New Jersey Institute of Technology Digital Commons @ NJIT

Theses

Electronic Theses and Dissertations

6-30-1969

A computer program for determining Hinshelwood rate mechanisims from nonisothermal pellet data

Joseph J. Atkins New Jersey Institute of Technology

Follow this and additional works at: https://digitalcommons.njit.edu/theses

Part of the Chemical Engineering Commons

Recommended Citation

Atkins, Joseph J., "A computer program for determining Hinshelwood rate mechanisims from nonisothermal pellet data" (1969). *Theses*. 2657. https://digitalcommons.njit.edu/theses/2657

This Thesis is brought to you for free and open access by the Electronic Theses and Dissertations at Digital Commons @ NJIT. It has been accepted for inclusion in Theses by an authorized administrator of Digital Commons @ NJIT. For more information, please contact digitalcommons@njit.edu.

Copyright Warning & Restrictions

The copyright law of the United States (Title 17, United States Code) governs the making of photocopies or other reproductions of copyrighted material.

Under certain conditions specified in the law, libraries and archives are authorized to furnish a photocopy or other reproduction. One of these specified conditions is that the photocopy or reproduction is not to be "used for any purpose other than private study, scholarship, or research." If a, user makes a request for, or later uses, a photocopy or reproduction for purposes in excess of "fair use" that user may be liable for copyright infringement,

This institution reserves the right to refuse to accept a copying order if, in its judgment, fulfillment of the order would involve violation of copyright law.

Please Note: The author retains the copyright while the New Jersey Institute of Technology reserves the right to distribute this thesis or dissertation

Printing note: If you do not wish to print this page, then select "Pages from: first page # to: last page #" on the print dialog screen



The Van Houten library has removed some of the personal information and all signatures from the approval page and biographical sketches of theses and dissertations in order to protect the identity of NJIT graduates and faculty.

A COMPUTER PROGRAM FOR DETERMINING

"HINSHELMOOD RATE MECHANISMS

FROM

NONISOTHERMAL PELLET DATA"

Bľ

JOSEPH J. ATKINS

A THESIS

PRESENTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR THE DEGREE

OP

MASTER OF SCIENCE IN CHEMICAL ENGINEERING

AT

NEWARK COLLEGE OF ENGINEERING

This thesis is to be used only with due regard to the rights of the author. Bibliographical references may be noted, but passages must not be copied without permission of the College and without credit being given in subsequent written or published work.

> Newark, New Jersey 1969

ABSTRACT

Hethods of determining Hinshelwood rate correlations from non isothermal catalyst data was studied. It was determined for any chemical system involving a reacting gas mixture over a porous catalyst a node analysis could be used to determine chemical concentration and temperature variation through the pellet. Calculation performed with a spectra 360/Fortran 4 program defined the Hinshelwood equation from estimated surface rates. Then utilizing node analysis to determine concentration and temperature variance, transport and rate equations were integrated through the pellet to obtain a total pellet rate of reaction. For acceptance of Hinshelwood equations the calculated total rate must equal the measured total rate and the Hinshelwood constants must meet the Hinshelwood acceptance criteria. A sample problem employing Hydrogen and Oxygen catalyzed over platinum was used for checkout. APPROVAL OF THESIS

A COMPUTER PROGRAM TO DETERMINE

HINSHELWOOD MECHANISMS

FROM NON ISOTHERMAL PELLET DATA

BI

JOSEPH J. ATKINS

FOR

DEPARTMENT OF CHEMICAL ENGINEERING

BX

FACULTY COMMITTEE

APPROVED

NEWARK, NEW JERSEY

JUNE, 1969

Acknowledgements

The author wishes to express his graditude to Dr. Saul I. Kreps for his quidance in completion of this work. The author also expresses his deep appreciation to his wife Corinne Atkins for the encouragement she gave every step of the way. TABLE OF CONTENTS

CHAPTER	- - -													PAGE
**	INTRODUCTI	01.	¢ ¢	¢ ¢	٠	\$.	đ	ë 4	٠	*	\$	٠	٠	
II.	DISCUSSION	OF AN	ALYSI	5.	0	4	\$	•) ()	¢		۵	0	1
	Catalyst	React	ions		۰	٥	0	45 4	•	۵.	8	0	\$	1
	Hinshelw	ood Ra	te Bq	ustior	ı Do	tem	d.wa	t1 01	ه ۱	\$	ø	¢	٩	12
	Reactor	Pellet	Data	Analy	101.0	٠	4	e 1	9 Ø	0	ø	8	¢	14
	Node Ana	lysis				\$	¢	¢ (5 Q	\$	4	\$	۵	15
	Node Pro	gran D	oscri	ption	۲	\$	Ģ	6 (\$	6	Φ	¢	24
	Hydrogen	CLARe	n C at	alysi	stan .	Sam	de	Prol	olen	\$	6	ą	۵	35
III.	CONCLUSION	IS .	\$ 6	8 &	đi	ŵ	۵	6	\$ \$	¢	۵	¢	\$	49
IV.	RECOMMENDA	TTONS	\$	* *	٠	۶	¢	•	* *	۰	4	Ŵ	¢	52
V.	APPENDIX	\$\$ \$\$	& Ø	¢ &	*	۲	¢	۲	¢ ¢	۲	¢	6	٨	63
VI.	REFERENCES	•	* *	6 6	۵	¢	\$	*		۵	۰	¢	\$	83

LIST OF FIGURES

FIGURE

PAGE

1.	Rate	versus	Node	(based	upon	diffu	sion	limits	and	
	least	square	appi	oximat	lon -	first	ite	ration).		19

 Rate versus Node (based upon diffusion limits and square approximation - Product ZD * (last node estimate is less than difference determined rate).

3.	Successive	Node	1	vore	rus	par	tial	. p:	res	sur	e A			
	iterations	* *	(á 41	Ø	٠	۵	ø	0	0	٠	¢	\$ \$	23

4. Computer Program Control Diagram. 25

5. Rate versus partial pressure of a hydrogen oxygen catalysis over platinum

LIST OF TABLES

TABLE			PAGE
Ĩ.	Reaction Rate Mechanisms	Part A	31
	Reaction Rate Mechanisms	Part B	
	Reaction Rate Mechanisms	Part C	
	Reaction Rate Mechanisms	Part D	
LL ¢	Input Data	* * * * * * * * * *	37
III,	Coefficients of Variation	* * * * * * * * * *	41
IV.	Rate Constants (H2/02) .	* * * * * * * * * *	42
V.	Comparison of Rate Data.	* * * * * * * * *	43
VI.	Node Rate Fractions	* * * * * * * * *	45

NOMERCIATURE LIST

AR or S	Mean transport area and AR 1s mean area between nodes
CA or CS	Concentration of components A through S
DEA or DES	Diffusivities of components A through S
ir or ji	Distance between nodes
	Pellet effectiveness
	Feed rate
A H	Heat of reaction
Lo	Total number of adsorption sites
K_1 and K_2	Forward and reverse rate constants
KE	Equilibrium constant
K ₁ to K ₅	Hinshelwood constants
k or cK	Thermal conductivity
N	Node number
PA or PS	Partial pressure of components A through S
POT	Potential term in Hinshelwood equation
RA	Diffusion rate
R(N)	Node rate reduced to meet equation and diffusion limits
T.	Total pellet reaction rate
P	Reaction rate
ř.	Pellet radius
z, x ¹	(X) conversion X^1 amount of component adsorbed on catalyst
ZD	Multiplier for adjusting surface rate estimate
	Number of adsorption sites used by a component
	Density

INTRODUCTION

A topic of significant interest in the field of catalyst research is the application of computer techniques to determine Langmuir Hinshelwood Rate Mechanisms as applied to the design of catalytic reactors. Hinshelwood Rate Mechanisms are defined by the rate equation which best fits experimental reactor data. The rate forms are all based on the assumption that one reaction step controls the reaction rate and that a linear Langmuir isotherm for adsorption of reactant is descriptive of the chemical reaction being studied.

A comprehensive review of the available literature in this area and the work done by previous investigators revealed that Hinshelwood rate equations determined to date have been primarily based upon experimental data using fine particle catalyst. This was apparently because the influence of temperature and concentration variation associated with fine particles is small thus minimizing errors in the results. In commercial chemical production plants, however, catalysts are generally in pellet form and such catalyst structures do encounter significant variations in temperature and chemical concentration.

From these considerations, the question arose whether the Hinshelwood rate equations based upon the fine particle catalyst data were valid for other pellet geometry, catalyst properties and flow conditions.

It was hypothesized that the errors introduced by the change in geometry might be reduced if the pellet data could, by some method, be analyzed directly to determine the catalytic mechanisms. The object of the work undertaken therefore, was to establish a means of determining Hinshelwood equations directly from pellet data.

L

7

The method developed estimated Hinshelwood rate equations from reactor pellet data. The process encompassed estimating surface rates, and then integration of the transport equations through the pellet to arrive at a total rate which agreed with catalyst total rates determined experimentally.

Node analysis was selected for integration of the transport equations. A computer program was assembled and sample problems examined via this form of analysis. One such sample encompassed several computer runs for Hydrogen-Oxygen Catalysis over platinum summarized at the end of this discussion. Discussion of program input and nomenclature is presented in the Appendix.

DISCUSSION OF ANALYSIS

A. Catalyst Reactions

A review of reaction rate controls indicated that a catalyst will not make a reaction proceed between chemical species that would not proceed in its absence, but it can increase reaction rates. The catalyst property promoting reaction rate is conjectured (5) to be chemisorption of gas or liquid on the catalyst surface producing an activated complex. The gas to catalyst complex is unstable and requires less energy for reaction to occur than is needed for reaction of the gas as without a catalyst. The change in the path of the chemical reaction sequence along with the accompanying decrease in energy requirement per step leads to greater chance of chemical reaction upon gas to catalyst contact. Interest in catalysts therefore, relates to the effect they have on the reaction rate. For purposes of analysis, one transport or reaction step is assumed to control. If the chemist is to determine a representative rate equation for catalyst data, he needs to know which of the following mechanisms is controlling.

Types of Rate Controlling Mechanisms

- 1. Mass transfer from the mainstream to and from the solid surface.
- 2. Diffusion of chemical species into and out of the catalyst pore structure.
- Activated adsorption of reactants and desorption of products.
 ^k. Speed of reaction of the adsorbed species on the catalyst.

II

For establishing a method of determining Hinshelwood mechanism from porous catalyst data, it is of major importance that the effect of each controlling mechanism or catalyst reaction be obtained. Then in the process of integrating the rates through the pellet, all factors will be accounted for providing the means for defining both the rate controlling step and estimating total pellet reaction rate. The representative rate equation should be based upon rates defined by reaction kinetics, unaltered by transport phenomena. Each of the four rate steps or mechanisms mentioned are considered in brief as follows.

1. <u>Main stream to pellet transport</u>. The Type 1 rate control -maint stream to pellet- limits the rate of reaction by failure of reactant to diffuse rapidly enough to the pellet surface to feed the reaction. This results from film formation over the catalyst, decreasing the diffusion rate of the reactant. If the main stream flow over the surfaces is high, films are swept away. Careful control of reactor flow conditions will make these effects negligible and minimize their influence on catalytic reaction rate. The influence of the variation of surface concentrations produced during transport of reactant from the main stream to the pellet is small as long as pellet pore diffusion effects observed are small. If variation caused by pore diffusion should be large, then surface concentration should be adjusted to account for effect of transport from the main stream.

2. <u>Pellet diffusion</u>. The Type 2 rate control -pellet diffusionis incurred by chemical diffusion limiting the flow into the catalyst pores. The diffusion effect upon reaction rate is analytically deterL,

minable by integrating the mass transport equations through the porous material. Reaction rates may be estimated from the concentration versus pellet location relationship. If diffusion limits are severe, the reaction rate may further be limited by the inability of the species to penetrate the pore structure or for the product to escape fast enough, preventing the feeding of the reaction.

For development of the analytical approach $(\underline{8})$ integration of transport equations is accomplished in the following manner. It is assumed that the catalyst is in the shape of a sphere and that the diffusion of the reactant "A" of partial pressure P is diffusing through a thin spherical shell of thickness ΔR . The difference between the amount of reactant diffusing into the shell, Na/in, and the amount exiting from the shell, Na/out, equals the amount depleted by the reaction in the shell.

$$Na/in - Na/out = \beta SPAR$$
(1)

The mass flux is equal to the product of the effective diffusivity for porous catalyst (D_A) and the concentration or partial pressure drop (dp/dr) across the shell. Substitution for NA gives us the following result:

$$D_{A} \partial P_{A} / \partial R / in - D_{A} \partial P_{A} / \partial R / out = S \tilde{F} \Delta R$$

$$(2)$$

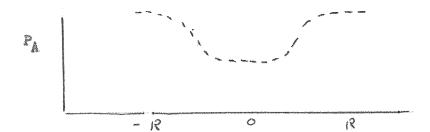
$$\partial / \partial R (D_{A} P_{A} / \partial R) - S \tilde{F} = 0$$

The above equation may be solved if rate r is first order with respect to partial pressure of "A" (KPA). The equation is then of the form as follows:

$$\partial/\partial \mathbf{r} \left(\frac{P_A}{\partial \mathbf{r}} \right) - \left(\frac{PSK_i}{D_A} \right) P_A = 0$$
 (3)

3

The term $\frac{PSK}{D}$ has been arbitrarily set equal to the square of the Theile modulus hp. Integration of the differential equation provides the partial pressure curve through the pellet as a function of radius.



For estimating the rate of reaction in single pellets, the transport equations have been solved using first order rate approximation of the data. When the total pellet rate is determined, it is divided by the rate for the same volume of catalyst unaffected by diffusion, obtaining a pellet effectiveness (\mathcal{E}). Effectiveness is plotted against Theile modulus for first order reactions, thus rates can be determined from these effectiveness plots for any given values of the modulus.

Estimating pellet rates becomes more complex if the rate equation is not a first order approximation. Since all Hinshelwood rate equations are more complex, it is the latter case in which we have the greatest interest.

An example problem illustrates methods of solving for pellet concentrations and rates. Analysis of carbon and carbon dioxide catalysis was performed by Austin and Walker ($\underline{\beta}$). The reaction of carbon dioxide to form carbon monoxide is written as follows:

Small amounts of carbon monoxide inhibit this reaction. Thus, diffusion of the carbon monoxide out as well as carbon dioxide into the catalyst must be considered. It was ascertained beforehand that a Hinshelwood rate equation represented the rate data:

$$\mathbf{r} = \mathbf{K}\mathbf{P}_{A} / (\mathbf{1} + \mathbf{K}_{2} * \mathbf{P}_{A} + \mathbf{K}_{3} * \mathbf{P}_{B})$$
(4)

Considering the mass transport equation for carbon dioxide P_A and carbon monoxide P_B , we obtain transport equations for CO_2 and CO_3

1.) carbon dioxide (CO_2)

$$\partial /\partial R (D_A \partial P_A /\partial R) - \int S [K_1 * P_A / (1 + K_2 * P_A + K_3 * P_B] = 0$$
 (5)

2.) carbon monoxide (CO)

$$\frac{\partial}{\partial \mathbf{r}} (D_{B} \partial P_{B} / \partial \mathbf{r}) - 2 \int S \left[K_{1} * P_{A} / (1 + K_{2} * P_{A} + K_{3} * P_{B}) = 0 \quad (6)$$

Multiplying equation (1) by $(\frac{\rho_0}{2})$ and equation (2) by ρ_A and subtracting 3 from 1 we get the following:

$$\partial /\partial \mathbf{r} (\mathbf{D}_{\mathrm{A}} \partial \mathbf{P}_{\mathrm{A}} / \partial \mathbf{R}) = -\frac{1}{2} \partial /\partial \mathbf{R} [\mathbf{D}_{\mathrm{B}} \partial \mathbf{P}_{\mathrm{B}} / \partial \mathbf{R}]$$
(7)

Integration occurs in two steps, and in each case R is the independent variable.

Step 1 Integration Vields the following:

 $D_{A} \supset P_{A} / \partial R = -\frac{1}{2} D_{B} \supset P_{B} / \partial R + C$ (8)

Solving for C we note the condition at pellet center where mass flux is zero.

$$R = 0 \quad \partial P_A / \partial R = 0 \quad \partial P_B / \partial R = 0$$

5

Step 2 Setting C = 0

$$D \partial P_{\rm A} / \partial R = -1/2 D_{\rm B} \partial P_{\rm B} / \partial R \tag{10}$$

Again integrating the partial pressures with respect to R we get the following:

$$D_A P_A = -1/2 D_B P_B + C$$
 (11)

We wake use of the second boundary condition that the partial pressures at the pellet surface are the stream conditions.

$$R = R$$
 $P_A = P_{AO}$ $P_B = P_{BO}$ (12)
 $C = D_A P_{AO} + 1/2 D_B P_{BO}$

Substituting and refining the equation, we get the following:

$$P_{\rm B} = 2 D_{\rm A} / D_{\rm B} (P_{\rm AO} - P_{\rm A}) + P_{\rm BO}$$
(13)

The authors integrated the equation assuming P_{BO} of carbon monoxide is zero at the surface and substituting back into the initial transport equation containing partial pressure (P_A) as a function of radius.

$$\partial/\partial R(D_A \partial P_A / \partial R) - SS(K_1 * P_A / (1 + K_2 * P_A + K_3 * D_A / D_B(P_A - P_A O)) = 0$$

It is worthy of note that the transport equations for diffusion of each chemical specie are interelated by the chemical mass balance. Also, the conditions of known surface concentrations and zero diffusion rate at pellet center are influential in node analysis. Node analyses are described (3) as used in determining termperatures of materials at specific locations called nodes.

(14)

The Austin-Walker example considers two chemical components. If these analyses are extended to consider a reaction of the type $(A + B \rightarrow R + S)$, the four chemical species require four mass transport equations. Temperature variation through the catalyst provides a fifth.

Because of the large number of partial differential equations involved, a node analysis was selected for determination of Einshelwood rate equations for non-isothermal pellet data.

3. Adsorption and desorption. The Type 3 rate control - adsorption and desorption - occurs when the speed of reaction is limited by the rate of adsorption and desorption of chemical species. It is noted (4) that the concentration (2) of chemical species adsorbed on a solid surface is related to the partial pressure of "A" in the main stream. This relation is defined as the Langmuir Isotherm.

$$X = a \left(P_{s} \right)^{n} \tag{15}$$

7

For adsorption rates or condensation on the catalyst surface, rate is assumed proportional to the partial pressure of "A". This is based upon kinetic theory of gases where the reaction is controlled by the number of molecular collisions molecule "A" makes with the catalyst surface. Hate of adsorption = $K_1 P_A (1 - \sigma)$. Here σ is the surface covered with reactant or product, and a linear isotherm (n = 1) has been assumed. Desorption on the other hand is a function of the product of a constant and the concentration of the adsorbed product. The desorption rate is defined as follows:

Rate of Desorption = K_2

At equilibrium condensation rate equals evaporation rate.

$$E_1 P_A (1 - \sigma') = E_2 \sigma'$$

 $\sigma = E_1 * P_A / (E_2 + E_1 * P_A)$ (16)

Further development involved study of more than one chemical species vying for the same site. Parameters σ and σ are the coverage of metal surface by species A and B, respectively. Then $(1 - \sigma - \sigma')$ is the uncovered catalyst surface.

Condensing rate of
$$A = K_1 (1 - \delta^- \delta^-) P_A$$
 (17)

$$Evaporation rate = K_2$$
 (18)

A similar equation for species B can also be defined.

$$K_{1} P_{B} (1 - \sigma - \sigma') = K' \sigma'$$

The catalyst surface coverage of component B, (σ^{+}) may now be obtained from the two equations for species A and B if we assume that the slow step is the adsorbing of "A". Thus surface coverage of "A" σ_{+} is negligible and influences the reaction very little. Solving the above equations for σ^{-1} we obtain the following:

$$\sigma^{-} = K_1 P_B \left[\frac{1}{K_2 + K_1 P_B} \right]$$
(19)

The rate of reaction of "A" is the product of the free surface $(1 - 6^{-1})$ and the specific rate of adsorption of "A" per unit free surface, or the rate of reaction of A proportional to a constant times partial pressure of species "A" upon the free adsorption sites (σ = 0).

$$\mathbf{r} = KP_{A} (1 - \sigma^{*})$$

$$\mathbf{r} = K K_{2}^{*} (\frac{1}{K_{2}^{*} + K_{1}^{*}P_{B}}) P_{A}$$
(20)

This is the form of one Hinshelwood equation. Other equations may be determined by assuming adsorption of B or desorption of products R and S control.

4. <u>Surface reaction</u>. The Type 4 rate control surface reaction is associated with the speed of the reaction on the catalyst surface. Concentrations of the chemiserbed reactant are controlled by the adsorption equilibrium between fluid and solid while the surface rate is a function of the surface adsorbed reactants and vacant site locations. In the case of a monomolecular reaction (5).

A → R

The chemical reaction is defined by the following equation:

$$\mathbf{r} = \mathbf{K}_{1} \left(\mathbf{P}_{A} - \mathbf{P}_{D} / \mathbf{K} \mathbf{E} \right) \tag{21}$$

If the reaction rate is controlling, the adsorption steps are assumed to be in equilibrium between condensation and evaporation of reactants and products. Surface concentrations of A and R can then be determined from Langmuir isotherm considerations. It is noted for specie "A" in the previous section, the following equation was defined.

$$C_A = \mathcal{O} = K * P_A / (1 + K * P_A)$$
 (22)

It is further noted that for equilibrium condition in a reaction, the equilibrium constant is defined as the ratio of the forward rate constant divided by the reverse rate constant.

$$K_1 (1 - \sigma) P_A = K_2 \sigma$$

 $K = K_1 / K_2 = \sigma / (1 - \sigma) P_A$ (23)

If component "A" is in an admixture with several other components A, B and R adsorbed on active sites, adsorption equilibrium equations may be written for each component. Available free sites will equal to the total number of sites less those sites ($C_A \cdots C_R$) used by the components

$$C_{L} = (1 - \sigma^{-}) = L - (C_{A} + C_{R})$$

$$(24)$$

Concentrations C_A and C_R are defined by equation 22 where the concentration is the product of the equilibrium constant, the number of free sites, and the activity or partial pressure of the component ($C_A = K(1 - \sigma^-)P_A$). The concentration of free sites may then be defined as follows:

$$C_{\rm L} = L_{\rm P}(K_{\rm L} - \sigma) P_{\rm A} + K_{\rm R} (1 - \sigma) P_{\rm B})$$
 (25)

Since C_{I} EQUALS L - σ we solve for C_{L} arriving at equation

$$C_{1} = L/(1 + K_{A} + P_{A} + K_{R} + P_{R})$$
 (26)

The equilibrium concentration of "A" on the catalyst surface is obtained by substituting for C_L or $(1 - \sigma)$ in equation $C_A = K(1 - \sigma) P_A$.

$$C_A = K_A (L/(1 + K_A * P_A + K_R * P_R) P_A$$
 (27)

and for the product concentration C_{R}

$$C_{R} = K_{R} (L/(K_{A} * P_{A} + K_{R} * P_{R}) P_{R}$$
 (28)

Making substitutions for C_A and C_R in the rate equation we obtain

$$\bar{\mathbf{r}} = \mathbf{k}_1 \left(\mathbf{L} / (\mathbf{k}_A * \mathbf{P}_A + \mathbf{k}_R * \mathbf{P}_R) \right) \left(\mathbf{k}_A * \mathbf{P}_A - \frac{\mathbf{k}_R * \mathbf{P}_R}{\mathbf{k}_E} \right)$$
 (29)

Additional equations have been derived assuming different surface rate steps controlling the bulk of which are known as Hinshelwood rate equations. A least square approximation of the rate constants is used to derive an equation representative of the rate versus concentration data. The equation best fitting the data is considered representative and because the equation is based upon a specific rate controlling step, the controlling mechanism is identified. 11

B. Hinshelwood Rate Equation Determination

The previous section discussed the centrol mechanisms and how the nature of these mechanisms affect the derivation of Hinshelwood equations. It was found that catalysis is composed of a sequence of reaction steps; and for analysis one step is assumed to control the overall rate. To pin point the controlling step the rate equation is determined for a reaction $A + B \rightarrow R + S$ the general rate equation as defined in (9) is:

$$r = \frac{K (P_A * P_B) - (P_R * P_S)/KE}{(1 + K_2^* * P_A + K_3^* * P_B + K_4^* * P_R + K_5^* * P_S)^n}$$
(30)

The Hinshelwood rate constants are then K, K_2 ', K_3 ', K_4 ', and K_5 '. To determine these constants from rate data the equation is rewritten with all the unknown constants to one side of the equation.

$$K_1 + K_2 * P_A + K_3 * P_B + K_4 * P_R + K_5 * P_3 = \left[\frac{POT}{r}\right]^{1/n}$$
 (31)

Solution of these constants is accomplished via least square linear approximation. Recent studies show non linear analysis to be more accurate for rate correlation but, here it was not needed to demonstrate methods of estimating constants from pellet information. The linear least square analysis assumes various rate equations and solves for values of K_1 , through K_5 using rate (r) and concentration data P_A , P_B , P_R , and P_S . As an example, let us consider the rate equation for adsorption of "A" controlling. Large equilibrium constant makes the second term of numerator negligible.

$$r = P_{A} * P_{B} / (1 + K_{3}) * P_{B} + K_{b} * P_{R} + K_{5} * P_{S})^{n}$$
(32)

Placing all rate constants on one side of the equation we obtain the rate for $(K_1 + K_3 + P_B + K_b + P_R + K_5 + P_s) = K + P_A + P_B/r$. For the results of the least square analysis to be acceptable the terms K_1 , K_3 , K_b , and K_5 must all be positive or zero otherwise equilibrium constant (forward and reverse rate) must be of opposite sign and cannot be equal as required for equilibrium. And since P_A does not appear in the denominator the constant K_2 must be zero. In similar manner, a large number of reactions are tried until all constants are positive or zero. When all the constants meet these requirements, the equation is found acceptable. Of the acceptable equations, the equation which shows the least deviation of the calculated rate from the measured rate is generally selected.

C. Reactor Pellet Data Analysis

The rate data itself is of importance to the analysis. Since results of Hinshelwood analyses are sensitive to errors introduced by the data, it is desirable to measure rates in a reactor segment where little change in physical conditions occur and chemical changes are readily measured. The two principal types of reactors used to measure rates are the differential and integral reactors.

The differential reactor is of interest because chemical reaction is performed in short reactor sections where conditions of temperature and stream chemical composition can be held constant. The reacting mixture is cycled through the reactor and the change in chemical composition noted. The rate of reaction in this increment of volume is defined (5) by an equation relating the changes in feed composition $(F \triangle X)$ to the rate of reaction (r) in the small increment of catalyst mass $(\triangle w)$:

$$\mathbf{F} * \triangle \mathbf{I} = \mathbf{F} * \triangle \mathbf{W} \tag{33}$$

Integral data is obtained from reactors where temperature and concentration vary. To determine reactor size integration of the equation 31 provides a relation between reactor weight catalyst, the feed rate F, and the amount of reaction (\triangle X) occurring in the reactor bed.

$$F/v = \int dX/r \qquad (34)$$

Integral data is plotted in terms of conversion X versus W/F. Thus for a given conversion it is possible to take the value of W/F and size the reactor for a given feed rate. Rates are determined by taking the slope of the plot ($\Delta X/\Delta W/F$); this provides a result similar to differential rate equation 31.

