1. Differentiate the function by first finding the product and then differentiating. $f(x)=(x^2+3)^2$

The Chain Rule

If g is differentiable at x and f is differentiable at $g(x)$, then the composite function $F = f \circ g$ defined by $F(x)=f(g(x))$ is differentiable at x and F' is given by the product

$$F' = f'(g(x)) \cdot g'(x)$$

In Leibniz notation, if $y = f(u)$ and $u = g(x)$ are both differentiable functions, then $\frac{dy}{dx} = \frac{dy}{du}\frac{du}{dx}$.

Concept behind the Chain Rule:

2. Differentiate the function by using the Chain Rule. $f(x)=(x^2+3)^2$

3. Differentiate the function by using the Chain Rule. $f(x) = a^x$

The Derivative of an Exponential Function

$$\boxed{\frac{d}{dx}\left(a^x\right) = a^x \ln a}$$

Differentiate:

4. $y = 3^x$

5. $y = \sin^2 x$

6. $y = e^x$

7. $y = 3^7$

8. $y = x^e$

9. $y = e^5$

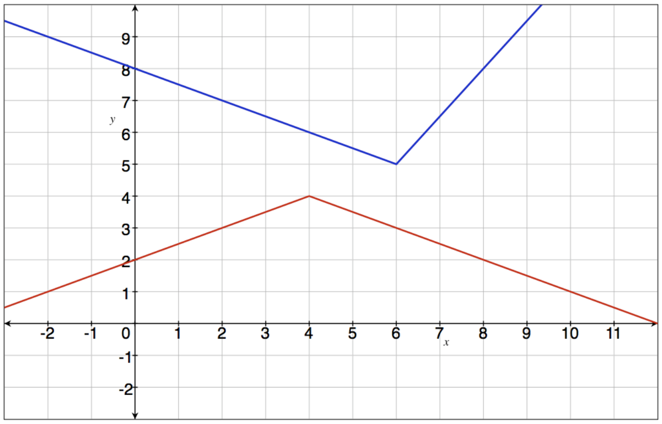
10. $y = 2\sin x$

11. $y = x\ln 3$

12. $y = x^{\ln 3}$

13. $y = e^{\ln x}$

Use the graph below of the functions f and g to answer problem 14.



14. If $u(x) = f(g(x))$, find $u'(2)$.

For each function, identify the type of function it is. If the function is the sum or difference of two or more functions, identify the type of function in each term. If the function is a product or quotient of two or more functions, identify the type of function in each factor. If the function is a composition of functions, determine the composite form and identify each part by name. Take the derivative of each function.

15. $y = x^5$

16. $y = 2^x + 1$

17. $y = x^e + \ln 2$

18. $y = \sec x - x$

19. $y = e^x \tan x$

20. $y = \sqrt{x^2 + 3}$

21. $y = x^{-2}$

22. $y = \sin\left(x^3\right)$

23. $y = \dfrac{x^2 + 4}{2^x}$

24. $y = e^{\cos x}$