Collection of data on Scattering

(1) The molecular Scattering of light in Benzene vapour and liquid :— K. R. R

Phys. Rev. 21, (5) 564, 1923.

$\frac{I_t}{I_e}$ = intensity at t°

$\frac{I_t}{I_e}$ = intensity for ether at 35°

ρ = depolarisation factor.

Saturated Benzene vapour.

t	I_t/I_e	$\rho \times 100$
35°		7·2
100		6·2
182°	·95	3·5
204°	1·56	3·4
228	3·00	2·5
247	4·9	2·0
267	11·9	1·5
280		0·9

Liquid Benzene

t	I_t/I_e	γ
35	3.2	43
125	3.67	32
182	5.48	19
205	7.21	14
228	11.0	9.5
268	20.5	3.0
280		2.8
283	102	

From the ~~calculat~~ value of β calculated from Dietrici's eqn, with an empirical correction factor he gets for the calculated value of I for benzene vapour at 267° 10 times that of ether. But obsd value = 11.9 — At other temps observed value is even higher.

(2) The scattering of light by dust-free liquids — changes with temp — by Martin & Lehrman — Journal of Phys. chem. p 538, 1923.

Benzene

t	$\rho \times 100$
0°	48.8
5°	48.3
10°	48.1
20°	49.0

mean = 48.5%

Benzene

t	$\rho \times 100$	relative I obsd	rel. I calcd from Einstein formula × $\frac{6(1+\rho)}{6-7\rho}$
20°	48.5	1.00	1.00
100°	39.4	1.33	1.32
200°	15.4	2.40	
250	6.1	6.0	
260°	4.5	10.7	
270°	2.5	19.4	
280°	1.5	62.0	
288 (critical)			

4.

Heptane (Kahlbaum and Petroleum B.P. 97.5–98°)

20°	12·7	1·00	1·00
100°	10·0	1·30	1·76
200°	3·8	3·97 ~~4·10~~	
225	2·6	6·8 ~~6·0~~	
240	2·0	10·1 ~~10·7~~	
250	1·7	13·4 ~~19·4~~	
260	1·65	16·8 ~~62·0~~	
critical		very high and metam	
270	1·53	28·1	

Naphthalene. B.P. 218°.

80°	71*	1·00
200°	63·5	1·04
300	41	1·30.

Naphthalene begins to discolour at high temps.

"The intensities for each liquid are taken only as relative to that for the same liquid at 20°. We hesitate to bring these to any common basis: round bulbs make such a comparison difficult, the bulb concentrating the beam by varying amounts depending on the size of the bulb and on the contained liquid. Naphtha however scatters about 3.9 and heptane .40 times as much light as does benzene

(3) Molecular Scattering of light in pure liquids — Part II — Martin and Lehr. J. Phys. Chem. 26, 25 1922.

Liquid	$\rho \times 100$.	$\frac{I}{I}$ (Benzene = 1)
Benzene	48·4	1·00
Toluene	49·0	1·14
Xylene (mixture of xylenes?)	52·5	1·26
Chlorobenzene	53·9	1·46
Methyl alcohol	7·1	·191
Ethyl alcohol	7·8	·200
n-propyl alcohol	8·5	·260
Isobutyl alcohol	8·5	·280
Iso Amyl alcohol	9·0	·298
Water	6·7	·68
CS_2	71	4·55
n-Hexane	10	·40
Cyclo hexane	8	·31
Glue	10	·355

they have directly cpd. $\frac{Ir^2}{EV}$ (where I is the intensity of the scattered light, and E that of the incid light, r the dist and V the volume) for CS_2 with milk glass, = ·00113, for $\frac{\text{ether}}{CS_2}$ = ·068. Using the exptal value for milk glass they calculate $\frac{Ir^2}{EV}$ for ether = $9{\cdot}2 \times 10^{-6}$

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(4) The relation betn light absorption and light scattering for liquids — Martin — J. Phys chem. 26, 471, 1922.

$$\epsilon = -\frac{1}{d}\log_e \frac{I}{I_0}$$

ϵ = absorption coeff. I/I_0 ratio of intensity of light transmitted after passing a length of column = d cms to the intensity of the incident light —

wave length	ϵ for water (dust free)	obsd value of $\frac{I\gamma}{EV}$	ϵ for benzene (dust free)
4358 Å	·00012		·00056
5461	·00034		·00024
5780	·00064		·00045

wavelength	Dust free Water ϵ	Dust free Water obsd value of $\frac{I\gamma^2}{EV}$	Dust free benzene ϵ	Dust free benzene obsd value of $\frac{I\gamma^2}{EV}$
4358	$1\cdot2 \times 10^{-4}$	$1\cdot77 \times 10^{-6}$	$5\cdot6 \times 10^{-4}$	$2\cdot6 \times 10^{-5}$
5461	$3\cdot4 \times$ "	$7\cdot2 \times 10^{-7}$	$2\cdot4 \times$ "	$1\cdot1 \times 10^{-5}$
5780	$6\cdot4 \times$ "	$5\cdot7 \times 10^{-7}$	$4\cdot5 \times$ "	$8\cdot4 \times 10^{-6}$

(5) The molecular scattering of light in vapours & in liquids and its relation to the opalescence observed in the critical state — by Dr K.R.R. P.R.S A 102, 157 (1922)

Scattering by Saturated Ether vapour

temp t°.	Scattering at t° / Scattering of liquid ether at 35° Obsd.	Calculated from Einstein formula $\times \frac{6(1+\rho)}{6-7\rho}$
33	·038	·036
54	·075	·074
75	·150	·140
91	·22	·23
108	·45	·45
123·5	·71	·71
144·5	1·31	1·29
164	2·7	3·0
170·5	3·9	4·0
179·2	9·1	7·9
183·5	13·0	12·2
186·5	21	19
190	42	39
191	63	55

Scattering by Ether above critical temp

	Scattg at t° / Scattg of liquid at 35°	
	Obsd	Calcd from Einstein Smoluchowski formula
194	378	290 at 195°
196	172	200 at 197°
198	126	
200	84	87
202	64	65
212.5	27	30
217	21	26

Scattering by liquid Ether

35	1.00	1.00
61	1.23	1.34
80	1.85	1.65
91	1.90	1.83
104	2.3	2.13 at 100°
125	3.0	
139	3.8	
145	4.9	8.2 at 150°
153	6.3	
170	12.0	14.1 at 175°
179	22	27.2
185	38	73 at 190.
190.5	82	

Polarisation of light scattered by liquid ether.

t	$\rho \times 100$
33	8
60	8
80	7
100	7·5
120	7·5
135	5
145	3
165	1·7
189	1·3

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(6) Raman and Rao's paper.

Have cfed the intensities of the liquids with that of ether vapour.

also determination of Avogadro const.

1

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(7) Kameswar Rao Liquid mixture

Phys. Review paper

~~Acetone~~ $\frac{\text{Scattering by acetone}}{\text{Scattering by } CS_2} = .066.$

ρ for acetone = 28.0

for CS_2 = 70.0.

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(8) Ganesan Oblique Scattering

	$\rho \times 100$
CS_2	70.4
Toluene	52.2
Benzene	48.0
Ether	8.44

(9) K. Rao Binary mixtures

$$\frac{I_{\text{acetic acid}}}{I_{\text{Toluene}}} = \cdot 50 \quad (\text{at } 30^\circ C)$$

$\rho \times 100$ (30°C)

R_{toluene} =

acetic acid — 58·5

Toluene 55

Taking $I_{\text{toluene}} = 1$

liquid	t	I_t (Toluene = 1) at 30°
CS_2	20	1·5
	30°	1·6
	40°	1·75
	50°	1·75
	60°	2

liquid	t	$\frac{I}{I_t}$ (Iodine at 20° = 1
Methyl alcohol	20°	.08
	30°	.08
	40·5°	.1
	50°	3·1
	60°	.33

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t	CS_2 100 p	CH_3OH 100 p	~~100~~ p
20°	70	9·5	
30°	70	9	
40·5°	70	9	
50°	69	9	
60°	69	9	

(10) Martin 1st paper.

Liquid	P × 100	I (Toluene = 1)
Water	6.7	·060
SO_2	22·0	·400
Methyl alcohol	7·0	·160
Ethyl "	7·1	·180
Ether	9·3	·236
Ethyl acetate	22·8	·210
Isobutyl chloride	18·0	·375
Heptane (mix of heptanes)	13·4	·374
Isobutyl butyrate	17·3	·320
Benzene	54	·91
Toluene	54	1·00
chlorbenzene	52	1·52
Ethyl benzoate	53	1·53
chloronaphthalene (α)	78	4·30
CS_2	70	

Colloidal Silica Sols — ·25

Substance	ρ_1	$\beta \times 10^6$ for abs at 30°	$n_{F-30°}$	M	$\Delta_{30°}$	$P_{30°}$ calcd.	$P_{30°}$ observed
Benzene	6·6	103	1·507	78·05	·8683	50·6	47.
Toluene	6·4	97	1·501	92·06	·8559	55·0	value adopted 51
Meta Xylene	6·7	91	1·502	106·08	·8563	59·8	56 53 G
Chlorbenzene	7·8	80	1·531	112·50	1·0954	61·0 ~~62·4~~	57·5 48 M
Paramonbenzene	7·8	72	1·568	156·96	1·4815	62·4	65 62·G
Methyl alcohol	2·7	131	1·329	32·03	·7825	17·6	6·0
Ethyl "	1·7	121	1·363	46·05	·7810	16·6	5·3
Dipropyl "	2·0	105	1·385	60·06	·7955	24·7	7·1
Isopropyl "	1·9	112	1·380	60·06	·7881	23·0	5·0.

Substance	ρ_1 x 100	$\beta_{30^\circ} \times 10^6$ per atm	n_{F-30°	M	Δ_{30°	ρ at 30° x 100 Calcd	Obsd.
n. Butyl alcohol	2·8	97	1·400	74·08	·8019	36·6 ✓	9·3
Iso Butyl alcohol	1·8	105	1·397	74·08	·7932	26·3	7·3
Ethyl alcohol	5·2	100	1·419	58·05	·8431	$42·8_5$ ✓	29·6.
Propyl formate	3·5	120	1·379	88·08.	·8942	38·9 ✓	21·0
~~Meth~~ Ethyl acetate	3·4	125	1·372	88·06.	·8883	$37·7_5$.	23·3 22·8 M. adopt 23·0
Acetone.	4·8	130	1·358	58·05	·7791	$38·9_5$.	23·6 17·0 G adopt 20.

Calculation of the anisotropy of the molecule from the depolarisation for the liquid.

I from ρ for liquid.

By Ramanathan's formula

$$\rho = \frac{2f}{\gamma\left(\frac{A+B+C}{3}\right)^2 + \frac{7}{5}f}$$

where $f = \frac{1}{15}\left(\Sigma A^2 - \Sigma AB\right)$ + $\gamma = \frac{RT\beta}{N} n_0 \left(\frac{R_0+2}{3}\right)^2$.