D. Node Analyses

The approach to determining Hinshelwood mechanisms from non-isothermal pellet data employs a node analysis similar to that used in Southwell's Relaxation Method. In Southwell's method (3) for heat transfer, nodes are specified geometric locations distributed uniformly throughout the material. Temperature gradients are calculated from node to node based upon known boundary temperatures, known material thermal properties and known fact that the sum of the heat fluxes into each node must be zero for steady state temperatures.

The heat fluxes are determined from node to node based upon the Fourier equation - q = (KA) $\overline{X} (T_{node 2} - T_{node 1}) = c' (T_{N2} - T_{N1}).$ (35)

Heat fluxes into and out of the nodes are summed with positive values for heat flux in, and negative for heat flux out. The sums of the heat fluxes in terms of node temperatures are set equal to residuals El to EN. The object of the analyses is to make these residuals go to zero. To accomplish this a table is formed which indicates how large the changes are in residuals for a unit change in node temperature. By inspection, the largest residual is altered to go to zero by changing one of the temperatures. Changes in all of the residual terms are noted and residual terms adjusted. The next highest residual is examined and temperatures are changed to make it go to zero. This is repeated until all residual terms are zero or sufficiently close to zero to be considered negligible. The set of adjusted temperatures provides the desired temperature distribution through the material. Hode analysis for heat and mass flux into the catalyst required significant modification as undertaken in the ensuing investigation. Temperatures were found to be dependent upon the amount of reaction occurring in the nodes. Analysis assumed the outermost node exhibited pellet surface conditions. Surface rates were used to estimate rate equations. The sum of the reactions in all nodes was required to equal the total rate observed for the pellet. Node rates were limited to values less than that defined by diffusion rates and by the rate equation determined from the surface rate estimates.

1. <u>Concentration distribution in pellet</u>. With non-isothermal pellet data the achievement of steady state conditions required that mass flux into a node be zero. To simplify the computer program a spherical pellet was selected having four nodes, each node representing 1/4 of the pellet volume. Nodes in the spherical pellet were defined as the surfaces of a thin spheres located centrally in the node shells. It was assumed that the amount of reaction occurring in each shell could be represented at the node. For the purpose of calculation, the total rate of reaction in a pellet (f_2) equals the sum of the rates in all four nodes. This means that transport of reactants and products is controlled by the concentration gradient for each. Thus for a reaction of A + B = R + S, the concentration drop between nodes may be determined from a set of equations describing flow between node N-1 and N:

$$-RA(N) = DEA * AR(N)/DR(N) C_A(N) - C_{AS}$$

$$-F^*RA(N) = DER * AR(N)/DR(N) C_B(N) - C_{BS}$$

$$H^*RA(N) = DER * AR(N)/DR(N) C_R(N) - C_{RS}$$

$$Q^*FA(N) = DES * AR(N)/DR(N) C_R(N) - C_{RS}$$
(36)

Here, the diffusion rate of each component is related to diffusion of species A or PA(N) times a coefficient determined by the mass balance from the reaction. Since product mass exiting equals reactant mass entering the mode, the requirement that mass flux in equals mass flux out is satisfied.

Diffusion rates are controlled by a requirement to feed the reaction at the inside node freation rates therefore influence the variation in concentrations observed. The solution for the concentration curve requires the solving of the above equations for $C_A(N)$, $C_B(N)$, $C_R(N)$, and $C_B(N)$ at each node N. Main stream concentrations are assumed known. The N in bracket refers to the node number and is written in this discussion in Matrix notation similar to the Fortran IV designation.

2. <u>Temperature distribution</u>. Temperature through the pellet is related to the heat released at each node from the reaction occurring there. The heat flux rate is based upon the heat generated in the inner nodes which must flow out to satisfy pellet steady state temperature conditions.

 $\sum_{n \neq 1} R(n) * \triangle H = CK * AR(n) / DR(n) * (T_{n2} - T_{n1})$ (37)

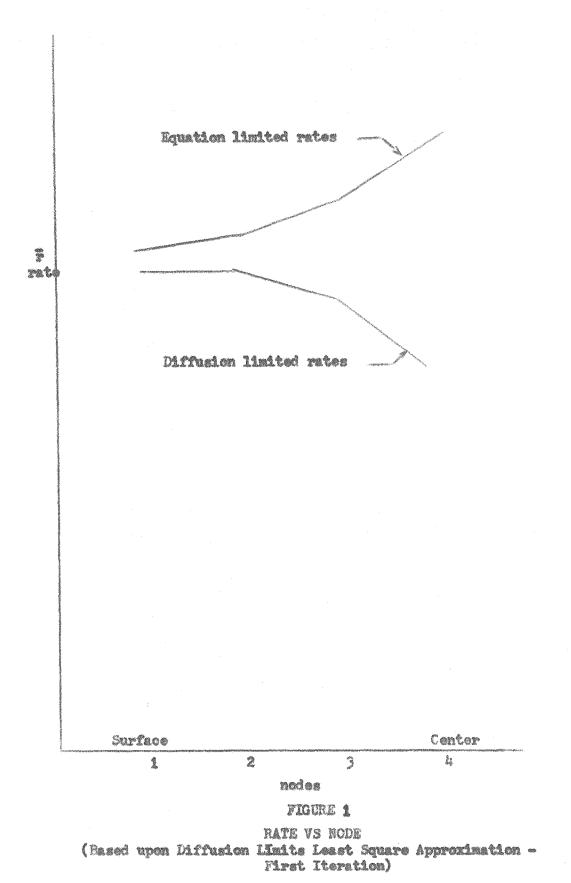
Temperatures for each node are obtained by summing and adding these to the experimentally determined surface temperature.

$$T_{\rm H} = T_{\rm S} + \xi \Delta T \tag{30}$$

3. <u>Fate determination</u>. For the initial least square approximation of the surface rates all of the reaction is assumed placed in the surface node. The program solves (via least square analysis) for the rate equation and constants which fit the data for high and low catalyst surface temperatures. If rates are calculated for each node using the least square equation, the total quantity reacted would be about four times the total mass experimentally observed to react in the pellet. Subsequent approximations alter the equation to reduce the calculated rates. Next considering the other extreme, if all the reacting mass diffuses as far as possible into the pellet, we find that the total reacting mass diffuses into the first two or three nodes, but because of diffusion restriction, the total pellet reaction flow may not reach the last node. These two conditions are represented by the curves in Figure 1.

Rate determination is accomplished by first assuming an initial rate distribution through the pellet. In this analysis we assume that the pellet total rate is disseminated to the interior nodes to the maximum allowable by diffusion. Then by decreasing the equation estimated rates at each node, the reacting mass in the inner nodes are moved to the outer ones until all nodes rates summed equal the total pellet rate.

Chemical concentration variance is estimated based on the following assumption critical to the argument presented: The amount of diffusion (quantity of mass) traveling from one node to the next is controlled by the rate of reaction occurring in the innermost nodes. If we take the center (Innermost) node, the amount diffusing into the node is the amount being reacted there. An equal mass must leave the node -- in this case, the products of reaction. Froduct accumulation does not allow a steady state chemical composition in the node. In similar manner, the amount



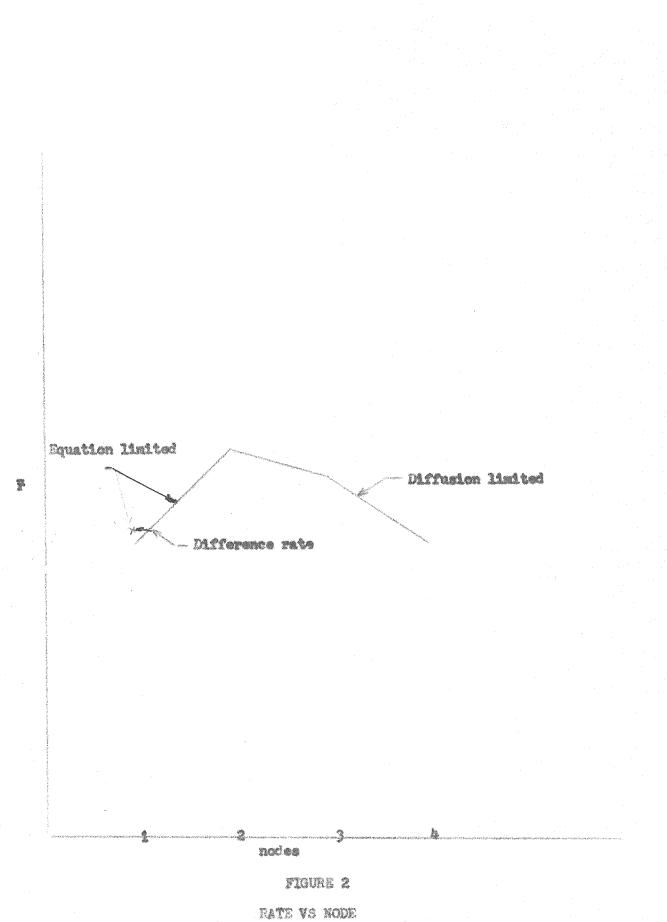


of diffusion between second and third nodes can be estimated as equal to the quantity of reactant needed to feed the inner nodes three and four. The same holds true for diffusion between nodes one and two. For calculations of interior node concentrations, the surface node concentration must be known. Internal rates and resultant concentration gradients provide the driving force for flow of reactants into the inner nodes.

These concentrations and temperatures are subsequently used in the rate equation to calculate node rates. Estimates of node one rate (surface rate) are used to determine the Hinshelwood rate equation. Employing equation calculated interior node rates, a difference determined node one is estimated by subtracting the node two, three and four rates from the total pellet rate. If this node one rate is smaller than the rate used to define the equation, the equation rates are decreased by taking incrementally smaller surface rate estimates. To achieve this, a percentage cut of the last surface or node one estimate is used. This is done by using a multiplier term call ZD. The term ZD is decreased and then used to multiply all pellet last estimated node one rates.

$$ZD = 0.8 + ZD$$
 (39)
r(i) = ZD * (last node one estimate)

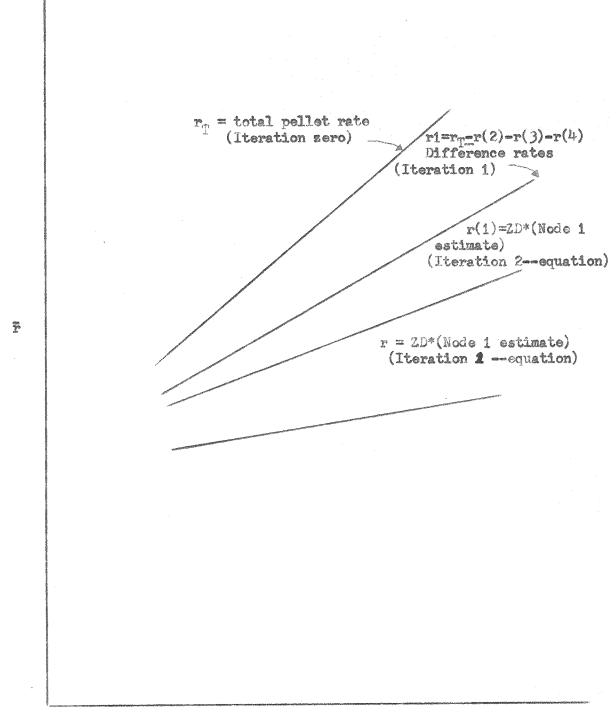
A least square approximation from the decreased pellet node one rates is calculated. Next, all rates used to define the Hinshelwood equation are compared with the difference determined rates. This process is continued until the surface node for pellets provides a 2D * (last node one estimate) product incrementally less than the difference determined node one rate yielding a rate versus node curve as shown in Figure 2.



(2D * last node estimate)

21

Up to this point, we considered single pellet analyses. The least square approximation rate curve is defined from many pellets. As indicated earlier, the least square equation defined from all pellets is modified until node one equation rates r(1) for all pellets are incrementally smaller than the difference determined node one rates. This means that one pellet sets the low value of rates and of ZD. The other pellet node one rates determined via the difference approach will tend to be high compared to their final value. If the difference between the least square approximation calculated rates (R1CALC) and the difference determined node one rates is small, the equation is accepted. When the difference as indicated by the coefficient of variation between node one rates calculated from the least squares approximation and difference determined node one rates deviates so as to reject the equation, the last difference determined node one rates are used for the next least square approximation. Thus, the shape of the curve is altered to reflect the high or low node one rates resulting from the previous pellet calculations. Each iteration should bring the least square approximated curve closer to the node one difference estimates as indicated in Figure 3.



63

PA

FIGURE 3

SUCCESSIVE NODE 1 VERSUS PARTIAL PRESSURE A ITERATIONS

E. Node Program Description

It was concluded from the analysis that a Node method for determining Hinshelwood equations from catalyst data was feasible. In view of the extensive number of calculations needed to converge to a representative Hinshelwood equation for the surface rates, a computer program appeared to be the only reasonable means of attaining the solution. A computer program was thus assembled which was composed of three major sections or loops designed to perform the following computations

1. Least square node one approximation.

- 2. Diffusion, temperature and node one rate determination.
- 3. Comparison of difference determined node one rates with the least square approximation node one rates.

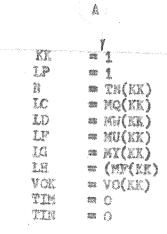
These loops are shown in the computer centrol diagram presented in Figure 4. The diagram indicates the controls statements but only calls out the analysis to be performed in each part. The three major loops are initiated from an if statement indicated by a diamond on page 25A. The diamonds (IN:2) are in the diagram lines containing indicators I = 1 and I = 2.

The indicators (I) are used to reference the storage matrices B and C. Storage matrices are defined as matrices in which experimental data has been placed. Frior to the three loop split the matrix values of B or C are transferred to working matrix A. Then, after performing computations in the first loop, the indicator I designates which matrix (B or C) the computed values are to be stored. We will consider operations in each loop in the fellowing discussion. Input and output is discussed in the APPENDIX. A program printout is also shown in the APPENDIX.

FIGURE 4

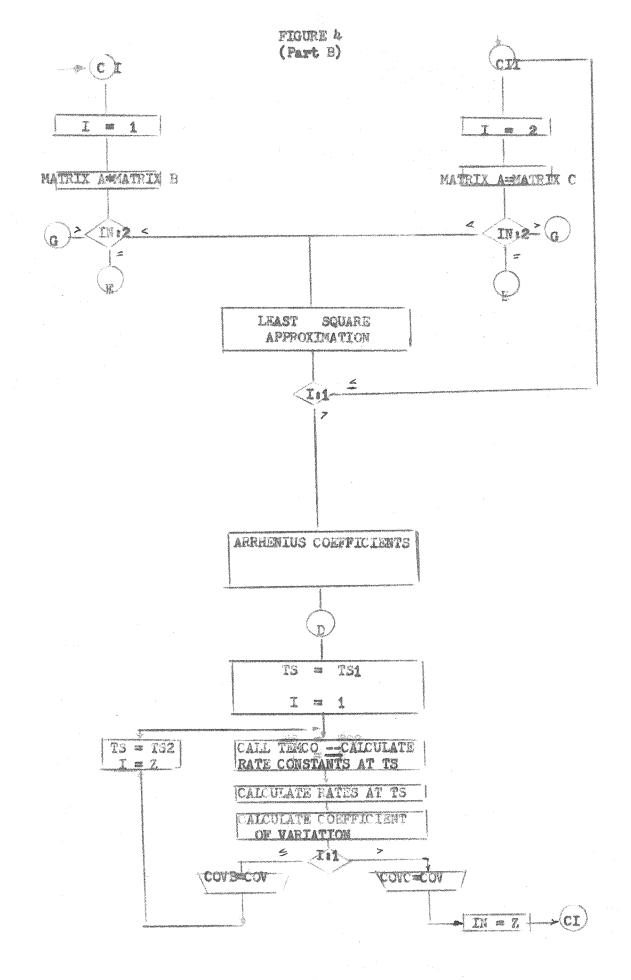
CONFUTER CONTROL DIAGRAM (ONLY) (Part A)

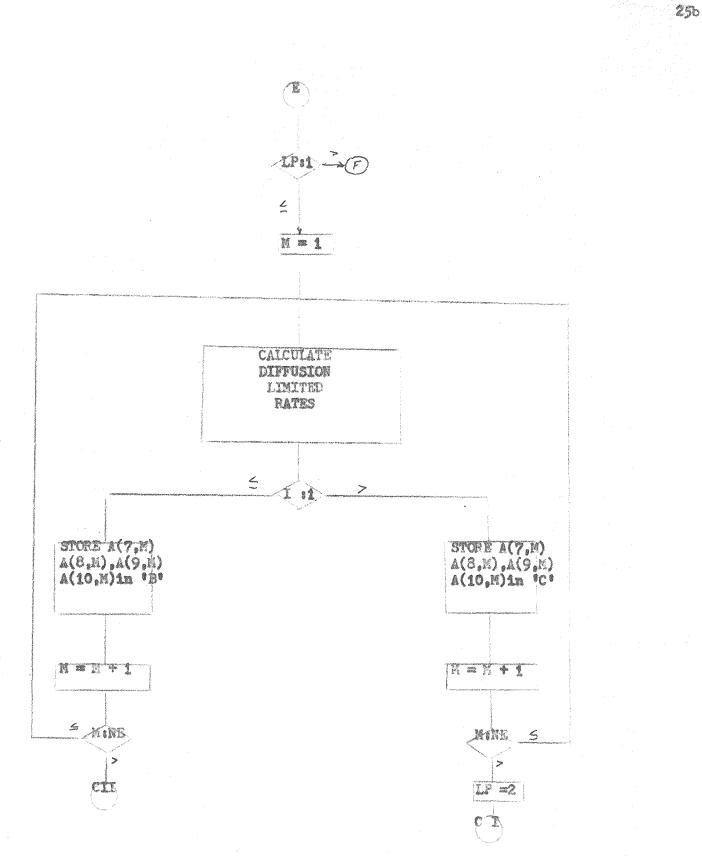
RATE MECHANISHS NQ, MM, MU, MY, MF, TN, VO DATA MATRIX E, C DIFFUSIVITIES DEA, DEB, DER, DES CONSTANTS RF, CP, HE, KF MASS BALANCE F, H, Q CONSTANTS UZ, CK, GC ITERATIONS FM, FM



В TN # 1.0 20 = 1.0 12 = 1.0

7 C I







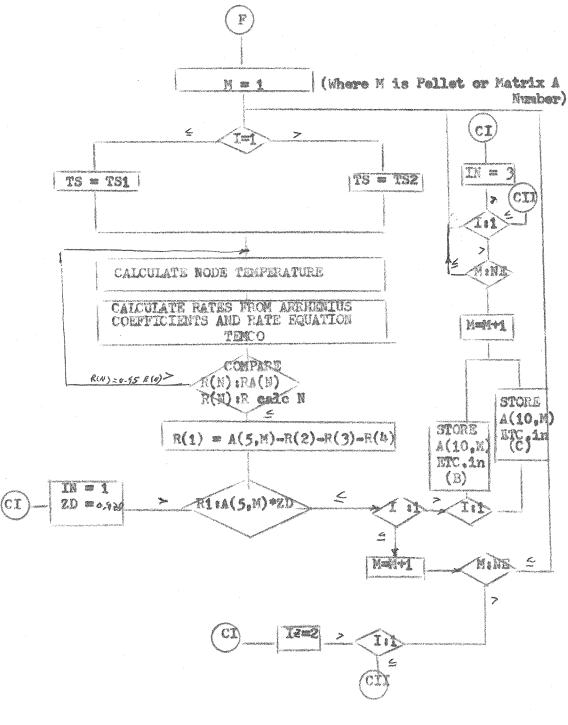


FIGURE 3 (Part D)

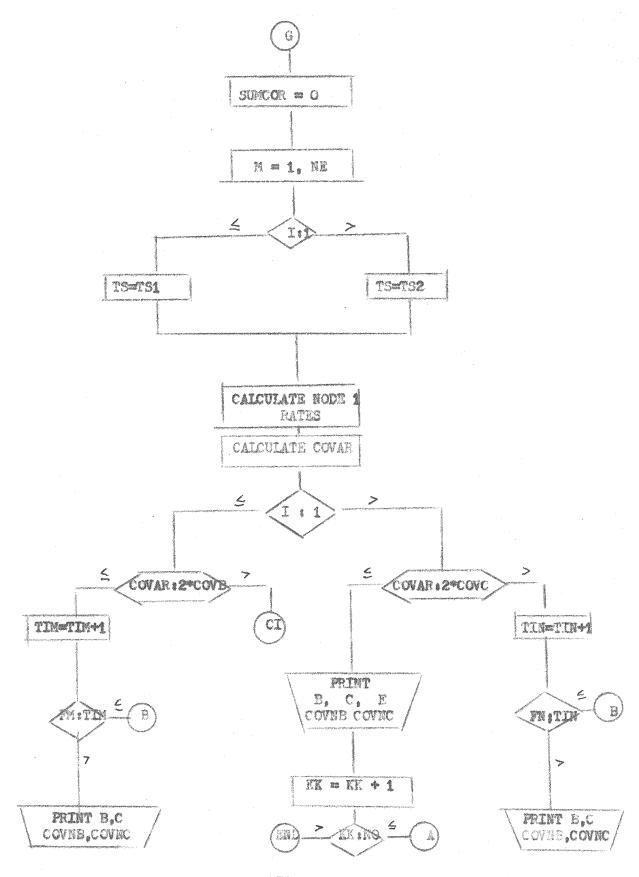


FIGURE 3 (Fart E) 1. Least equare approximation loop (IE = 1). In loop 1 and node 1, rates and concentrations are used for defining the Hinshelwood rate equation. Node one rate estimates are initially specified in the input data. The Hinshelwood rate form is preselected by the programmer and called out in the input to the computer. Using the preselected rate forms, the computer performs a linear least square analysis of the surface rates evaluating the equation for the rate equation constants. These constants are used to calculate the Arrhenius constants. The last operation in the loop determine the closeness of fit of the equation derived rates to the previously determined node one rates. Closeness of fit of the difference determined node one rates and the Hinshelwood equation calculated rates is indicated by a coefficient of variation.

a. <u>Hinshelwood rate equation</u>. The calculations performed in loop one are as follows: The rate equation is assembled by calling for terms from several function subroutines. Rate forms are designated from addresses included in the program input. Refer to the Appendix for a more detailed description. The generalised rate form is defined by the equation:

* * Kinetic term * potential term (adsorption Term) N

Table I through IV provides a list of terms in Kinetic, potential and individual adsorption terms encompassing those included in the subroutines. The equation is rewritten in terms of reactant and product concentrations as follows:

$$K_1 + K_2 * P_A + K_3 * P_B + K_4 * P_R + K_5 * P_S = (POT) 1/8$$
 (40)

Table I Reaction Rate Mechanisms (Tables are from Ref. 9)

Part A

.

DRIVING POTENTIAL TERMS

le {

 Reaction	ΛR	A R+S	A+B _ R	A+B — R+S
Adsorption of A con- trolling	$a_A = \frac{a_R}{K}$	$a_{k} = \frac{a_{R}a_{S}}{k}$	$a_A = \frac{a_R}{Ka_B}$	$a_{A} = \frac{a_{R}a_{S}}{Ka_{B}}$
 Adsorption of B con- trolling	0	О	$a_B = \frac{a_R}{Xa_A}$	$a_{B} = \frac{a_{R}a_{S}}{Ka_{A}}$
 Descrption of R con- trolling	$a_A = \frac{a_R}{K}$	$\frac{a_A}{a_S} - \frac{a_R}{X}$	a _A a _B - a _R K	$\frac{a_A a_B}{a_S} = \frac{a_R}{K}$
 Surface reaction con- trolling	$a_A = \frac{a_R}{K}$.	$a_A = \frac{a_B a_S}{K}$		$a_A a_B = \frac{a_R a_S}{K}$
Impact of A control- ling (A not edsorbed)	0	0	$a_A a_B \frac{a_R}{K}$	$a_A a_B = \frac{a_B a_S}{K}$
 Homogeneous reaction controlling	$a_A - \frac{a_R}{K}$	$a_A = \frac{a_R a_S}{\lambda}$	$a_A a_B = \frac{a_R}{K}$	$a_A a_B = \frac{a_R a_S}{A}$

Part B

REPLACEMENTS IN THE GENERAL ADSORPTION TERMS.

Reaction	A ⊒ R	A = R+S	A*B R	A+B R+S
Where adsorption of A is rate controlling replaca K _{ABA} by	K _A a _R K	KABHAS	K ^{YaB}	KaRas KaB
Where issorption of B is rate controlling replace K _B a _B by	0	0	KBaR KaA	KBakas Kak
Where descrption of R is rate controlling replace K _{RAR} by	KK _R a _A	KKK AA	KKRªAªB	KKR <mark>abab</mark>
Where adsorption of A is rate controlling with dissociation of A replace K _A a _A by	A A A	V KAGRAS	XAR KAB	KAARAS A AB
Where equilibrium adso	orption of	A takes pla	ce with ais:	sociation
of A replace K _A a _A by	XAªA	V KARA	KAAA	KAAA .
and similarly for other c	omponents	adsorbed wit	h dissociat	ion.
Meré A is not adsor replace $K_A a_\lambda$ by	bed ·	0	0	0
and similarly for other c	omponents	which are no	t adsorbed.	1

 $\left[1 + K_{A}a_{A} + K_{B}a_{B} + K_{K}a_{R} + K_{S}a_{S} + K_{I}a_{I}\right]^{n}$

Table I Reaction Rate Mechanisms (Continued) (Tables are from Ref. 9)

Part C

Part C KINETIC TERMS.
Multiply each of the torms below by EL except for the homogeneous reaction.
Adsorption of A controlling k_A Adsorption of B controlling k_B Desorption of R controlling k_RX Adsorption of A controlling with dissociation $\frac{3}{2} k_A$
 Impact of A controlling k _A K _B Homogeneous reaction controlling k
Surface Reaction Controlling
$A \xrightarrow{-} R \qquad A \xrightarrow{-} R^+S \qquad A^+B \xrightarrow{-} R \qquad A^+B \xrightarrow{-} R^+S$
Without dissociation $k_{g}K_{A} = k_{g} + K_{A} = k_{b} + k_{b} + k_{b} = k_{A}K_{B} = k_{A}K_{B}$
Kith dissociation of A kss KA ks s KA kss(s-1KAKB kss(s-UKAKB
B not adsorbed $k_{B} K_{A} = k_{S} S K_{A} = k_{S} K_{A} = k_{B} S K_{A}$
B not adsorbed, A dis $k_s s K_A$

Part D EXPONENTS OF ADSORPTION TERMS

Adsorption of A controlling Desorption of R controlling Adsorption of A controlling Impact of A without dissoc:	; with dis	sociation		n = 1 n = 1 n = 2 n ₁ = 1
Impact of A without dissoc: Homogeneous reaction	lation A+H	R+S	۶۰ .(.	n = 2 n = 0
Surface Reaction Controllin	A 🕂 R	A R+S	A+B R	A+B R+S.
No dissociation of A Dissociation of A	1 2	2	2	· 2 · 3
Dissociation of A (B not adsorbed)	2 '	2	2	
No dissociation of A (B not adsorbed)	1	2	1 1 1	2
				A an annan-stana ananan-menetapat an <u>an-ana</u> kanan

This equation form is used for linear fitting of the node one rate data. The linear least square analysis is performed as described by Hougen and Watson (3). Values for the terms K_1 , K_2 , K_3 , and K_4 and K_5 are stored in a matrix E in preparation for the next step that of computation of the Arrhemius constants.

b. <u>Arrhenius constant determination</u>. After the rate constants in loop one are calculated for the matrix B and matrix C data at two surface temperatures, the temperature dependence of the constants is represented by the Arrhenius exponential function:

$$K = K_{o} e^{P(-A/RT)}$$
(41)

Where K_{0} and A are constants to be determined, R is the universal gas constant and T is the temperature of the reaction. The Arrhenius constants are determined by taking the log form of the above equation. Substituting into two simultaneous equations the K1B and K1C constants from matrix E, A and K are then defined by the equations below.

