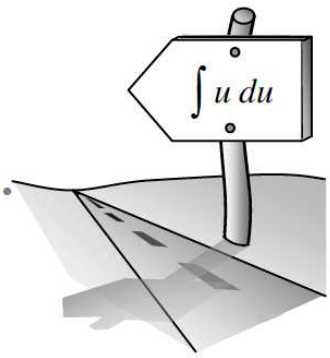
7.2.1 If *u* can do it, then *du* can undo it!



Undoing the Chain Rule

7-57. EASY HARD-LOOKING INTEGRALS

Work with your team to evaluate these integrals. Some look intimidating, but all have a similar format. Check your answers as you go - you will not see patterns or shortcuts if you are not 100% confident your answers are correct.

a. $\int \sin(x^2)\cdot 2x\,dx$

b. $\int \sin x\cdot e^{\cos x}\,dx$

c. $\int (7x^2+1)^4\cdot(14x)\,dx$

d. $\int (1+\cos x)^4\cdot \sin x\,dx$

e. $\int \sin(5x)\cdot\cos^2(5x)\,dx$

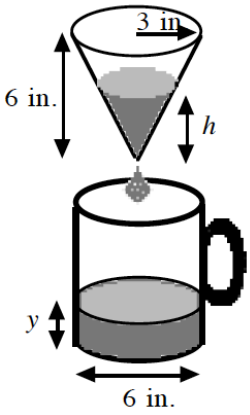
f. $\int (x^2+2x+5)^{7/3}\cdot(x+1)\,dx$

g. How did you decide what constant(s) you needed to multiply by? Write a complete explanation.

h. In each case you had to undo a complicated expression. Describe your process and include the following words in your explanation: composite function, derivative, outer function, and inner function.

i. Use your pattern to write another, similar problem. Your new integrals should be challenging, and each team member should write his/her own.

7-58. Water drips from a conical filter into a coffee mug as shown below. Suppose the height of the water in the filter is *h*, the height of the water in the cup is *y*, and there is a total of 9 in^3 of water in the filter and cup. Write an equation relating $\frac{dy}{dt}$ and $\frac{dh}{dt}$.



Review & Preview

7-59. Differentiate. Homework Help

a. $y^2 = 3\cos x$

b. $y = \tan^2\left(\sqrt{x}\right)$

c. $y = \sin(\cos x)$

7-60. Integrate. Homework Help

a. $\int (3x-5)^2 dx$

b. $\int_{-3}^{3} 9\sin(\pi x)\,dx$

c. $\int (6m^{-7}+2)dx$ where m is a constant

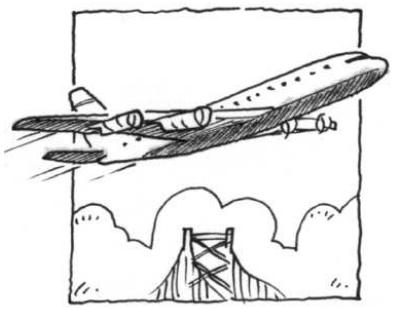
7-61. Sam the snowman has a spherical head that is melting at a rate of 12 in^3 per hour. Assume that as it melts, it remains spherical. Find the radius of Sam's head when the radius is changing at 0.25 inches per hour. Homework Help

7-62. Find a so that the parabola $y = ax^2 + 3$ is tangent to the line $y = 5 - x$. Also, state the point of tangency. Homework Help

7-63. The value of a new car is \$10,000. Its value decreases by 2% each year. Find its average value during the 12 years of its life. Homework Help

7-64. The velocity of a plane flying from San Francisco is:

$$v(t) = 270\sqrt{t}$$



where t is measured in hours and $v(t)$ in miles per hour. Find the average velocity of the plane between the 1st and 4th hours. Homework Help

7-65. No calculator! Given $f(x) = 3^x - 2$ and $g(x) = \frac{1}{2}\sin x$, find the following limits:

Homework Help

a. $\lim_{x \to 1} f'(x)$

b. $\lim_{x \to \pi/4} g''(x)$

c. $\lim_{x \to \pi} f(g(x))$

d. $\lim_{x \to \pi/2} f(g'(x))$

e. $\lim_{h \to 0} \frac{f(x+h)-f(x)}{h}$

f. $\lim_{x \to \frac{\pi}{4}} \frac{g(x)-\frac{\sqrt{2}}{4}}{x-\frac{\pi}{4}}$

7-66. Set up an equation to represent the following situation. Be sure to define your variables.

The rate at which a bucket leaks water, in cm^3/min, is directly proportional to the amount of water in the bucket at any given time.