Assuming for simplicity $B = C$. $f = \frac{1}{15}(A-B)^2$

$$\therefore \rho = \frac{\frac{2}{15}\left(\frac{A}{B}-1\right)^2}{\frac{\gamma}{9}\left(\frac{A}{B}+2\right)^2 + \frac{7}{45}\left(\frac{A}{B}-1\right)^2}$$

$$\frac{\frac{A}{B}-1}{\frac{A}{B}+2} = \sqrt{\frac{5\gamma.\ \rho}{6-7\rho}}$$

$$= \sqrt{\frac{5}{9} \cdot \frac{8.315 \times 10^7 \times 293 \times 10^{-12}}{1.0132} \times \frac{\Delta}{M} \cdot \beta \times 10^6 \text{ gradi} \times (n^2+2)^2 \cdot \frac{\rho}{6-7\rho}}$$

Since we are going to cf the values of $\frac{A}{B}$ calculated as above with $\frac{A}{B}$ calculated from the Kerr Constant

and the exptal values for B in general refer to D line and 20° C we shall assume that our exptal value of ρ also refers to the same wavelength and temp.

$$\therefore \frac{\frac{A}{B}-1}{\frac{A}{B}+2} = \text{antilog } T\cdot 0630 \times \sqrt{\frac{\Delta \times \beta \times 10^6 \text{ per cm} (n^2+2)^2 \cdot \rho}{M \quad 6-7\rho}}$$

$$= \cancel{k \text{ say}} \quad = \delta = \frac{\Sigma A^2 - \Sigma AB}{(A+B+C)^2}$$

$$\frac{A}{B} = \frac{1+2k}{1-k}$$

II $\frac{A}{B}$ from Kerr const. B for liquid

From Langevin's formula

$$B = \frac{(k-1)(k+2)(n^2-1)(n^2+2)\,M}{120\,\pi\,R\,T\,\Delta\,\lambda\cdot n} \cdot \frac{(A-B)^2}{(A+2B)^2}$$

assuming his α_1 and α_2 = resp. σ_1 & σ_2 = A, B of Ramanathan

$$\frac{\frac{A}{B}-1}{\frac{A}{B}+2} = \sqrt{\frac{120\,\pi\,R\,T\,\Delta\,\lambda\,n\;B}{M(k-1)(k+2)(n^2-1)(n^2+2)}}$$

$$= \sqrt{\text{anti log } \cancel{1.2364}\ 1.7336 \cdot \frac{\Delta \cdot B \times 10^7 \times n}{M \cdot (k^2-1)(k+2)(n^2-1)(n^2+2)}}$$

whence $\frac{A}{B}$ as before

III. $\frac{A}{B}$ from ρ for vapour

If we put in the expression for the liquid

(I) $\gamma = 1$

$$\frac{\frac{A}{B}-1}{\frac{A}{B}+2} = \sqrt{\frac{5\rho}{6-7\rho}}$$

For polar molecs instead of B use

following Born

$$\frac{B}{1 + \frac{\mu^2}{KT \cdot \frac{3}{2}\frac{M}{\Delta N}}}$$

K = Boltzmann's const

$= 1.34 \times 10^{-16}$

$$B' = \frac{B}{1 + \text{anti log } 1.0125 \cdot \frac{\Delta(\mu \times 10^{18})^2}{M}}$$

putting $N = 6.062 \times 10^{23}$; $T = 293$

28 and in the case of -ve Kerr constants we use only the absolute values.

Born's expression for the Kerr constant of polar molecules given above was taken from a paper by Lyon and Wolfram Ann. der Phys. but it is a misquotation.

The same error is repeated in Lyon's recent paper Zs. Phys. 28, 1924.

Born's ~~ex~~ real expression is

$$B_1 = \text{Langevin's } B \cdot \left(1 + \frac{\mu^2}{RT(A-B)}\right)$$

where A, B are the moments induced along and $\perp^r$ to the direction of permanent moment (per unit incid field)

Now $\left(\frac{A-B}{A+2B}\right)^2 = \delta$ is known from Scattering data.

$$\frac{K-1}{K+2} = \frac{4\pi}{3} n_0 \frac{A+2B}{3}.$$

$$= \frac{4\pi}{3} \cdot \frac{\Delta}{M} N \quad \frac{A+2B}{3}.$$

$$A + 2B = \frac{9}{4\pi N} \frac{M}{\Delta} \frac{K-1}{K+2}.$$

$$\therefore \quad A - B = \frac{9}{4\pi N} \cdot \frac{M}{\Delta} \frac{K-1}{K+2} \sqrt{\delta}.$$

molecr. repr. =.

whence $\quad 1 + \dfrac{\mu^2}{KT(A-B)}$

K in the above expression is the contribution from dielec cons- from the induced moments only.

30 (1) Amylene

(2) Ethyl bromide no B

allyl (3) Ethylene bromide "

Propyl chloride

iso " (4) " Ethylene chloride no β. Calculate for I

allyl " (5) methylene chloride

methyl sulphide

Ethyl " (6) $CHCl_3$

acid anhydrides (7) Acetic acid

(8) Ether

(9) Toluene

(10) Ethyl benzene

(11) ~~Ortho xylene~~

(11) chloro benzene

(12) Bromo benzene

(13) nitro benzene

(14) Aniline

(15) methyl alcohol

(16) Ethyl alcohol

(17) Propyl "

(18) iso " Butyl "

(19) iso "

(20) Tertiary "

(21)

(22) Iso Amyl alcohol

(23) Allyl "

(24) Benzyl "

methyl ethyl (25) Propyl formate

(26) Ethyl acetate

Propyl acetate acetaldehyde (27) Acetone

methyl ethyl ketone (28) Diethyl ketone

(29) Water

Calculation of the Kerr constant from the depolarisation factor for liquids and gases by using Gans's formula. (Est.)

$$\rho = \frac{48\pi n \lambda B}{\frac{1}{3}\beta (n^2-1)^2 (n^2+2)^2 \cdot \zeta + 56\pi n \lambda B}$$

$$\zeta = \frac{(K-1)(K+2)}{(n^2-1)(n^2+2)}$$



$$B = \frac{\beta (n^2-1)^2 (n^2+2)^2 (K-1)(K+2)}{24\pi n \lambda} \cdot \frac{\rho}{6-7\rho}$$

In the following calculations we shall assume, as we might reasonably, that ρ wherever it has been measured with white incid light only, is practically independent of λ ($\because$ most of the liquids which might be expected to show any change have been investigated with colour filters), and is at the room temp indep of temp, so that we may take the value of ρ as being the

for the sodium line and 20° C for our convenience in calculations.

Refs.

M (1) — Scattering of light by dust free liquids by Martin J. Phys. Chem. 24, 478, 1920.

M (2) Martin — Light absorption & Scattering for liquids — J. Phy Chem 26, 471, 1922.

~~M (3)~~

M (3) Martin — Relation betw. the depolarisation of the scattered light and the Kerr effect in liquids — Journ Phy. Chem. 28, 1284 (1924)

M. L (1) — Martin and Lehrman — Scattering by dust free liquids — J. Phy Chem 26, 75, 1922

M. L (2) Martin & Lehrman — scattering by dust free liquids chang's with temp — J. P. Chem 27, 558, 1923

R - R. Raman & Rao. —

R (1) Ramanathan

R (2)

G (1) Gans.

G (2) Gans.

Pentane

$\rho = \cdot 078$ (which agrees well with Martin's $\cdot 072$ (J. Phys. chem 28, 1284 1924)

adopt $\cdot 075$

$n_{13\cdot1^\circ} = 1\cdot3606$ $\quad$ $n_{20^\circ} = 1\cdot3556$

~~$n_{15\cdot7} = 1\cdot3581$~~ $\quad$ ~~$n_{20^\circ} =$~~

$n_{15\cdot7} = 1\cdot3581$ $\quad$ $n_{20^\circ} = 1\cdot3555$ $\quad$ $1\cdot3556$

$\beta_{20^\circ} = 215$

We have no data for Ic; we may take $\zeta = 1$. Since for all other members of the Paraffin series we have data n^2 is very nearly $= K$.

$$B_{D\text{-}20^\circ} = \frac{215 \times 10^{-6} \times (n^2-1)^2 (n^2+2)^2}{\text{antilog } 3\cdot6530 \cdot n} \times \frac{\cdot 078}{5\cdot454}$$

$$= \cdot 052 \times 10^{-7}$$

using we take $\rho = \cdot 075$

$$B_{D\text{-}20^\circ} = \cdot 050 \times 10^{-7}$$

Observed value

Leiser's value for room temp relative to $CS_2 = 100$

adjusted by Bergholm $= 1\cdot55$

$\therefore B = \cdot 050 \times 10^{-7}$

Pentane cont'd

$\theta = \dfrac{\Sigma A^2 - \Sigma AB}{(A+B+C)^2}$

I $\frac{A}{B}$ from ρ for liquid

ρ = ·078 (K.S.K.)
·072 (Martin) } adopt mean ·075

Δ_{20° = ·6263 ; β_{20° = 215 ; $n_{D\,20^\circ}$ = 1·356

M = 72·10 n^2+2 = 3·839.

$$R = \text{anti-log}\,\bar{1}\cdot0630 \sqrt{\frac{\cdot6263 \times 215 \times 3\cdot839^2 \times \cdot075}{72\cdot10 \times 5\cdot475}}$$

·07254

$\therefore \frac{A}{B} = 1\cdot23$

θ_R (i.e. from Ramanathan's formula) = ~~·00526~~ ·00504

θ_G (from Lagemann): ~~·00321~~ ~~·00298~~ ·00308.

II $\frac{A}{B}$ from B. for liquid

B = ·050 (Geiser) $\times 10^{-7}$

$$\therefore R = \sqrt{\text{anti-log}.\frac{1\cdot7334}{\cancel{1\cdot2361}} \times \frac{\cdot6263 \times \cdot050 \times 1\cdot356}{72\cdot10 \times \cdot839^2 \times 3\cdot839^2}}$$

= ~~·02367~~ ~~·0313~~

~~θ = ·000978~~

$\frac{A}{B}$ = ~~1·008~~ 1·10

θ = ·00307

III $\frac{A}{B}$ from ρ for vapour

$\rho = .034$ (Ganesan)

$R = \sqrt{\frac{.170}{5.762}} = .172$

$\theta = .0295$

$\frac{A}{B} = 1.62$

IV no data for ~~deposit~~ Kerr curve for vapour.