 $A = R (TS1 - TS2/TS1 * TS2) \log (K_1B/K_1C)$ $K_0 = K_1B EXP (A/R * TS1)$

The Arrhenius constants in the computer program are defined as AK for K_{α} and DB for A.

c. <u>Coefficient of variation</u>. The coefficient of variation indicates how far apart the node one rates are from the equation determined rates. A coefficient of variation is determined for each matrix (B and C) in the following manner. We set the termperature (2) for the Arrhenius constant equal to the surface temperature and compute values for the Hinshelwood

constants using the Arrhenius equation. Rates are calculated for each pellet based upon these constants and the surface concentrations of the species.

$$RC = \frac{K}{(K_1 + K_2 + P_A + K_3 + P_B)^N}$$
(43)

These calculated rates are then compared with the rates R(1) determined from either the initial estimate supplied by the programmer in the input or from the difference determined node one rates which are calculated in loop two and stored in terms E(10,N) or C(10,N).

R (1) = (total rate) * (multiplier defined in the program)

The multiplier is the product of the node one rate fraction from matrix terms B(10,M) or C(10,M) and the value of 2D which is set equal to 1 for the first iteration but is decreased in loop two during subsequent iterations. The term M corresponds to the pellet assigned number in the matrix.

The coefficient of variation is determined from the rates by solving the following equation:

COV (B or C)
$$= \sqrt{\frac{2(RC) - R(1)}{N-1}}$$
 (44)

When coefficients of variation have been computed for data in matrix B and C, the computer sets IN equal to 2 sending the program to loop two indicated as Location E in the diagram.

2. <u>Diffusion.</u> temperature, and node one rate determination (IN = 2). The second loop location E, performs several key operations. The calculations performed in this loop determine diffusion rate limits, node 1. J

temperature, node concentrations, and node rates. The first calculation for diffusion limits is performed when indicator LP in loop two equals i. The calculations employ average effective diffusivities at temperatures observed for the nodes. Temperature dependent diffusivities may be introduced into the program but average values were selected here to simplify calculation. After determining the diffusion limits for all data points, LP is set equal to 2 and further analyses bypass this section.

The second section of loop two calculates temperatures at each node. An initial rate estimate for the nodes is that the pellet reacting mass is diffused into the pellet as far as possible. In some cases this results in all of the reaction occurring in node four (all reacting mass diffusing into center node). The method of analysis used starts with high estimates of interior node rates and decreases the rates in each of the innermost nodes two, three and four by decreasing the linear least square approximation rates. The outermost node (node one) rate referred to as the difference determined rate is the rate determined from the total pellet rate less the rates from nodes two, three and four. When the difference determined node one rates become incrementally larger than the estimated surface rate we know the sum of the node rates must be slightly less than the total observed pellet reaction rate. This condition exists because the difference determined rate is larger than the surface rate estimate which was used to define the rate equation and calculate node two, three and four rates. These node one rates are forwarded to loop three for a final comparison of the rates determined from the equation versus those from the difference methods.

a. <u>Diffusion limited rates</u>. The calculations performed in loop two are as follows: In section one of loop two calculations of the mass flux between the nodes is determined. Several assumptions are made. The maximum flow of reactant into the pellet is assumed not to exceed the total reaction taking place in the pellet. Diffusion of each reactant and product is assumed related by the chemical reaction mass balance to one another. Thus, the reaction concentration diminishes proportionately to increases in product concentration. For a given pressure and temperature, the total number of moles/unit volume for a gas is known. The sum of the molar concentrations of the reactants and products in the node, moles per unit volume, must be equal to the total molar concentration moles/unit volume. Concentrations are subsequently calculated for each node with the exception that node one is assumed to have the same concentration as that of the main stream.

Starting with total rate of reaction of A in the pellet to be that diffusing to node two, the concentrations at node two is determined from the following equations. Terms AR and DR are the mean transfer area and distance between nodes respectively and RA is the diffusion rate of specie A. Terms C_{AS} to C_{SS} are surface concentrations.

$$C_{A} = -RA * DR(2) / (DEA * AR(2)) + C_{AS}$$

$$C_{B} = -F * RA * DR(2) / (DEB * AR (2)) + C_{BS}$$

$$C_{R} = +H * RA * DR(2) / (DER * AR (2)) + C_{RS}$$

$$C_{S} = +Q * RA * DR(2) / (DES * AR (2)) + C_{SS}$$
(45)

This process is repeated for node three assuming the values of $C_{\rm A}$

through C_S determined for node two are the new values of C_{AS} to C_{SS} . After calculating each set of concentrations, the concentrations are summed and compared with the total number of moles which a node (1/4 pellet volume) will hold. The total node quantity is bracketed by limits PD and FR placed in the program input.

$$(C_A + C_B + C_R = C_S) : FD$$

$$(C_A + C_B + C_R + C_S) : FR$$
(46)

If the sum falls outside these limits, the value of RA is decreased.

$$RA = 0.95 * RA \tag{47}$$

It is known that for RA equal to zero the concentration must be that of the surface concentrations $C_{AS} + C_{AE}$ etc. Thus it is expected as RA goes to zero that some value of RA will provide a total concentration that falls within the defined limits FD and FR.

b. <u>Temperature determination in nodes</u>. Returning to section two of loop two, the temperatures are determined on the basis that heat generated by the reaction must flow out of the pellet for thermal equilibrium. The \triangle T can be determined if an effective conductivity is used in the following equation:

$$Q = P(N) * HR = (CK * AR(N) * \Delta T)/DR(N)$$
(48)

The temperature rise from node to mode is determined and added to the surface temperature to determine the node temperature. For each iteration node temperatures are recomputed.

$$T = TS + \angle \Delta T \tag{49}$$

c. <u>Difference determination of node 1 rates</u>. R(N) In the determination of representative node one rates a reduced rate term R(N) is compared with diffusion limit rate RA(N) and the calculated rate R1 CALC. R1 CALC is determined from the least square approximation using node temperatures and concentrations estimated. If R(N) is larger than either of these rates, an increment of rate is removed from the node reducing R(N). The increment of reaction is then placed in the next outermost node.

Since initial node rates are determined from difference of diffusion into and out of the nodes, all of the reacting mass RA (N) is allowed to diffuse to the innermost nodes, therefore if anything is changed, it is the removing of some of the reaction from the inner nodes. The rates in each node one to four are compared with diffusion limited rate and with the calculated rates from the Hinshelwood equation employing Arrhenius constants. If there is more reaction in the node than allowed by these limits, R(N) is decreased.

$$R(N) = 0.95 * R(N)$$
 (50)

When R(N) falls within these limits (Least square approximation and diffusion limits) the rate is considered representative of that node rate. Then, using a node one difference rate (total rate less inner node rates) a comparison is made between the node one rate and one defined by the product of 2D and the initial node 1 rate estimate. To obtain the initial node one estimate, the product A(10,M) * A(5,M) is determined where A(10,M) is the node rate fraction inputted or calculated and A(5,M) is the total rate. If from the comparison we find the difference rate is the lesser, the value of 2D is decreased.

The new value of 2D is sent back to loop one and multiplies all node one rates stored in matrix B and C. The ZD modified rates are used to obtain another least square approximation; a new Arrhenius constant, a new coefficient of variation and the program returns to loop two where the same rate adjustment process is continued. This process is repeated until the difference determined rates for the pellets are greater than the respective values of the product 2D and the initial node one rate estimate. When the node one rates are defined, they are stored in matrix B and C as B(10,M) and C(10,M) and are forwarded to loop three.

3. Loop three acceptance or rejection of least square linear approximation. The last loop (G) determines a second coefficient of variation. This time it provides a measure of deviation between the difference determined node one rates and the least square equation node one rates. The new coefficient of variation COVAR is then compared with the previous coefficient of variation COV. In the program as it presently stands, if COVAR is less than twice COV, the equation is accepted and constants printed out.

The calculations performed in this section repeat those performed in section one, part C, with the exception that the initial and final coefficients of variation (COV and COVAR) are compared.

F. Hydrogen Oxygen Catalysis - Sample Problem

A sample case, Hydrogen - Oxygen over platinum catalyst was used to determine the types of problems which might be encountered in the proposed computer analysis. Data was reviewed from two papers. The papers described experimental studies in which the first paper investigated catalyst particles and pellets subjected to mixed streams of Hydrogen and Oxygen gas simulating a stirred tank reactor, and the second paper studied catalysis of Hydrogen/Oxygen in a small tubular flow integral reactor. In the former paper by Mayno and Smith (6) the low oxygen concentration range (0-4 mole %) was examined and it was concluded that rates were nearly first order with respect to oxygen partial pressure:

$$R = 0.655 \exp(-5230) P_{02}^{0.804}$$
(52)

Leder and Butt (2) studied the low hydrogen end of the gas mixture range and concluded that a Hinshelwood equation represented the data. They concluded that surface adsorbed oxygen reacting with hydrogen in the gas phase controlled rates thus providing correlation with the following rate equation:

$$\frac{R = K P_{02} P_{H2}^{2}}{1 + K_{0} P_{02} + K_{w} P_{w}}$$
(53)

Maymo and Smith also noted that reactions at high oxygen/low hydrogen mixture ratios were second order with respect to hydrogen concentration. The problem posed is: does the mechanism implied by the Hinshelwood equation submitted by Leder and Butt provide an Acceptable rate form for the data at the opposite ends of the hydrogen/oxygen mixture range obtained by Maymo and Smith? 1. Test data. Data from (5) is summarized in Table II, part A. Rates were reported by Maymo and Smith in moles per gram - second but in this application, rates for entire pellets (average weight 2.0 grams) are listed because the total pellet rate was used in the analysis. The rates at oxygen partial pressure varying from 0.009 to 0.111 atmospheres ranged from 19.2 X 10^{-6} moles to 267×10^{-6} moles pellet sec. The observed surface temperatures were between 89° C and 180° C. Other parameters reported and used in the computer analysis were the effective diffusion rate for oxygen of 0.166 cm²/sec, the effective conductivity of the pellet 6.4 X 10^{-4} cal/cm(sec) (0 C) and the heat of reaction of 115,000 cal/gm mole. All other values used were selected or calculated.

Diffusivities of hydrogen (4.37 cm^2) and water vapor (0.6 cm^2/sec) were sec estimated from the effective diffusivity equations employing bulk and Knudsen diffusion. Specific heat and equilibrium constant were obtained from the Handbook of Physics and Chemistry. The results of several computer runs performed with input data (Table II, Part B) are discussed in the following sections.

2. <u>Computer results</u>. Several computer runs were made to determine if the Binshelwood equation proposed by Leder and Butt would fit the experimental rate data of Maymo and Smith. The forms used were as follows:

(a)
$$r = P_{02}/(K_1 + K_2 * P_{02})$$

(b) $r = P_{02} * P_{H2}/(K_1 + K_2 * P_{02})$
(54)

In determining the equation constants the program employs the partial pressures of Hydrogen and Oxygen in the following equations:

$$K_1 + K_2 * P_{02} + K_3 * P_{H2} = (P_{02} P_{H2} - P_{H20}/KE)$$
 (55)

TABLE II

PART A

```
RATE DATA (6)
```

Pellet Number	Surface Temperature	Oxygen Concentration	Hydrogen Concentration	Pellet Eate mole/pellet	
	¢	atm	atm.	(r X 10 ⁶)	
11-1	101	0.029	0.971	57.8	
11-2	101	0.054	0.946	101.0	
11-3	100	0.0094	0.991	19.2	
12-3	102	0.060	0.940	106.0	
24-1	206	0.046	0.954	267.0	
24-3	130	0.046	0.954	110.0	
24-1	117	0,111	0.889	248	
21	127	0.027	0.923	81	
51	181	0.027	0.973	118	

TABLE II

PART B

```
IN-FUT DATA (2)
```

	In-Put Description	Computer Term	Example Value
2.	Number of rate mechanisms	NO	2
2.	Rate mechanism (addresses)	MQ, MU, MV, MY, MZ, TN, VO	2, 11, 1, 2, 2, 1, 3
3.	Number of Data Points	mf, nf	4, 2
4.	Matrix B Data	B(1, 1) B(14, MF)	.027, 0.973, 0, 0, 0.1E-04, 1, 1, 1, 1, .025, 1.0, 1.0, 1.0, 1.0
5.	Matrix C Data	C(1, 1) B(14, MF)	Same
6.	Diffusion Constants	DEA, DEB, DER, DES	0.166, 0.60, 1.0, 0
7.	Constants: Pollet radius, Specific Heat of Gas, Heat of Re- action, Equilibrium Constant	RP, CP, HR, KE	0.93, 7.0, 115,000, 2,000
8.	Constant: From Mass Balance A + P*B	F, H, Q	2, 2, 0
	° ₂ + 2H ₂ → 2H ₂ 0		
9.	Surface Temperatures	TS1, TS2	373°K, 403°K
10.	Constants: Number of Constants to be solved for, effect- ive Thermal Conduct- ivity of Pellet, Universal Gas Constant	U2, CK, GC	2, 6.5 X 10 ⁻⁴ , 1.98
11.	Number of Iterations	FM, FN	3, 3

Solution involves determination of K_1 , K_2 , and K_3 for each mechanism investigated. The constant for water is indeterminable because of pellet surface water vapor pressure being negligible. To determine if the constant K_3 is zero for the case of adsorbed oxygen reacting with hydrogen in the gas phase, it is necessary to solve for the three constants but if one of the constants is zero, the subroutine SOLV now in use (see Appendix) writes out the word EXTOL. The computer bypasses further calculation of that case. Thus the method of evaluating the constant is to run three rate forms. The first form with all constants K_1 , K_2 , and K_3 . The second rate form with K_1 and K_2 only setting K_3 equal to zero, and the third rate form containing only K_1 and K_3 setting K_2 equal to zero. It is noted that the simultaneous equation solution performed by subroutines MAT and SOLV when replaced by the existing computer library subroutines will print out zeros for these constants which are zero and accomplish this analysis in one run.

3. <u>Discussion of Computer analysis performed</u>. During this investigation, computer runs were performed on oxygen/hydrogen rate data. The analyses considered calculation of constants K₁ and K₂ assuming K₃ zero. Equations examined were as follows:

(1)
$$r = \frac{P_{02}}{K_1 + K_2 + P_{02}}$$

and

(2)
$$r = \frac{P_{02} * PH_2^2}{K_1 + K_2 * P_{02}}$$

39

(56)

Four data points were placed in matrix B all having surface temperatures of 373° K and two pellet data points placed in matrix C with surface temperatures of 403° K. An iteration limit of three was imposed to limit machine time. Initial runs indicated that convergence was occurring extremely slowly and results of node one rate comparison indicated wide deviation existed at the end of three iterations and so the number of pellet points were reduced to three in matrix B. The next run appeared to converge more rapidly than the previous one, but did not reach convergence within the three iterations allowed. Therefore, the number of points in matrix B was decreased to two and the iteration limit increased to five. Convergence to a fixed value appeared to have been achieved in this run. The coefficients of variation for the two mechanism misms were close with the coefficient for mechanism two appearing slightly better as indicated in Table III, The rate equation defined for the second mechanism can be written as follows placing the values of K_i and K_p in Arrhenius constant form in the denominator:

$$r = \frac{P_{02} P_{H2}^2}{0.0128 \exp \left(\frac{10800}{RT}\right) + (639T - 2.600.000) P_{02}}$$
(57)

The linear form of the equation for the temperature dependant constant is used if one or more constants determined from least square analysis are negative. The Hinshelwood constants printed out in program are tabulated in Table IV.

The rate data comparison between calculated node one and difference determined node one rate are summarized in Table V.

TABLE III

COEFFICIENTS OF VARIATION

<u>Mechanian</u>	COVN B	COVN C
$r = P_{02}/(K_1 + K_2 * P_{02})$	0.166 E-04	0.224 E-04
$r = P_{02} P_{H2}^{2} / (K_1 + K_2 + P_{02})$	0.164 E-04	0.140 E-04

VI SIHAT

RATE CONSTANTS (H2/02)

		Hinshelwood	Coefficients
		n ny teoreta en la constante en la constante en la constante en presentation de la constante en la constante en La constante en la constante en	
	Temperature	K ₁	K ₂
Natrix B	373° K	2230	- 22000
Matrix C	403° K	765	~ 2840

TABLE V

COMPARISON OF FATE DATA (Iteration Nechanism)

	P _{O2}	P _{II2}	Node 1 Calc.	Node 1 Difference	Total Pellet Rate
Matrix	.0283	0.972	16.6 x 10 ⁻⁶	20.9 X 10 ⁻⁶	57.8 x 10 ⁻⁶
B	.0580	0.942	54.0 X 10 ⁻⁶	68.0 X 10 ⁻⁶	106 x 10 ⁻⁶
Matzix	.027	0.973	37.1 X 10 ⁻⁶	49.5 X 10 ⁻⁶	81 X 10 ⁻⁶
C	0.044	0.956	62.9 x 10 ⁻⁶	78.6 x 10 ⁻⁶	110 X 10 ⁻⁶

The calculated rate varies from the difference determined rates in each case by a factor of 0.8 which is equal to the size of an iteration step used. Iteration steps were made large to reduce computer run time but for greater accuracy the iteration step needs to be decreased such that the product of 2D and the rate multiplier varies only a few percent instead of the 20% used in this case. A second conclusion drawn from the table is that a large portion of the total rate is estimated to be occurring in node one. Looking at the matrix print out we get a reading of the reacted fractions for each node in Table VI. From the node rate fractions shown in the table the amount of the reaction taking place in node one increases with pellet rate. In the ensuing discussion it is seen that this condition is a result of the temperature sensitivity of the Hinshelwood rate constants which may or may not result from a recognizable physical phenomenon.

4. Discussion of analysis. From the analysis we are interested in whether the Hinshelwood rate form fits the data and whether the node one rates are of similar magnitude to the intrinsic rates obtained for particles. The first question is undoubtedly debatable because very little data was used, and there is some question of how representative the data was. However, in reviewing the runs performed, there appeared to be a consistent pattern in the way the Hinshelwood constants (K_1 and K_2) in the equation:

$$K_1 + K_2 + P_{02} = \frac{POT}{r}$$
 (58)

behaved with temperature. In all cases K_1 decreased slightly (see Table IV) with temperature increase while K_2 underwent a major increase.

TABLE VI

NODE RATE FRACTIONS

	MATR	TX B	MATR	and the second
Point	Å.	2	. 1	2
				stivites multiple state interaction that the state
Node 1	0.36	0.642	0.609	0.714
Node 2	0.352.	0.207	0.199	0.146
Node 3	0.201	0.107	0.123	0.0963
Node 4	0.0859	0.044	0.0687	0.044

The rise in K2 was so pronounced that rates dropped off with distance into the interior of the pellets. Physically it does not appear reasonable that such a change in adsorption equilibrium constant would take place, and for this reason the mechanism proposed by Leder and Butt at low hydrogen high oxygen concentration does not seem applicable to the Maymo and Smith data.

In regard to calculated rates equations several results are noted. The first iteration in the case number 2 provided an equation indicated as follows:

$$\mathbf{r} = \frac{P_{02} P_{H2}^2}{0.411 \exp\left(\frac{6180}{RT}\right) + 1.66 \times 10^{11} \exp\left(-\frac{13100}{RT}\right) P_{02}}$$
(59)

If we assume negligible value for P_{02} we can rewrite the equation as follows: $2.5 \exp(-\frac{6180}{87}) = \frac{2}{P_{02}} = \frac{2}{P_{H2}}$ (60)

by Maymo and Smith.

20

$$r = 0.655 \exp RT * P_{02}$$
 (61)

However, after five iterations, the equation was altered to the

following form:

$$r = \frac{P_{02} P_{H2}^{2}}{\frac{(10800)}{.0128 \exp RT} + (639T - 2,600,000)} P_{02}}$$
(62)

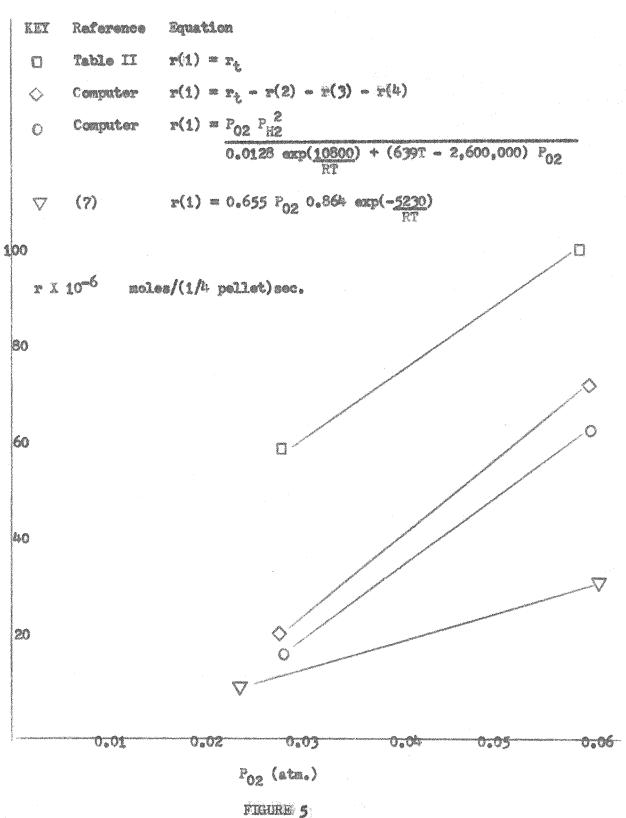
or in this case, assuming negligible PO2 the equation becomes the following:

$$r = 80 \exp \frac{(-10800)}{RT} P_{02} P_{H2}^2$$
 (63)

The activation energy of 10.8 kilo calories is quite close to that of Leder and Butt who reported 10 \pm 2 kilo calories as the activation energy for the Hinshelwood equation they defined in their data. These equations are illustrated in Figure 5 showing each of the above equations plotted as rate versus the partial pressure of oxygen. The rates are for node one of the pellet and thus, results in rates of reaction per 1/4 pellet or per 1/2 gram. In all cases the program calculated curves have steeper slopes than the rate curve defined by Maymo and Smith paper. At low partial pressures the rates are about the same for each equation but rates differ significantly at high partial pressures. Deviation is caused by the combined effects of the rate form being examined and the temperature variation of the data.

This problem also showed that the selection of specific rate forms have a major influence upon the percentage of reaction occurring in each node as a function of pellet radius. This was evidenced in the Maymo and Smith data as represented by the Hinshelwood equation proposed by Leder and Butt. The equilibrium constant (adsorption of oxygen) in the denominator of the rate equation increases rapidly with temperature, which would not happen if this specific constant was assumed zero and another one studied. This results in rate decreasing with temperature.

Since the temperature rises with distance into the pellet, the resultant decrease observed in rate might be explained by decreases in adsorbed exygen. In view of this conclusion, a look at how the exygen adsorption for platinum varies with temperature should be made.





It was found that adsorption rate decreases with temperature (2) according to the following equation:

$$\frac{P(1 \rightarrow)}{277 \text{ MKT}} - 6 \rightarrow (64)$$

Since this indicates the forward rate of oxygen adsorption is decreasing with temperature for equilibrium, the desorption rate must also decrease indicating a lower rate of product formation. From equation 64 a 30% to 40% decrease may occur for a 2 to 1 change in temperature but no change as great as that observed in the computer analysis. It is, therefore, believed that the large variation in this coefficient is unlikely.

SECTION III

CONCLUSIONS

A computer program has been constructed that takes data from heterogenious reactions, gas phase reaction with solid pellet catalyst, and for given mainstream compositions, pellet surface temperatures, catalyst properties, and reaction rates estimates the representative Hinshelwood rate equation. In the sample problem (hydrogen and coygen catalized by platimum) the calculated equations for the first iteration exhibited a similar activation emergy to that determined by authors of (2).

Equation: (7)

$$r = 0.655 \exp(-\frac{5230}{RT})$$
 (P₀₂) (65)

Commuter Calculated Hinshelwood Ecustion:

$$r = \frac{P_{02} * P_{H2}^{2}}{0.411 \exp(\frac{+6180}{RT}) + 1.66 \times 10^{11} \exp(\frac{-13100}{RT}) (P_{02})}$$
(66)

which at low values of Pop provides the following equations

$$r = 2.4 \exp\left(-\frac{6180}{RT}\right) \left(\frac{P_{02}}{P_{02}}\right) \left(\frac{P_{H2}}{P_{H2}}\right)$$
(67)

The activation energy 6180 cal/mole is of similar magnitude to 5230 cal/mole in spite of the fact that rate forms assumed (first order versus Einshelwood) were different. This rate form, however, did not fully explain the temperature characteristics of the system and the final equation had an activation energy of approximately 10.8 kilo calories more mearly agreeing with the 10 $\stackrel{*}{\sim}$ 2K calories observed for hydrogen exygen over platimum study of (8). A negative low temperature oxygen adsorption constant was obtained rejecting this equation.

The findings of the computer program are by no means conclusive but several observations are significant in determining the type of information which may be obtained.

First rate fractions (of total pellet rate) are defined for each node in each pellet. Applying the equations defining temperature drop and concentration variation as a function of node rates from Section 2 of Part E, temperature and concentration through the pellet may be calculated. From temperature and concentration versus radius plots, it is possible to determine how the rate equations affect the shape of these plots. This may be instrumental in selection of the representative rate mechanisms.

Such a result was inadvertantly encountered when the temperature sensitivity of the Hinshelwood constants in the sample problem Part F produced decreases in rate as the temperature rose with distance into the pellet. While such decreases can occur as a result of changes in adsorption constants the abruptness of the change placed this rate form in doubt.

It is conjectured that when Hinshelwood rate equations represent the data, Kinetic phenomena controls rates at the pellet surface but as the reactant diffuses into the center, diffusion can control. Furthermore with variation in chemical reactant or product concentrations it is possible that further inside the pellet chemical rates may again control

rate. Such variations are not likely to be picked up by first order rate approximations but would be recognized in the node analyses.

