INDIAN INSTITUTE OF TECHNOLOGY GANDHINAGAR

MA 202: MATHEMATICS - IV

Semester–II, Academic Year 2022-23

Tutorial Set -3
Question - 3

By

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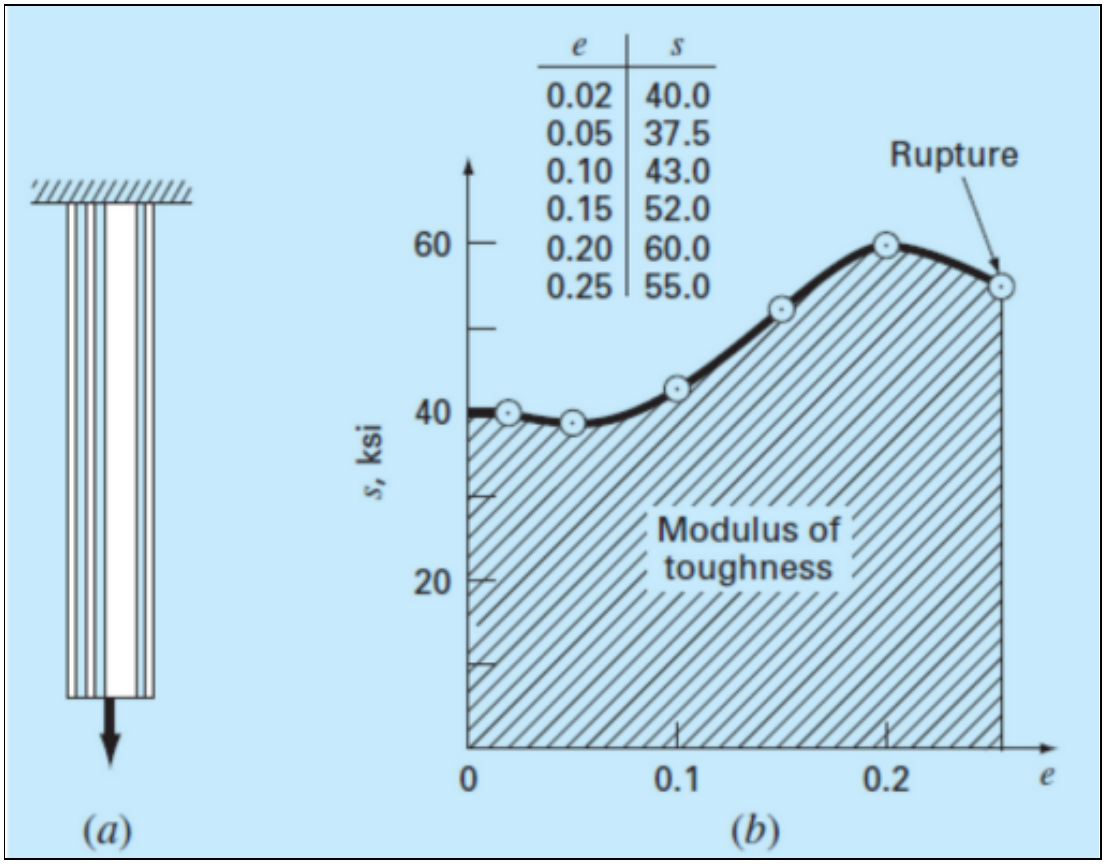
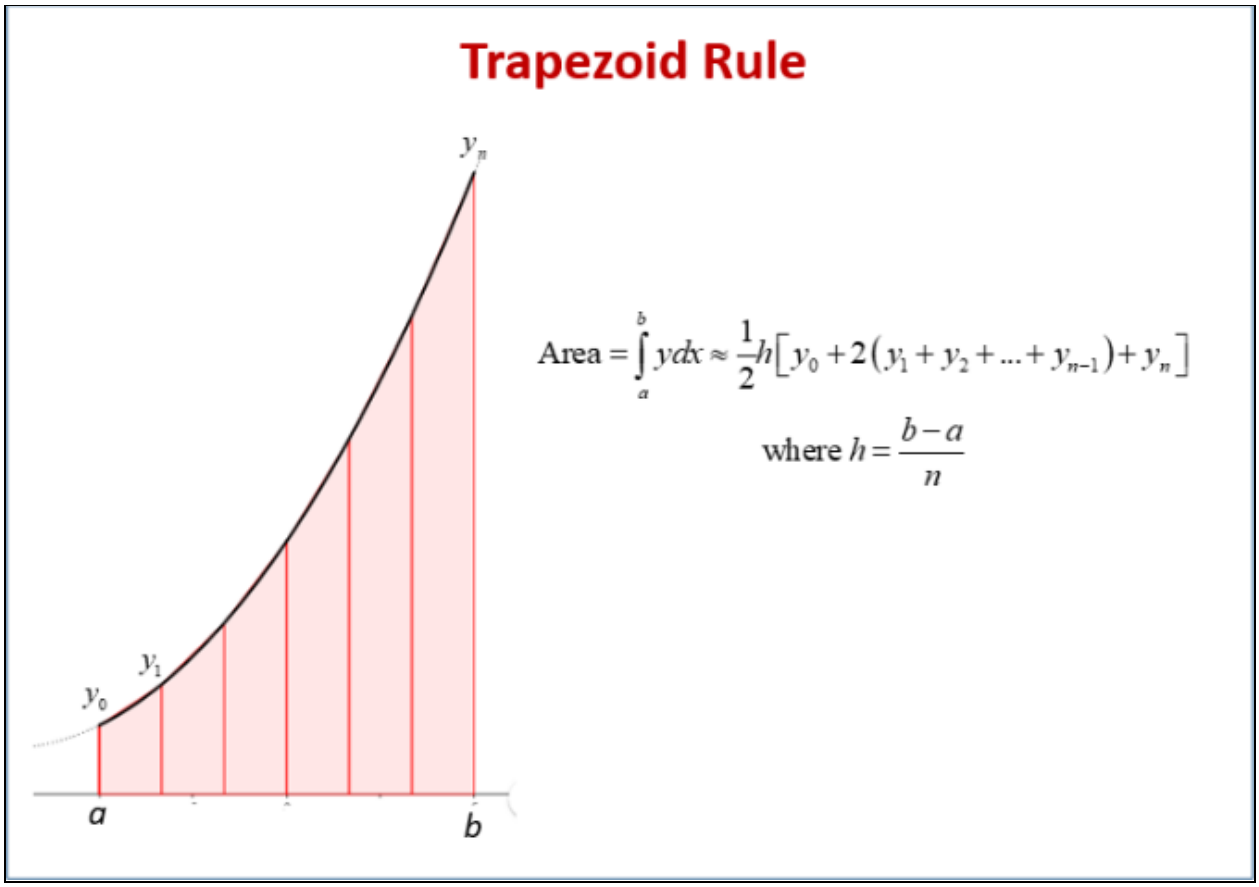
➔ In question 3, we are supposed to find out the modulus of toughness for the shown stress-strain curve by using the Trapezoidal method. Instead of the equation of the stress-strain curve, the data points on the curve are given as an input. It is easier to estimate the value of toughness by directly using the points. We are given input data points as shown below.



