

TABLE 1
Summary of key equations

$$d \left(\frac{nG}{RT} \right) = \frac{-nH}{RT^2} dT + \frac{nV}{RT} dP + \sum \frac{\mu_i}{RT} dn_i \quad (34)$$

$$d \left(\frac{nG^R}{RT} \right) = \frac{-nH^R}{RT^2} dT + \frac{nV^R}{RT} dP + \sum \ln \hat{\phi}_i dn_i \quad (37)$$

$$d \left(\frac{nG^E}{RT} \right) = \frac{-nH^E}{RT^2} dT + \frac{nV^E}{RT} dP + \sum \ln \gamma_i dn_i \quad (66)$$

$$\frac{G}{RT} = \sum x_i \frac{\bar{G}_i}{RT} = \sum x_i \frac{\mu_i}{RT}$$

$$\frac{G^R}{RT} = \sum x_i \frac{\bar{G}_i^R}{RT} = \sum x_i \ln \hat{\phi}_i$$

$$\frac{G^E}{RT} = \sum x_i \frac{\bar{G}_i^E}{RT} = \sum x_i \ln \gamma_i$$

$$d \left(\frac{nG^{id}}{RT} \right) = \frac{-nH^{id}}{RT^2} dT + \frac{nV^{id}}{RT} dP + \sum \frac{\mu_i^{id}}{RT} dn_i \quad (64)$$

With μ_i replaced by \bar{G}_i in Eq. (34) and μ_i^{id} replaced by \bar{G}_i^{id} in Eq. (64), we subtract these two equa-

$$d \left(\frac{nG^E}{RT} \right) = \frac{-nH^E}{RT^2} dT + \frac{nV^E}{RT} dP + \sum \frac{\bar{G}_i^E}{RT} dn_i \quad (65)$$

tions where the definitions of Eqs. (49) and (50) have been invoked. In view of Eq. (60), this equation may also be written

$$d \left(\frac{nG^E}{RT} \right) = \frac{-nH^E}{RT^2} dT + \frac{nV^E}{RT} dP + \sum \ln \gamma_i dn_i \quad (66)$$

Equation (66) is analogous to both Eqs. (34) and (37); analogous to Eqs. (38) through (40), we have

$$\frac{H^E}{RT} = -T \left(\frac{\partial (G^E/RT)}{\partial T} \right)_{P,x} \quad (67)$$

$$\frac{V^E}{RT} = \left(\frac{\partial (G^E/RT)}{\partial P} \right)_{T,x} \quad (68)$$

$$\ln \gamma_i = \left(\frac{\partial (nG^E/RT)}{\partial n_i} \right)_{T,P,n_j} \quad (69)$$

The formulation of solution thermodynamics through excess properties derives its usefulness from the fact that H^E , V^E , and γ_i can all be found by experiment. This relative abundance of experimental entries provides alternative measurements that yield property data. However, the excess-property formulation provides even less-complete property information than the residual-property formulation, because it tells us nothing about the properties of the pure chemical species.

In Table 1, we bring together for comparison the parent fundamental property relation for the Gibbs function and the two analogous property relations which follow from it for the residual and excess Gibbs functions. Included as well are the equations which relate the three mixture Gibbs functions to their respective partial properties. These are particular applications of Eq. (11). □

ChE books received

Fundamentals of Chemistry, Second Edition, James E. Brady, John R. Holm; John Wiley & Sons, Inc., New York; \$34.95 (1984)

Handbook of Powder Science and Technology, Edited by M. E. Fayed and L. Otten; Van Nostrand Reinhold, 135 West 50th Street, New York, 10020; 850 pages, \$79.50 (1984)

Analytical Pyrolysis: Techniques and Applications, Edited by Kent J. Voorhees; Butterworths, 80 Montvale Ave., Stoneham, MA 02180; 486 pages, \$69.95 (1984)

Heat and Mass Transfer in Rotating Machinery, Darryl E. Metzger, Naim H. Afgan; Hemisphere Publishing Co., 79 Madison Ave., New York 10016; 713 pages, \$74.50

Cheaper, Safer Plants or Wealth and Safety at Work, Trevor A. Kletz; Institution of Chemical Engineers, 165-171 Railway Terrace, Rugby, England; (1984)

Engineering Information Resources, Margaret T. Schenk and James K. Webster; Marcel Dekker, Inc., New York 10016; 232 pages, \$24.75 (1984)

From Technical Professional to Corporate Manager; A Guide to Career Transition, David E. Dougherty; John Wiley & Sons, Somerset, NJ 08873; 279 pages, \$19.95 (1984)

Natural Product Chemistry: A Mechanistic and Biosynthetic Approach to Secondary Metabolism, Kurt B. G. Torssell; John Wiley & Sons, Inc., Somerset, NJ 08873; 401 pages, \$24.95 (1984)

The Wiley Engineer's Desk Reference, Sanford I. Heisler; John Wiley & Sons, New York 10158; 567 pages, \$34.95; (1984)

Laboratory Manual of Experiments in Process Control, Editor, Ch. Durgaprasada Rao; ChE Education Development Center, Indian Institute of Technology, Madras 600 036 India, \$20 (1984)