This form of analysis, because of its sensitivity to these parameter variations can be more useful in selecting rate equations than other methods now in use.

The accuracy of the analyses performed is dependent upon the presence of accurate values for effective diffusivities and effective thermal conductivity. The node analysis can be made as accurate as required by increasing the number of nodes, obtaining data describing catalyst properties and by accurate measurement of chemical concentrations and reaction rates.

RECOMMENDATIONS

The computer program in this study has been designed to give maximum freedom to the programmer for alteration as may be required for any heterogenious reaction. It is recommended that the computer program be made more accurate by decreasing size of iteration steps and by calling for the library sub-routine for simultaneous linear solutions of the rate equations for the Hinshelwood constants.

It is recommended that the computer program be used to study industrial reactor data and that the Hinshelwood rate equations from the pellet data be compared with previous correlations derived from particles or pellets. Results are expected to define areas where further experimental study may be profitable.

In general, it is felt that this computer program can act effectively in augmenting experimental investigations.

IV

APPERDIX

COMPUTER PROGRAM IMPUT AND OUTPUT CONSIDERATIONS

This discussion is designed to be a guide to utilizing the "Hinshelwood rate from catalyst data" computer program. In brief, this discussion considers the input data package and then some areas where hang-ups may occur. A nomenclature list summarises the principal variables on pages

1. Input Considerations

First, it is noted that there are eleven dimension statements and one common statement. Matrices B and C are storage matrices. B and C contain the input data with fourteen bits of information used per data point. The term GC is the universal gas constant and is input in whatover dimensions the programmer wishes to use. The program is thus able to work in any set of dimensions but the programmer must make certain that the input data is in consistent dimensions.

The imput data begins with the statement read 5, NO and continues for twelve statements to read 13, FM, FM.

Summary input parameters. The following outlines the data as input to the computer based upon an equilibrium equation of the reaction of the type $A + B \rightarrow R + S$.

1. NO - The mumber of cases (KE) or mechanisms to be run and specifies mumber of cards in the next sequence.

2. MW. MQ. MU. MY. TN. VO - The values NW through MZ define addresses in function routines used for rate mechanisms. MW is the address in the potential function of POTF: MQ the address of the A adsorption term in function routine KSORPA: MU is the address of the B adsorption term in KSORPB and likewise, MQ, MZ are addresses in the function subroutines for defining adsorption terms R and S in KSORPR and KSORPS. The term TN indicates the power which the adsorption terms are raised. The term VO defines the terms that are to be used in the SOLV subroutine. This accomplished by directing the computer to place terms generated from the least squares computation in matrix G or in matrix GV in the correct form for simultaneous linear equation solution. The equations are solved in subroutine SOLV. VO also is then used to define the value of the Hinshelwood constants that are returned from SOLV back to the main program. As may be noted from this sequence described above. potential program hang-up may have greatest chance of occurring in selection of the correct value of VO.

3. The terms MF and NF define the number of points to be placed in matrix B and matrix C. The two matrices are selected for use with two pellet surface temperatures observed. The values MF and NF also determine the number of input cards to follow. Since half the data per point is allotted to a card, the number of cards will be double that of MF and NF.

4 - 5. Matrix B(J,L1) and (J2, L2) input data. These matrices are doubly subscripted. The first number (J) representing a unit of data point and (L) representing the data point number. The first four values

of J are partial pressures or concentrations of component A, B, R and S. The fifth value is the total pellet rate. Terms J6 through 9 are the diffusion limits at nodes one, two, three, four defined by some fraction of the total rate for which diffusion may occur. That is RA(M)/A(5,M)RA representing diffusion rate which could reach node N from the next outermost node. The value (A(5,M) is the total reaction rate which was input to matrix B or C. The last terms J10 to 13 are rate limits based upon combined rate equation and diffusion limits depending upon which is controlling the rate in each node two to four. The last column J14 is now stores surface temperature but may be used to store additional data if desired, since surface temperature is introduced in another input location.

6. The diffusion constant DE () are values of diffusivities of species A, B, R and S representing best average value for the four nodes investigated. For greater accuracy it may be desirable to introduce an equation to correct diffusivities for varying node conditions.

7. Next, several constant RP -- pellet radius, CP gas-specific heat, HR heat of reaction and KE equilibrium constant are introduced.

8. Then temperatures applying to surface temperature of pellets matrix B is TS1 and for matrix C is TS2.

9. Another set of constants included are F, H and Q which are the node relation of species B, R and S to specie A.

 $(F = \frac{\text{moles } B}{\text{moles } A}$ for mass balance)

10. Additional information introduced includes the number of unknown constants to be solved for in the least squares solution (U2), the effective thermal conductivity of the pellet/gas combination (CK) and the universal gas constant (GC).

11. Values of FR and FD terms 2 to 4 indicate the allowable deviation of the sum of the concentrations in nodes two to four defined for the diffusion program.

12. Last, the values for the number of iterations per mechanism to be allowed in the calculations. It is estimated that convergence from initial estimate of total pellet reaction taking place in node one requires at least three iterations. Then, review of data and better initial estimates of node one rates should provide convergence more rapidly.

II. Problem Areas Computer May Encounter

First, in providing the matrix GV which is subsequently sent to the subroutine SOLV. It is necessary to place the pertinent matrix terms in form such that unknowns appear in the first (U2) columns with the residual or known term column in (U2 + 1) column. Thus the subroutine mat has been used to move the pertinent variable to the correct matrix locations for solution. At present, mat does not have all the possible combinations and it may be necessary to add additional ones for GU sets to be evaluated. Similar considerations of output for the correct Himshelwood coefficient from subroutine SOLV may be required.

It is possible that subroutine SCLV may bomb out if any of the coefficients being solved for go to zero at which point the subroutine

prints out the word "EXTOL" indicating a zero coefficient and the program will go to the next case NO(KK). Other than these locations, the program will probably run to completion unless a term exceeds the storage capacity of the computer.

The program has taken into consideration that Hinshelwood coefficients may be zero and to by-pass difficulties in being stopped at an early iteration because of difficulties in computing temperature correlation based upon Arrhenius equation. The subroutine temce computes either an Arrhenius or a linear relation and uses that for the next iteration. Thus the print-out of the Hinshelwood constants at the end of a run should be made to see if constants are negative. This is done by checking values printed out of the matrix E(2, 5) where values of AK and DB are listed. AK is the constant and DB is the exponential term (or slope in linear result) exp(DB/RT).

<u>Output data</u>. The program is designed to print out the final values of the terms in matrix A and B thus giving fractional rates in terms of diffusion limits and diffusion/rate limits combines. Also printed out is the coefficient of variation for the difference between node one rates and the equation derived rates. This is printed out of matrix COVNE(KK) and COVNC(KK). Further data is printed out of the AK and DE matrices which provide Arrhenius relation coefficients as indicated in the following equation:

$$K = (AK) \exp \left(\frac{DE}{RT}\right)$$

As a check on the validity of AK and DB is matrix E which provides the Hinshelwood coefficients for each matrix from which the Arrhenius coefficients have been calculated. From these data most pertinent results can be determined both in terms of individual nodes and node one versus rate equation comparisons. It may be of interest to store calculated rates and node one rates at the end of the last iteration for each matrix. This will undoubtedly require additional storage matrices.

MOMENCLATURE

(Computer)

COMPUTER PROGRAM

MW	Address in subroutine POTF
MQ	Address in subroutine KSORPA
NV	Address in subroutine KSORPB
MX	Address in subroutine KSORPR
NZ.	Address in subroutine KSCRPS
	Exponent of the adsorption term
Yo	Designates addresses in subroutine MAT and SOLV
٨	Matrix values used in working program
B	Matrix used to store data before use in matrix A
G	Matrix used to store data before use in matrix A
2	Matrix used to store Hinshelwood coefficients (K1BK5B) (K1CK5C)
an.	Matrix used in subroutine TEMCO to store $K_1($)
	K ₅ ()
AK	Arrhenius coefficient
DB	Arrhenius coefficient in exponential term
G and GV	Eatrices in which summation used in least squares routine are held prior to simultaneous linear equation solution
K(1)===K(6)	Constants returned by subroutine SOLV
RA(n)	Diffusion limited rate
R(N)	Node rates limited by both rate equation and diffusion
R1 calc (N)	Rates calculated from rate equation
TA(n)	Node temperatures

Arrhenius equation Distance between nodes (diffusion path) $\mathcal{DR}(\mathbb{N})$ AR(N) Near area between node locations for heat and mass flow CA(H) or PA Concentration of species A for node M CB(N) or PB Concentration of species B for node N CR(N) or FR Concentration of species R for mode N CS(N) or PS Concentration of species S for node N NOTE: With "S" added to end - stands for stream condition 7D(N) Concentration sum node limit FR(N) Concentration sum node limit KSORPA Function subroutine A adsorption value KSORPB Function subroutine B adsorption value KSORPR Function subroutine E adsorption value KSORPS Function subroutine S adsorption value NF Number of data points in matrix B NF Number of data points in matrix C $\mathbb{R}P$ Pellet redius CP Specific heat of gas composition Best of reaction 開発 KE Reaction equilibrium coefficient X Matrix storing values from solutions in SOLV sectoroutines DEA DEB No. Diffusion coefficients of species A, B, R and S DER DES Contract, Co

Temperature dependent constants calculated from

WE and YK

Surface temperatures of pellets whose data is supplied TS1 and TS2 in matrix B and C respectively Moles of B, R, or S involved in reaction per mole F, H, and Q of A reacted Number of unknown in least square solution UZ. CK Effective thermal conductivity of pellet GC Universal gas constant Limit of concentration of species summed at each node FD and FR LP Indicator defining whether diffusion branch of program is to be run or not TIM Iteration counter in program matrix B TIN Iteration counter in program matrix C T Matrix B or C indicator IN Loop indicator 嬎 Data point indicator for working matrix $\mathbf{Z}\mathbf{D}$ Multiplier for adjustment of rate equation in iteration process 12 Indicator which prevents storage of rate values until ZD achieves satisfactory value COV(Coefficient of variation (different endings with) Location in program) DEX The denominator of the rate equation containing the KSCRP terms SIGF Subroutine which checks sign of sums of concentrations

							62
	and the second second second second second second second second second second second second second second second second second	•			:		
RIRAN IV	MUCE	L 44 PS.	VERSION 3;	LEVEL 1	DATE 691	19	
	ang na	TIMENSIIN MA	(S), MQ(S), MUT	ran wyigi .M	7101.TN191		
9 £ C 2			(14,10),B(14,			1 V L (71	
03 33		DIMENSION AT		10/ 1011 1720	<u></u>		
90 04		DIMENSION EN				μ	
04 05		DIMENSION DE					
62 \$6			(5,6), GV(5,6)	N BARAN			
					ili anaron manja pojajira ifu yenenifu na dijajira		· · · ·
67					/ + WK(4) + I	K141, D814), AR14)	**************************************
03 03			(4),CB(4),CR(.41,65141			
89 10		DIMENSION FO	-	· · · ·	Alfande of Malastatic contractions and an angular a		
10	-		EVNB(S),COVNC	(9)			
11		DIMENSION D(4		1999 1999 1999 1999 1999 1999 1999 199			
12		REAL MW.MQ.I	NU, NY, MZ				
13		REAL KE			an ginger all was do y do y do y angle angle do	B. 10788 BF Manuschermunger ungestigte physics provide and construction for the same and an advanced and advance Advanced and advanced an advanced advanced and advanced a vanced advanced a vanced advanced ad	adat Kanya Laut
14			2B,K3B,K4B,K5		КЗС,К4С,К51	C	
15			,KSCRPB,KSCRP	PR,KSURPS			
10		REAL K					
217		READ 5,NU					
649				J(KK),MY(KK'), MZ(KK), T/	N(KK),VO(KK),KK=	-1,
)19		READ 15, MP , M		an a se ar an			-
320		DJ & L1=1,MH					
221	6	-READ(-1,106)				Next Here's Constant and a start framework and held an approximate provide start representation of the Astronomy and the start and th	
522		DO 10 L2=1		g de i e			
323	10	READ(1,1C6)	•	12=1-141			
924 924	7		DEA, DEB, DER, D				
J24 J25			P,CP,HR,KE	160		naman na nan na na 1946 a na 1967 a 1977 a 1977 a na 1976 a n	101 - Tan San San Ja
J25 J26	6 G	READ 12, READ 13, TS					
	7						
		READ 14, F, H					
0.2.8 0.2.8		READ 14, U2, 0	-				
02.9 <u>7</u>			(LD), FR(LD), t	_C=2,41			
03.0	······	READ 13, FM, F					
331		FURMAT(7F4.0)	 Insertion - electric destruction to enservance all many content content content many and enservance 	Westminister (15 m) a fallence on their advantagement of standard age, some rised in gauge assess		- PERMANDER BERKENDE HER HER VERSEN HER VERSEN BERKENDE Ander Beskende Anstallen einen Berkende Berke	1 West West and 1
0/32	5	FORMAI(112)	·				
333	11	FURMAT (6F4.					
0,34.	12	FURMAI(4E1C.					
335	13	FORMAT (2F1C.2					
036	14	FOR MAT(3E 10.					
537		-FURMATE 2141	(1) The A			4.9.8 Million and a second second second second statement of the second	
)38	75		7H HINSHELWCC	O RATE MECH	HANISM// ,	7E10.3)	
339 <u></u>	76		HEMÁTRIX-B, T7		ي و و، دوني 10 K (¹⁰ C	1110021	
04C	77	-	IFFUSIVITIES/				
541	78		F,E1C.3,5X,2	•		@r 3.4	
541 042	79					U.3/ R,E10.3,3H KE,E1	• •
							. U e
143					EIU.Jaiuna.	3F GU, E10 . 31	-
) 4 4 	81		; 10H ITERATIC				
545		FORMAT(1X//I			· · · · · · · · · · · · · · · · · · ·	······	~
0,4 0	83				/1X,3H AK,	5E10.3,3H DB,5E1	ŧ0,
047		FORMAT(1X,9)		, (7E12.3)			
24 E	106	FURMAT(7E10.3		غب	<i>,</i>		
j49	. We define the shear is a first specific property of the state of the		L-NU				darran alama a
)		*					
49 			045ga 1-35ga 				
energi		nge, prim ung mje elanes slov, in spjeraar oorthaagen, en arten aantagene atmateriatuu te seneraa. In aantate s			is.		**********
				-		VS Wearing at the	~

			63
	en e	 International contraction of the second s Second second s Second second s Second second s Second second seco	
GRIRAN IV	MCDEL	L 44 PS VERSION 3, LEVEL 1 DATE 69119	
5 55 5051	40	PRINT 75, MW(KK), PG(KK), MU(KK), MY(KK), MZ(KK), IN(KK), VO(KK) DO 41 LI=1, MF	
2052 C053	41	PRINT 76, (8t J, L1), J=1, 14) DO 42 L2=1, NF	
0054 0055	42		
5056 5057	anyan ana di minamana kananan mga papat yan mgangaga P P	PRINT 79, RP, CP, HR, KE PRINT 78, F, H, Q	and all the state of the state
3657 3658 2059		PRINT 8C, L2, CK, GC PRINT 81, FM, FN	
5055 5060 5061	98	PRINI CI,FM,FN KK=1 LP=1	a ya ana a a a a a a a a a a a a a a a a
1062 1063	- 99	N=TN(KK)	
0.054		LC=MQ(KK)	
2065 2066		LF=MU(KK) 	
20 67 2068		L H=MZ(KK) TIM=0.0	
0069 3070	100	$TIN=C \cdot C$ $IN=1$	
5071 5072		Z D = 1 • 0 IZ = 1	Secure 1991/1997 Parameters by request on a
2073 1074	101	I = 1 VUK=VU(KK)	and the second second second second
3075 3076		NE=MF EN=MF	
5077 5078	107	J = 1 $L = 1$	
.C79 3086	109 	K J=J M= <u>t 1</u>	ale sealth (PMA are) an anna an an
.C81 .C82		A(KJ,M) =B(J,L1) J=J+1	
)083 .C84	111	IF(J-14) = 1CS, 1C9, 112 J = 1	
085 086		LI = LI + I -IF(LI - MF) - ICS, 10S, 114	1.2 2 - 2
087	114		
1089 2990		VOK=VC(KK)	Nagona Alfonson and a success
1051 1052		EN=NF $J2=1$	
093		$J^{2} = I$ $L^{2} = I$ $KJ=J^{2}$	
CS5 DS6		M = 12 A(KJ,M)=C(J2,L2)	*
6097		A(KJ), M = G(JZ), LZ $JZ = JZ + 1$ $IF(JZ = 14) + 12C, 12C, 123$	and the second
\$\$\$8 	122	IF(J2-I4) 12U,12U,123	
5 La			
1			

RTRAN IV	MODEL 44 PS. VERSION 3, LEVEL I DATE	69119
655	123 J2 =1	
100	L2 = L2 + 1	
hòr	IFTL2-NFJ12C,12C,125	
102	125 IF(IN-2) 200,259,599	
103	200 SUMV=C	
104	SUMVA 1=0	
	SUMVA 2 =0	
305	SUM VA 3=0	
106		
107	SUMVA4=C	
108	SUMA 1=C	
109	SUMA 2= C	
110	SUMA 3=0	
811	SCMA4=C	
112	SUMA1X=C	
113	SUMA12=C	
114	SUMA 13=C	
115	SUMA 14=C	
.110	SUMA 2X=0	
31700	SUMA 23=0	
118	SUMA 24 = C	
119	SUMA 3X=C	
120	SUMA 34=C	
121	SUMA 4X=C	
122	201 DO 221 M=1,NE	
323	PA = A(1,M)	
124	PB = A(2,M)	
	$\frac{PB - A(2, m)}{PR = A(3, m)}$	
125		
126	PS = A(4, M)	
127	AI=KSORPA(LC,PA,PB,PR,PS,KE)	
128	A2=KSORPB(LF,PA,PB,PR,PS,KE)	
7.29	A3=KSCRPK(LG,PA,PB,PR,PS,KE)	
130	A4=KSORPS(LH,PA,PB,PR,PS,KE)	
131	PT=POTTLD,PA,PB,PR,PS,KE)	
132	V = (PT/(A(5, N) * A(1C, M) * ZD)) * * (1, O/N)	
133	SUM V= SLM V + V	
134	$VA1 = V \neq A1$	
1,35	Stmval=Sumval+val	
136	204 VA2 = V#A2	
137	SUMVA2=SUNVA2+VA2	· · · · · · · · · · · · · · · · · · ·
138	$2C5 \qquad VA3 = V*A3$	
139	SUMVA3=SUMVA3+VA3	
140	$2C6 \qquad VA4 = V * A4$	
141	SUMVA4=SUMVA4+VA4	
142	207 SUMA 1= SUMA 1+A1	
143	208 SUMA 2=SUMA 2+A2	·
244	209 SUMA 3=SUMA 3+A 3	
145	210 SUMA4=SUMA4+A4	
	211 A1X = A1 **2	
146		
1247	SUMA1X=SUMA1X+A1X	
a start and a start and a start		
		· · · · · · · · · · · · · · · · · · ·
- Server	1940 1962	
	· · · · · · · · · · · · · · · · · · ·	
	••••••••••••••••••••••••••••••••••••••	

