***Al Basrah university  
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***Mathematics and Statistics\ first stage***

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***2020\2021***

***Functions:***

***Def : is a rule that assigns to each element in a nonempty set X one and only one element in set Y. (X is the domain of the function, while Y is the range of the function).in another meaning to denote the dependence of one quantity on another.***

* ***Domain:***
* ***Range: the set of all images of points in the domain .***

***Arithmetic Operations on functions:***

* ***Sum:***
* ***Difference :***
* ***Product:***
* ***Quotient::where .***

***The Limit of function at point:***

***the expression ,where a is b real number andf is a function. This is read as: “the limit of fxas x approaches b.***

***#Now ,we will discuss four cases:***

***1.Evaluating the Limit of a Polynomial Function at a Point:***

***Example1 .Calculate ?***

***Solution .***

***2. Evaluating the Limit of a Rational Function at a Point:***

***Example2 .Calculate ?***

***Note that f is a rational function with implied domain .***

***Solution = 8.***

***Example3 , Calculate ?***

***Notice that the function is not defined when x =2,because the denominator is zero we use the simplification first and then we substitute the value of x.***

***Solution***

***=***

***Example4: Let Find if it exists?***

***Solution: The values of f (x) can be made arbitrarily large by taking x close enough to 0. Thus the values of f (x) do not approach 0 number, so does not exist.***

***3.Evaluating the Limit of a Constant Function at a Point:***

***Example 5 Let Find ?***

***Solution: =. since there is no x in anyway.***

***4. One and Two sided limits:***

***is a two-sided limit operator in , because we must consider the***

***behavior of f as x approaches b from both the left and the right.is read as :the limit of as x approaches b from the left.is read as: the limit of as x approaches b from the right.***

***Example 6 Let ,***

***Find the left and the right ?and explain if if it exists?***

***Solution :***

***is exists and equal -3.***

***Example 7 Let , Find the left and the right ? and explain if if it exists?***

***Solution :***

***We notice does not exist.***

***The Limit Laws***

***If b and k are real numbers and and ,then***

***1.Sum Rule:***

***2.Difference Rule:***

***3.Constant Multiple Rule:***

***4.Product Rule:***

***5.Quotient Rule:***

***6.Power Rule:***

***7.Root Rule:***

***Example 8 Calculate the following :***

***a)***

***b)***

***c)***

***d)***

***Solution***

***a)***

***=***

***d)***

***We can Multiply both numerator and denominator by the conjugate radical expression (obtained by changing the sign after the square root).***

***=***

***Therefore,***

***Differentiation:***

***Derivative definition :the function is called the derivative with respect to of the function . The domain of f0consists of all the points for which the limit exists. The domain of consists of all the points for which the limit exists.***

***Geometric interpretation of the derivative:***

***Slope of the tangent Rate of change interpretation. function whose value at x is the instantaneous rate of change of y with respect to x at the point x.***

***Notes***

* ***A function that has derivatives at a point is said to be differentiable at .***
* ***A function that is differentiable at every point of its’ domain is called differentiable.***
* ***The differentiation operation is often denoted by () , which read ( the derivative of with respect c.***

***Example1: Find the derivative of by definition ?  
Sol. :-***

***\****

* ***Example2: Find the derivative of***

***by definition ?***

***Sol:***

* ***Example3: Find the derivative of by definition ?***
* ***Sol:***

***() .***

* ***Example3: Find the derivative of by definition ?***

***Sol:***

***.***

***Slopes and Tangent Lines:***

***When the value () is exists is called slope of the curve at . The line through the point (, ) with slope ( is the tangent to the curve at .***

***Now, steps to find the equation of the tangent :-***

1. ***Find a contact point (, ).***
2. ***Find the slope of the curve () .***

***3.Apply following relation -().***

***Example1: Find the equation for the tangent to the curve = at ?***

***Sol. :- from steps a bove:***

***1.Find a contact point 4.***

***(, ) (2,4)***

***2.Find the slope ()***

***→4 ()***

***→ ()***

***3.Apply the relation***

***4 16(2) 16 32***

***16***

***16***

***→ The equation for tangent is***

* ***Example 2 :- Find equation for the tangent to the curve at***

***Sol. :-***

1. ***firstly find (, ) by***

***(, )***

1. ***Then, find slope m= ()***

***→()=***

***→ m= () = =***

***3.Now, Apply the equation :-***

***→ The equation for tangent is***

***Example 3:- find equation for the tangent to the curve at ?***

***Sol. :-***

***1. find (, ) by 2***

***→,***

***2. find slope ()***

***→(***

***(***

***3. Apply equation***

***()***

***() →***

***So, equation of tangent is (.***

***Example 4:- find equation for the tangent to the curve***

***Sol. :-***

***firstly, find slope of curve:***

***2 → (***

***Apply equation***

***1 ( )***

***→equation of tangent is***