.525

Iso pentane

$\rho = 0.626$

$n_{7^\circ} = 1.3613$ } $n_{20^\circ} = 1.353$

$n_{14.2^\circ} = 1.3576$ }

$\beta_{20^\circ} = 218$

We take as in the case of pentane $\zeta = 1$

$$B_{D-20^\circ} = \frac{218 \times 10^{-6} \times 0.831^2 \times 3.831^2}{\text{ant log } 3.6530 \times 1.353} \times \frac{0.056}{5.608}$$

$$= 0.036 \times 10^{-7}$$

Observed value

The value quoted in Kauffmann's book is 1.55 (relative to CS_2) so that we get for pentane $B = 0.050 \times 10^{-7}$. [However it is not improbable that Kauffmann's value really refers to Pentane)

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I

Isopentane contd

$\rho = \cdot 056$ (K.S.K)

$\Delta_{20^\circ} = \cdot 6196$ $\beta_{20^\circ} = 218$; $n_{D-20^\circ} = 1\cdot 353$

$n^2 + 2 = 3\cdot 831$

$M = 72\cdot 10$

I A/B from ρ for liquid

$$k = \sqrt{\left\{ \text{an.log } \bar{2}\cdot 1259 \times \frac{\cdot 6196 \times 218 \times 3\cdot 831^2 \times \cdot 056}{72\cdot 10 \times 5\cdot 608} \right\}}$$

$= \cdot 0615$ $\theta_R = \cdot 00367$

$\frac{A}{B} = 1\cdot 20$ $\theta_{G.L} = \cdot 00225$

II A/B from Kerr const for liquid $B = \cdot 050 \times 10^{-7}$

$$k = \sqrt{\left\{ \text{a.log } \overset{1\cdot 7336}{\cancel{1\cdot 2361}} \times \frac{\cdot 6196 \times \cdot 05 \times 1\cdot 353}{72\cdot 10 \times \cdot 831^2 \times 3\cdot 831^2} \right\}}$$

$= \cdot 0314$ $\theta = \cdot 00311$

$\therefore \frac{A}{B} = 1\cdot 10$

III IV no data for either ρ or B for vapour.

Hexane

$\rho = \cdot 099$ (which agrees with Mandl (1) 10·0)

adopt ·10 K_{17} (Nernst) = 1·880 from Landolt's Tables. $\lambda = \infty$

$K_{14\cdot 2}$ (Landolt & Jahn) = $1\cdot 85_9$ " " $\lambda = \infty$

Recently E.H.L. Meyer (Zeits f. Phys. 24, 151, 1924) has obtained the following values.

t	−8°	+3·7°	+12·0°
K	1·765	1·749	1·739.

K_{20} extrapolated = 1·729.

n_{20} = 1·3754.

β_{20} = 155.

$$B_{D-20} = \frac{155 \times 10^{-6} \times \cdot 891 \times 3\cdot 891 \times \cdot 729 \times 3\cdot 729 \times \cdot 099}{\text{anti log } 3\cdot 6530 \times n \quad \cdot 5\cdot 307}$$

$= \cdot 044 \times 10^{-7}$

with $\rho = \cdot 10$ $\quad B_{D-20} = \cdot 044_5 \times 10^{-7}$.

Observed values

(1) Schmidt's value relative to CS_2 (and) = 1·4

which gives $B = \cdot 045 \times 10^{-7}$

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(2) Leiser's relative value quoted by Bergholm

$= 1.73$ wh gives $B = .056 \times 10^{-7}$

Hexane contd Calcn of $\frac{A}{B}$.

I $\frac{A}{B}$ from ρ for liquid

$\rho = .099$ K.S.K
$.100$ M+L } adopt $.100$

$\Delta_{20^\circ} = .6595$ $\beta = 155$ $n = 1.3754$

$M = 86.11$ $n^2+2 = 3.891$

$$R = \sqrt{\text{anti log } \bar{2}.1259 \times \frac{.6595 \times 155 \times 3.891^2}{86.11} \times \frac{.100}{5.3}}$$

$\theta_R = .00453$

$= .0643$

$\frac{A}{B} = 1.21$ $\theta_{G.L} = .00269$

II $\frac{A}{B}$ from the Kerr const for liquid

$B = .045 \times 10^{-7}$ Schmidt
$= .056 \times 10^{-7}$ Leiser } ~~adopt Leiser's value~~

$$R = \sqrt{\text{an. log } \cancel{1.2361}\ 1.7336 \times \frac{.6595 \times .056 \times 1.3754}{86.11 \times .891 \times 3.891 \times .729 \times 3.729}}$$

$= .0328$ using Leiser's value $\theta = .00341$
Schmidt $\theta = .00274$.

$\frac{A}{B}$ = ·10 .

III $\frac{A}{B}$ from ρ for vapour.

ρ = ·033 (Equation)

$k\frac{A}{B} = \sqrt{\frac{\cdot 165}{5\cdot 769}}$ = ·169.

θ = ·0286.

$\frac{A}{B}$ = 1·61

~~IV no data for depolarisation for vapour.~~

using Ramanathan's value 147

r = ·021

$\theta = \frac{\cdot 105}{5\cdot 853} = \cdot 0179.$

$\frac{4.71}{3.3}$

C_6H_2 45

Cyclohexane

Martin & Lehrman's M.L. (1) value for $\rho = \cdot 08$.

$K_{20^\circ} = 2\cdot 05$ [Cauwood & Turner – Kauffmann's work

$n_{16\cdot 6^\circ} = 1\cdot 4281$

$\Delta_{20^\circ} = 0\cdot 779$.

$\beta_{20^\circ} =$

$n_{20^\circ} = 1\cdot 427_3$

$\beta_{25^\circ} = 110\cdot 8 \times 10^{-6}$ [illegible] $n^2 = 2\cdot 038$

~~Let us assume~~ $\beta_{20^\circ} = 110 \times 10^{-6}$.

$$B_{20^\circ} = \frac{110 \times 10^{-6} \times 1\cdot 038^2 \times 4\cdot 038^2}{\text{an log } 3\cdot 1530 \times 1\cdot 427_3} \times \frac{\cdot 08}{5\cdot 44}$$

$$= \cdot 044 \times 10^{-7}$$

Observed $= 2\cdot 30$ relative to $CS_2 = 100$

$\therefore B = \cdot 074 \times 10^{-7}$.

Heptane.

ρ = ~~·099~~ ·100 wh is less than Martin's (M.E.) value 12·7

adopt ·114.

molecular refraction calculated from atomic refraction in Landolt's Table = 34·53 — mol. wt. = 100·13.

$$S_{20^\circ} = \frac{\cdot 70048}{1\cdot 0288}.$$

$$\therefore n_{20^\circ} = 1\cdot 386.$$

$$\beta_{20^\circ} = 130$$

taking $\zeta = 1$

$$B_{D-20^\circ} = \frac{130 \times 10^{-6} \times \cdot 922^2 \times 3\cdot 932^2 \times \cdot 114}{\text{anti log } 3\cdot 6530 \times 1\cdot 386 \times 5\cdot 202}$$

$$= \cdot 061 \times 10^{-7}$$

Observed values

(1) Schmidt's relative value = 2·2 which gives

$$B = \cdot 071 \times 10^{-7}$$

(2) Leiser's value = 3·26 which gives

$$B = \cdot 105 \times 10^{-7}$$

$\frac{50}{I}$ from ρ for liquid Heptane cond.

$\rho = \cdot 100$ (K.S.K)
$\cdot 134$ M.
$\cdot 127$ M.L. later paper } adopt $\cdot 114$

$\Delta = \cdot 6836$ $\beta = 130$ $n = 1\cdot 386$ $n^2+2 = 3\cdot 932$

$M = 100\cdot 13$.

$$R = \sqrt{\text{an.log.}\bar{2}\cdot 1259 \times \frac{\cdot 6836 \times 130 \times 3\cdot 932^2}{100\cdot 13} \times \frac{\cdot 114}{5\cdot 202}}$$

$= \cdot 0634$

$\theta_R = \cancel{\cdot 00398}$ $\cdot 00402$

$\theta_{G.L} = \cancel{\cdot 00232}$ $\cdot 00234$.

$\frac{A}{B} = 1\cdot 20$

II $\frac{A}{B}$ from B for liquid $B = \cdot 105$ Leiser

$$R = \sqrt{\left\{\text{antilog}\ \cancel{1\cdot 2361}\ 1\cdot 7336 \times \frac{\cdot 6836 \times \cdot 105 \times 1\cdot 386}{100\cdot 13 \times \cdot 932^2 \times 3\cdot 932^2}\right\}}$$

$= \cancel{\cdot 0357}$ $\theta = \cdot 00397$.

$\frac{A}{B} = \cancel{1\cdot 11}$

using Schmidt's value

$\theta = \cdot 0027$

III $\frac{A}{B}$ from ρ for vapour

Constant value for $\rho = .031$

$$k = \sqrt{\frac{.155}{5.783}} = .164.$$

$\theta = .0268.$

$$\frac{A}{B} = 1.59$$

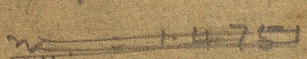
IV no data for Kerr const. for vapour.

Octane.

$\rho = \cdot 129$

$K_{13\cdot 8^\circ} = 1\cdot 93_4$ Landolt + Jahn (Landolt's Tab.)

$K_{17^\circ} = 1\cdot 94_9$ Nernst "



$n_{15\cdot 1} = 1\cdot 4007$

$n_{17\cdot 6} = 1\cdot 3988$

$n_{20^\circ} = 1\cdot 398$

$n_{20^\circ} = 1\cdot 396$

$n_{20^\circ} = 1\cdot 397.$

$\beta_{20^\circ} = 118$

→ taking Nernst's value and reducing to 20° with Lorentz modulus relation $K_{20^\circ} = 1\cdot 945$.

$$B_{D-20^\circ} = \frac{118 \times 10^{-6} \times \cdot 953 \times 3\cdot 953 \times \cdot 945 \times 3\cdot 945 \times \cdot 129}{\text{anti log. } 3\cdot 6530 \times 1\cdot 397 = 5\cdot 097}$$

$= \cdot 067 \times 10^{-7}$

Observed value

(1) Schmidt's relative value 2·4 gives $B = \cdot 077 \times 10^{-7}$

while (2) Lesser's value 4·21 quoted by Berghoff

gives $B = \cdot 136 \times 10^{-7}$

529

I $\frac{A}{B}$ from ρ for liquid Octane cont'd

$\rho = \cdot 129$ (K.S.K)

$\Delta = \cdot 7022$ $\beta = 118$ $n = 1 \cdot 397$ $n^2+2 = 3 \cdot 953$

$M = 114 \cdot 14$

$$R = \sqrt{\left\{ \text{anlog. } \overline{2} \cdot 1259 \times \frac{\cdot 7022 \times 118 \times 3 \cdot 953^2}{114 \cdot 14} \times \frac{\cdot 129}{5 \cdot 097} \right\}}$$

$= \cdot 0619$ $\theta_R = \cdot 00384$

$\frac{A}{B} = 1 \cdot 20$ $\theta_{CH_2} = \cdot 00221$

II $\frac{A}{B}$ from β for liquid $\beta = \cdot 136 \times 10^?$

$$R = \sqrt{\left\{ \text{a.l. } \frac{1 \cdot 7336}{\cancel{\cdot 2361}} \times \frac{\cdot 7022 \times \cdot 136 \times 1 \cdot 397}{114 \cdot 14 \times \cdot 953 \times 3 \cdot 953 \times \cdot 945 \times 3 \cdot 945} \right\}}$$

$= \cdot 0379$ $\beta = \cdot 136 \times$ $\theta = \cdot 00451$

$\frac{A}{B} = 1 \cdot 12$ $\beta = \cdot 077$ $\theta = \cdot 00255$

III $\frac{A}{B}$ from ρ for vapour $\rho = \cdot 027$

$$R = \sqrt{\frac{\cdot 135}{5 \cdot 811}} = \cdot 152$$

$\theta = \cdot 0232$.