CPTKAN IV MGC6L +4 PS VERSICN 3, LEVEL 1 CATE 69119 C145 SLMA 12 - SLMA 14/2 C150 213 A13 - STMA 12 C151 SUMA 12 - SLMA 14/4 C152 214 A14 - STMA 14/4 C153 SLMA 12 - SLMA 14/4 C153 SLMA 14 - SLMA 14/4 C154 SLMA 14 - SLMA 14/4 C155 SLMA 24 - SLMA 14/4 C156 SLMA 24 - SLMA 14/4 C157 SLMA 24 - SLMA 14/4 C158 SLMA 24 - SLMA 14/4 C159 SLMA 24 - SLMA 14/4 C150 SLMA 24 - SLMA 14/4 C151 SLMA 24 - SLMA 24/4 C152 SLMA 24 - SLMA 24/4 C153 SLMA 24/4 C160 SLMA 24/4 C161 SLMA 24/4 C162 C17 C163 SLMA 24/4 C164 SLMA 24/4 C165 SLMA 24/4 C166 SLMA 24/4 C167 G12/1/9 C168 SLMA 24/4 C169 G11/1/1/1 C164 SLMA 24/4 C165 SLMA 24/4 C166 G12/1/9 C167 G12/1/9 C168 G14/1/9 C169 G12/1/9 </th <th></th> <th>an di Maria</th> <th></th> <th>6</th>		an di Maria		6
Cives 212 A12 = A1 = A2 Cives SUMA12=SUMA12+A12 Cives SUMA12=SUMA12+A12 Cives SUMA13=SUMA13+A13 Cives SUMA13=SUMA13+A13 Cives SUMA13=SUMA13+A13 Cives A14 = A1 *A3 Cives SUMA13=SUMA13+A14 Cives A14 = A1 *A4 Cives A12 = A2 *A2 Cives SUMA14=SUMA14+A14 Cives A12 = A2 *A2 Cives Cives Cives A2 = A2 *A2 Cives Cives Cives Cives <th>an menyang kang di sebut s Sebut sebut sebu</th> <th>lete F</th> <th></th> <th></th>	an menyang kang di sebut s Sebut sebut sebu	lete F		
146 SUMA 12=SUMA 12+A12 150 213 A 13 = A 14A 151 SUMA 13 = SUMA 13 + A13 152 214 A 14 = A 1 + A4 153 SUMA 13 = SUMA 13 + A14 154 215 A2 = A 2 + a2 155 SUMA 23 = A 2 + A2 + A2 156 216 A 23 = A 2 + A2 156 217 A24 = A 2 + A2 156 217 A 24 = A 2 + A2 156 217 A 24 = A 2 + A2 157 SUMA 24 = SUMA 24 + A24 166 218 A 34 + A 34 157 SUMA 34 = SUMA 34 + A34 167 SUMA 34 = SUMA 34 + A44 168 SUMA 34 + SUMA 34 + A4A 169 SUMA 34 + SUMA 34 + A4A 164 220 A 44 + 2 165 221 SUMA 4 + SUMA 34 + A4A 166 G (2, 1) = SUMA 1 170 G (2, 1) = SUMA 1 171 G (2, 2) = SUMA 1 172 G (2, 2) = SUMA 1 173 G (2, 2) = SUMA 1 174 G (2, 2) = SUMA 1 175 G (4, 7) =	TRAN IV	MOCEU	44 PS VERSICN 3, LEVEL 1 DATE 69119	
LISC 213 A1 2 = A1 wA3 151 SUMA 13 = SUMA 13 + A1 3 152 214 A1 4 = A1 * A 4 153 SUMA 13 = SUMA 14 + A 14 154 A2 3 + A2 * Q 155 SUMA 24 = SUMA 25 + A2 × Q 155 SUMA 25 = SUMA 25 + A2 × Q 155 SUMA 25 = SUMA 25 + A2 × Q 155 SUMA 25 = SUMA 25 + A2 × Q 156 217 A 24 = a 2 * A3 157 SUMA 25 = SUMA 25 + A2 × Q 158 217 A 24 = a 2 * A4 159 SUMA 24 = SUMA 25 + A2 × Q 161 SUMA 24 = SUMA 25 + A2 × Q 162 218 SUMA 24 + SUMA 24 + A2 164 SUMA 24 + SUMA 24 + A4 × A4 166 220 A4 × = A4 * A2 165 221 SUMA 44 × SUMA 44 × A4 × 166 G(1 + 1) = SUMA 1 167 G(1 + 1) = SUMA 1 168 221 SUMA 47 × SUMA 1 169 G(1 + 1) = SUMA 1 170 G(1 + 2) = SUMA 1 171 G(1 + 2) = SUMA 1 172 G(2 + 2) = SUMA 1 173<		212		n na
151 SUMA 13 + SUMA 13 + A13 152 214 A14 + A1 + A14 154 219 A2 + = A1 + A4 155 SUMA 14 + SUMA 14 + A14				
152 214 $A_1 + c_1 + b_1 c_1$ 153 SUMA 14 + SUMA 14 + A 14 154 215 $A_2 + c_2 + b_2$ 155 SUMA 22 + SUMA 22 + A2 155 SUMA 22 + SUMA 22 + A2 157 SUMA 22 + SUMA 22 + A2 157 SUMA 22 + SUMA 22 + A2 156 217 A 24 + A2 + A4 156 SUMA 24 + SUMA 24 + A2 160 218 A 34 + A2 + A4 161 SUMA 24 + SUMA 34 + A3 162 219 A 3 + A2 + A4 163 SUMA 24 + SUMA 34 + A3 164 SUMA 24 + SUMA 34 + A3 165 SUMA 24 + SUMA 24 + A34 166 Cf 1, 1 = SUMA 34 + A34 167 G 1, 1 = SUMA 1 168 221 SUMA 44 + SUMA 1 165 SUMA 44 + SUMA 1 166 Cf 1, 1 = SUMA 1 167 G 1, 1 = SUMA 1 168 G 1, 1 = SUMA 1 170 G 1, 2 = SUMA 12 171 G 1, 2 = SUMA 12 172 G 1, 2 = SUMA 12 173 G 1, 2 = SUMA 12 174		213		
153 SUMA 14 SUMA 14 + SUMA 14 + A14 154 215 $A2x = SUMA 2x + A2x$ 155 SUMA 2x = SUMA 2x + A2x 156 216 $A 23^{-2} = A2 + A2$ 157 SUMA 2x = SUMA 2x + A2x 158 217 $A 24^{-2} = A2 + A2$ 156 217 $A 24^{-2} = A2 + A4^{-2}$ 160 218 $A 24^{-2} = A2 + A4^{-2}$ 161 SUMA 2x = SUMA 2x + A2x 162 219 $A 3^{-4} = A3 + A4^{-4}$ 163 SUMA 3x = SUMA 2x + A4x 3x 164 220 $A^{-4} + 44 + 32^{-4}$ 165 221 SUMA 4x = SUMA 4x + A4x 166 G1 z + 1 + EVM 166 G1 z + 1 + SUMA 1 356 G1 z + 1 + SUMA 1 357 G1 z + 1 + SUMA 1 356 G1 z + 1 + SUMA 1 357 G1 z + 1 + SUMA 1 357 G1 z + 1 + SUMA 1 356 G1 z + 1 + SUMA 1 357 G1 z + 1 + SUMA 1 357 G1 z + 2 + SUMA 1 357 G1 z + 2 + SUMA 1 357 G1 z + 2 + SUMA 1 <td< td=""><td></td><td></td><td></td><td></td></td<>				
154 215 $A2X = A2 + A2$ 155 SUMA 2X = SUMA 23 + A2X 157 SUMA 23 = SUMA 23 + A2X 157 SUMA 23 = SUMA 23 + A2X 156 217 A24 = A 2 + A4 159 SUMA 24 = SUMA 24 + A2X 161 SUMA 24 = SUMA 24 + A2X 162 219 $A3A = A3 + 42$ 163 SUMA 24 = SUMA 34 + A3X 164 220 $AAx = A3 + 42$ 165 211 SUMA 24 = SUMA 34 + A3X 164 220 $AAx = A4 + 42$ 165 221 SUMA 24 = SUMA 34 + A4X 166 220 $AAx = A4 + 42$ 167 G12, 11 = SUMA 1 168 G14, 11 = SUMA 1 170 G12, 71 = SUMA 1 171 G14, 71 = SUMA 1 172 G12, 72 = SUMA 1 173 G13, 72 = SUMA 1 174 G14, 72 = SUMA 1 175 G14, 73 = SUMA 2 174 G14, 72 = SUMA 1 175 G14, 73 = SUMA 2 176 G14, 73 = SUMA 2 177 G2, 24 = SUMA 1		214		
155 SLMA 2x = SUMA 2x + A 2x 156 216 A 23 = A 2 + A 2x 157 SLMA 22 = SUMA 22 + A 23 158 217 A 24 = A 2 + A 24 156 217 A 24 = A 2 + A 24 156 218 A 2x = A 3 + A 24 160 218 SUMA 24 = A 3 + A 24 161 SUMA 34 = SUMA 24 + A 24 162 219 A 24 = A 3 + A 3 163 SUMA 34 = SUMA 24 + A 34 164 220 A 34 = X = X + A 4 + 22 165 221 SUMA 44 = SUMA 44 + A 34 166 G (1 + 1) = E M SUMA 24 = SUMA 24 + A 34 166 G (2 + 1) = SUMA 1 SUMA 24 = SUMA 24 + A 44 × 166 G (1 + 1) = E M A 1 SUMA 24 = SUMA 24 + A 44 × 166 G (1 + 1) = SUMA 1 SUMA 24 = SUMA 14 170 G (2 + 2) = SUMA 12 SUMA 24 = SUMA 24 + A 44 × 171 G (1 + 2) = SUMA 13 SUMA 24 = SUMA 24 + A 44 × 172 G (2 + 2) = SUMA 14 + A 44 × SUMA 24 + A 44 × 173 G (2 + 2) = SUMA 14 + A 44 × SUMA 24 + A 44 × 174 G (2 + 3) = SUMA 24 + A 44 × SUM		The Acres Francisco		
156 216 $A 22 = A 2 2 A 3$ 157 SUMA 23 = SUMA 23 + A23 158 217 $A 24 = A 2 A 4 4$ 159 SUMA 24 = SUMA 24 + A 24 160 218 $A 2 x = A 3 + A 2$ 161 SUMA 37 = SUMA 33 + A 3 X 162 219 $A 34 = A 3 + A 4$ 164 SUMA 37 = SUMA 32 + A 3 X 165 211 SUMA 47 = SUMA 24 + A 4 164 SUMA 37 = SUMA 24 + A 34 165 221 SUMA 47 + SUMA 4 166 C(1 + 1) = SUMA 167 G (2, 1) = SUMA 1 168 G (4, 1) = SUMA 2 166 G (4, 1) = SUMA 2 166 G (4, 1) = SUMA 2 166 G (4, 1) = SUMA 1 170 G (5, 2) = SUMA 12 171 G (1, 2) = SUMA 13 172 G (2, 2) = SUMA 12 174 G (4, 2) = SUMA 14 175 G (5, 2) = SUMA 12 176 G (1, 3) = SUMA 2 177 G (2, 2) = SUMA 12 178 G (5, 7) = SUMA 2 179 G (2, 2) = SUMA 14 170		215		nan sekon menden en honen het den konstrukter en namme mensen ander in dem samme den mensen opgenet wekke anderem produkter
157 SUMA 23 = SUMA 23 + A23 156 217 $A24 = A24A4$ 150 SUMA 24 = SUMA 24 + A24 160 218 $A2x = A3442$ 161 SUMA 34 = $A34A4$ 162 219 $A34 = A34A4$ 163 SUMA 34 = $A34A4$ 163 SUMA 34 = $A34A4$ 164 SUMA 34 = $A34A4$ 165 SUMA 44 = SUMA 44 + A4X 166 G(1+1) = SUMA1 165 G(1+1) = SUMA1 165 G(1+1) = SUMA1 166 G(1, 1) = SUMA1 170 G(5, 1) = SUMA1 171 G(1, 2) = SUMA1 172 G(7, 2) = SUMA1 173 G(3, 2) = SUMA1 174 G(4, 2) = SUMA1 175 G(5, 2) = SUMA1 176 G(4, 3) = SUMA2 177 G(2, 2) = SUMA12 178 G(5, 3) = SUMA2 179 G(4, 4) = SUMA2 170 G(4, 4) = SUMA2 177 G(2, 5) = SUMA2 176 G(4, 4) = SUMA3 162		9-1-Z		
156 217 $A 24 = A 2 4 A 4$ 159 SUMA24=SUMA24+A24 160 218 $A 2x = A 3 4 A 2$ 161 SUMA3X=SUMA3X+A3X 162 219 $A 3 4 = A 3 \pi A 4$ 163 SUMA34=SUMA34+A34 164 220 $A 4x = A 4 4 4 2$ 165 221 SUMA3+SUMA4X+A4X 166 G(171)=CN 167 G(2,1)=SUMA1 168 G(1,1)=SUMA2 170 G(5,1)=SUMA1 171 G(1,2)=SUMA1 172 G(2,2)=SUMA1A 173 G(2,2)=SUMA12 174 G(4,2)=SUMA12 175 G(4,2)=SUMA12 176 G(1,3)=SUMA2 177 G(2,2)=SUMA12 178 G(2,2)=SUMA12 178 G(4,2)=SUMA2 179 G(4,3)=SUMA2 170 G(2,3)=SUMA2 171 G(2,3)=SUMA2 172 G(4,3)=SUMA2 173 G(2,1)=SUMA12 174 G(4,2)=SUMA2 175 G(4,4)=SUMA2 176 G(4,		210		
159 SLMA24=SUMA24+A24 16C 218 $A^2 x = x^3 x^4 x^2$ 161 SUMA24=SUMA3+A3x 162 219 $A^3 4 = x^3 x^4 x^4$ 163 SUMA34=SUMA3+A34 164 220 $A^3 4 = x^3 x^4 x^4$ 165 SUMA34=SUMA34+A34 166 G(1,1)=SUMA34 167 G(2,1)=SUMA1 188 G(1,1)=SUMA2 167 G(1,1)=SUMA2 168 G(1,1)=SUMA2 170 G(1,2)=SUMA1 171 G(1,2)=SUMA1 172 G(1,2)=SUMA1 173 G(3,2)=SUMA12 174 G(1,2)=SUMA14 175 G(5,2)=SUMA14 176 G(1,3)=SUMA2 177 G(2,3)=SUMA12 178 G(1,3)=SUMA2 179 G(4,3)=SUMA2 170 G(1,4)=SUMA2 171 G(1,4)=SUMA2 172 G(4,3)=SUMA2 173 G(2,3)=SUMA2 174 G(4,3)=SUMA2 175 G(4,3)=SUMA2 176 G(4,3)=SUMA2		217		
160 218 $A33 + z = A3 + 42$ 161 $SUMA 32 + SUMA 33 + A3 X$ 162 219 $A34 - A33 + A4$ 163 $SUMA 34 + SUMA 34 + A3 A$ 164 220 $A4x = A3 + A4 + 2$ 165 $SUMA 4x + SUMA 4x + A4 X$ 166 $G(1, 1) + EN$ 167 $G(2, 1) = SUMA 1$ 188 $G(3, 1) = SUMA 2$ 166 $G(4, 1) = SUMA 2$ 170 $G(5, 1) = SUMA 1$ 172 $G(2, 2) = SUMA 1$ 173 $G(3, 2) = SUMA 12$ 174 $G(4, 2) = SUMA 13$ 175 $G(2, 3) = SUMA 2$ 177 $G(2, 3) = SUMA 2$ 178 $G(1, 3) = SUMA 2$ 176 $G(4, 3) = SUMA 2$ 176 $G(4, 4) = SUMA 2$ 162 $G(4, 4) = SUMA 2$ 162 $G(4, 4) = SUMA 3$ 162 $G(4, 4) = SUMA 3$ 164		6. <u>1</u> . 1		
161 SUMA 3X = SUMA 3 > A 3 × A 162 219 $A 3^4 = x 3 * A^4$ 163 SUMA 34 = SUMA 34 + A 34 164 220 $A 4 x = x 4 4 * 2$ 165 221 SUMA 4x = SUMA 4x + A 4x 166 G(1, 1) = SUMA 1 167 G(2, 1) = SUMA 1 168 G(3, 1) = SUMA 2 167 G(2, 1) = SUMA 1 168 G(3, 1) = SUMA 3 170 G(5, 1) = SUMA 4 171 G(1, 2) = SUMA 1 172 G(2, 2) = SUMA 12 173 G(3, 2) = SUMA 12 174 C(4, 7, 2) = SUMA 14 175 G(5, 2) = SUMA 12 176 G(1, 3) = SUMA 2 177 G(2, 2) = SUMA 14 176 G(1, 3) = SUMA 2 177 G(2, 2) = SUMA 14 178 G(1, 4) = SUMA 2 179 G(4, 3) = SUMA 2 181 G(1, 4) = SUMA 3 182 G(2, 4) = SUMA 3 183 G(2, 4) = SUMA 3 184 G(1, 4) = SUMA 4 185 G(5, 4) = SUMA 4 186 G(2, 5)	effective and the second se	218		۲۰ - VIII Martin Sanaya - Jones - Martin Sanaya - Sanaya
162 219 $434 = 33 \times 44$ 163 $SUMA 34 = SUMA 24 \times 34$ 164 220 $A4x = 34 \times 42$ 165 221 $SUMA 4x = SUMA 4x + 44x$ 166 $G(1, 1) = SUMA1$ 167 $G(2, 1) = SUMA2$ 166 $G(4, 1) = SUMA2$ 166 $G(4, 1) = SUMA2$ 166 $G(4, 1) = SUMA2$ 170 $G(5, 2) = SUMA4$ 171 $G(1, 2) = SUMA4$ 172 $G(2, 2) = SUMA4$ 172 $G(2, 2) = SUMA4$ 173 $G(2, 2) = SUMA4$ 174 $G(4, 2) = SUMA4$ 175 $G(5, 2) = SUMA12$ 174 $G(4, 2) = SUMA12$ 174 $G(4, 2) = SUMA14$ 176 $G(1, 3) = SUMA2$ 176 $G(2, 2) = SUMA2$ 177 $G(2, 2) = SUMA2$ 178 $G(2, 3) = SUMA2$ 178 $G(2, 3) = SUMA2$ 178 $G(2, 3) = SUMA2$ 164 $G(1, 4) = SUM3$ 162 $G(2, 4) = SUMA3$ 164 $G(1, 4) = SUM3$ <td></td> <td></td> <td></td> <td></td>				
163 SUMA 34 = SUMA 24+A 34 164 220 $A4x = A4+82$ 165 221 SUMA 4x = SUMA 4x + A4x 166 G(1,1) = SUMA 167 G(2,1) = SUMA2 168 G(3,1) = SUMA2 169 G(4,1) = SUMA1 170 G(5,1) = SUMA2 171 G(1,2) = SUMA1 172 G(2,2) = SUMA1X 173 G(2,2) = SUMA1X 174 G(4,2) = SUMA13 175 G(5,2) = SUMA13 176 G(1,3) = SUMA12 177 G(2,3) = SUMA12 178 G(5,2) = SUMA12 179 G(4,3) = SUMA2X 177 G(2,3) = SUMA2X 178 G(3,4) = SUMA2X 179 G(4,3) = SUMA2X 176 G(4,3) = SUMA2X 177 G(2,2) = SUMA12 178 G(3,4) = SUMA2X 189 G(4,4) = SUMA3 182 G(2,4) = SUMA23 184 G(4,4) = SUMA3 185 G(3,5) = SUMA4 186 G(3,5) = SUMA4 187 G(4,5) = SUMA4		219-		
164 22C $A4x = A4 + 42$ 165 221 $SUMA 4x = SUMA 4x A4x$ 166 G(1,1) = EVMA 167 G(2,1) = SUMA2 168 G(2,1) = SUMA2 169 G(1,1) = SUMA2 169 G(1,1) = SUMA4 170 G(1,2) = SUMA4 171 G(1,2) = SUMA4 172 G(2,2) = SUMA1A 173 G(3,2) = SUMA1A 174 G(1,2) = SUMA12 174 G(1,2) = SUMA12 175 G(1,3) = SUMA2 176 G(1,3) = SUMA2 177 G(2,3) = SUMA12 178 G(1,3) = SUMA2 179 G(4,3) = SUMA2 176 G(1,3) = SUMA2 177 G(2,3) = SUMA2 178 G(1,4) = SUMA2 183 G(3,4) = SUMA2 184 G(1,4) = SUMA2 185 G(2,4) = SUMA2 184 G(1,4) = SUMA2 185 G(2,5) = SUMA2 184 G(1,4) = SUMA2 185 G(2,5) = SUMA4 186 G(2,5) = SUMA4				
165 221 SUMA4x = SUMA4 x + A4x 166 G(1,1) = SUMA1 187 G(2,1) = SUMA1 186 G(3,1) = SUMA2 165 G(4,1) = SUMA4 170 G(5,1) = SUMA4 171 G(1,2) = SUMA1 172 G(2,2) = SUMA1A 173 G(3,2) = SUMA12 174 G(4,2) = SUMA1A 175 G(5,2) = SUMA12 176 G(1,3) = SUMA2 177 G(2,3) = SUMA12 176 G(1,3) = SUMA2 177 G(2,3) = SUMA12 178 G(1,3) = SUMA2 179 G(4,4,3) = SUMA2 170 G(2,3) = SUMA2 177 G(2,4) = SUMA2 178 G(1,4) = SUMA2 179 G(4,4,3) = SUMA2 170 G(2,4) = SUMA2 171 G(2,4) = SUMA2 175 G(1,5) = SUMA2 176 G(4,4,3) = SUMA2 177 G(2,4) = SUMA2 178 G(2,5) = SUMA2 189 G(3,5) = SUMA2 184 G(4,4) = SUMA3 185		22C		
166 $G(1, 1) = EN$ 167 $G(2, 1) = SUMA1$ 186 $G(2, 1) = SUMA2$ 165 $G(4, 1) = SUMA3$ 170 $G(5, 1) = SUMA4$ 171 $G(1, 2) = SUMA1$ 172 $G(2, 2) = SUMA14$ 173 $G(3, 2) = SUMA12$ 174 $G(4, 2) = SUMA12$ 175 $G(5, 2) = SUMA12$ 176 $G(1, 3) = SUMA2$ 177 $G(2, 2) = SUMA14$ 176 $G(1, 3) = SUMA2$ 177 $G(2, 2) = SUMA14$ 178 $G(1, 3) = SUMA2$ 178 $G(1, 3) = SUMA2$ 178 $G(1, 4) = SUMA2$ 179 $G(2, 4) = SUMA23$ 180 $G(1, 4) = SUMA23$ 181 $G(1, 4) = SUMA3$ 182 $G(2, 4) = SUMA3$ 183 $G(2, 5) = SUMA4$ 184 $G(2, 5) = SUMA4$ 185 $G(4, 4) = SUMA4$ 186 $G(2, 5) = SUMA4$ 187 $G(2, 5) = SUMA4$ 188 $G(4, 5) = SUMA4$ 189 $G(4, 6) = SUMA4$ 190 G				
167 $G[2,1] = SUMA1$ 1366 $G[2,1] = SUMA2$ 166 $G[4,1] = SUMA3$ 170 $G[5,1] = SUMA4$ 171 $G[1,2] = SUMA1$ 172 $G[2,2] = SUMA1X$ 173 $G[3,2] = SUMA12$ 174 $G[4,2] = SUMA12$ 176 $G[1,3] = SUMA2$ 177 $G[2,3] = SUMA12$ 176 $G[4,3] = SUMA2$ 177 $G[2,3] = SUMA12$ 176 $G[4,3] = SUMA2$ 177 $G[2,3] = SUMA12$ 176 $G[4,3] = SUMA2$ 177 $G[2,3] = SUMA12$ 178 $G[4,4] = SUMA23$ 184 $G[1,4] = SUMA23$ 184 $G[4,4] = SUMA24$ 184 $G[4,5] = SUMA24$ 184 $G[2,5] = SUMA24$ 186 $G[2,5] = SUMA24$ 186 $G[2,5] = SUMA24$ 186 $G[2,5] = SUMA24$ <td></td> <td></td> <td>G(1,1)=EN</td> <td>ang mang mang mang mang mang mang mang m</td>			G(1,1)=EN	ang mang mang mang mang mang mang mang m
165 $G(4,1) = SUMA 3$ 170 $G(5,1) = SUMA 4$ 171 $G(1,2) = SUMA 1$ 172 $G(2,2) = SUMA 1 x$ 173 $G(3,2) = SUMA 1 2$ 174 $G(4,2) = SUMA 1 3$ 175 $G(5,2) = SUMA 1 3$ 175 $G(5,2) = SUMA 1 2$ 177 $G(2,3) = SUMA 2$ 178 $G(4,3) = SUMA 2$ 176 $G(4,3) = SUMA 2$ 176 $G(2,4) = SUMA 3$ 122 $G(4,4) = SUMA 3$ 124 $G(3,4) = SUMA 3$ 124 $G(3,4) = SUMA 4$ 126 $G(2,5) = SUMA 4$ 126 $G(2,6) = SUMA 4$ 126 $G(2,6) = SUMA 4$ 151 $G(1,6) = SU$				
170 $G(5, 1) = SUMA 4$ 171 $G(1, 2) = SUMA 1$ 172 $G(2, 2) = SUMA 1$ 173 $G(2, 2) = SUMA 12$ 174 $G(4, 2) = SUMA 12$ 174 $G(4, 2) = SUMA 12$ 176 $G(1, 3) = SUMA 2$ 176 $G(2, 2) = SUMA 12$ 176 $G(1, 3) = SUMA 2$ 177 $G(2, 2) = SUMA 12$ 178 $G(2, 3) = SUMA 2$ 176 $G(4, 3) = SUMA 2$ 183 $G(2, 4) = SUMA 3$ 184 $G(2, 4) = SUMA 3$ 184 $G(4, 4) = SUMA 3$ 184 $G(2, 5) = SUMA 4$ 187 $G(2, 5) = SUMA 4$ 186 $G(2, 5) = SUMA 4$ 180	<u>क्र 8</u>		G(3,1)=SUMA2	
171 $G(1,2) = SUMA1$ 172 $G(2,2) = SUMA1x$ 173 $G(3,2) = SUMA1x$ 174 $G(4,2) = SUMA12$ 174 $G(4,2) = SUMA13$ 175 $G(5,2) = SUMA14$ 176 $G(1,3) = SUMA2$ 177 $G(2,3) = SUMA2$ 177 $G(2,3) = SUMA2$ 176 $G(3,3) = SUMA2$ 176 $G(4,3) = SUMA2$ 162 $G(4,4) = SUMA23$ 162 $G(2,4) = SUMA33$ 162 $G(4,4) = SUMA33$ 163 $G(2,5) = SUMA44$ 184 $G(4,5) = SUMA44$ 167 $G(2,5) = SUMA44$ 186 $G(3,5) = SUMA44$ 187 $G(4,5) = SUMA44$ 189 $G(4,5) = SUMA44$ 190 $G(5,5) = SUMA44$ 192 $G(2,6) = SUMVA2$			G(4,1)=SUMA3	
172 $G(2,2) = SUPA1 x$ 173 $G(3,2) = SUPA12$ 174 $G(4,2) = SUMA13$ 175 $G(5,2) = SUMA14$ 176 $G(1,3) = SUMA2$ 177 $G(2,3) = SUMA2x$ 177 $G(2,3) = SUMA2x$ 177 $G(2,3) = SUMA2x$ 177 $G(2,3) = SUMA2x$ 178 $G(3,3) = SUMA2x$ 176 $G(4,3) = SUMA2x$ 181 $G(1,4) = SUMA3$ 182 $G(2,4) = SUMA33$ 183 $G(3,4) = SUMA34$ 184 $G(4,5) = SUMA4x$ 187 $G(2,5) = SUMA4x$ 188 $G(3,5) = SUMA4x$ 188 $G(3,5) = SUMA4x$ 189 $G(4,5) = SUMAx$ 190 $G(5,5) = SUMA4x$ 192 $G(2,6) = SUMVA1$ 192 $G(2,6) = SUMVA3$ 194 $G(4,6) = SUMVA3$				
$\hat{1}73$ $G(3,2) = SUPA12$ 174 $G(4,2) = SUMA13$ 175 $G(5,2) = SUMA14$ 176 $G(1,3) = SUMA2$ 177 $G(2,3) = SUMA2$ 178 $G(3,3) = SUMA2$ 178 $G(4,3) = SUMA23$ $28C$ $G(5,3) = SUMA24$ 181 $G(1,4) = SUMA33$ 182 $G(2,4) = SUMA33$ 183 $G(3,4) = SUMA33$ 184 $G(4,4) = SUMA33$ 185 $G(2,5) = SUMA44$ 187 $G(2,5) = SUMA44$ 187 $G(2,5) = SUMA44$ 188 $G(4,5) = SUMA34$ 189 $G(4,5) = SUMA44$ 189 $G(1,6) = SUMVA1$ 188 $G(3,c) = SUMVA1$ 189 $G(2,c) = SUMVA1$ 189 $G(2,c) = SUMVA1$ 183 $G(3,c) = SUMVA2$ 194 $G(4,c) = SUMVA3$ 195 $G(5,c) = SUMVA4$				
1,74 $G(4,72) = SUMA 13$ 175 $G(5,2) = SUMA 14$ 176 $G(1,3) = SUMA 2$ 177 $G(2,3) = SUMA 2x$ 176 $G(3,3) = SUMA 2x$ 176 $G(4,3) = SUMA 2x$ 126 $G(5,3) = SUMA 24$ 184 $G(1,4) = SUMA 3x$ 182 $G(4,4) = SUMA 23$ 184 $G(4,4) = SUMA 3x$ 185 $G(5,4) = SUMA 4$ 186 $G(4,5) = SUMA 4$ 186 $G(2,5) = SUMA 14$ 186 $G(2,5) = SUMA 4$ 186 $G(2,5) = SUMA 4$ 186 $G(2,5) = SUMA 4$ 187 $G(2,5) = SUMA 4$ 188 $G(3,5) = SUMA 4$ 189 $G(4,5) = SUMV$ 190 $G(2,6) = SUMVA 2$ 192 $G(2,6) = SUMVA 2$ 194 $G(4,6) = SUMVA 3$ 195 $G(5,6) = SUMVA 3$ 195 $G(5,6) = SUMVA 4$ 195 $G(5$				nenerarieun dur narmatikary "enerarie den et spanietigeniek wijd die Versteinige beierdigeleinienen aus aus aus verlant en
175 $G(5, 2) = SUMA 14$ 176 $G(1, 3) = SUMA 2$ 177 $G(2, 3) = SUMA 12$ 177 $G(2, 3) = SUMA 2$ 177 $G(4, 3) = SUMA 2$ 176 $G(4, 3) = SUMA 2$ 177 $G(4, 3) = SUMA 2$ 161 $G(1, 4) = SUMA 3$ 182 $G(2, 4) = SUMA 3$ 183 $G(3, 4) = SUMA 3$ 184 $G(4, 4) = SUMA 3$ 184 $G(4, 4) = SUMA 3$ 184 $G(4, 4) = SUMA 3$ 186 $G(2, 5) = SUMA 4$ 186 $G(2, 5) = SUMA 4$ 187 $G(2, 5) = SUMA 4$ 188 $G(3, 5) = SUMA 4$ 189 $G(4, 5) = SUMA 4$ 189 $G(4, 5) = SUMV 4$ 192 $G(2, 6) = SUMVA 1$ 193 $G(3, c) = SUMVA 2$ 194 $G(4, c) = SUMVA 3$				
176 $G(1,3) = SUMA2$ 177 $G(2,3) = SUMA2 x$ 178 $G(3,3) = SUMA2 x$ 178 $G(4,3) = SUMA2 x$ 181 $G(1,4) = SUMA3$ 182 $G(2,4) = SUMA3$ 183 $G(3,4) = SUMA3$ 184 $G(4,4) = SUMA3x$ 184 $G(4,4) = SUMA3x$ 184 $G(4,4) = SUMA3x$ 185 $G(2,5) = SUMA44$ 186 $G(2,5) = SUMA44$ 187 $G(2,5) = SUMA44$ 188 $G(3,5) = SUMA44$ 189 $G(4,5) = SUMA44$ 189 $G(4,5) = SUMVA4$ 190 $G(2,6) = SUMVA1$ 192 $G(2,6) = SUMVA4$ 194 $G(4,6) = SUMVA4$ 195 $G(4,6) = SUMVA4$ 195 $G(4,6) = SUMVA4$				
177 $G(2, 2) = SUMA12$ 178 $G(3, 3) = SUMA2x$ 177 $G(4, 3) = SUMA2x$ 177 $G(4, 3) = SUMA2x$ 126 $G(5, 3) = SUMA24$ 181 $G(1, 4) = SUMA3$ 182 $G(2, 4) = SUMA3$ 182 $G(2, 4) = SUMA33$ 183 $G(3, 4) = SUMA33$ 184 $G(4, 4) = SUMA3X$ 185 $G(5, 4) = SUMA3X$ 186 $G(2, 5) = SUMA44$ 186 $G(2, 5) = SUMA44$ 186 $G(2, 5) = SUMA44$ 188 $G(3, 5) = SUMA44$ 188 $G(2, 5) = SUMA44$ 189 $G(4, 5) = SUMA4X$ 189 $G(4, 5) = SUMA4X$ 190 $G(2, 6) = SUMVA4$ 192 $G(2, 6) = SUMVA1$ 193 $G(3, c) = SUMVA3$ 194 $G(4, c) = SUMVA3$ 195 $G(4, c) = SUMVA3$			•	
178 $G(2, 3) = SUMA2x$ 179 $G(4, 3) = SUMA23$ 280 $G(5, 3) = SUMA24$ 181 $G(1, 4) = SUMA3$ 182 $G(2, 4) = SUMA13$ 183 $G(2, 4) = SUMA13$ 184 $G(4, 4) = SUMA3x$ 185 $G(5, 4) = SUMA4$ 186 $G(1, 5) = SUMA4$ 187 $G(2, 5) = SUMA4$ 188 $G(3, 5) = SUMA4$ 188 $G(2, 5) = SUMA4x$ 189 $G(4, 5) = SUMA4x$ 189 $G(4, 5) = SUMA4x$ 190 $G(5, 5) = SUMA4x$ 191 $G(1, 6) = SUMV$ 192 $G(2, 6) = SUMVA1$ 193 $G(4, 6) = SUMVA3$ 194 $G(4, 6) = SUMVA4$ 195 $G(5, 6) = SUMVA4$ 195 $G(5, 6) = SUMVA4$				NNE da anno an an an Andréa a sann an ann an Anna an an Anna an Anna an Anna an Anna an Anna an Anna an A
179 $G(4,3) = SUMA 23$ 180 $G(5,3) = SUMA 24$ 181 $G(1,4) = SUMA 3$ 182 $G(2,4) = SUMA 13$ 183 $G(3,4) = SUMA 23$ 184 $G(4,4) = SUMA 3x$ 185 $G(5,4) = SUMA 3x$ 184 $G(4,4) = SUMA 3x$ 185 $G(5,4) = SUMA 3x$ 186 $G(1,5) = SUMA 4$ 187 $G(2,5) = SUMA 4$ 188 $G(2,5) = SUMA 4$ 188 $G(2,5) = SUMA 24$ 188 $G(2,5) = SUMA 4x$ 189 $G(4,5) = SUMA 4x$ 190 $G(5,5) = SUMA 4x$ 191 $G(1,6) = SUM V$ 192 $G(2,6) = SUM VA 1$ 153 $G(3,c) = SUM VA 3$ 195 $G(5,6) = SUM VA 3$ 195 $G(5,6) = SUM VA 4$ 195 $G(5,6) = SUM VA 4$				
280 $6(5,3) = SUMA24$ 181 $G(1,4) = SUMA3$ 182 $6(2,4) = SUMA13$ 183 $G(3,4) = SUMA23$ 184 $G(4,4) = SUMA3x$ 185 $G(5,4) = SUMA3x$ 186 $G(1,5) = SUMA4$ 187 $G(2,5) = SUMA4$ 188 $G(2,5) = SUMA14$ 188 $G(2,5) = SUMA24$ 189 $G(4,5) = SUMA4x$ 190 $G(5,5) = SUMA4x$ 192 $G(2,6) = SUMVA1$ 183 $G(3,c) = SUMVA1$ 192 $G(2,6) = SUMVA2$ 194 $G(4,c) = SUMVA3$ 195 $G(5,6) = SUMVA4$ 195 $G(5,6) = SUMVA4$				nan bernen han wennen annen an einen einen eine eine ein
181 $G(1, 4) = SUMA3$ 182 $G(2, 4) = SUMA13$ 183 $G(3, 4) = SUMA23$ 184 $G(4, 4) = SUMA3X$ 185 $G(5, 4) = SUMA3X$ 186 $G(1, 5) = SUMA4$ 187 $G(2, 5) = SUMA4$ 188 $G(3, 5) = SUMA4$ 188 $G(2, 5) = SUMA4$ 188 $G(3, 5) = SUMA24$ 189 $G(4, 5) = SUMA4X$ 190 $G(4, 5) = SUMA4X$ 191 $G(1, 6) = SUMV$ 192 $G(2, 6) = SUMVA1$ 193 $G(3, c) = SUMVA2$ 194 $G(4, 6) = SUMVA3$ 195 $G(5, 6) = SUMVA4$ 195 $G(5, 6) = SUMVA4$				
132 $G(2,4) = SUMA13$ 183 $G(3,4) = SUMA23$ 184 $G(4,4) = SUMA3x$ 125 $G(5,4) = SUMA3x$ 1265 $G(5,4) = SUMA3x$ 186 $G(1,5) = SUMA4$ 187 $G(2,5) = SUMA4$ 188 $G(2,5) = SUMA4$ 188 $G(2,5) = SUMA24$ 188 $G(4,5) = SUMA24$ 189 $G(4,5) = SUMA4X$ 190 $G(5,5) = SUMA4X$ 191 $G(1,6) = SUMV$ 192 $G(2,6) = SUMVA1$ 193 $G(3,c) = SUMVA2$ 194 $G(4,6) = SUMVA3$ 195 $G(5,6) = SUMVA4$ 195 $G(5,6) = SUMVA4$				ан на н
183 $G(3,4) = SUMA23$ 184 $G(4,4) = SUMA3x$ 165 $G(5,4) = SUMA34$ 186 $G(1,5) = SUMA4$ 187 $G(2,5) = SUMA4$ 188 $G(3,5) = SUMA24$ 189 $G(4,5) = SUMA34$ 190 $G(5,5) = SUMA4x$ 191 $G(1,6) = SUMV$ 192 $G(2,6) = SUMVA1$ 153 $G(3,c) = SUMVA2$ 194 $G(4,6) = SUMVA3$ 195 $G(5,6) = SUMVA4$ 195 $G(5,6) = SUMVA4$				
184 $G(4,4) = SUMA3X$ 125 $G(5,4) = SUMA34$ 186 $G(1,5) = SUMA4$ 187 $G(2,5) = SUMA4$ 188 $G(3,5) = SUMA24$ 189 $G(4,5) = SUMA34$ 190 $G(4,5) = SUMA4X$ 191 $G(1,6) = SUMV$ 192 $G(2,6) = SUMVA1$ 153 $G(3,c) = SUMVA2$ 194 $G(4,6) = SUMVA3$ 195 $G(5,6) = SUMVA4$ 195 $G(5,6) = SUMVA4$				
125 $G(5,4) = SUMA 34$ 186 $G(1,5) = SUMA 4$ 187 $G(2,5) = SUMA 14$ 188 $G(3,5) = SUMA 24$ 188 $G(3,5) = SUMA 24$ 189 $G(4,5) = SUMA 34$ 190 $G(5,5) = SUMA 4X$ 191 $G(1,6) = SUMV$ 192 $G(2,6) = SUMVA 1$ 193 $G(3,c) = SUMVA 2$ 194 $G(4,6) = SUMVA 3$ 195 $G(5,6) = SUMVA 4$ 195 $G(5,6) = SUMVA 4$ 195 $G(5,6) = SUMVA 4$			•	-
386 $G(1,5)=SUMA4$ 187 $G(2,5)=SUMA14$ 188 $G(3,5)=SUMA24$ 189 $G(4,5)=SUMA24$ 189 $G(4,5)=SUMA34$ 190 $G(5,5)=SUMA4X$ 190 $G(5,5)=SUMA4X$ 191 $G(1,6)=SUMV$ 192 $G(2,6)=SUMV$ 192 $G(2,6)=SUMVA1$ 193 $G(3,c)=SUMVA2$ 194 $G(4,6)=SUMVA3$ 195 $G(5,6)=SUMVA4$ 195 $G(5,6)=SUMVA4$ 195 $G(5,6)=SUMVA4$			•	— we were a set on a set of the first off and the set of t set of the set
187 $G(2,5) = SUMA14$ 188 $G(3,5) = SUMA24$ 189 $G(4,5) = SUMA34$ 190 $G(5,5) = SUMA4X$ 191 $G(1,6) = SUMV$ 192 $G(2,6) = SUMVA1$ 193 $G(3,c) = SUMVA2$ 194 $G(4,6) = SUMVA3$ 195 $G(5,6) = SUMVA4$ 195 $G(5,6) = SUMVA4$ 196 $IF(VOK=1) = 222, 224, 224$				
188 G(3,5)=SUMA24 189 G(4,5)=SUMA34 190 G(5,5)=SUMA4X 191 G(1,6)=SUMV 192 G(2,6)=SUMVA1 193 G(3,c)=SUMVA2 194 G(4,6)=SUMVA3 195 G(5,6)=SUMVA4 196 If(VOK=1)				
189 G(4,5)=SUMA34 190 G(5,5)=SUMA4X 191 G(1,6)=SUMV 192 G(2,6)=SUMVA1 193 G(3,c)=SUMVA2 194 G(4,6)=SUMVA3 195 G(5,6)=SUMVA4 195 IF(VOK=1)				
ISO $G(5,5)=SUMA 4X$ ISI $G(1,6)=SUMV$ IS2 $G(2,6)=SUMVA1$ IS3 $G(3,c)=SUMVA2$ IS4 $G(4,6)=SUMVA3$ IS5 $G(5,6)=SUMVA4$ IS6 IF(VOK=1) 222,224,224				
ISI $G(1,6) = SUMV$ $I92$ $G(2,6) = SUMVA1$ IS3 $G(3,c) = SUMVA2$ I94 $G(4,6) = SUMVA3$ I95 $G(5,6) = SUMVA4$ I56 IF(VOK=1) 222,224,224				
192 G(2,6)=SUMVA1 193 G(3,6)=SUMVA2 194 G(4,6)=SUMVA3 195 G(5,6)=SUMVA4 196 IF(VOK=1) 222,224,224				
193 G(3,c)=SUMVA2 194 G(4,6)=SUMVA3 195 G(5,6)=SUMVA4 196 IF(VOK=1) 222,224,224				·
G(4,6)=SUMVA3 G(5,6)=SUMVA4 ISE IF(VOK-1) 222,224,224				· · ·
195 G(5,6)=SUMVA4 156 IF(VOK=1) 222,224,224				
196 IF(VOK-1) 222,224,224			•	
				9
	ananana ana manana manana kana kana a ara ara kana ka kanana an ananya yant	alaalaa ahaa ahaa ahaa ahaa ahaa ahaa a		
· ·				
•				

