 \right)=7 \\\\ & f\left(7 \right)=2\left(7 \right)+1 \end{aligned} Find the output for the outer function and repeat the process if there are any further outer functions. f(7)=15, \text{ so } ff(3)=15. If f(x)=3x+2, g(x)=x^{2} and h(x)=\frac{x}{2}, find hfg(-5) : Use the number to be evaluated as the input for the inner function and substitute it into the expression. g\left(-5 \right)={{\left(-5 \right)}^{2}} Find the output for the inner function and substitute it into the expression for the outer function. \begin{aligned} & g\left(-5 \right)=25 \\\\ & f\left(25 \right)=3\left(25 \right)+2 \end{aligned} Find the output for the outer function and repeat the process if there are any further outer functions. f(25)=77 Repeat Step 2 for h(77) h(77)=\frac{77}{2}=38.5 So hfg(-5)=38.5 In order to find composite functions: Take the most inner function and substitute in to the next outer function wherever there is an x .Simplify the expression as appropriate.Repeat for any further outer functions. If f(x)=3x-1 and g(x)=x^2+2, find fg(x) : Take the most inner function and substitute in to the next outer function wherever there is an x. \begin{aligned} & fg\left(x \right)= f({{x}^{2}}+2) \\\\ & =3({{x}^{2}}+2)-1 \end{aligned} Simplify the expression as appropriate. \begin{aligned} & fg\left(x \right)=3{{x}^{2}}+6-1 \\\\ & =3{{x}^{2}}+5 \end{aligned} Repeat for any further outer functions. No further outer functions, so fg(x)=3x^2+5 . If f(x)=2x+1 and g(x)=x^2, find gf(x) : Take the most inner function and substitute in to the next outer function wherever there is an x. \begin{aligned} & gf\left(x \right)=g\left(2x+1 \right) \\\\ & ={{\left(2x+1 \right)}^{2}} \end{aligned} Simplify the expression as appropriate. \begin{aligned} & gf\left(x \right)=4{{x}^{2}}+2x+2x+1 \\\\ & =4{{x}^{2}}+4x+1 \end{aligned} Repeat for any further outer functions. No further outer functions, so gf(x)=4x^2+4x+1. If f(x)=x+2, g(x)=x^2+1 and h(x)=3x, find fgh(x): Take the most inner function and substitute in to the next outer function wherever there is an x. \begin{aligned} & fgh\left(x \right)=fg\left(3x \right) \\\\ & =f\left[{{\left(3x \right)}^{2}}+1 \right] \end{aligned} Simplify the expression as appropriate. Repeat for any further outer functions. \begin{aligned} & fgh\left(x \right)=f\left(9{{x}^{2}}+1 \right) \\\\ & =\left(9{{x}^{2}}+1 \right)+2 \\\\ & =9{{x}^{2}}+3 \end{aligned} So, fgh(x)=9x^2+3 . Mistaking composite functions for the product of the functions A common mistake is to think that fg(x) means f(x) \times g(x) .E.g. If f(x)=x+1 and g(x)=2x-3 , the error will be to think that fg(x)=(x+1)(2x-3) , rather than the correct answer of fg(x)=2x-2 . The functions are applied from left to right instead of right to left A common error is to apply the functions in the wrong order. fgh(x) means we should apply the functions in the order h , then g , then f , which is right to left.A common mistake is to apply them from left to right. Thinking of fgh(x) as f[g(h(x))] can help to use the functions in the correct order, i.e. starting with the innermost function and working outwards. Practice composite function questions g(-3)=10 , then f(10)=48. f(4)=1 , then h(1)=5, then g(5)=25. gf(x)=g(4x+6)=\frac{4x+6}{2}-3=2x. fg(x)=f(2x+3)=(2x+3)^2-1. Composite functions GCSE questions 1. f(x)=3x+1 and g(x)=x^2+2 . (a) Find gf(-2) (b) Find an expression for fg(x). (4 marks) (a) f(-2)=-5 (1) g(-5)=27 (1) (b) g(x) substituted into f, 3(x^2+2)+1 (1) 3x^2+7 (1) 2. f(x)=2x^2-1, g(x)=x+6, h(x)=3(x-4) (a) Find ghg(3) (b) Write an expression for hfg(x). (6 marks) (a) hg(3)=15 (1) ghg(3)=21 (1) (b) g correctly substituted into f, fg(x)=2(x+6)^2-1 (1) fg(x) simplified , fg(x)=2x^2+24x+71 (1) fg correctly substituted into h (1) Fully simplified answer hfg(x)=6x^2+72x+201 (1) 3. f(x)=2x+1 and g(x)=x^2-2 (a) Find fg(x) (b) Find when fg(x)=gf(x) (6 marks) (a) 2(x^2-2)+1 (1) 2x^2-3 (1) (b) gf(x)=(2x+1)^2-2 (1) Set equal 2x^2-3=4x^2+4x-1 (1) Attempt to solve/ factorise 2(x+1)(x+1)=0 (1) x=-1 (1) You have now learned how to: Where appropriate, interpret simple expressions as functions with inputs and outputsInterpret the succession of two functions as a 'composite function' Laws of IndicesFactorisingInequalities Prepare your KS4 students for maths GCSEs success with Third Space Learning. Weekly online one to one GCSE maths revision lessons delivered by expert maths tutors. Find out more about our GCSE maths revision programme.

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