$\frac{A}{B} = 1 \cdot 54$

IV [illegible]

β iso Amylene.

$\rho = \cdot 258$

Amylene $K_{15\cdot 8^\circ} = 2\cdot 20_1$ (Landolt + Jahn Landolt's Tables.)

Amylene $n_{20^\circ} = 1\cdot 3758$

$\beta_{20^\circ} = 177$

using Lorentz Mossotti relation } $K_{20^\circ} = 2\cdot 191$

$$B_{D-20^\circ} = \frac{177 \times 10^{-6} \times \cdot 892 \times 3\cdot 892 \times 1\cdot 191 \times 4\cdot 191 \times \cdot 258}{\text{anti log } 3\cdot 6530 \times 1\cdot 3758 \times 4\cdot 194}$$

$= \cdot 305 \times 10^{-7}$

Observed values

(1) Schmidt's value 7·1 gives $B = \cdot 229 \times 10^{-7}$.

(2) Leiser's value 7·9 quoted by Kauffmann in his book gives $B = \cdot 239 \times 10^{-7}$

Amylene contd

$\rho = \cdot 258$ (K.S.K)

$\Delta = \cdot 6476$. $\beta = 177$ $n^2 + 2 = 3 \cdot 892$ $M = 70 \cdot 08$

III $\frac{A}{B}$ from depolarisation for vapour

Gausain's value for $\rho_1 = \cdot 061$.

$\frac{A}{B} = 1 \cdot 92$ $\theta = \frac{\cdot 305}{5 \cdot 573} = \cdot 0547$

I from depolarisation for liquid.

$$R = \sqrt{\left\{ \bar{2} \cdot 1259 \cdot \frac{\cdot 6476 \times 177 \times 3 \cdot 892^2 \times \cdot 258}{70 \cdot 08 \times 4 \cdot 194} \right\}}$$

$= \cdot 143$.

$\frac{A}{B} = 1 \cdot 50$ $\theta_R = \cdot 0203$

$\theta_{G.L} = \cdot 0121$

θ from Kerr const for liquid & Langevin's fun

adopt $B = \cdot 234 \times 10^{-7}$.

$$\theta = \text{an log } 1 \cdot 7336 \; \frac{\cdot 6476 \times \cdot 234 \times 1 \cdot 376}{70 \cdot 08 \times \cdot 892^2 \times 3 \cdot 892^2}$$

$\theta_L = \cdot 0134$. (a.l $\bar{2} \cdot 1261$)

mol-polar.

Ethyl bromide

$\phi = 250$

K_{20° (walden) $= 9.5$
$\alpha_{20^\circ} = .0058$ } Landolt Tables.

$\beta_{20^\circ} = 131$ (Tyrer)

$n_{D-20^\circ} = 1.4244$

$$B_{D-20^\circ} = \frac{131 \times 10^{-6} \times 1.028 \times 4.028 \times 8.5 \times 11.5 \times .250}{\text{anti log } 3.6530 \times 1.4244 \times 4.25}$$

$$= 4.87 \times 10^{-7}$$

No ~~dat~~ exptal data available for comparison

62

from ~~[illegible]~~ r_{vapour} Ramanathan's value

$= \cdot 032.$

224

wh gives $\theta = \dfrac{\cdot 160}{5 \cdot 776} = \underline{\underline{\cdot 0277}}$

(1) ~~[illegible]~~ ~~θ~~ from $r_{liquid} = \cdot 250.$

$$\Delta_{20} = \frac{1 \cdot 4982}{1 + \cdot 0_2 1338 \times 20 + \cdot 0_5 150 \times 20^2 + \cdot 0_7 17 \times t^3}$$

$= 1 \cdot 456.$

$M = 108 \cdot 96.$ $\quad n^2 + 2 = 4 \cdot 028$

$$\theta_R = \text{antilog } \bar{2} \cdot 1259 \times \frac{1 \cdot 456 \times 131 \times 4 \cdot 028^2 \times \cdot 250}{108 \cdot 96 \times 4 \cdot 25}$$

$= \cdot 0223$

$\theta_{GL} = \underline{\underline{\cdot 0124}}$

Ethylene bromide

$\rho = .61$

$K_{18^\circ} = 4.865$ Turner (Landolt Table)

$K_{20^\circ} = 4.849$ [using Lorentz Mossotti relation]

$n_{D-20^\circ} = 1.5538$

$\beta_{20^\circ} = 59$

$$B_{D-20^\circ} = \frac{59 \times 10^{-6} \times 1.364 \times 4.864 \times 3.865 \times 6.865 \times .61}{\text{antilog } 3.6530 \times 1.5538 \times 1.73}$$

$$= 4.75 \times 10^{-7}$$

64

methylene chloride

$r = 0.31$ $\quad R_{20} = 8.3.$ $\quad M = 84.93$

$\Delta = 1.336$ $\quad n_{20} = 1.4237.$ $\quad n^2 = 2.027.$

To calculate β' 2.17

$$1.24 = \frac{\beta'}{189} \times \frac{1.027^2}{0.832^2} \times \frac{\frac{1.31}{3.83}}{\frac{1.08}{5.44}}.$$

$$\beta'_{20} = \frac{1.24 \times 189 \times 0.832^2 \times 1.08 \times 3.83}{5.44 \times 1.027^2 \times 1.31} = 89.3.$$

Ethylene chloride

$\rho = .36$

$K_{20} = 10.4$ } Walden – Landolt's Tables.

$K_{20^\circ} = 9.96$ Walden (latest). $\alpha_{20^\circ} = .0056$

$\beta_{20^\circ} = 80.7$ Tyrer

$n_{D\,20^\circ} = 1.444\boxed{4}$

$$\therefore B_{D-20^\circ} = \frac{80.7 \times 10^{-6} \times (n^2-1)(n^2+2)(9.4 \times 12.4}{\left[1.0132 \times 10^{6} \cdot 24\pi \times 589 \times 10^{-7}\right] n} \times \frac{.36}{6-2.52}$$

1.086×4.086

3.48

anti log 3.6530

$= 6.65 \times 10^{-7}$

obsd values

(A) McComb $B_{D-18^\circ.6} = 4.71 \times 10^{-7}$

Calculation of $\frac{A}{B}$

I from the depolarisation for liquid.

$\rho = .36$ $\quad \Delta_{20^\circ} = 1.2511$, $\beta_{20^\circ} = 80.7$ $\quad n = 1.44444$

$n^2 + 2 = 4.086$ $\quad M = 98.95$

$$R = \sqrt{\left\{ \bar{2}.1259 \cdot \frac{1.2511 \times 80.7 \times 4.086^2 \times .36}{98.95 \times 3.48} \right\}}$$

$= .1535$ $\quad \theta_R = .0235$

$\frac{A}{B} = 1.554$ $\quad \theta_{GL} = .0127$.

II From Kerr const. for liquid

$$\theta_L = \text{anti-log } 1.7336 \times \frac{1.251 \times 4.71 \times 1.44444}{98.95 \times 1.086^2 \times 4.086^2}.$$

$= .236$ (a.l. T.3737)

calculate μ from dielec. const. Data at diff. temps.

$CHCl_3$

ρ = ·242 agrees ~~fair~~ with Gauss's ·238

adopt ·240

But Prof (R.R.) gets ·150 which has recently been confirmed by Martin M(3) after specially purifying the substance

Isnardi's [Zeits 9, 153, 1922] value of K ~~are~~

$K_{20°}$ = 4·853

Meyer's [Zeit. Phys. 24, 148, 1924) values are

t	K
13·2	4·850
28·4	4·566
41·90	4·352

~~Tangl~~ M. Grutz machr (Zeits Phys 28, 342 1924

✓ $K_{20°}$ = 5·042 $n_{D-20°}$ = 1·4467

$\beta_{20°}$ = 101· Tyrer F.

$$B_{D-20°} = \frac{101 \times 10^{-6} \times 1.093 \times 4.093 \times 4.042 \times 7.042 \times .240}{\text{anti-log } 3.6530 \times 1.4467 \times 4.32}$$

$= 1.10 \times 10^{-7}$

obsd values

~~(1) Lyon's value = − 2·94.~~

But ~~gives~~ Martin's recent value [J. Phys. Chem. 28, 1284, 1924] for $CHCl_3$ after very careful purification = ·150 agreeing perfectly with R.R's value ·150 using this value of ρ

$B_{D-20^\circ} = \cdot 60 \times 10^{-7}$

Obsd values

(1) Lyon $B_{D-20^\circ} = -2\cdot 94 \times 10^{-7}$

(2) McComb $B_{D-23^\circ} = -3\cdot 32 \times 10^{-7}$

III $\frac{A}{B}$ from depolarisation for vapour

Gausa's value for $\rho = \cdot 032$

which gives $\frac{A}{B} = 1\cdot 60$

using the value $\rho = \cdot 030$

$\frac{A}{B} = 1\cdot 57_5$

adopt $\rho = \cdot 031$

$$A = \frac{\cdot 155}{5\cdot 783} = \cdot 0268.$$

I from depolarisation for liquid

$\rho = .240$ α $.150$ $M = 119.4$

$\Delta = 1.4898$ $\beta = 101$ $n = 1.4467$ $n^2+2 = 4.093$

with $\rho = .240$

$$k = \left\{ \bar{2}.01259 \cdot \frac{1.4898 \times 101 \times 4.093^2 \times .240}{119.4 \times 4.32} \right\}$$

$= .125$ using $\rho = .240$ $\begin{cases} \theta_R = .0157 \\ \theta_{GL} = .00842 \end{cases}$

$\frac{A}{B} = 1.43$ $\rho = .150$ $\begin{cases} \theta_R = \cancel{.00980}\ .00855 \\ \theta_{GL} = \cancel{.00526}\ .00459 \end{cases}$

with $\rho = .150$ $\frac{A}{B} = 1.30_5$

II from Kerr const for liquid

moment of molec. $= 1.266 \times 10^{-18}$ Ismardi
$1.358 \times$ " Lertes

adopt 1.31×10^{-18}

B = (taking mean of Lyon's & Mecuth) $= 3.13 \times 10^{-7}$

$$B' = \frac{3.13 \times 10^{-7}}{1 + \text{anti log } 1.0125 \times \frac{1.4898 \times 1.31^2}{119.4}} = \cancel{\text{anti log}}\ \frac{3.13}{1.220}$$

$= 2.56 \times 10^{-7}$

$$\therefore k = \sqrt{\left\{ \frac{\text{antilog } \overset{1.7336}{\cancel{1.2861}} \times 1.4898 \times \overset{3.13}{\cancel{2.80}} \times 1.4467}{119.4 \times 1.093^2 \times 4.093^2 \times \cancel{4.042 \times 7.042}} \right\}}$$

$= .127.$

$\theta_L = .153$

$\theta_B = \frac{\theta_L}{15}$ or $\frac{\theta_L}{21}$

$= .0102$ or $.00728.$

according as $\rho = .240$ or $.150.$

* putting n^2 for k

$$A - B = -\frac{9 \times 119.4}{4\pi \times 6.062 \times 10^{23} \times 1.490} \times \frac{1.093}{4.093} \sqrt{.00842}$$

using $\rho = .240$

$= \text{antilog } \overline{24}.4171$

using $\rho = .150$ antilog $\overline{24}.2853.$

$$\frac{\mu^2}{kT(A-B)} = -\frac{1.31^2 \times 10^{-36}}{1.372 \times 10^{-16} \times 293\,(A-B)}$$

$= -16$ or -22

$\therefore$ the absol. value of kerr const is -15 or -21 times the value calculated from Langevin's theory.