RTRANTIV	MUDEL 44 PS VERSION 3, LEVEL I DATE 69119
157	ZZZ CALL SOLVIG,VOK,UZ,TELR,K)
158	IF(K(6)-1) 223,223,617
1.33	223 IF(1-1) 226,226,227
:20C	224 CALL NAT(G, VDK, GV)
201	CALL SOLV(GV,VOK,U2,TOLR,K)
202	IF(K(6)-1) 225,225,617
204	$\frac{225}{226} = \frac{171 - 17}{226} = \frac{226}{226} = \frac{226}{226} = \frac{171 - 17}{226} = \frac{226}{226} = \frac{171 - 17}{226} = \frac{171 - 17}{$
N285	K2B=K(2)
206	$K_{3B} = K(3)$
207	K48=K(4)
2.6.8	K5B = K(5)
209	I=2
210	GO TO 115
211	227 K1C=K(1)
212	K2C=K(2)
213	K3C=K(3)
2114	K4C = K(4)
215	K5C=K(5)
216	E(1,1) = K 1B
217	E(2,1) = K1C
218	E(1,2) = K2B
219	Et 2, 2) = K2C
220	E(1,3)=K38
.2,21	E(2,3) = K3C
222	E(1,4) = K4B
223	E(2,4)=K4C
224	E(1,5)=K5B
225	E(2,5)=K5C
226	DC 233 NL=1,5
227	229 IF(E(2,NL))231,231,23C 23C IF(E(1,NL))231,231,232
228	= 23C = 1F(E(1,NL)) / 23L, 23L, 23L, 23L = 23L = AK(NL) = (E(2,NL) - E(1,NL)) / (TS2 - TS1) = (E(2,NL) - E(1,NL)) / (TS2 - TS1) = (TS2 - TS1
230	DB(NL) = E(1, NL) - AK(NL) + TS1
231	GO TC 233
232	232 DB(NL) = GC * (TS1 * TS2) / (TS1 - TS2) * ALCG(E(1, NL) / E(2, NL))
233	$\frac{252}{\text{Ak(NL)} = E(1, NL) \times EXP(UB(NL)/(GU \times TS1))}$
234	233 CONTINUE
235	246 TS=TS1
236	
237	
238	247 TS=TS2
239	248 CALL TEMCO(E,TS,AK,DB,EM)
240	K(1) = EN(1)
241	K(2)=EN(2)
242	K(3) = EM(3)
243	K(4)=EN(4)
244	K(5) = EM(5)
245	DU 280 NL=1,5
· ·	
- 4 - 1994	هوپ مورب
11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	5.

		67
CRIRAN IV	MUDEL 44 PS. VERSION 3, LEVEL 1 DATE 69119	
0246	28C PRINT 281,AK(NL),DB(NL)	
0240	281 FORMAT(4H AK,E10.3,4H CB,E10.3)	
\$ 348	249 SUMCO=C	
0249	250 DO 255 M=1,NE	
0250	PA = A(1,N)	
0851 0252	PB = A(2,N) $PR = A(3,N)$	an - John was a was a star
0253	PS = A(4, M)	
&254	A1=KSGRPA(LC,PA,PB,PR,PS,KE)	
0255	A Z=KSOR PB (LF, PA, PB, PR, PS, KE)	
0256	A 3 = K SOR PR (LG, PA, FB, PR, PS, KE)	
0257 0258	A4=K SORPS(LH,PA,PB,PR,PS,KE) PT=PUT(LD,PA,PB,PR,PS,KE)	
C259	DEN=(K(1)+K(2)*A1+K(3)*A2+K(4)*A3+K(5)*A4)**N	
\$250	V=(PT/(A(5,M)*A(10,M)*ZD))**(1.0/N)	
G261	RC = A(5, M) * A(10, N) * ZD	
J262	IF(DEN-C.1+V)251,252,252	
1203	251 IF(DEN+C.1*V) 252,252,253 252 RCAL=PT/DEN	
0264 0265	GO TO 254	
1265	$-253 - R(\Lambda) = PT/(0.1*V)$	9
5267	254 CO=(RCAL-RC)**2	
0268	255 SUMCC = SUMCC + CC	
0369	COV=(SUMCC/EN) **0.5	
C27C	$\frac{256}{111} = \frac{11}{257,257,259}$ $\frac{257}{257} = 0.000 = 0.000$	yn wrain hawlan fermyn aran y e ymryngar fe'r ynnon yn ymrai a gan y manae allwryf y nyfaer annan yn y ynyf y y
C271 3272	257 CUVB = CLV PR IN T 258, CUVB	
5273	258 FORMAT(5H COVB,E10.3)	
3274	1=2	
2275	GO TO 247	
270 CD 77	259 CUVC=COV	n) nanagaga mbin bina ndar sana nana hin kéd ana nana na sagan a ana dinanangan kédalanggapan s
\$277 \$278	PRINT 260,0000 260 FORMAT(5H COVC,E10.3)	and a second
2219	282 IN=2	
280	GO TC 1C1	
1281	299 IF(LP-1) 3CC; 3CC; 399	
282	300 M=1	an a
0283 0284	DR(2)=0.1037*RP DR(3)=0.141*RP	
9284 9285	DR(3)=0.141*RP DR(4)=C.315*RP	
286	AR(2)=12.53*C.553*C.848*RP**2	
.287	AR(3)=12.53*C.848*0.7076*RP**2	
1288	AR(4)=12.53*0.7C76*C.315*RP**2	ար չ ԱՄՈՆՆ ԱԱՆ ԱՆԱՆՄԻՆԻՆԻՆԻՆԻՆԻՆՆՆՆՆՆՆՆՆՆՆՆՆՆՆՆՆ
1289	3C1 CAS=A(1,M)	
250 (251	CBS=A(2,M) CRS=A(3,M)	
2292	CSS=A(4,N)	
253	DG 309 NR=2,4	
2254	RA(MR) = A(5, M)	
fra - Sant Frank	- 1400 - 1400	
		45 mm

	•
RIRAN IV	MODEL 44 PS VERSION 3, LEVEL 1 DATE 69119
295 296	302 CA(MR) =- RA(MR) *DR(MR) / (DEA*AR(MR)) + CAS CB(MR) =- F * RA(MR) * DR(MR) / (DE E* AR(MR)) + CBS
297	CR(MR) = H*RA(MR) * DR(MR) / (DER*AR(MR)) + CRS
298	CS(MR) = Q*RA(MR) + DR(MR) / (DES + AR(MR)) + CSS
299 3°C C	CALE SIGF (CA, CB, CR, CS, IK)
	IF(IK-1) 303,303,304
<u>301</u> 302	303 RA(MR)=0.95*RA(MR) GD TO 302
302	
304	3C4 SUMC =CA(MR)+CB(MR)+CR(MR)+CS(MR)
	PRINT 311, SUMC
305	IF(FD(MR)-SUNC) 3C5,3C6,306
306	305 RA(MR)=0.95*RA(MR)
367 269	GO TU 3C2
368	3C6 IF(FR(MR)-SUMC) 3C8,3C8,3C7
365	307 RA(MR)=0.55*RA(MR)
310	
311	308 CAS=CA(MR)
312	CB S=CB (MR)
313	CRS=CR(MR)
314	C S S = C S (MR)
315	309 CONTINUE
316	A(7, M) = RA(2) / A(5, M)
317	A(8,M) = RA(3)/A(5,M)
318	A(S,M) = RA(4)/A(S,M)
315	PRINT 311;A(7;N)
32C	311 FORMAT(3H A7,E1C.3)
321	M=M+1
322	IF(M-NE) 301,301,310
323	-31C IF(1-1)325,325,328
324	325 DO 326 M=1,NE
325	B(7,N) = A(7,N)
326	B(8, M) = A(8, M)
327	B(9, M) = A(9, M)
328	326 CONTINUE
3.29	GC TC 115
330	328 DO 325 M=1, NE
33 <u>1</u>	C(7, M) = A(7, M)
332	C(8, M) = A(8, N)
333	C(9,M) = A(9,N)
334	329 CONTINUE
335	33C LP=2
336	GO TE 1C1
337	399 M=1
338	400 IF(I-1) 401, 401, 402
335	401 TSA=TS1
340	GO TO 4C3
341	402 TSA=TS2
342	403 RD1=A(5,M)
843	RD2=A(5, M)*A(7, M)
la 1	
· · · · · · · · · · · · · · · · · · ·	

							69
		 A start				(1) Specific and a separately in the last state of the specific and the	
CRIRAN	MOLE	L 44 PS	VERSION 3,	LEVEL	DATE 69119		
		v					
<u>0344</u> (345	, Alex and a selection areas and the selection of the sel	RD3=A(5,M)*A		iterinenterinenterinen også som etter at i som etter som som generalise og generalise forsenande andare oppare	, MARE RADIE I SUIT AMERICAN ANT AN ANT AND AN	an fair ann a fair a' fhar air an bhair an an bhair an an bhair ann an bhair ann an	
C345	Maximulana ay magazing disabilingka may paran ilay saysa	RD4=A(5,N)*A R(1)=A(5,N)-1	-				
0346		R(2) = R(5, M) = 1 R(2) = R(2 - R) = R				Walling and a second	ana 1990 ang
C348		R(2)=R02-R03 R(2)=R03-R04			·		
0348		R(4) = RD4					
6350	404	$\frac{R(4)=KU4}{DT2=DR(2)*IR}$	-	~ + + + + - + - + - + - + - + - + - + -	. A set of only only only on a set of the set	ann a bharann an sheatharann an a bha bhar ann agu ann a bharann a	
C351	TUT	UTE=DR(3)*(R					· · · · · · · · ·
russi 10352	n Alleh er en bespärallener og en 1977 "De beskelsener – overer og et al. et al. et al. et al. et al. et al. et a				1		·
10353	405	TA(1) = TSA	1411 MIDE AVIA	*481711			
C354	202	$\frac{1}{TA(2)} = TSA + DT2$	3				
C355		TA(2) = TA(2) + C					
C350		TA(3) = TA(2) + t			n Managaran yang mang mang mang mang mang mang mang m	- Mar gives that Good terror any gives to suggest and the band of the same that as the same same same	
0357	496	CAS=A(1,M)	J 4 78				
0358 0358	1 × ~	CBS=A(2,M)					
0359		CR S=A (3, M)		•			
0350 0360		-CSS=A(4,M)					
0361	497	00 505 ML=2	. la				
6362		-DU501 LK=1	•	la ^{te} s a la segur de la seconda			
0363		IF(E(1,LK))	•				
C364	498				- 		•
3365	499	WK(LK) = AK(LK)				s	
0300			· · · · · · · · · · · · · · · · · · ·			-	
0367	500	hK(LK) = AK(LK))*EXP(-DB(L	KI/ (GC*TA(M	(L))).		
03c8	501	CUNTINUE			have if it is a second se		
0369	*	D(2)=R(2)+R(3))+R(4)				
\$370		D(3)=R(3)+R(4)					
0371		D(4)=R(4)					
0372		PA=D(ML)*DR(1					
373		PB = -F * D(ML) * DF					
0374	- Canal Constant, Constant Constant, Constant, Constant, Constant, Constant, Constant, Constant, Constant, Const	-PR=-H*0(-Vt)*01					
C375		PS= Q*D(ML)*DF					
¢376		AI=K SORPATLC					
\$377		A2=KSORPB(LF)					
\$378	And the second sec	A 3=KSORPRILG	PATP3 PRTP	S,KE)			
C379		A 4=KSCRPS(LH		S,KE)			
¢38¢	The second sum of the second	SRA=A1*WK(2)-					
1361		$SRB = A 2 \neq WK(3)$					
0382	· · · · · · · · · · · · · · · · · · ·					· · · · · · · · · · · · · · · · · · ·	
6383		SRS=A4*WK(5)					
0.384		PT=POT(LD, PA	PB, PR, PS, KI	E)	· · · · · · · · · · · · · · · · · · ·		· · ·
0385	•	CAS=PA					
0365		CBS=PB	Andrea Antoinianan magint ana ana an ini ini ini ana ana an ini ana ana	"Ministra Ministra " Sali A No Seamang na Ministra Na Ministra na Amangana Tengo, ng muna na manana migu ga			
0367		CR S=PR					
6388		CSS=PS					
0389		DEN=(WK(I)+SR/					
¢390		V=(PT/(A(5,M))		······
C391	··	IF(DEN-0.1*V)			er en statuer en statue		
\$352	502	IF(DEN: 0.1*V)	1504,504,50	5		* .	- The density of the state of the
		·					
				······································			
			(a) a difference in the second sec				

