**Chapter 4**

**Differentiation of Functions of Several Variables**

**4.5 The Chain Rule**

**Section Exercises**

**For the following exercises, use the information provided to solve the problem.**

1. Let  where  and  Find 

Answer: 

1. Let  where  and  Find  and 

Answer:  and 

1. If  and  find  and 

Answer:  

1. If  and  find .

Answer: 

1. If  and  find  and express the answer in terms of  and 

Answer: 

1. Suppose  and  where  and  Find.

Answer: 

**For the following exercises, find  using the chain rule and direct substitution.**

1. , 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1.  

Answer: 

1.  

Answer: 

1. Let   and  Express as a function of  and find  directly. Then, find  using the chain rule.

Answer:  in both cases

1. Let  where  and  Find 

Answer: 

1. Let  where  and  Find  when  and 

Answer: 

**For the following exercises, find  using partial derivatives.**

1. 

Answer:

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. 

Answer: 

1. Find  using the chain rule where  and 

Answer: 

1. Let  and  Find 

Answer: 

1. Let  and  Find 

Answer: 

1. Find  by the chain rule where  and 

Answer: 

1. Let  and  Find  and 

Answer:  and 

1. Let  where  and  Find  and 

Answer: 

1. If   and  find  and  when  and 

Answer:  

1. Find  if  and 

Answer: 

1. If  and  find 

Answer: 

**For the following exercises, use this information: A function  is said to be homogeneous of degree  if  For all homogeneous functions of degree  the following equation is true:  Show that the given function is homogeneous and verify that **

1. 

Answer:  

1. 

Answer: 

1. 

Answer:  

1. The volume of a right circular cylinder is given by  where  is the radius of the cylinder and *y* is the cylinder height. Suppose  and  are functions of  given by  and  so that  are both increasing with time. How fast is the volume increasing when  and 

Answer:

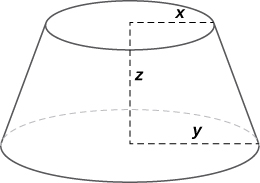
1. The pressure  of a gas is related to the volume and temperature by the formula  where temperature is expressed in kelvins. Express the pressure of the gas as a function of both  and  Find  when   cm3/min,  K/min,  cm3, and 

Answer: 

1. The radius of a right circular cone is increasing at  cm/min whereas the height of the cone is decreasing at  cm/min. Find the rate of change of the volume of the cone when the radius is  cm and the height is  cm.

Answer:

1. The volume of a frustum of a cone is given by the formula  where  is the radius of the smaller circle,  is the radius of the larger circle, and  is the height of the frustum (see figure). Find the rate of change of the volume of this frustum when 



Answer: 

1. A closed box is in the shape of a rectangular solid with dimensions  (Dimensions are in inches.) Suppose each dimension is changing at the rate of  in./min. Find the rate of change of the total surface area of the box when 

Answer: 

1. The total resistance in a circuit that has three individual resistances represented by  and  is given by the formula . Suppose at a given time the  resistance is  the *y* resistance is  and the  resistance is  Also, suppose the  resistance is changing at a rate of  the  resistance is changing at the rate of  and the  resistance has no change. Find the rate of change of the total resistance in this circuit at this time.

Answer: 

1. The temperature  at a point is and is measured using the Celsius scale. A fly crawls so that its position after  seconds is given by  and  where  are measured in centimeters. The temperature function satisfies  and . How fast is the temperature increasing on the fly’s path after  sec?

Answer: 

1. The  components of a fluid moving in two dimensions are given by the following functions:  and ;  The speed of the fluid at the point  is . Find  and  using the chain rule.

Answer: 

1. Let  where  Use a tree diagram and the chain rule to find an expression for 

Answer: 

This file is copyright 2016, Rice University. All Rights Reserved.