CCl_4.

$\rho = \cdot 061$ [which is not far different from Gauss $\cdot 0454$]

value adopted $= \cdot 053$

Isnardi's [Zeit. Phy. 9, 153, 1922] value for

$K_{20^\circ} = 2 \cdot 322$

$K_{20} = 2 \cdot 1900$ Grützmacher Zs. Phy 28, 342, 1924

β_{20° (Tyrer) $= 1 \cdot 06$ $\quad n_{D-20^\circ} = 1 \cdot 4607$

$$B_{D-20^\circ} = \frac{106 \times 10^{-6} \times \overset{1 \cdot 134 \times 4 \cdot 134}{(n^2-1)(n^2+2)} \cdot 1 \cdot 19 \times 4 \cdot 19}{\text{anti log } 3 \cdot 653 \times 1 \cdot 4607} \times \frac{\cdot 061}{5 \cdot 573}$$

$= \cdot 041 \times 10^{-7}$

using $\rho = \cdot 053$

$B_{D-20^\circ} = \cdot 0365 \times 10^{-7}$

observed values

The value quoted in Kauffmann's book viz 2·3 gives for B. $\cdot 074 \times 10^{-7}$.

Calc contd

I $\frac{A}{B}$ from ρ for liquid

$\rho = \cdot 061$ k.sk
$\cdot 045$ gans } Adopt $\cdot 053$

$\Delta = 1{\cdot}5939$. $\beta = 106$ $n^2+2 = 4{\cdot}134$ $M = 153{\cdot}84$

$$R = \sqrt{\left\{ a \log.\bar{2}{\cdot}1259 \times \frac{1{\cdot}594 \times 106 \times 4{\cdot}134^2}{153{\cdot}84} \times \frac{\cdot 053}{5{\cdot}629} \right\}}$$

$= \cdot 0492$ $\theta_R = \cdot 00236$

$\frac{A}{B} = 1{\cdot}15$ $\theta_{GL} = \cdot 00124$

II $\frac{A}{B}$ from Kerr const for liquid

$B = \cdot 074 \times 10^{-7}$

$$R = \sqrt{\left\{ a.\log.\overset{1{\cdot}7336}{\cancel{1{\cdot}2361}} \times \frac{1{\cdot}594 \times \cdot 074 \times 1{\cdot}4607}{153{\cdot}84 \times 1{\cdot}134 \times 4{\cdot}134 \times 1{\cdot}19 \times 4{\cdot}19} \right\}}$$

$\theta = \cdot 00260$

$= \cdot 0287$

$\frac{A}{B} = 1{\cdot}09$

III $\frac{A}{B}$ from ~~[illegible]~~ ρ for vapour.

Gaussian's value for $\rho = \cdot 019$.

$$k = \sqrt{\frac{\cdot 095}{5 \cdot 867}} = \cdot 127$$

$$\theta = \cdot 0162.$$

$$\frac{A}{B} = 1 \cdot 44.$$

IV no data for ~~depolarising~~ Kerr const. for vapour

Smyth calculating from Isnardi's data gets for the moment of the molec of CCl_4 $\cdot 39 \times 10^{-18}$ at 0° and $\cdot 48 \times 10^{-18}$ at 62° and not zero.

CS_2

ρ = ~~.68~~ .69. adopt.

Isnardi's [Z. Phys. 9, 153, 1922] values for K are

t	K	K
14°	~~[illegible]~~	2.643
50°		2.548

~~Tangl~~

✓ $K_{20°} = 2.593$. Gratz machr. [Zs Phy 28, 342, 1924]

Tyrer's $\beta_{20°} = 93.8$

$n_{15.7°} = 1.631$ $\quad n_{20°} = 1.627$.

$$B_{D-20°} = \frac{93.8 \times 10^{-6} \times 1.646 \times 4.646 \times 1.593 \times 4.593 \times .69}{\text{anti log } 3.6530 \times 1.627 \times 1.17}$$

$$= 4.23 \times 10^{-7}$$

using Gain's value for ρ (= .64)

$$B_{D-20°} = 3.02 \times 10^{-7}$$

Observed values (1) Chaumont's value for $B_{D-20°}$ [Ann. de Phys. Tome IV, 61 1920]

~~Chaumont's value for B_{D-20° = 3·226~~

(quoted by Pantheries) [Journal de Phys. Tome II 384, 1921] = $3 \cdot 226 \times 10^{-7}$

(2) Lyon's value $B_{D-20^\circ} = 3 \cdot 21 \times 10^{-7}$

(2) McComb's value for $B_{D-22^\circ 5} = 3 \cdot 09 \times 10^{-7}$

calculation of $\frac{A}{B}$.

$\rho_1 = \cdot 69$ K.S.K and others. } use both values
$\rho_2 = \cdot 64$ Gans.

$\Delta = 1 \cdot 2632$ $\beta = 93 \cdot 8$ $n^2 + 2 = 4 \cdot 646$ $M = 76 \cdot 14$

III $\frac{A}{B}$ from depolarisation for vapour

Gans's value $\rho = \cdot 167$ gives $\frac{A}{B} = 3 \cdot 14$ $\theta = \cdot 173$
Rayleigh $\rho = \cdot 120$ gives $\frac{A}{B} = 2 \cdot 55$ $\theta = \cdot 116$

Ramanathan's $\cdot 143$ $\theta = \frac{\cdot 715}{4 \cdot 999} = \cdot 143$

I from depolarisation for liquid

using $\rho = \cdot 69$

$$R = \left\{ \bar{2} \cdot 1259 \cdot \frac{1 \cdot 2632 \times 93 \cdot 8 \times 4 \cdot 646^2 \times \cdot 69}{76 \cdot 14 \quad 1 \cdot 17} \right.$$

$\theta_R = \cdot 265$ $\theta_{GL} = \cdot 110$ $= \cdot 5145$

$\frac{A}{B} = 4 \cdot 18$. $\mu = \cdot 685$ $\theta_R = \cdot 255$

$\theta_{G.L.} = \cdot 106$.

Taking Gans's value $\rho = \cdot 64$.

$\frac{A}{B} = 3 \cdot 31$ $\theta_R = \cdot 189$

$\theta_{G.L.} = \cdot 079$

II $\frac{A}{B}$ from Kerr const- for the liquid

$B = 3 \cdot 226 \times 10^{-7}$.

$$R = \sqrt{\left\{ \text{anlg } 1 \cdot 7336 \; \frac{1 \cdot 2632 \times 3 \cdot 226 \times 1 \cdot 627}{76 \cdot 14 \times 1 \cdot 646 \times 4 \cdot 646 \times 1 \cdot 593 \times 4 \cdot 593} \right\}}$$

$= \cdot 327$. $\therefore \frac{A}{B} = 2 \cdot 46$

$\theta = \cdot 084$

Acetic acid

$\rho = \cdot 47$ Gain $\cdot 439$ adopt $\cdot 45_5$

$K_{18^\circ} = 9 \cdot 7$ [Francke – Landolt's Tables]

$K_{18^\circ} = 6 \cdot 05$ [Dobrosserdow – Kauffman's book]

$K_{19^\circ} = 6 \cdot 29$ [Drude. — "]

β_{20° (Zyrr) $= 92$

$n_{D-20^\circ} = 1 \cdot 3718$

K_{20° using Lorentz Mossotti relation $= 6 \cdot 02$

$$B_{D-20^\circ} = \frac{92 \times 10^{-6} \times \cdot 881 \times 3 \cdot 881 \times 5 \cdot 02 \times 8 \cdot 02 \times \cdot 455}{\text{anti log } 3 \cdot 6530 \times 1 \cdot 3718 \times 2 \cdot 815}$$

$= 3 \cdot 32 \times 10^{-7}$

Observed values

(1) Pontiac's values ~~for CS~~ at 17° relative to $CS_2 = 1 \cdot 30$ — using Chaum

$\therefore B = 4 \cdot 19 \times 10^{-7}$

calculation of $\frac{A}{B}$

I from depolarisation for liquid.

$\rho = \cdot 45_5$ $\quad \Delta = 1 \cdot 0491$ $\quad \beta = 92$

$n = 1 \cdot 3718$ $\quad n^2 + 2 = 3 \cdot 881$ $\quad M = 60 \cdot 03$

$$R = \sqrt{\left\{ \text{antilg } \bar{2} \cdot 1259 \times \frac{1 \cdot 0491 \times 92 \times 3 \cdot 881^2 \times \cdot 455}{60 \cdot 03 \times 2 \cdot 815} \right.}$$

$= \cdot 229.$

$\frac{A}{B} = 1 \cdot 89.$

θ from B for liquid.

$$\theta_L = \text{a.lg. } 1 \cdot 7336 \times \frac{1 \cdot 049 \times 4 \cdot 19 \times 1 \cdot 3718}{60 \cdot 03 \times \cdot 881^2 \times 3 \cdot 881^2}.$$

$= \cdot 465$ (ref. T. 6677)

Ethyl ether.