➔ The idea behind the Trapezoidal method is to evaluate the area under the curves by dividing the total area into smaller trapezoids rather than using rectangles. This integration works by approximating the region under the graph of a function as a trapezoid, and it calculates the area. Approximation for Trapezoidal method, as we know, is given by:



➔ As we can see in the formula, we only need the value of $y_0, y_1, y_2, \ldots\ldots, y_n$. We are already given the value of y (f(x)). In my function also, I have just done each step according to the formula. The value of a and b is also given in the figure so I can easily find h. After that, I calculated the summation and then put all the values in the formula as shown above.

➔ It is a fact that the trapezoidal formula could not give us the exact answer because it is basically summation of areas of a rectangle. So, it is easy to understand that we cannot find the exact answer. But by increasing the value of n we can increase the number of divided parts and for small and thin part, we can assume it rectangle so by doing this we can increase the accuracy.

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% SUBMITTED BY - KUSH PATEL (20110131)
% Tutorial-3
% Question-3

% Trepezoidal Method
% Create a fuunction to call the value of n and return t(Modulus of Toughness)
function t = T3_20110131(n)
% According to the graph (given)
a = 0;
b = 0.25;
% to print the value of x_r up to long decimal digits
format('long')
h = (b-a)/n;        % Calculating the value of h
% Given data
s = [40, 37.5, 43, 52, 60, 55];
sum = 0;            % Define the initial sum = 0
for i=2:n           % Run a loop to fina the summ of all values of f(x)
    sum = sum + s(i);
end
% Calculate the final answer by applying the formula of Trepezoidal rule
t = (h/2) * (s(1) + s(n+1) + 2*(sum));
end
```

Code of Trapezoidal Method

```
>> t = T3_20110131(5)

t =

    12

>>
```

Simulated output

➔ Here, we are given only 6 points so that we can divide the whole section in maximum 5 parts. So, this answer is more accurate than the answer for n=4,3,2…

➔ Here we are getting the modulus of toughness is equal to 12 units.