<u>~</u>____

•

$\begin{array}{cccccccccccccccccccccccccccccccccccc$	<pre>E IF(RCALC(2)=R(2)) 512,5C7,507 7 IF(RCALC(3)=R(3)) 513,508,508 8 IF(RCALC(4)=R(4)) 514,5C9,509 5 IF(RD2=R(2)=R(3)=R(4)) 512,510,510 C IF(RC3=R(3)=R(4)) 513,511,511 1 IF(RD4=R(4)) 514,515,515 2 R(2)=C. %*R(2) GU TO 404 3 R(3)=0.8*R(3) R(2)=R(2)+C. 2*(R(3)/C. 8) GO TO 404 4 R(4)=R(4)*C.8 R(3)=R(3)+C.2*(R(4)/0.8) GO TO 404 5 R(1)=R(3)+C.2*(R(4)/0.8) GO TO 404 5 R(1)=A(5;M)=R(2)=R(3)=P(4) PRINT 4C6,R(3) 5 FORMAT(3H R3;E1C.3) IF(A(5,M)*A(10,M)*ZC=R(1)) 517,517,516 5 D=0.8*ZD IN=1 GO TO 1C1 7 IF(1Z=1) 518,518,521</pre>
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	<pre>3 RCALC(MU)=PT/(0.1*V) GC TC 5C5 4 RCALC(MU)=PT/DEN 5 CONTINUE 6 IF(RCALC(2)=R(2)) 512,5C7,507 7 IF(RCALC(3)=R(2)) 512,5C7,507 8 IF(RCALC(4)=R(4)) 512,500,510 C IF(RC2=R(2)=R(3)=R(4)) 512,510,510 C IF(RC3=R(3)=R(4)) 513,511,511 1 IF(R04=R(4)) 514,515,515 2 R(2)=C(*R(2)) GU TO 404 3 R(3)=0.**R(2) R(2)=R(2)+C.2*(R(3)/C.8) GU TO 404 6 R(4)=R(4)*C.8 R(3)=C(2*(R(4))/C.8) GU TO 404 5 R(1)=A(5;M)=R(2)=R(3)=R(4) PRINT 4C6,R(3) 6 FORMAT(3)=R(2)=R(3)=R(4) PRINT 4C6,R(3) 6 FORMAT(3)=R(2)=R(1)) 517,517,516 5 ZD=0.**ZU IN=1 GO TO TC1 7 IF(IZ=1) 518,518,521 7 M=M+1 IF(M-NE)4CC,4CC,519</pre>
A94 355 50 356 50 357 50 358 50 358 50 359 50 405 51 405 51 405 51 405 51 405 51 405 51 405 51 405 51 407 51 408 51 409 40 414 51 413 40 414 51 414 51 414 51 415 51 414 51 415 51 42 52 42 52 42 52 42 52 42 52 42 52 42 52 42 52 42 52 42 52 52 52	GC TC 5C5 RCALC(ML)=PT7DEN CONTINUE FIF(RCALC(2)=R(2)) 512,5C7,507 FF(RCALC(3)=R(3)) 513,508,508 FIF(RCALC(4)=R(4)) 513,508,508 FIF(RCALC(4)=R(4)) 513,508,508 FIF(RCALC(4)=R(4)) 513,511,510 FF(RC3=R(3)=R(4)) 513,511,511 FF(R04=R(4)) 514,515,515 CTF(R03=R(2)=C.2*(R(3)/C.8) GU TO 404 R(2)=R(2)+C.2*(R(3)/C.8) GU TO 404 R(4)=R(4)*C.8 R(3)=R(3)+C.2*(R(4)/0.8) GU TO 404 FORMAT(3)=R(2)=R(2)=R(3)=P(4) PRINT 4C6,R(3) FORMAT(3)=R(3)=E1C.3) FF(A(5,M)*A(10,M)*ZC=R(1)) 517,517,516 FOCMAT(3)=R(3)=E1C.3 FF(A(5,M)*A(10,M)*ZC=R(1)) 517,517,516 FOCMAT(3)=R(3)=E1C.3 FF(A(5,M)*A(10,M)*ZC=R(1)) 517,517,516 FOCMAT(3)=R(3)=E1C.3 FF(R(3)=R(3)=E1C.3) FF(A(5,M)*A(10,M)*ZC=R(1)) 517,517,516 FOCMAT(3)=R(3)=E1C.3 FF(R(3)=R(3)=E1C.3) FF(A(5,M)*A(10,M)*ZC=R(1)) 517,517,516 FOCMAT(3)=R(3)=E1C.3 FF(R(3)=R(3)=E1C.3
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	<pre>4 RCALC(ML)=PT7DEN 5 CONTINUE 6 IF(RCALC(2)=R(2)) 512,5C7,507 7 IF(RCALC(3)=R(3)) 513,508,508 8 IF(RCALC(4)=R(4)) 513,508,509 9 IF(RCD2=R(2)=R(3)=R(4)) 512,510,510 C IF(RD2=R(2)=R(3)=R(4)) 513,511,511 1 IF(RD4=R(4)) 514,515,515 2 R(2)=C.8*R(2) 6 GU TO 404 3 R(3)=0.3*R(2) R(2)=R(2)+C.2*(R(3)/C.8) 6 GU TO 404 4 R(4)=R(4)*C.8 R(3)=R(3)+C.2*(R(4)/0.8) 6 GU TO 404 5 R(1)=A(5,M)=R(2)=R(3)=P(4) 9 RINT 4C6,R(3) 5 FORMAT(2H=R3,E1C.3) IF(A(5,M)*A(10,M)*ZD=R(1)) 517,517,516 5 ZD=0.8*ZD IN=1 6 GU TO 1C1 7 IF(1Z=1) 518,518,521 5 M=M+1 IF(M=NE)4CC,4CC,519</pre>
356 $5C$ 397 $5C$ 388 $5C$ 397 $5C$ 369 $5C$ $4C$ 51 102 51 102 51 102 51 105 51 106 51 105 51 106 51 107 16 11 51 12 51 11 51 12 51 12 51 12 51 12 51 12 51 12 51 12 51 12 51 12 52 22 52 22 52 22 52 22 52 22 52 22 52 22 52 22 52	5 CONTINUE FIRCALC(2)=R(2)) 512,5C7,507 7 IF(RCALC(3)=R(3)) 513,508,508 5 IF(RCALC(4)=R(4)) 514,5C9,509 5 IF(RD2=R(2)=R(3)=R(4)) 512,510,510 C IF(RC3=R(3)=R(4)) 513,511,511 1 IF(R04=R(4)) 514,515,515 2 R(2)=C.8*R(2) GU TO 404 3 R(3)=0.8*R(2) GU TO 404 4 R(4)=R(4)*C.8 R(3)=R(3)*C.2*(R(3)/C.8) GO TO 404 5 R(1)=A(5,M)=R(2)=R(3)=R(4) PRINT 4C6,R(3) 5 FORMAT(3)=R(3)=R(4) PRINT 4C6,R(3) 5 FORMAT(3)=R(3)=R(3)=R(4) PRINT 4C6,R(3) 5 FORMAT(3)=R(3)=R(3)=R(4) PRINT 4C6,R(3) 5 FORMAT(3)=R(3)=R(3)=R(4) PRINT 4C6,R(3) 5 FORMAT(3)=R(3)=R(3)=R(4)=R(3)=R(4)=R(3)=R(4)=R(3)=R(4)=R(3)=R(4)=R(3)=R(4)=R(3)=R(4)=R(3)=R(4)=R(3)=R(4)=R(3)=R(4)=R(3)=R(4)=R(3)=R(4)=R(3)=R(4)=R(3)=R(4)=R(4)=R(4)=R(4)=R(4)=R(4)=R(4)=R(4
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	<pre>E IF(RCALC(2)=R(2)) 512,5C7,507 7 IF(RCALC(3)=R(3)) 513,508,508 8 IF(RCALC(4)=R(4)) 514,509,509 5 IF(RD2-R(2)=R(3)=R(4)) 512,510,510 C IF(RC3-R(3)=R(4)) 513,511,511 1 IF(RD4-R(4)) 514,515,515 2 R(2)=C. & *R(2) GU TO 404 3 R(3)=0.8*R(2) R(2)=R(2)+C.2*(R(3)/C.8) GU TO 404 4 R(4)=R(4)*C.8 R(3)=R(3)+C.2*(R(4)/0.8) GO TO 404 5 R(1)=A(5,M)=R(2)=R(3)=R(4) PRINT 4C6,R(3) 5 FORMAT(3H=R3,E1C.3) IF(A(5,M)*A(10,M)*ZD=R(1)) 517,517,516 5 ZD=0.8*ZD IN=1 GO TO 1C1 7 IF(1Z=1) 518,518,521 5 M=M+1 IF(M=NE)4CC,4CC,519</pre>
358 50 359 50 400 51 400 51 400 51 400 51 400 51 400 51 400 51 400 51 400 51 400 51 400 51 400 51 400 51 413 40 413 40 414 51 415 51 416 51 417 51 42 52 42 52 42 52 42 52 42 52 42 52 42 52 42 52 42 52 42 52 42 52 52 52 52 52 52 52 52 52 52 52 52 52 52 52 52 52 52 52 53 52 54 52	<pre>7 IF(RCALC(3)-R(3)) 513,508,508 8 IF(RCALC(4)-R(4)) 514,509,509 9 IF(RD2-R(2)-R(3)-R(4)) 512,510,510 0 IF(RD3-R(3)-R(4)) 513,511;511 1 IF(RD4-R(4)) 514,515,515 2 R(2)=C. & & R(2) 9 GU TO 404 3 R(3)=0.8 & R(2) R(2)=R(2)+C.2 & (R(3)/C.8) 9 GO TO 404 4 R(4)=R(4) & C.8 R(3)=R(3)+C.2 & (R(4)/0.8) GO TO 404 5 R(1)=A(5,M)=R(2)=R(3)=R(4) PRINT 4C6,R(3) 9 FORMAT(3H R3,E1C.3) IF(A(5,M)*A(10,M)*Z0-R(1)) 517,517,516 5 ZD=0.8 & ZD IN=1 GO TU 1C1 7 IF(IZ-1) 518,518,521 5 M=M+1 IF(M-NE)4C(,4CC,519</pre>
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	<pre>5 IF(RCALC(4)=R(4)) 514,509,509 5 IF(RD2-R(2)-R(3)-R(4)) 512,510,510 C IF(RC3-R(3)-R(4)) 513,511,511 1 IF(RD4-R(4)) 514,515,515 2 R(2)=C.&*R(2) GU TO 404 3 R(3)=0.8*R(3) R(2)=R(2)+C.2*(R(3)/C.8) GU TO 404 4 R(4)=R(4)*C.8 R(3)=R(3)+C.2*(R(4)/0.8) GU TO 404 5 R(1)=A(5,M)=R(2)=R(3)=R(4) PRINT 4C6,R(3) 5 FORMAT(3H R3;E1C.3) IF(A(5,M)*A(10,M)*ZD-R(1)) 517,517,516 5 ZD=0.8*ZU IN=1 GU TU 1C1 7 IF(1Z-1) 518,518,521 5 M=M+1 IF(M-NE)4CC,4CC,519</pre>
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	<pre>S IF(RD2-R(2)-R(3)-R(4)) 512,510,510 C IF(RC3-R(3)-R(4)) 513,511,511 1 IF(RD4-R(4)) 514,515,515 2 R(2)=C.8*R(2) GU TU 404 3 R(3)=U.8*R(3) R(2)=R(2)+C.2*(R(3)/C.8) GO TO 4C4 4 R(4)=R(4)*C.8 R(3)=R(3)+C.2*(R(4)/0.8) GO TO 404 5 R(1)=A(5,M)=R(2)=R(3)=R(4) PRINT 4C6,R(3) 5 FORMAT(3H:R3,E1C.3) IF(A(5,M)*A(10,M)*ZD=R(1)) 517,517,516 5 D=0.8*ZU IN=1 GO TU 1C1 7 IF(1Z=1) 518,518,521 5 M=M+1 IF(M=NE)4CC,4CC,519</pre>
401 51 $4C2$ 51 $4C3$ 51 $4C4$ 51 $4C5$ 51 $4C6$ 51 $4C6$ 51 $4C6$ 51 $4C6$ 51 $4C8$ 51 407 416 411 51 412 414 413 $4C$ 414 51 416 51 416 51 416 51 420 51 422 52 423 52 424 52 425 52 426 427 428 429	C IF(RC3-R(3)-R(4)) 513,511,511 1 IF(RD4-R(4)) 514,515,515 2 R(2)=C.8*R(2) GU TO 404 3 R(3)=0.8*R(3) R(2)=R(2)+C.2*(R(3)/C.8) GU TO 4C4 4 R(4)=R(4)*C.8 R(3)=R(3)+C.2*(R(4)/0.8) GO TO 404 5 R(1)=A(5,M)=R(2)=R(3)=R(4) PRINT 4C6,R(3) 5 FORMAT(3h;R3,E1C.3) IF(A(5,M)*A(10,M)*ZD=R(1)) 517,517,516 5 ZD=0.8*ZU IN=1 GO TU 1C1 7 IF(1Z=1) 518,518,521 3 M=M+1 IF(M=NE)4CC,4CC,519
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	<pre>1 IF(RD4-R(4)) 514,515,515 2 R(2)=C.8*R(2) GU TO 404 3 R(3)=0.8*R(2) R(2)=R(2)+C.2*(R(3)/C.8) GO TO 4C4 4 R(4)=R(4)*C.8 R(3)=R(3)*C.2*(R(4)/0.8) GO TO 404 5 K(1)=A(5,M)=R(2)=R(3)=R(4) PRINT 4C6,R(3) 5 FORMAT(3H R3,E1C.3) IF(A(5,M)*A(10,M)*ZD=R(1)) 517,517,516 5 ZD=0.8*ZD IN=1 GO TO 1C1 7 IF(1Z=1) 518,518,521 8 M=M+1 IF(M-NE)4CC,4CC,519 </pre>
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	<pre>2 R(2)=C. & R(2) GU TO 404 3 R(3)=0.8*R(2) R(2)=R(2)+C.2*(R(3)/C.8) GO TO 4C4 4 R(4)=R(4)*C.8 R(3)=R(3)+C.2*(R(4)/0.8) GO TO 404 5 R(1)=A(5,M)=R(2)=R(3)=R(4) PRINT 4C6,R(3) 5 FORMAT(3H R3,E1C.3) IF(A(5,M)*A(10,M)*ZD=R(1)) 517,517,516 5 ZD=0.8*ZD IN=1 GO TU 1C1 7 IF(1Z=1) 518,518,521 6 M=M+1 IF(M=NE)4CC,4CC,519</pre>
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	GU TO 404 3 R(3)=0.8*R(3) R(2)=R(2)+C.2*(R(3)/C.8) GU TO 4C4 4 R(4)=R(4)*C.8 R(3)=R(3)+C.2*(R(4)/0.8) GU TO 404 5 K(1)=A(5,M)=R(2)=R(3)=R(4) PRINT 4C6,R(3) 5 FORMAT(3H R3,E1C.3) IF(A(5,M)*A(10,M)*ZD=R(1)) 517,517,516 5 ZD=0.8*ZD IN=1 GU TU 1C1 7 IF(1Z=1) 518,518,521 5 M=M+1 IF(M=NE)4CC,4CC,519
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	<pre>3 R(3)=0.8*R(2) R(2)=R(2)+C.2*(R(3)/C.8) GO TO 4C4 4 R(4)=R(4)*C.8 R(3)=R(3)*C.2*(R(4)/0.8) GO TO 404 5 R(1)=A(5,M)=R(2)=R(3)=R(4) PRINT 4C6,R(3) 5 FORMAT(3H R3,E1C.3) IF(A(5,M)*A(10,M)*ZC=R(1)) 517,517,516 5 ZD=0.8*ZD IN=1 GO TU 1C1 7 IF(1Z=1) 518,518,521 8 M=M+1 IF(M=NE)4CC,4CC,519</pre>
$\begin{array}{r} 406 \\ 407 \\ 408 \\ 51 \\ 509 \\ 410 \\ 411 \\ 51 \\ 412 \\ 413 \\ 413 \\ 40 \\ 414 \\ 413 \\ 414 \\ 415 \\ 51 \\ 416 \\ 417 \\ 416 \\ 51 \\ 420 \\ 421 \\ 51 \\ 420 \\ 421 \\ 51 \\ 422 \\ 52 \\ 423 \\ 424 \\ 52 \\ 52 \\ 423 \\ 424 \\ 52 \\ 52 \\ 52 \\ 425 \\ 52 \\ 426 \\ 427 \\ 428 \\ 429 \\ 429 \\ 429 \\ 429 \\ 429 \\ 400 \\ 51 \\ 51 \\ 51 \\ 51 \\ 51 \\ 51 \\ 51 \\ $	R(2)=R(2)+C.2*(R(3)/C.8) GO TO 4C4 A R(4)=R(4)*C.8 R(3)=R(3)*C.2*(R(4)/O.8) GO TO 404 D K(1)=A(5,M)=R(2)=R(3)=R(4) PRINT 4C6,R(3) S FORMAT(3H R3,E1C.3) IF(A(5,M)*A(10,M)*ZD=R(1)) 517,517,516 D ZD=O.8*ZD IN=1 GO TU 1C1 7 IF(1Z=1) 518,518,521 B M=M+1 IF(M=NE)4CC,4CC,519
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	GO TO 4C4 R (4)=R(4)*C.8 R(3)=R(3)+C.2*(R(4)/0.8) GO TO 404 F (1)=A(5,M)=R(2)=R(3)=R(4) PRINT 4C6,R(3) FORMAT(3H R3,E1C.3) IF(A(5,M)*A(10,M)*ZD=R(1)) 517,517,516 D =0.8*ZD IN=1 GO TO 1C1 I F(1Z=1) 518,518,521 M=M+1 I F(M=NE)4CC,4CC,519
$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	<pre>4 R(4)=R(4)*C.8 R(3)=R(3)+C.2*(R(4)/0.8) GO TO 404 5 K(1)=A(5,M)=R(2)=R(3)=R(4) PRINT 4C6,R(3) 5 FORMAT(3H=R3,E1C.3) IF(A(5,M)*A(10,M)*ZD=R(1)) 517,517,516 5 ZD=0.8*ZD IN=1 GO TO 1C1 7 IF(1Z=1) 51E,51E,521 8 M=M+1 IF(M=NE)4CC,4CC,519</pre>
$\begin{array}{c} 409 \\ 410 \\ 411 \\ 51 \\ 412 \\ 413 \\ 413 \\ 40 \\ 414 \\ 415 \\ 51 \\ 416 \\ 417 \\ 416 \\ 417 \\ 416 \\ 51 \\ 420 \\ 421 \\ 51 \\ 420 \\ 421 \\ 51 \\ 422 \\ 52 \\ 423 \\ 424 \\ 52 \\ 423 \\ 424 \\ 52 \\ 425 \\ 52 \\ 425 \\ 52 \\ 426 \\ 427 \\ 428 \\ 429 \end{array}$	R(3)=R(3)+C.2*(R(4)/0.8) GO TO 404 5 R(1)=A(5,M)=R(2)=R(3)=R(4) PRINT 4C6,R(3) 5 FORMAT(3H=R3,E1C.3) IF(A(5,M)*A(10,M)*ZO=R(1)) 517,517,516 5 ZD=0.8*ZU IN=1 GO TU IC1 7 IF(1Z=1) 518,518,521 8 M=M+1 IF(M=NE)4CC,4CC,519
$\begin{array}{c ccccc} 410 \\ 411 & 51 \\ 412 \\ 413 & 40 \\ 414 \\ 415 & 51 \\ 416 \\ 417 \\ 416 \\ 417 \\ 416 \\ 417 \\ 418 & 51 \\ 420 \\ 421 & 51 \\ 422 & 52 \\ 423 \\ 424 & 52 \\ 423 \\ 424 & 52 \\ 425 & 52 \\ 425 & 52 \\ 426 \\ 427 \\ 428 \\ 429 \\ \end{array}$	GO TO 404 5 K(1)=A(5,M)=R(2)=R(3)=R(4) PRINT 4C6,R(3) 5 FORMAT(3H=R3,E1C.3) IF(A(5,M)*A(10,M)*ZC=R(1)) 517,517,516 5 ZD=0.8*ZU IN=1 GO TU IC1 7 IF(1Z=1) 51E,51E,521 8 M=M+1 IF(M=NE)4CC,4CC,519
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	<pre>5 K(1)=A(5,M)=R(2)=R(3)=P(4) PRINT 4C6,R(3) 5 FORMAT(3H=R3,E1C.3) IF(A(5,M)*A(10,M)*ZC-R(1)) 517,517,516 5 ZD=0.8*ZU IN=1 GO=TU=1C1 7 IF(1Z-1) 51E,51E,521 8 M=M+1 IF(M-NE)4CC,4CC,519</pre>
412 413 4C 414 51 415 51 416 51 417 51 418 51 419 51 420 51 421 51 422 52 423 52 424 52 425 52 426 427 428 429	PRINT 4C6,R(3) FORMAT(3H=R3,E1C.3) IF(A(5,M)*A(10,M)*ZD=R(1)) 517,517,516 D=0.8*ZD IN=1 GO TU 1C1 7 IF(1Z=1) 518,518,521 B M=M+1 IF(M=NE)4CC,4CC,519
$\begin{array}{c} 413 & 4C \\ 414 & \\ 415 & 51 \\ 416 & \\ 417 & \\ 418 & 51 \\ 420 & \\ 421 & 51 \\ 420 & \\ 421 & 51 \\ 422 & 52 \\ 423 & \\ 424 & 52 \\ 423 & \\ 425 & 52 \\ 425 & 52 \\ 426 & \\ 427 & \\ 428 & \\ 429 & \\ \end{array}$	<pre>5 FORMAT(3H=R3,E1C.3) IF(A(5,M)*A(10,M)*ZD=R(1)) 517,517,516 5 ZD=0.8*ZD IN=1 GO TU IC1 7 IF(1Z=1) 518,518,521 8 M=M+1 IF(M=NE)4CC,4CC,519</pre>
414 415 51 416 417 418 51 419 51 420 421 51 422 52 423 424 52 425 52 426 427 428 429	<pre>IF(A(5,M)*A(10,M)*ZC-R(1)) 517,517,516 ZD=0.8*ZU IN=1 GO TU 1C1 7 IF(1Z-1) 518,518,521 8 M=M+1 IF(M+NE)4CC,4CC,519</pre>
415 51 416 417 417 51 418 51 419 51 420 421 421 51 422 52 423 52 424 52 425 52 426 427 428 429	<pre>5 ZD=0.8*ZD IN=1 GO_TU_IC1 7 IF(IZ=1) 518,518,521 8 M=M+1 IF(M=NE)4CC,4CC,519</pre>
416 417 418 51 419 51 420 421 51 422 52 423 52 424 52 425 52 426 427 428 429	IN=1 GO TU IC1 7 IF(IZ-1) 518,518,521 8 M=M+1 IF(M-NE)4CC,4CC,519
417 418 51 419 51 420 51 421 51 422 52 423 52 424 52 425 52 426 427 428 429	GO TO 1C1 7 IF(1Z-1) 518,518,521 8 M=M+1 IF(M-NE)4CC,4CC,519
418 51 419 51 420 51 421 51 422 52 423 52 424 52 425 52 426 52 427 428 429 52	7 IF(1Z-1) 518,518,521 B M=M+1 IF(M+NE)4CC,4CC,519
419 51 420 51 421 51 422 52 423 424 424 52 425 52 426 427 428 429	B M = M + 1 IF(M+NE)4CC,4CC,519
420 421 51 422 52 423 424 52 425 52 425 52 426 427 428 429	IF(M-NE)4CC,4CC,519
421 51 422 52 423 52 424 52 425 52 426 52 427 428 429 52	
422 52 423 424 52 425 52 425 52 426 427 428 429	G IF(I-I) 115,115,52 C
423 424 52 425 52 426 427 428 428	
424 52 425 52 426 427 428 428	I Z = 2
425 52 426 427 428 429	GC TC ICI
426 427 428 429	I IF(I-1) 522,522,523
427 428 429	2 B(IC, M) = R(I) / A(5, M)
428 429	B(11,M)=R(2)/A(5,M)
425	B(12,M)=R(3)/A(5,M)
	B(13,M) = R(4) / A(5,M)
6.2.6	D(14,N)=TA(2)
	GC TC 524
431 52	5 C(10,M)=R(1)/A(5,M)
432	C(11,M)=R(2)/A(5,M)
433	C(12,M)=R(3)/A(5,M)
434	C(13,M) = R(4) / A(5,M)
35	C(14, M)=TA(2)
436 52	
437	IF(M-NE) 40C,40C,526
438 52	j
	7 GC TO 115
44C 53	IN=3
741	GO Từ 1CI
- ,	- Maye - Maye
\cdots . The set of the	

in fig staat stat derivederen van op staat waar gestaat se staat gewaard van die stat geveen van die stat gevee Gebeure		71
CRTRAN IV	MODEL 44 PS VERSION 3, LEVEL 1 DATE 69119	
5442	599 SUMCUR=C	
2443	DO 607 M=1,NE	
544	IF(I-I) 6CC,6CC,6O1	
445	600 TS=TS1	
446	GO TO 602	
647	6C1 [S=TS2	
448 449	602 PA=A(1,M) PB=A(2,M)	an an an and the second
445 450	PD-A(2), PJ PR=A(3, M)	
451	P = A (4, N)	
452	CALL TEMCO(E,TS,AK,DB,EM)	
453	YK(1) = EM(1)	
454	TK(2)=EV(2)	·····
455	YK(3) = EM(3)	
<u>\$56</u>	YK(4)=EN(4)	· - ·
457	YK(5) = EM(5)	
458	AI=KSORPA(LC;PA;PB;PR;PS;KE)	
1.59	A2=KSGRPB(LF,PA,PB,PR,PS,KE)	
460	A3=KSORPK(LG,PA,PB,PR,PS,KE)	
461	A 4=KSCRPS(LH, PA, PB, PR, PS, KE)	
462	PT=POT(LD,PA,PB,PR,PS,KE)	
463	SPA=A1*YK(2)	
464	SPB=A2*YK(3)	
465	SPR=A3*YK(4)	
466	SP 5=A 4*YKT 5)	***
467	DEN=(YK(1)+SPA+SPB+SPR+SPS) **N	
468	$K_{1} = A(5, M) * A(10, M)$	
469	V = (PT/(A(5, M) * A(10, M))) * * (1.0/N)	
470	IF(DEN -0.1*V) 6C3,6C5,605	
4/1	6C3 IF(DEN+C.1*V) 6C5,6C5,604	
473	604 R1CALC = PT/T0.1*V) GU TO 606	
474	60 10 808	
475	PRINT 62S, RICALC, RI	
476	= 606 CUR = (R1CA1C - R1) * *2	
477	607 SUMCOR=SUMCCR+CCR	
478	CUVAR = SQRT (SUMCCR/EN)	
479	PRINT 616,COVAR	
480	616 FORMAT(6H COVAR,E10.3)	
481	608 IF(1-1)6C9,6C9,512	
482	609 COVIB=2.C*CCVB	
483	COVNB(KK) = CCVAR	
4 Ê 4	IFICOVIB-COVAR) 610,610,611	
485	61C IN=1	
48 <u>6</u>	TIM=TIM+1	
487	IF(TIM-FM) 1CC,617,617	
488	611 G0 T0 115	
489	612 COVIC=2.0*CCVC -	
450	CUVNC(KK)=CCVAR	
79		
). 1940-0 1950 - Charles Martin, 1960 - 1970 - 1980 - 1980 - 1980 - 1980 - 1980 - 1980 - 1980 - 1980 - 1980 - 1980 - 19 19	neg a de la de	
		andari dalapi kuni waka manangi kuni ya

. 72 GRIRAN IV MUDEL 44 PS VERSION 3, LEVEL J DATE 69119 6451 IF(CUVIC-CUVAR)613,613,614 \$692 613 IN=1TIN=TIN+1 \$493 0494 IF(TIN-FN) 100,617,617 0455 614 CONTINUE DO 618 L1=1,MF 0.496 617 6497 00 618 J=1,14 618 PR INT 76, B(J, L1) C4.58 3495 619 PKINT 83, E, AK, DB 0500 00 62C M=1,MF 00501 62C B(10,M)=1.C 0502 DO 621 L2=1,NF 5553 DU 621 J2=1,14 0504 PRINT 84,C(J2,L2) 621 D0 622 M=1,NF 0505 0506 622 $C(1C, M) = 1 \cdot C$ 0507 624 KK=KK+1 IF(KK-N0) 59,99,625 0508 5555 00 626 KK=1, NC 625 0510 626 PRINT 82,COVNB(KK),CEVNC(KK) 651T 625 FORMAT(7H R1CALC, E10.3, 5X, 3H R1, E10.3) C512 STOP 0513 END $\sim q^{1/2}$ 1 J.L. ¢. Sen