$\rho = \cancel{\ldots}\ .080$

The following values are Isnardi's (Zeits 9, 153, 1922)

t	18°	40°	$K_{20°} = 4.351$
k	4.389	3.966	

~~Dangl~~. $\beta_{20°}$ (Tyrer) = 189

$n_{20°} = 1.3538$

$$\therefore B_{D-20°} = \frac{189 \times 10^{-6} \times .832 \times 3.832 \times 3.351 \times 6.351 \times .080}{\text{anti log } 3.6530 \times 1.3538 \times 5.44}$$

$$= .31 \times 10^{-7}$$

observed values

(1) Lyon's value for $B_{D-20°} = -.604 \times 10^{-7}$

(2) Becker's (Ann. der Phys. 76, 849, 1925) value for $\lambda = 586\ \mu\mu$ and 20° C $= \left.\begin{matrix} -.618 \\ \pm .002 \end{matrix}\right\} \times 10^{-7}$.

Calculation $\frac{A}{\beta}$

II $\frac{A}{\beta}$ from the depolarisation for vapour

~~$\rho = 3 \cdot 2$~~

Equal's value $\rho = \cdot 032$ gives $\frac{A}{\beta} = 1 \cdot 60$

$\theta = \cdot 0277$

I from depolarisation for liquid

$\rho = \cdot 08$ $\quad \Delta = \cdot 7135$ $\quad \beta_{20} = 189$

$n = 1 \cdot 3538$ $\quad n^2 + 2 = 3 \cdot 832$ $\quad M = 74 \cdot 08$

$$k = \sqrt{\left\{ \text{anly } \overline{2} \cdot 1259 \times \frac{\cdot 7135 \times 189 \cdot 3 \cdot 832^2}{74 \cdot 08} \right\} \cdot \frac{\cdot 080}{5 \cdot 44}}$$

$A = \cdot 0725$

$\theta_R = \cdot 00525$

$\theta_{G.L} = \cdot 00322$

$\frac{A}{\beta} = 1 \cdot 23_5$

moment of the molec.

Lane and Edwards from data for liquid get $\mu = 1 \cdot 435 \times 10^{-18}$ C.G.S. units - which agrees well with last value obtained by Smyth from the same data for liquid and Baedeker's data for vapour by his own method.

II $\frac{A}{B}$ from Kerr constant for liquid

$B = \cdot 618 \times 10^{-7}$

$$B_0' = \frac{\cdot 618 \times 10^{-7}}{1 + \text{antilog } 1\cdot0125^{-} \cdot \cdot 7135 \times 1\cdot435^{2}} =$$

$$= \frac{\cdot 618 \times 10^{-7}}{1\cdot204} = \cdot 513 \times 10^{-7}$$

$$K = \text{antilog } 1\cdot2361 \times \frac{\cdot 7135^{-} \times \cdot 513 \times 1\cdot3538}{74\cdot08 \times \cdot 832 \times 3\cdot832 - 3\cdot351 \times 6\cdot351}$$

$= \cdot 0412.$ $\therefore \frac{A}{B} = 1\cdot13.$

$\frac{K-1}{K+2} \cdot \frac{M}{\Delta} = 38$ from Debye's method

$\mu = \cdot 84 \times 10^{-18}.$

$A - B = \text{antilog } \overline{24}\cdot4062$

$\frac{\mu^2}{K(A-B)} = 7\cdot4$

adopted $\beta = \cdot 618 \times 10^{-7}$

$$\theta_L = \text{alog } 1\cdot 7336 \times \frac{\cdot 7135 \times \cdot 618 \times 1\cdot 3574}{74\cdot 08 \times \cdot 832^2 \times 3\cdot 832^2}$$

$$= \cdot 0429.$$

$$\theta_\beta = \frac{\theta_L}{6\cdot 4} = \cdot 00672.$$

Benzene

$\rho = \cdot 47$

The following values of K are from ~~Mayer's~~ Isnardi's paper [Zeit. f Phys. 9, 153, 1922].

t	11°	15°	30°
K	2·300	2·283	2·260

✓ Grüitz machers values [ZS Phys 24, 342 1924]

are

10° 2·298 $K_{20°} = 2·284$

30° 2·271 $n_{D-20°} = 1·501_4$

$\beta_{20°}$ Tyre $= 95·6_5$

$$B_{D-20°} = \frac{95·6_5 \times 10^{-6} \times 1·254 \times 4·254 \times 1·284 \times 4·284 \times \cdot 47}{\text{anti lg } 3·85030 \times 1·501_4 \times 2·71}$$

$$= \cdot 72 \times 10^{-7}$$

obsd values

(1) Mc Comb $B_{D-23·7} = \cdot 593 \times 10^{-7}$

Benzene contd

$\rho = \cdot 47$.

$\Delta = \cdot 8790$ $\beta = 95 \cdot 65$ $n^2 + 2 = 4 \cdot 254$; $M = 78 \cdot 05$

I $\frac{A}{B}$ from refraction for liquid

$$k = \sqrt{\left\{ \text{antilog } \bar{2} \cdot 1259 \cdot \frac{\cdot 8790 \times 95 \cdot 65 \times 4 \cdot 254^2 \times \cdot 47}{78 \cdot 05 \times 2 \cdot 71} \right\}}$$

$= \cdot 2125$.

$\theta_R = \cdot 0452$

$\theta_{G \cdot L} = \cdot 0225$

$\frac{A}{B} = 1 \cdot 81$

II $\frac{A}{B}$ from Kerr constant for liquid

$B = \cdot 593 \times 10^{-7}$.

$$k = \sqrt{\left\{ \text{antilog } \frac{1 \cdot 7336_n}{1 \cdot 3381} \times \frac{\cdot 8790 \times \cdot 593 \times 1 \cdot 501_4}{78 \cdot 05 \times 1 \cdot 254 \times 4 \cdot 254 \times 1 \cdot 284 \times 4 \cdot 28} \right\}}$$

$= \cdot 0967$.

$\theta = \cdot 0184$

$\frac{A}{B} = 1 \cdot 25$.

III $\frac{A}{B}$ from depolarisation for vapour

Ewan's $\rho = .066$ gives $\frac{A}{B} = 1.97$

$\theta = \frac{.330}{5.538} = .0596.$

or $\rho = .067$ $\theta = \frac{.335}{5.531}$

.469

$= .0606.$

Toluene.

$\rho = \cdot 525$ M. L. 49·0 Gas 50·7 Gaust 52·2

adopt 51 Isnardi's (Zeit 9, 153, 1922) values for K are

t	15	40
K	2·400	2·337

✓ Grüntzmacher's [Zs. Phys 24, 342, 1924] values for K are

t	K
10°	2·3841
30°	2·3522

$K_{20°} = 2·368$

$n_{D-20°}$

$\beta_{20°}$ (Tyrer) = 90·8

$n_{14·7} = 1·499·2$ $n_{20°} = 1·496$

$n_{16·4} = 1·4978$ $n_{20°} = 1·496$

$n_{20°} = 1·496$

$$B_{D-20°} = \frac{90·8 \times 10^{-6} \times 1·239 \times 4·239 \times 1·368 \times 4·368 \times ·51}{\text{anti log } 3·6530 \times 1·496 \times 2·43}$$

$= ·89 \times 10^{-7}$

Observed values

(1) Schmidt's relative value 24·0 gives for B

$·774 \times 10^{-7}$

(2) ~~Lyo~~ Leiser's value quoted by Bergholm

24.3 gives $B = \cdot 784 \times 10^{-7}$

(1) Becker's (Ann. der Phys. 76, 849, 1925) value for

$\lambda = 586$ and $20°$ C. $= \cdot 753 \pm \cdot 003$. $\times 10^{-7}$

Calculation of A/B

III $\frac{A}{B}$ from depolarisation for vapour.

Ganesan's value for $\rho = \cdot 064$

who gives $\frac{A}{B} = 1 \cdot 95$. $\theta = \cdot 0576$

I from depolarisation for liquid

$\rho = \cdot 51$ d.p.p. $\Delta = \cdot 8659$. $\beta = 90 \cdot 8$

$n = 1 \cdot 496$ $n^2 + 2 = 4 \cdot 239$ $M = 92 \cdot 06$

$$k = \sqrt{\left\{ \text{an. log } \bar{2} \cdot 1259 \times \frac{\cdot 8659 \times 90 \cdot 8 \times 4 \cdot 239^2 \times \cdot 51}{92 \cdot 06 \times 2 \cdot 43} \right\}}$$

$= \cdot 1506$.

$\theta_R = \cdot 0431$

$\frac{A}{B} = 1 \cdot 78_5$

$\theta_{GL} = \cdot 0216$.

III from Kerr const. for liquid value of the moment of molecule

$= \cdot 491 \times 10^{-18}$ (Serts)

$B = \cdot 753 \times 10^{-7}$

$$B' = \frac{\cdot 753 \times 10^{-7}}{1 + \text{antilog } 1\cdot 0125 \times \frac{\cdot 8659 \times \cdot 491^2}{92\cdot 06}}$$

$$= \frac{\cdot 753 \times 10^{-7}}{1\cdot 023} = \cdot 736 \times 10^{-7}$$

$$k = \sqrt{\left\{ \text{an. log } 1\cdot 2361 \times \frac{\cdot 8659 \times \cdot 736 \times \cancel{10^{-7}} \times 1\cdot 496}{92\cdot 06 \times 1\cdot 239 \times 4\cdot 239 \times 1\cdot 368 \times 4\cdot 368} \right\}}$$

$= \cdot 0754 \qquad \therefore \frac{A}{B} = \underline{\underline{1\cdot 24_5}}$

$$A - B = \frac{9}{4\pi N} \times 31\cdot 06 \times \sqrt{\cdot 0216}$$

$= \text{anti log } \overline{24}\cdot 7319$

$$\frac{\mu^2}{KT(A-B)} = \frac{\cdot 491^2 \times 10^{-36}}{1\cdot 372 \times 10^{-16} \times 293 \times (A-B)} = 1\cdot 1$$

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adopt $B = \cdot 753 \times 10^{-7}$

$$\theta_L = \text{alg } 1\cdot 7336 \times \frac{\cdot 8659 \times \cdot 753 \times 1\cdot 496}{92\cdot 06 \times 1\cdot 239^2 \times 4\cdot 239^2}$$

$= \cancel{\cdot 0637}$ $\cdot 0208$.

$\theta_B = \cancel{\cdot 0189}$ $\cdot 01$.

Ethyl benzene.

$\rho = \cdot 58$

$K_{14\cdot6^\circ} = 2\cdot35_5$ Landolt + Jahn - Landolt Jahn

$K_{17^\circ} = 2\cdot42_4$ Nernst "

K_{20° by Lorentz-Lorenz relation $= 2\cdot419$

$n_{14\cdot5^\circ} = 1\cdot4988$ $n_{20^\circ} = 1\cdot495$

β_{20° (Estimated) $= 85$

$$B_{D\text{-}20^\circ} = \frac{85\times10^{-6}\times1\cdot236\times4\cdot236\times1\cdot419\times4\cdot419\times\cdot53}{\text{anti log } 3\cdot6530\times1\cdot495\times2\cdot29}$$

$$= \cdot96\times10^{-7}$$

Observed values

(1) Seiser's value quoted by Bergholm 25-6 gives for $B_\infty = \cdot826\times10^{-7}$

(2) Becka's [Ann der Phys 76, 849, 1925] for $\lambda = 5\cdot86$ $\mu\mu$ and 20° C $= \cdot754 \pm \cdot005$ $\times10^{-7}$

calculation of $\frac{A}{\sqrt{\beta}}$.

