

$$\Delta_n = (1/2) \sum_{i=1}^n (-1)^{i-1} / (i-1)! \quad (7)$$

and

$$S_n = 1/2 \sum_{i=1}^n (n-i+1)(-1)^{i-1} / (i-1)! \quad (8)$$

When n is large, Δ_n represents the average number of isolated functional groups of either variety, X or Y, per substituent.¹ The series in (7) converges rapidly as n increases giving in the limit $\Delta_\infty = 1/2e$. That is, a fraction equal to $1/2e$, or 18.4%, of the functional groups is isolated at completion of the condensation.

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Some Heat Capacity Data for Gaseous 2,2,4-Trimethylpentane

BY MILO KIPERASH AND GEORGE S. PARKS

Recently Pitzer¹ has reported a single experimental value for the heat capacity at 423°K. and 1 atm. (constant pressure) of gaseous 2,2,4-trimethylpentane. On the basis of statistical calculations and with the guidance of this value he also has suggested the general equation

$$C_p = -227.3 + 110 \log T \quad (1)$$

for the heat capacity of this hydrocarbon as a function of the absolute temperature.

Two years ago, in connection with some other work on organic compounds in the gaseous state, we likewise made five determinations of the molal heat capacity at 1 atm. pressure of gaseous 2,2,4-trimethylpentane. A "constant flow" method, briefly described elsewhere by Parks and Shomate,² was employed, and the uncertainty in the resulting data is probably within 1.5%. Our results lie between 442 and 458°K. and are given in the second column of Table I. For comparison the value of Pitzer is included parenthetically. Column 3 contains the corresponding values calculated by Pitzer's equation, from which our data differ on the average by 1.4%. In view of the facts this is a reasonable check.

In Column 4 appear C_p^0 values for the gas at zero pressure. These have been derived from the previous experimental results by use of Berthelot's equation of state ($C_p^0 = C_p - 81RPT_c^3 / 32P_cT^3$) and with the assumption of 25 atm. and

(1) Pitzer, *THIS JOURNAL*, **62**, 1224 (1940).

(2) Parks and Shomate, *J. Chem. Phys.*, **8**, 429 (1940).

TABLE I

SOME HEAT CAPACITY DATA FOR GASEOUS 2,2,4-TRIMETHYLPENTANE

Units are cal. per degree per mole.

T, °K.	C_p (1 atm.)		C_p^0	
	Expt.	Calc. eq. 1	Expt.	Calc. eq. 2
423	(61.6 ± 0.6)	61.6	(61.1)	60.3
442	63.8 ± 1.0	63.7	63.4	62.2
442	64.6 ± 1.0	63.7	64.2	62.2
448	65.6 ± 1.0	64.3	65.2	62.9
449	65.3 ± 1.0	64.4	64.9	63.0
458	66.7 ± 1.0	65.4	66.3	63.9

550° for P_c and T_c , respectively. The calculated values for C_p^0 in the last column have been obtained from Pitzer's general empirical equation for gaseous paraffins

$$C_p^0 = 5.65n - 0.62 + t(0.0111n + 0.0158) \quad (2)$$

where n is the number of carbon atoms and t is the centigrade temperature.³ While he suggests that this latter equation is probably applicable to branched paraffins as well as to the normal compounds, it apparently runs a little low in the case of this highly branched compound. In passing, we should note here that heat capacity values calculated for 2,2,4-trimethylpentane by the semi-theoretical methods of Bennewitz and Rossner⁴ are of the order of 10 per cent. low, or more, as Pitzer likewise found in the case of their experimental determination on *n*-heptane.

(3) Pitzer, *THIS JOURNAL*, **63**, 2413 (1941).

(4) Bennewitz and Rossner, *Z. Physik. Chem.*, **B39**, 126 (1938).

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The Identification of Alcohols in Aqueous Solution

BY WILLIAM N. LIPSCOMB AND ROBERT H. BAKER¹

The identification of an alcohol when it appears in aqueous solution as from the saponification of an ester usually involves its isolation by repeated distillation, salting out, and drying. Henstock² was able to avoid this time-consuming procedure by the use of the Schotten-Baumann reaction of *p*-nitrobenzoyl chloride at -15°.

We have found that the more satisfactory 3,5-dinitrobenzoates may be formed by slight modification of the Henstock procedure. The process involves adding alkali and sodium acetate to the aqueous solution of the alcohol and shaking it at

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(2) Henstock, *J. Chem. Soc.*, 216 (1933).