***Solution Section* 2.4 – Chain Rule**

***Exercise***

Express as a function of *t*, then evaluate  at the given value of *t*.



***Solution***

|  |  |
| --- | --- |
|  |  |



***Exercise***

Express as a function of *t*, then evaluate  at the given value of *t*.



***Solution***













***Exercise***

Express as a function of *t*, then evaluate  at the given value of *t*.



***Solution***





















***Exercise***

Express as a function of *t*, then evaluate  at the given value of *t*.



***Solution***



















***Exercise***

Express as a function of *t*, then evaluate  at the given value of *t*.



***Solution***









***Exercise***

Express as a function of *t*, then evaluate  at the given value of *t*.



***Solution***





***Exercise***

Express  and  as functions of *u* and *v* if , then evaluate  and  at the point .

***Solution***







































***Exercise***

Express  and  as functions of *u* and *v* if , then evaluate  and  at the point .

***Solution***

































***Exercise***

Express ,  and  as functions of *x, y* and *z* if , then evaluate ,  and  at the point .

***Solution***



















































***Exercise***

Find the values of  and if  at the point 

***Solution***

















***Exercise***

Find the values of  and if  at the point 

***Solution***





















***Exercise***

Find the values of  and if  at the point 

***Solution***

















***Exercise***

Find  when  if 

***Solution***

















***Exercise***

Find  when  if 

***Solution***















***Exercise***

Find  and  when  if 

***Solution***











***Exercise***

Find  and  when  if 

***Solution***



























***Exercise***

Find  and  when  and  if 

***Solution***























***Exercise***

Assume that  and . Find  and 

***Solution***









***Exercise***

Evaluate the derivatives , where 

***Solution***









***Or***





***Exercise***

Evaluate the derivatives , where 

***Solution***









***Exercise***

Evaluate the derivatives  and  , where 

***Solution***

















***Or***









***Exercise***

Evaluate the derivatives , , and  , where 

***Solution***





















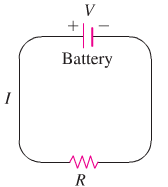


***Or*** 

***Exercise***

The voltage *V* in a circuit that satisfies the law  is slowly dropping as the battery wears out. At the same time, the resistance *R* is increasing as the resistor heats up. Use the equation



To find how the current is changing at the instant when , , , and 

***Solution***











***Exercise***

The lengths *a, b*, and *c* of the edges of a rectangular box are changing with time. At the instant in question, , , and . At what rates the box’s volume *V* and surface area *S* changing at that instant? Are the box’s interior diagonals increasing in length or decreasing?

***Solution***









***Exercise***

Let  be the temperature at the point  on the circle  and suppose that



1. Find where the maximum and minimum temperatures on the circle occur by examining the derivatives  and .
2. Suppose that . Find the maximum and minimum values of *T* on the circle.

***Solution***

1. 















 on the interval 





 ⇒ T has a minimum at 

 ⇒ T has a maximum at 

 ⇒ T has a minimum at 

 ⇒ T has a maximum at 

1. 









The maximum value is 6 at  and 

The minimum value is 2 at  and 

***Exercise***

Evaluate : 

***Solution***





***Exercise***

Evaluate : 

***Solution***



***Exercise***

Evaluate : 

***Solution***





***Exercise***

Evaluate : 

***Solution***





***Exercise***

Evaluate : 

***Solution***





***Exercise***

Evaluate : 

***Solution***





***Exercise***

Evaluate  : 

***Solution***





***Exercise***

Evaluate  : 

***Solution***



***Exercise***

Find  and  at the given point. 

***Solution***





***Exercise***

Find  and  at the given point. 

***Solution***





















***Exercise***

Find  and  at the given point. 

***Solution***

































***Exercise***

Find  and  at the given point. 

***Solution***























***Exercise***

Consider the surface and parameterized curves *C* in the *xy-*plane



1. Find  on *C*.
2. Imagine that you are walking on the surface directly above *C* consistent with the positive orientation of *C*. Find the values of ***t*** for which you are walking uphill.

***Solution***

1. 









1. Walking uphill 









***Exercise***

Consider the surface and parameterized curves *C* in the *xy-*plane



1. Find  on *C*.
2. Imagine that you are walking on the surface directly above *C* consistent with the positive orientation of *C*. Find the values of ***t*** for which you are walking uphill.

***Solution***

1. 









1. Walking uphill 









***Exercise***

Find the value of the derivative of  with respect to *t* on the curve  at 

***Solution***



















***Exercise***

Define *y* as a differentiable function of *x* for , find the values of  at point 

***Solution***