I from depolarisation for liquid

$\rho = .53$ $\Delta = .8759$ $\beta = 85^-$

$n = 1.495$ $n^2+2 = 4.236$. $M = 106.08$.

$$R = \sqrt{\left\{ \frac{2}{3} \cdot 1259 \times \frac{.8759 \times 85 \times 4.236^2}{106.08} \times \frac{.53}{2.29} \right\}}$$

$= .$[illegible]

$\frac{A}{\sqrt{\beta}}$ [illegible]

ad 7.

Orthoxylene.

$\rho = \cdot 40$

$K_{17^\circ} = 2\cdot 567$ Nernst – Landolt – Tables

K_{20° (using Lorentz Mossotti relation) $= 2\cdot 561$

$n_{14\cdot 1^\circ} = 1\cdot 5082$ $\quad n_{20^\circ} = 1\cdot 505$

$n_{15\cdot 5^\circ} = 1\cdot 5078$ $\quad n_{20^\circ} = 1\cdot 505$ $\quad n_{20^\circ} = 1\cdot 505$

$\beta_{20^\circ} = 80$

$$B_{D-20^\circ} = \frac{80\times 10^{-6} \times 1\cdot 265 \times 4\cdot 265 \times 1\cdot 561 \times 4\cdot 561 \times \cdot 40}{\text{anti log } 3\cdot 6530 \times 1\cdot 505 \times 3\cdot 20}$$

$$= \cdot 57 \times 10^{-7}$$

Observed values

(1) Schmidt's value 41·0 gives $B = 1\cdot 32 \times 10^{-7}$

(2) Leiser's value quoted by Bergholm 41·2 gives $B = 1\cdot 33 \times 10^{-7}$

Calculation of $\frac{A}{B}$.

I from depolarisation for liquid

$\rho = \cdot 40 \qquad \Delta = \cdot 8633 \; ; \; \beta = 80 \; ; \qquad n = 1 \cdot 505$

$n^2 + 2 = 4 \cdot 265 \; ; \; M = 106 \cdot 08$

$$R = \sqrt{\left\{ \overline{2} \cdot 1259 \cdot \frac{\cdot 8633 \times 80 \times 4 \cdot 265^2}{106 \cdot 08} \times \frac{\cdot 40}{3 \cdot 20} \right\}}$$

$$= \cdot 141.$$

$$\frac{A}{B} = 1 \cdot 49.$$

meta xylene

$\rho = \cdot 56$

Isnardi's [Zeit. Phys. 9, 153, 1922] values for K are

t	K
19°	2·394
44°	2·351

$\Big\}\ K_{20°} = 2\cdot 392$

$\beta_{20°}$ (Dyn) = 85·7

$n_{14\cdot 9°} = 1\cdot 4996 \quad n_{20°} = 1\cdot 497$

$n_{15\cdot 7°} = 1\cdot 4996 \quad n_{20°} = 1\cdot 497$

$\Big\}\ n_{20°} = 1\cdot 497$

$$B_{D-20°} = \frac{85\cdot 7 \times 10^{-6} \times 1\cdot 242 \times 4\cdot 242 \times 1\cdot 392 \times 4\cdot 292 \times \cdot 56}{\text{ant log } 3\cdot 6530 \times 1\cdot 497 \times 2\cdot 08}$$

$= 1\cdot 08 \times 10^{-7}$

using Gauss value for ρ (= ·533)

$B_{D-20°} = \cdot 94 \times 10^{-7}$

Observed values

(1) Schmidt's value 23·8 gives $B = \cdot 77 \times 10^{-7}$

(2) Leiser's (Bergholm) value 24·4 gives $B = \cdot 79 \times 10^{-7}$

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(3) Becker's (Ann. der Phys 76, 849, 1925)
value for $\lambda = 586$ and 20°C
$= \cdot 858 \pm \cdot 001 \times 10^{-7}$.

Calculation of $\frac{A}{B}$.

III $\frac{A}{B}$ from depolarisation for vapour.
Cuneen's value $\rho = \cdot 067$ gives $\frac{A}{B} = 1 \cdot 98$
$\theta = \cdot 0606$

I from depolarisation for liquid

$\rho = \cdot 56$ or $\cdot 533$ $M = 106 \cdot 08$

$\Delta = \cdot 8658$ $\beta = 85 \cdot 7$ $n = 1 \cdot 497$ $n^2+2 = 4 \cdot 242$

(1) using $\rho = \cdot 56$.

$$k = \sqrt{\left\{ \overline{1} \cdot 1259 \times \frac{\cdot 8658 \times 85 \cdot 7 \times 4 \cdot 242^2}{106 \cdot 08} \times \frac{\cdot 56}{2 \cdot 08} \right\}}$$

$= \cdot 154$

$\theta_R = \cdot 0453$

$\theta_{GL} = \cdot 0227$

$\frac{A}{B} = 1 \cdot 81$

(2) using Cuneen's value $\cdot 533$ $\frac{A}{B} = 1 \cdot 745$

$\theta_R = \cdot 0395$ ~~$\theta_R = \cdot 0431$~~

$\theta_{GL} = \cdot 0198$. ~~$\theta_{GL} = \cdot 0216$~~

II from the Kerr const. for liquid

$$k = \sqrt{\left\{ \text{an log } \cancel{1.2361}\ 1.7336 \times \frac{.8658 \times .858 \times 1.497}{106.08 \times 1.242 \times 4.242 \times 1.392 \times 4.392} \right\}}$$

$$= \cancel{.0945 \cdot .0749 \cdot \frac{A}{B}} = \underline{\underline{1.24}}$$

$$\theta = \underline{\underline{.0176}}.$$

para xylene.

$\rho = \cdot 66$

$K_{18\cdot 2^\circ} = 2\cdot 15$ [Dobrosserdow - Kauffman's book]

K_{20° (using Lorentz mossotti relation) $= 2\cdot 15$

$n_{14\cdot 7^\circ} = 1\cdot 4985 \quad n_{20^\circ} = 1\cdot 496$

$n_{16\cdot 2^\circ} = 1\cdot 4974. \quad n_{20^\circ} = 1\cdot 496$ $\Big\}$ $n_{20^\circ} = 1\cdot 496$

$\beta_{20^\circ} = 87$

$$B_{D-20^\circ} = \frac{87 \times 10^{-6} \times 1\cdot 239 \times 4\cdot 239 \times 1\cdot 15 \times 4\cdot 15 \times \cdot 66}{\text{anti log } 3\cdot 6530 \times 1\cdot 496 \times 1\cdot 38}$$

$= 1\cdot 55 \times 10^{-7}$

using Gauss's value for ρ : ~~58.3~~ $\cdot 583$

$B_{D-20^\circ} = \cdot 984 \times 10^{-7}$

Observed values

(1) Schmidt's value 22·9 gives $B = \cdot 74 \times 10^{-7}$.

(2) Leiser's value 22·6 quoted by Bergholm gives $B = \cdot 73 \times 10^{-7}$

Calculation of $\frac{A}{\beta_3}$

I from the depolarisation for the liquid

$\rho = .66$ or $.583$ $\Delta = .8611$ $\beta = 87$

$n = 1.4796$ $n^2+2 = 4.239$ $M = 106.08$

Using $\rho = .66$

$$R = \sqrt{\left\{ \frac{2 \cdot 1259 \times .8611 \times 87 \times 4.239^2}{106.08} \times \frac{.66}{1.38} \right\}}$$

$= .196 \cdot .285$

$\frac{A}{\beta_3} = 2.195$

(2) Using $\rho = .583$ $k = .227$

$\frac{A}{\beta_3} = 1.88$

Chlorobenzene

$\rho = \cdot 575$

$K_{10\cdot 8} = 10\cdot 95$ Veley — Landolt Tables

$K_{12-14^\circ} = 5\cdot 65$ (Walden) $K_{20^\circ} = \underline{5\cdot 80}$ Dobrosserdow — Kauffman's book

$\beta_{20^\circ} = 75\cdot 2$ (Tyrer)

$n_{20^\circ} = 1\cdot 5248$

$$B_{D-20^\circ} = \frac{75\cdot 2 \times 10^{-6} \times 1\cdot 325 \times 4\cdot 325 \times 4\cdot 80 \times 7\cdot 80 \times \cdot 575}{\text{anti log } 3\cdot 6530 \times 1\cdot 525 \times 1\cdot 975}$$

$= \underline{6\cdot 85 \times 10^{-7}}$

using Martin and Lehrman's value for ρ

$(= \cdot 539)$ $B_{D-20^\circ} = 5\cdot 69 \times \underline{10^{-7}}$

Martin in his last paper gives $\cdot 48$ for ρ

in that case $B_{D-20^\circ} = \underline{4\cdot 28 \times 10^{-7}}$

<u>obsd values</u>

(1) McCombs $B_{D-2} = 9\cdot 1 \times 10^{-7}$

Calculation of $\frac{A}{B}$

III $\frac{A}{B}$ from depolarisation for vapour

Equation value $\rho = .078$ gives $\frac{A}{B} = 2.09_5$

$\theta = .0715$.

I from depolarisation for liquid

$\rho = 1.1064$

$n = 1.5248$ $\Delta =$ $B =$

$n^2+2 =$ $M = 112.5$

$\rho = .575$ or $.48$; $\Delta = 1.1064$ $B = 75.2$

$n = 1.5248$ $n^2+2 = 4.325$ $M = 112.5$

(1) using $\rho = .575$.

$$R = \sqrt{\left\{ \text{anlg } \overline{2}.1259 \times \frac{1.1064 \times 75.2 \times 4.325}{112.5} \times \frac{.575}{1.975} \right\}^2}$$

$\theta_R = .0538$

$\theta_{GL} = .0259$.

$\frac{A}{B} = 1.90_5$.

(2) using $\rho = .48$ $\frac{A}{B} = 1.67$

$\theta_R = .0336$

$\theta_{GL} = .0162$

II From Kerr const. for liquid

Smyth's value for the moment of molec.

