Problem 1.2.2 Isobutylene decomposed to its products and the following data were obtained.

C_A, mol/L	1.00	0.943	0.892	0.805	0.733	0.579	0.407
$-r_A$, mol/(L.s)	2.024×10^{-4}	1.799×10^{-4}	1.609×10^{-4}	1.31×10^{-4}	1.087×10^{-4}	6.773×10^{-5}	3.352×10^{-5}

Estimate the overall order of reaction.

Solution: Test the data for first-order kinetics first and then check for unknown order. For a nth order batch reactor,

$$-r_A = k.C_A^n$$
$$\ln(-r_A) = \ln(k) + n.\ln(C_A)$$

Conc, C_A, mol/L	$-r_A$, mol/(L.s)	$X = \ln(C_A)$	$Y = \ln(-r_A)$
1.00	2.024×10^{-4}	0	-8.8505
0.943	1.799×10^{-4}	-0.059	-8.623
0.892	1.609×10^{-4}	-0.115	-8.735
0.805	1.31×10^{-4}	-0.217	-8.94
0.733	1.087×10^{-4}	-0.311	-9.127
0.579	6.773×10^{-5}	-0.547	-9.6
0.407	3.352×10^{-5}	-0.899	-10.303

Plot Y versus X and draw a straight line though these points. Measure the slope (n).

$n = 2$

Isobutylene follows the second order kinetics.

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