LATKAN, IV NUCLE 44 P\$ VERSION 3, LEVEL 1 DATE 63119 CC1 FUNCTION POTICO PAYPS, PRYPS, NT 1 CC2 REAL KE CC3 UN TO TO TIST, 152, 153, 134, 156, 157, 158, 159, 1603, 100 CC55 GUIDPA-PAYAKE CC4 CS CG TO CONTROL CC50 GUIDPA-PAYAKE CC4 CG TO PAYAPAYAKE CC4 CG TO PAYAPAYAYAKE CC4 CG TO PAYAPAYAYAYAYAYAYAYAYAYAYAYAYAYAYAYAYAY	7.5				
CC1 FUNCTION PGTILD;PATPB,PK,PS,NE1 CC2 REAL KE CC3 COTOTISI;152;153;154;156;167;153;159;160;);10 CC4 151 CC5 GOTOTIEC A006 152 CC6 COTOTIEC A006 152 CC7 CC6 CC6 COTOTIEC A006 152 CC7 CC6 CC6 COTOTIEC A007 COTOTIEC A008 COTOTIEC A009 COTOTIEC A001 FPAPS) C11 COTOTIEC C12 ISP POTEPAP-PRAKE C13 COTIEC C14 ISP POTEPAP-PRAKE C15 COTIEC C16 ISP POTEPAPEPAK C17 GOTOTIEC C18 ISP POTEPAPEPAK C19 ISPAPS-PKAKE C11 COTOTIEC C12 END					
EC2 REAL KE CC3 GU TO (1 tk1 f152, 153, 154, 156, 157, 158, 159, 160 1, 10 CC4 151 P01+0 CC5 GO TO TEC A006 152 P01+PA-PX/KE CC7 GO TC TEC DC8 159 P01+PA-PX/KE CC7 GO TC TEC DC8 159 P01+PA-PX/KE CC7 GO TC TEC CC6 GO TO TEC C16 154 P01+PA-PS/KE C17 GO TO TEC C18 P01+PA-PS/KE C19 GO TO TEC C10 GO TO TEC C11 GO TO TEC C12 156 P01+PA-PS/FX/KE C13 GO TO TEC C14 157 P01+PA-PS/FX/KE C15 F00 TPA-PS/FX/KE C16 157 P01+PA-PS/FX/KE C17 GO TO TEC C18 159 P01+PA-PS/FX/KE C19 16C TEC TEC C11 GO TO TEC TEC C12 156 P01+PA-PS/FX/KE C13 156 P01+PA-PS/FX/KE C14 157 P01+PA-FX/KE C15 150 P01+PA-PS/FX/KE C2 EN0		ERSION 3, LEVEL 1 DATE 69119	MUCEL 44 PS	VMUCE	RTRAN IV
CG2 REAL KE CG3 CUTO T1817152715371567157715871601710 CC5 CG10T16C CG2 152 PD1+PA-PX7KE CG3 CG T10C CG4 159 PD1+PA-PX7KE CG5 CG10T16C CG6 159 PD1+PA-PX7KE CG6 159 PD1+PA-PX7KE CG7 CG1C 154 PD1+PA-PX7KE CG7 CG1C 154 PD1+PA-PX7KE CG1 CG1C 157 PD1+PA-PX7KE CG1 CG1C 157 PD1+PA-PX7KE CG1 CG1C 157 PD1+PA-PX7KE CG2 CG10T1+CC 157 PD1+PA-PX7KE CG3 CG10T1+CC 157 PD1+PA-PX7KE CG4 157 PD1+PA-PX7KE 157 CG1 156 PD1+PA-PX7KE 157 CG1 156 PD1+PA-PX7KE 157 CG1 156 PD1+PA-PX7KE 157 CG1 157 PD1+PA-PX7KE 157 CG2 END 157 CG1 CC END CG2 END 157 CG1 CC END CG2			ET KYP T T K L		
CO3 CO-1151r152r152r153r154r156r157r188r159r160)r10 CC4 151 P01+C CC5 CO-1C CC6 CO-1C CC7 CO-1C CC8 152 P01+PA-PA/KE CC7 CO-1C CC8 152 P01+PA-PA/KE CC8 152 P01+PA-PA/KE CC9 CC TC-1CC CC6 CO-1C-1CC CC6 CO-1C-1CC CC7 CO-1C-1CC CC8 152 P01+PA/PS/KE CC1 CO-1C-1CC CC1 CO-1C-1CC CC1 CO-1C-1CC C14 157 P01+PA/PS/PA/KE C15 CO-3T0-1CC C16 158 P01+PA/PS/PA/KE C17 GO-1C-1CC & 183 159 P01+PA/PS/FK/E C18 159 P01+PA/PS/FK/E C19 FA/PS/FK C19 FA/PS/FK C19 FA/PS/FK C10 FA/PS/FK C11 CO-1C-1CC FA/PS/FK FA/PS/FK		J \$ F A \$ F D \$ F K \$ Y S \$ KE }			
CC4 151 P01+0 CC5 C0 10 120 SC6 152 P01+0A-PX/KE		,153,154,156,157,153,159,160),LD	GU 10 (151,		003 <u>, 100, 100, 100</u>
004 152 P01=PA-PA/KE 057 GG-TC-16C 058 152 P01=PA/PS)-(FA/KE) 051 154 P01=PA/PS)-(FA/KE) 051 154 P01=PA/PS)-(FA/KE) 051 154 P01=PA/PS)-(FA/KE) 051 154 P01=PA/PS/KE 051 154 P01=PA/PS/RKE 052 051 P01=PA/PS/RE 053 051 P01=PA/PS/RE 054 157 P01=PA/PS/RE 055 P01=PA/PS/RE P01=PA/PS/RE 056 051 CG 051 P01=PA/PS/RE 051 CG CG 157 P01=PA/PS/RE 051 P01=PA/PS/RKE 051 CG CG 156 P01=PA/PS/RKE 157 CG 158 159 159 P01=PA/PS/RKE 150 P01=PA/PS/RKE 151 P01=PA/PS/RKE 152 END			151 POT=0	151	
CC (CG TC-16C GC 152 PC1=FA-(PRAPS)/KE GO TC-16C CC (C12 154 PU1=PA4PA-PR/KE C13 CO TC-16C C14 157 C15 CO TC-16C C16 158 PU1=PA4P3-PR/KE C17 CO TC-16C C18 159 PU1=PA4P3-PR/KE C17 CO TC-16C C18 159 PU1=PA4P3-FKKE C17 CO TC-16C C18 159 PU1=PA4P3-FKKE C15 150 C16 CO TC-16C C17 CO TC-16C C18 159 PU1=PA4P3-FKKE C19 END				152	
C1C 154 PD1=(PA/PS)-(FR/XE) C11 C3 C1C 164 C12 154 PD1=PAAPR>PR/KE C3 C13 C0 TC TEC C3 C14 157 PD1=PAAPB>PR/KE C3 C15 C6 TO TEC C4 C16 L56 PD1=PAAPB>PR/KE C4 C17 GO TC TEC C4 C17 GO TC TEC C4 C17 GO TC TEC C4 C18 L59 POT=PAAPB>=RXPEXKE C13 C16 C7 END C4 C17 GO TC TEC C4 C18 L59 POT=PAAPB>=RXPEXE C5 C16 END C4 END	n balan merilika kara di mana di mana di mana panya di panga baran bara			بری اس بط	
C1C 154 PDT=(PA/PA)=(PA/KE) C11 C0 TO 16C C12 156 PUT= PA+PR-PR/KE C13 C0 TO 1C 1cC C14 157 POT=PA+PB-PR/KE C15 C0 TO 1C0 C C16 156 PUT=PA+PB-PR/KE C17 GC TO 1C 1cC C18 159 PUT=PA+PB-FR/KE C15 16C RETURN P2C END C15 E		KE CONTRACTOR OF A CONTRACTOR OF		153	
C11 G0 TC 160 C12 156 PUT = PA+PA-PH/KE C13 C0 TO TCC C14 157 PUT = PA+PS ¥ 2 - PA/KE C15 C0 TO 160 C16 156 PUT = PA+PB - PK ×PE C17 G0 TC 16C C18 159 PUT = PA+PB - PK ×P S/KE C19 160 RETURN C20 END C20 END C	· · · · · · · · · · · · · · · · · · ·			167	
C12 156 PUT = PA*PA-PA/KE C13 C0-T0-16C C14 157 PUT=PA*PQ*2-FR/KE C15 C0-T0-16C C16 156 PUT=PA*PG-PR/KE C17 G0-T0-16C C18 159 PUT=PA*PG-FK*PS/KE C19 END C20 END C30				104	
C14 157 Pd T=PA *PB **Z=FR/KE 015 GD TD *1C0 C16 15E PD T=PA *PB **PE **KE C17 GD TTC 12C C18 155 PD T=PA *PB *FK *FE **KE C19 150 RETURN F2C END C19		Ended to the second se Second second se Second second sec second second sec	156 PUI= PA*PR-P	156	12
615 C0 TO 160 C16 150 PD1=PA*P3-PR/KE C17 GC TC 1c (c C18 159 PD1=PA*P3-FR*PS/KE C19 160 RETURN E2C END		· · · · · · · · · · · · · · · · · · ·		۵۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲ ۱۹۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ - ۲۰۰۰ -	
G16 156 PUTEPAXP3-PK/KE G17 G0-TC-TEC G18 159 POTEPAXP3-FKXPS/KE G19 150 RETURN G2C END G19 G19 G19 G19 G19 G19 G19 G19 G19 G19		/ KE		157	
C17 GC 1C -1cC (18 159 PD T=PA*P3-FK*P5/KE C15 1cC -RETURN C2C END C15 C C C C C C C C C C C C C C C C C C				158	
			GG TC 1eC		17
		/KE			
				100	N
			4	ana Anna	* *** *
	· · · · · ·			· · · · · · · · · · · · · · · · · · ·	
			and a standard stand Standard standard stan		
			999999 - 197999444444 - 44400 44400 - 44000- 44000- 44400- 44000- 444000- 444000- 444000- 444000- 444000- 444000-		
				al der Fahren sier ein soch ande beson frankt im sommen beitig menten an oppennen 17	
				· · · · · · · · · · · · · · · · · · ·	
					abland (Marage, reprint a second state and and and
	÷				
			a a a a a a a a a a a a a a a a a a a		
			· · · ·		
	· · · ·				
					· · · · ·
				an a	••••••••••••••••••••••••••••••••••••••
				· .	
				· · · · · · · · · · · · · · · · · · ·	
•				· * *	
	an the an a fight for a standard as a standard for the second standard	•			

	74
CRTRANIV	MODEL 44 PS VERSION 3, LEVEL 1 DATE 69119
2001	REAL FUNCTICK KSCRPATLC, PA, PE, PR, PS, KET
C9C2	REAL KE
¢003	GU TU(171,172,173,174,175,176,177,178,179,130,181,182),LC
C004	171 KSORPA=C
CCC5	GC TC 182
CCC6 0007	172 KSORPA=PR/KE GU TC 182
CSC8	173 K SORPA=(PA)**(1/2)
3009	<u>GU TU 182</u>
CCIC	174 KSORPA = (PR + PS)/KE
CC11	
0012	175 KSORPA=(PR/KE)**(1/2)
約13	<u>GU TU 182</u>
0014	176 KSORPA=(PR*PS/KE)**(1/2)
CC15	GO TO 182
6016	177 KSORPA=PR/(KE*PB)
0017 CC18	GCTC-182 178 KSORPA=(PR/(KE*PB))**(1/2)
0010 0010	GU TU 132
0020	175 KSCRPA= PR*PS/(KE*P8)
ÁČ21	GO TO 182
0022	180 KSORPA=(PR*PS/(KE*PB))**(1/2)
0023	GO TO 182
0024	181 KSORPA= PA
5025	182 RETURN
0026	END
γ'	
8 mm	
- · ·	
.)	
2 2	
1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	
· · · · · · · · · · · · · · · · · · ·	
inne Eine	
an an ann an an ann an an an an an an an	

							15	
								· · · · · · ·
CRTRAN	MUDEL	44 25	VERSTON	3, LEVEL	DATE	69119		· · · · · · · · · · · · · · · · · · ·
An a strange and a sector					,	0/44/		
CCO 1 CCC 2		REAL FUNCTI REAL KE	ON KSORPB	TLF, PA, PB, P	R, PS, KET	*****	an fernalisis a suffer " en el sentitis estat des d'insertition entre service many service	
CCC3-0002		GO TO TIE4,	185,186,1	87) . I F				
CCC4		KSCRPB = C						
CCC5 6006		GO TO 188						
CCU7	100	KSORPB=PR/(K			n fra na disa dalambanakan nakasing nakasing nakasing nakasing nakasing sa			inter werden statemente witzeweitigten.
6668		KSORPB=PR*PS	I/(KE≑PS)					
2009		-GU TC 188-						
CO10 0C11		KSORPB=PB RETURN						
0012	100	END						
			e data e a destado estas o a conservante enclande enclando estas destas e una consecutor estas		ann ann a chuidh an deanach an an ann an an ann an ann an ann an an	nan han an a		fantasian artana any disebut any dia
			1/10/10/10/10/10/10/10/10/10/10/10/10/10					
- See								
	anaganganan tarah si ngga ka kasi si dalam ka							
	· Verlandska seremenneme		M ^{an} halfföller vilke ¹ antal ma fördelser i var fördelska mende förstadet att som som köre			aller mennen som	a na 1971 - Martin Salaka kata kata kata kata kata kata kata	
								\$p
ja						1999 (1999) (199		
	in 1985, alter franzisk samsjag (p. 19					······································		
2								
	1994 a. antore a popular d'aya ant 199	nfeldform o'r y'r ddorsylw o'r lloren Ondanko War o'r lafor o'n achor o'r lloren y yn o'r arfaraechanogae.		e - malana an	en - 19 het in Santa		anna	
· · /	and the second							
1.								
	en anna a statut	an a			An High Marine To are and an estimation of an estimation of a second second second second second second second		nanna muuna an cuis maaadon ad co a co so addin cho derena adro de mana	-
		-					1979) was a manufacture of the Second Add Add Add Add Add Add Add Add Add A	
						7		
		In contraction of the second of a constraint of the second of the sec		nannan mananan san dikaranga in saras saras sanan kanangan kanangan kanangan kanangan kanangan kanangan kanang				
) . 2	··· · · · · · · · · · · · · · · · · ·						·	
	Faile							
	Wedel - Web - Stanlagers & Missan analisation	ananan ar a sanan ang dari sa sa sa anan ang dari sa dari sa			an ann an de anna an agus agus ann an an agus an an an ann an an ann an an ann an an		***	······
								** A M MAX memory measurement and server
a 			and the state of the second		•	· · · · · · · · · · · · · · · · · · ·		
					, vie			
	ти потералистически поли и околоми.	alan bir de manaren, artara andre samble Bassissi bir an disarren andre samble andre sent y engen andre sent y			, with a farmer's constant and a solution of the solution of the fact to be a solution of the solution of the s	- And An Andrean and An and	an managaman an ang an ang an ang ang ang ang ang	where we are a subscription of the subscription of
les 1997 - A California de la companya d 1997 - A California de la companya d								
la se			∼istop					
ket () (n marinana w () (n marina () () () () () () () () () () () () ()			- 24					
n Se Service and a second s	• *****		nan - nan a d'Al Vel Vel Vel Vel a de la desende d'anné a senar non na antasan a se		9 8 /	a progen Ve 1941 a Amirida da parte da ser a consta da des ad Antis da La de academica na ac	d gaf seneratur en engen oggen og av en føde seneratur og for at sen at sen at seneratur og angen er seg	12.8 1911-1911-1911-1911-1911-1911-1911-191
				•				
· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·					W Tableton Alberton San ang aga ang ang ang ang ang ang ang a		

iner bestat Statestatige average			- 76
JRTRANIV	MODE	L 44 PS VERSION 3, LEVEL 1 DATE 69119	
001		REAL FUNCTION KSCRPR(LG, PA, PB, PR, PS, KE)	
0002		REAL KE	
00 3	100	GU TU (185,150,151,152,193,194) ,LG	
0004	189	K SOR PR = PR GU TG 195	
3000	190	K SORPR = 0	
20 C 7	ne ter Wellen an enter an enter a	<u>CU TC 195</u>	
0008 300 5	191	KSGRPR=KE*PA GC TG 195	
	192	KSCRPR=KE*PA/PS	
011			-
012	193	K SORPR = KE *PA *PB	
2013 2014	194	GO TO 195 KSORPR=KE*PA*PB/PS	
015		RETURN	
010		END	
1 	and the state of the second se		
des .			
яř			
	-		
°a . √			
3			
1999 - Tanan Santa S 1			a da da seria da segunda da deseria, en consela sidaren erreta en actuar da erreta da erreta da erreta da erret
ylan.		•	
rije V			
		. /	
2			dia mandri C. Mandri ang
۵۰. 			
			¢
		•	
-		"sg.	
			· · · · ·
Manana da Angeles de Martina ana angela na akan kanana ang kanana ang kanana ang kanana ang kanana ang kanana a		•	

: 77 MUDEL 44 PS CRIRANIV VERSIUN 3, LEVEL 1 DATE 69119 KEAL FUNCTION KSCRPS(LH, PA, PE, PR, PS, KE) coor 5002 REAL KE 4003 GO TC (197,198), LH 40004 197 KSORPS=PS 0005 GU 10 199-0000 198 KSURPS=CRETURN 0007 199 8000 END 4 .

						ter s dependent and the AM Artificial class associations approximately and the province of the	28
CRERA	N IV MODEI			3, LEVEL I			
Ŕ		•		6		.19	
0001 0002		SCBRUCTIN IF(CA-C) 7	E SIGFICA,CB CC.4697.697	,CR,CS,/IK/)		nan nyangkalan yang da a tanan karang kang kang kang kang kang kang kang k	
ទី០០3ា		IFIC8-C) 7	CC,698,698				
LCC4 DCC5-	698 	IF(CR-0) IF(CS-C)	700,655,655 700,701,701-				All and ware with American start of the American Start and the start of the American Start Start Start Start St
3006		IK=1					
0007 008	701	<u>GC TC 7C2</u> IK=2	nin dha yaan aa ahaa ahaa ahaa ahaa ahaa ahaa	nine menera, i panta nanggan ngama na u apamama nangan nang nang nang nangan sang nang	nine a 1979 mar - 2019 fi litera kato e de materia a sua na sua na sua sua de sua sensa de se	and the first sector product the resolution of the resolution of the sector of the sec	nen et al an
<u>%</u> 00a_		RETURN					
C G I C	•	END					
••••••••••••••••••••••••••••••••••••••						· ·	
÷.				anna ann an Anna ann ann ann ann an Anna an Anna ann ann	an anna an far air an anna ann ann an ann ann an ann ann	nen anderen en blanderen en e	un en
· · ·							· · · · · · · · · · · · · · · · · · ·
					·····	1999 (1997 1997 1997 (1997 1997 1997 199	· · · · · · · · · · · · · · · · · · ·
han .							
der And					in a na sharan na sharan karan karan karan karan ya karan	MARTEN MEN MEN MEN MEN AN	
	•					9	
						A an all second and a second and	
) •		т. Полити имая бали алакани бильковый на скланичений А.С.Диголькани и им импозития на					
d. M						Reservation of States 1 () () () () () () () () () (annen en annen
y							
			an a sa a				
		n na na start da facilitat da seconda da sec		r m na sa			
-							
						•	
e							
1 Mar And 10						•	
					# 17 10-01 \$ \$10,000,000 \$7 10-000 \$200 \$200 \$200 \$200 \$200 \$200 \$200		n sana na manganga panga pangangan wata sa
Ma 99 and 100 a				997	a a successive a successive state and an address of a successive a successive a successive as	alah konstanta da sakaan in 1 saka na anan jujuja 1 - Japangan	
						-,	
			- Malas				
				· · · · · · · · · · · · · · · · · · ·			and a second
					na). Na na mangana na mangana mangana mangana na panangana na panangana pangana na panangana pangana pangana pangana	er e fan de f	i Na minina wa affi kata kata akwa kata na mana na kata kata kata kata kata kata kat
				•			
				and and the second s			

							79

CRIRAN IV	MODEL	44 PS	VERSIC	IN 3, LEVEL 1	DATE	69119	
200Cl		SUBRITINE	TENCTIE	TS,AK,DB,/EM/			·····
0002		GC=1.98					
COC3	1	DIMENSION- DO 5 MV=1		(15),CB(5),EM(5)		
CUC5	4	TF(E(I;MV)					
6003	2	IF(E(2,MV)					
6008	3	EM(TTV)=AK(GO TO 5	MAL #12#08	(MV)	alle des la des services en releva (no 1000 visitale visita de la construction de la construction de la constru		ann ta bhainn an an an an an ann an ann an ann an
2009	Zy	EN(MV)=AK(MV)*EXP(-	DB(MV)/(GC +TS))		
[CC1C [CC1C]	5	CONTINUE RETURN					
0012	0	END					
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1						na an a	
* · · · · · · · · · · · · · · · · · · ·						•	
- Alexa		ο στο στο στο στο στο στο στο στο στο στ	9990-11-12-22-22-24 Millio -12-27-20-20-20-20-20-20-20-20-20-20-20-20-20-			- Ada - 27	
and the second sec			n a Marana ana amin'ny fisiana amin'ny fisiana amin'ny fisiana amin'ny fisiana amin'ny fisiana amin'ny fisiana	ar - ton una articlean agus a la una dagana an an an ann an ann an an an an an a		n Martin Carlon a martin a data apar, papa Nacional Sanca Sanca Sanca Sanca Sanca Sanca Sanca Sanca Sanca Sanc	
l setas Banda inconstruction							
•							
· · · · · · · · · · · · · · · · · · ·							
			arten 1. 14. Distanta da anti-ten de la constanta di tendera di desta de se se se en escana anti-				an an an ann an t-ann an An C-an Ann an A
iner ner		н Н					
*							
	waan faree waxaa ahaa ahaa ahaa ahaa ahaa ahaa aha		•				
							ander ein der eine auferte seine gesetzte der der der der der eine Besternenzeichnet anneren andere Konner Kon
7 %.							
}							
3.84			Ale en Arres e mentales dans de la construction de la construcción de la conseguration que	ner en		nen sakan di dalam di Mala dalam a mana si kasan gena kasin karan majara sakan yang kasan kasan kasan ka	na na shekara na
				ne V Sandiade anna anna an ann ann ann ann an an an a			
¥-			an fair a' bhliach hach cho at bair ionaith ma y rug à bhliach anns an tha cho Mhair a'	- solah bertekan menangkan penangkan penangkan penangkan penangkan penangkan penangkan penangkan penangkan pen			

2		·				-	
			allade 1991 a " A 1998 here were been an aus rannan or a success and an and				
			-style-				
; ; ; ; ;							
			×.		-19		قر.
				en e	ан антис и перенерание на сорона сорона сорона и на сорона на сорона на сорона на сорона на сорона на сорона н В перенерани		
· · · · · · · · · · · · · · · · · · · ·						······	

CRTRAN IV	MODEL 44 PS VERSIEN 3, LEVEL 1 DATE 69119	, 1
1001	SUBROUTINE MAT(G,VUK,/GV/)	
002	DIMENSION G(5,6)	
002	DIMENSION GV(5,6)	
10.04	KP = VCK	
CC5	GU TC (1,2,3,4), KF	
006	1 GV(1,1)=G(1,1)	
000	GV(2,1) = G(2,1)	nante, militar attarette na tradu patan special pata da tradita a taga a que eque a de specialmente tradució d
668	GV(3,1) = G(3,1)	
000	GV(1,2)=G(1,2)	
010	GV(2,2)=G(2,2)	
C11	-Gv(3,2)=G(3,2)	
012	GV(1,3)=G(1,3)	
013	GV(2,3) = G(2,3)	
014	GV(3,3) = G(3,3)	
C15	GV(2,4) = (2,6)	
016	GV(3,4) = (3,6)	а. А
7017	2 - GV(1, 1) = G(1, 1)	
018	GV(2,1)=G(2,1)	
C19	GV(2,1)=G(2,1)	
020	GV(4,1) = G(4,1)	
Č21	Gv(1,2)=G(1,2)	
022	GV(2,2)=G(2,2)	
023	GV(3,2)=G(3,2)	
024	$GV(4_72) = G(4_72)$	
025	GV(5,2)=G(5,2)	
.026	GV(1,3)=G(1,3)	
C27	GV(2,3)=G(2,3)	
028	GV(3,3)=G(3,3)	
1029	GV(4,3)=G(4,3)	
020	GV(1,4) = G(1,4)	
.031	GV(2,4) = G(2,4)	
032	GV(3,4)=G(3,4)	
C33	GV(4,4) = G(4,4)	
1034		
035	$3 = GV(1_{3}1) = G(1_{3}1)$	· · · · · · · · · · · · · · · · · · ·
C36	GV(2,1)=G(2,1)	
.037	GV(1,2) = G(1,2)	
3603	GV(2,2)=G(2,2)	
039	GV(1,3) = G(1,6)	
040	GV(2,3) = G(2,6)	
641	GO TO 5	
1042	4 GV(1,1) = G(1,1)	
.043	GV(2,1)=G(3,1)	
044	GV(1,2)=G(1,3)	
;045	GV(2,2)=G(3,3)	
C4.6	GV(1,2)=G(1,2)	
64.7	GV(2,3)=G(3,6)	
CC48	5. RETURN -	
C4S	EN D	
270 for		

and and a second se Second second second Second second		810
n an	에는 이상에 가지 않는 것이 있는 것이 있다. 것이 있는 것이 있는 것이 있는 것이 있는 것이 있다. 것이 있는 것이 있는 같이 같이 같이 있는 것이 같이 있는 것이 같이 있는 것이 있	
-URTRAN IV	MODEL 44 PS VERSION 3, LEVEL 1 DATE 69119	i i Marana Marana Marana
0001	SUBROUTINE SOLV(A,VCK,U2,TOLR,/K/)	
0002	DIMENSION A(5,6),K(6)	
0003	REAL K	
0004	N 2=U 2	
0005	N1=N2+1	••••••••••••••••••••••••••••••••••••••
0006	DO 14 $I = 1, N2$	
0007	DIAG=A(I,I)	uller uns im verkleit de metricanaarberenna zanzengen felten angelege ferkleiten op
0008	IF(DIAG) 5,25,5	
0009	5 DU ć J=1,N1	
010	6 A(I,J) = A(I,J) / DI AG	
0011	KJ=1	n dan series and series
0012	S IF(KJ-I) 11,13,11	
	11 FCTR=A(KJ,I)	. Alter a discussion of the second
0014	DO 12 $J=1,N1$	
¢C15	$\frac{12}{12} = A(KJ,J) = A(KJ,J) - FCTR \neq A(I,J)$	
0016	13 KJ=KJ+1	
0017	IF(KJ=N2) 9,9,14	
0018	14 CONTINUE	
0019	IF(VCK=1) 2C,2C,21	Na kan la ang balan kang pang kang balan na pang kang pang kang pang pang pang pang pang pang pang p
&020	20° K(1)=A(1,6)	
\$C21	$K(2) = A(2, \epsilon)$	
J022 .	K(3) = A(3, 6)	
0023	K(4)=C	
0024	K(5) = C	
0025	K(t) = 1	anna ann an Sanna an
QC26	21 IF(VOK-3) 22,23,24	
6027	22 K(1)=A(1,5)	·
0028	K(2) = A(2,5)	
0029	K(3) = A(3,5)	
CC3C	K(4) = A(4,5)	
0031	K(5) = C	
0032	K(b) = 1	
0033	GU TU 27	W MARK AND AND A COMPANY AND
Q034	23 K(1) = A(1,3)	
CC35	K(2)=A(2,3)	
0036	K(3) = C	
0037	K(5)=0	, A faith a three have named a first of some some PROS (some some and the some name some some
GC38	K(6)=1	
CC35		
<u>C04C</u>	24 K(1)=A(1,3)	
S041	K(2) = C	
C042	K(3) = A(2,3)	
CC43	K(4)=0	
6644	K(5) = 0	
0045	K(6)=1	······································
ÇC46		
EC47	19 FURMAT(E13.2)	
CC48	25 PRINT 26,A(I,I)	•
CC49	K(6)=2	ىرىنى يىلى ئەرىپىيى تەرىپىرىنى بىرىپىرىنى بىرىپىرىنى تەرىپىرىيەت تەرىپىرىنى بىرىپىرىنى بىرىپىرىنى بىرىپىرىنى بى يېلىرىنى يېلىرىنى بىرىپىرىنى بىرىپىرىنى بىرىپىرىنى بىرىپىرىيى بىرىپىرىنى بىرىپىرىنى بىرىپىرىنى بىرىپىرىنى بىرىپى
	- Aux	
- Tenneng en andere en en andere en andere en en andere en		a,
		الماريخ و در

TUT AN CTU	MEREL	7. 7. D C	VED CTON 2	· · · · · · · · · · · · · · · · · · ·		ht stigt
		•	VERSION 3,		ALE 69119	
C05C CC51	26 27	FURMAT I RETURN	GH EXTLE, EIC.3)	n ben an de service and an		
052		END	· · · · · · · · · · · · · · · · · · ·			
	Min Processory and any process sector of a 1 or process of an	-			· · · ·	
	ann an ann an Suite ann ann an Suite an Suite ann an Suite	,				
		. <u></u>		1999		
187 - Frankrik Agentika Amerika						
		•	1			
		Mark				
	· · · ·					
				, myanada yangan kuta kata kata kuta kuta kuta kuta kuta		
	. · ·					n Statistics Statistics
	aa maaqaanaa ah aa ah a			an a		
					· · · · · · · · · · · · · · · · · · ·	
	neuronaisceanna a sealar an cons a social servicia canada actor					
e site	1.101 · 17 · 1920a · 101 · 11 · 11 · 11 · 11 · 11 · 11 ·			· .	*	
						•
			-		· · · · · · · · · · · · · · · · · · ·	
				· · · ·		
				*		
				· · · · · · · · · · · · · · · · · · ·		
······································			France .			
	kalala on hillion on you do by a wey out an initial out		ananananan ar ar ar ar an		na an manana an a	

REPERINCES

Aris, Introduction to Analysis of Chemical Reactors (N. J. Prentice Hall). 1966

2P. G. Ashmore, <u>Catalysis and Inhibition of Chemical Reaction</u> (Lendon, Butterworths, 1963).

³Eckert and Drake, <u>Heat and Mass Transfer</u> (McGraw Hill Book Company, New York: 1959), p.69.

⁴C. N. Hinshelwood, <u>Kinetics of Chemical Change</u> (Oxford: Clarendon Press, 1940), p. 185.

⁵O. A. Hougen and K. M. Watson, <u>Chemical Process Pinciples</u> - Volume III, 938 (New York: John Wiley and Sons, 1947).

⁶F. Leder and J. Butt, <u>Surface Catalysis of the Hydrogen Oxygen</u> <u>Reaction on Platinum at Low Temperature</u>, (AIChE Journal <u>12</u> (4) 718 (1966).

7J. A. Maymo and J. M. Smith, <u>Catalytic Oxidation of Hydrogen</u> <u>Intrapellet Heat and Mass Transfer</u> (AIChE Journal 12(5) 845 (1966).

⁸E. E. Petersen, <u>Chemical Reaction Analysis</u> (N.J.: Frentice Hall, 1965), p. 77.

9R. H. Yang and C. A. Hougen. <u>Determination of Mechanism of</u> <u>Catalyzed Gaseous Reactions</u> (CEP <u>46</u> 146, 1950).