$= 1.42 \times 10^{-18}$

~~II $\frac{A}{B}$ from [illegible]~~.

$$B = 9.1 \times 10^{-7}$$

$$\therefore B' = \frac{9.1 \times 10^{-7}}{1 + \text{antig } 1.0125 \cdot \frac{1.1064 \times 1.42^2}{112.5}} = \frac{9.1 \times 10^{-7}}{1.204}$$

$$= 7.56 \times 10^{-7}$$

$$k = \sqrt{\left\{ \text{an log } 1.2361 \times \frac{\Delta \cdot B \cdot 1.525}{M \cdot 1.325 \cdot 4.325 \times 4.80 \times 7.80} \right\}}$$

$$= .0954 \qquad \therefore \frac{A}{B} = 1.31_5$$

$$A - B = \frac{9}{4\pi W} \times 31.12 \times \sqrt{.026}$$

$$= \text{an log } \overline{24} \cdot \overset{7730}{\cancel{7367}}$$

$$\frac{\mu^2}{RT(A-B)} = 8.5.$$

$$\theta_L = \text{alog } 1.7336 \times \frac{1.1064 \times 9.1 \times 1.525}{112.5 \times 1.325^2 \times 4.325^2}$$

$$= .225$$

$$\theta_B = \cancel{.0264} \cdot .0300$$

Bromobenzene

$\rho = .65$

$K_{20^\circ} = 5.2$
$\alpha_{20^\circ} = .0028$ } Walden – Lander Tables

$n_{20^\circ} = 1.55598.$

$\beta_{20^\circ} = 67.$

$$B_{D-20^\circ} = \frac{67 \times 10^{-6} \times 1.433 \times 4.433 \times 4.2 \times 7.2 \times .65}{\text{anti log } 3.6530 \times 1.560 \times 1.45}$$

$= 10.06 \times 10^{-7} = 8.22 \times 10^{-7}$

using Lander's value for $\rho = .62$

$B_{D-20^\circ} = 6.85 \times 10^{-7}$

Obsd values

McCombs value is $B_{D-24.9} = 9.1 \times 10^{-7}$.

→ appt $\rho = .63_5$

Calculation of $\frac{A}{B}$.

III $\frac{A}{B}$ from depolarisation for vapour

Ramsay's $\rho = .078$ gives for $\frac{A}{B}$ 2.09_5

$\theta = .0715$

I from depolarisation for liquid

$\rho = .63_5$ $\quad \Delta = 1.4953$ $\quad \beta = 67$

$n = 1.5598$ $\quad n^2+2 = 4.433$ $\quad M = 156.96$

$$R = \sqrt{\left\{ \text{au. log } \bar{2}.1259 \cdot \frac{1.4953 \times 67 \times 4.433^2 \cdot .635}{\cdot 156.96 \times 1.555} \right\}}$$

$= .262$ $\quad \theta_R = .0685$

$\therefore \frac{A}{B} = 2.06$ $\quad \theta_{RL} = .0352$

II From Kerr const. for liquid

Smyth from data of Lertes gets the moment of the molec. $\mu = 1.39 \times 10^{-18}$

$$B' \times 10^7 = \frac{9.1}{1 + \text{au log } 1.0125 \cdot \frac{1.4953 \cdot 1.39^2}{156.96}}$$

$$= \frac{9.1}{1.1.89} = 7.65$$

$$K = \sqrt{\left\{ \text{alog } 1.2361 \cdot \frac{\Delta B \cdot 1.560}{M \cdot 1.433 \times 4.433 \times 4.2 \times 7.2} \right\}}$$

$K = .101$ $\qquad \frac{A}{B} = 1.34$

$$A - B = \frac{9}{4\pi N} \times 34.02 \times \sqrt{.0352}$$

$$= \overline{24} \cdot 8.775$$

$$\frac{\pi^2}{RT(A-B)} = 6.4$$

$$\theta_L = \text{alog } 1.7336 \times \frac{1.4953 \times 9.1 \times 1.560}{156.96 \times 1.433^2 \times 4.433^2}$$

$$= .181_5$$

$\theta_B = .0281 \cdot .0336.$

nitro benzene.

·74

The values of K of Abegg and Seitz (Z. Phy. chem. 29, 247, 1899) quoted by Meyer (Zeits Phy. 24, 148, 1924) are ($\lambda = \infty$)

t	K
14°	38·5
19°	37·1
33°	34·9

$K_{20°} = 36{\cdot}9_5$

$\beta_{20°} = 50{\cdot}0$ (Tyrr)

$n_{20°} = 1{\cdot}553$

$$B_{D-20°} = \frac{50{\cdot}0 \times 10^{-6} \times 1{\cdot}411 \times 4{\cdot}411 \times 35{\cdot}9_5 \times 38{\cdot}9_5 \times {\cdot}74}{\text{anti log } 3{\cdot}6530 \times 1{\cdot}553 \times {\cdot}82}$$

$= 563 \times 10^{-7}$

using Martin's value ·684 for ρ

$B_{D-20°} = 352 \times 10^{-7}$

Observed values

(1) Lyon's value for $B_{D-20°} = 399 \times 10^{-7}$

(2) McComb's value for $B_{D-22{\cdot}5} = 250 \times 10^{-7}$

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(3) Szivessy's (Zeit. f. Phys. 2, 47, 1920) value for $\lambda = 546$ μμ at 20° C

$= 283 \times 10^{-7}$

for $\lambda = 589$. $B = 256 \times 10^{-7}$.

calculation of $\frac{A}{B}$

I from depolarisation for liquid.

$\rho = .74$ or ~~.684~~ $\Delta = 1.2032$ $\beta = 50.0$

$n = 1.553$ $n^2+2 = 4.411$ $M = 123.05$

(1) using $\rho = .74$

$$R = \sqrt{\left\{ \text{an. lg } \bar{2}.1259 \times \frac{1.2032 \times 50 \times 4.411^2 \times .74}{123.05 \times .82} \right.}$$

$= .339$

$\theta_R = .115$

~~$\frac{A}{B} = 2.53$~~ $\theta_G = .0530$

(2) using the value $\rho = .684$

$\frac{A}{B} = 2.10$

(3) using Ramanathan's $r_{vapour} = .056$.

$$\theta = \frac{.280}{5.608} = .0499.$$

$$A - B = \frac{9}{4\pi N} \times 32.74 \sqrt{.0530}$$

$$\text{anlog } \overline{24}.9496.$$

μ from Debye's work : 3.75×10^{-18}

$$\therefore \frac{\mu^2}{RT(A-B)} = 39.3$$

using $B = 283 \times 10^{-7}$

$$\theta_L = \text{anlog } 1.7336 \times \frac{1.2032 \times 283 \times 1.55^{-3}}{123.05 \times 1.411^2 \times 4.411^2}$$

$$= 6.008.$$

$$\theta_B = .153.$$

Aniline

$P = \cdot 60$.

$K_{18^\circ} = 7 \cdot 316$ Turner
$\alpha_{15^\circ} \quad \cdot 0035$ Ratz
} Landolt Table.

Jezewski's [Journ de Physique] Tome III 293, 1904
values for K are

t	K
18·4	6·977
35·7	6·530

$\therefore K_{20^\circ} = 6 \cdot 936$

$n_{D\text{-}20^\circ} = 1 \cdot 5863$

$B_{20^\circ} = 45 \cdot 9$ (Dyer)

$$B_{D\text{-}20^\circ} = \frac{45 \cdot 9 \times 10^{-6} \times 1 \cdot 518 \times 4 \cdot 518 \times 5 \cdot 936 \times 8 \cdot 936 \times \cdot 60}{\text{anti-log } 3 \cdot 6530 \times 1 \cdot 5863 \times 1 \cdot 80.}$$

$= 7 \cdot 80 \times 10^{-7}$

Observed values

(1) Schmidt value which is just the same as Leiser's value (-38) gives

$B = -1 \cdot 23 \times 10^{-7}$

Calculation of $\frac{A}{B}$

I from depolarisation for liquid

$\rho = .60$ $\quad \Delta = 1.0216$ $\quad \beta = 45.9$

$n = 1.5863$ $\quad n^2+2 = 4.518$ $\quad M = 93.06$

$$R = \sqrt{\left\{ \text{antilog } \bar{2}.1259 \times \frac{1.0216 \times 45.9 \times 4.518^2 \times .60}{93.06 \times 1.80} \right\}}$$

$= .214.$ $\quad \therefore \frac{A}{B} = 1.82$

$\theta_R = $ ~~.0446~~ $.0458$

$\theta_{GL} = $ ~~.0020~~ $.0202$

II using Ramanathan's $\gamma_{vapour} = .049$

$$\theta = \frac{.245}{5.657} = .0433$$

Calculate μ from dielectric data.

$\rho = .82$ O-nitrotoluene.

$K_{18^\circ} = 27.7$ Turner (Landolt Tables)

$K_{19.1} = 26.2$ Dobrosserdow - Kauffman's book

Schmidt's (Ann der Phys. 76, 571, 1925)

values of β are

t	β	$\beta_{20^\circ} = 49$.
10°	47.03	
24°	50.00	$n_{20^\circ} = 1.5475$

$$B_{D-20^\circ} = \frac{49 \times 10^{-6} \times 1.394 \times 4.394 \times 25.2 \times 28.2 \times .82}{\text{anti log } 3.6530 \times 1.5475 \times .26}$$

$$= 966 \times 10^{-7}$$

observed values

(1) the value of Leiser quoted by Bergholm : 5400 gives for B 174×10^{-7}

(2) McCombs value for nitrotoluene (probably mix of the isomerides) $B_{D-24^\circ} = 117 \times 10^{-7}$

Calculation of $\frac{A}{B}$.

I $\frac{A}{B}$ from depolarisation for liquid

$P = \sim\!\!\sim\!\!\sim\!\!\

Methyl alcohol

$\rho = .060$ [

K_{30} (Abegg + Seitz) = 31.2 — Landolt Tels.

β_{30} (Tyrer) = 123

$n_{D-20} = 1.330$.

$$B_{D-20} = \frac{123 \times 10^{-6} \times .769 \times 3.769 \times 30.2 \times 33.2 \times .060}{\text{ant log } 3.65 \quad 30 \times 1.330 \times 5.58}$$

6.42×10^{-7}

Observed value

(1) Schmidt's value 30 grs $B = .97 \times 10^{-7}$.

calculation of $\frac{A}{B}$

III from depolarisation for vapour

Gaussian's $\rho = \cdot 027$ gives $\frac{A}{B} = 1.54$. $\theta = \cdot 0232$

I from depolarisation for liquid

$\rho = \cdot 060$ $\Delta = \cdot 7915$ $\beta = 123$

$n = 1.330$ $n^2+2 = 3.769$ $M = 32.03$

$$k = \sqrt{\left\{ \text{an. lg. } \bar{2}.1259 \times \frac{\cdot 7915 \times 123 \times 3.769^2 \times \cdot 060}{32.03 \times 5.58} \right\}}$$

$\theta_R = \cdot 00621$

$= \cancel{\cdot 0635}\ \cdot 0788 \therefore \frac{A}{B} = 1.25_5 - \theta_{gl} = \cdot 00393.$

II ~~from depolarisation for the va~~
From the Kerr const. for the liquid

Jona from data for vapour 1.61×10^{-18} –
Smyth from the same data by a different method calculates $\mu = 1.78 \times 10^{-18}$

$$B' \times 10^7 = \frac{\cdot 97}{1 + \text{am log } 1\cdot0125 \times \frac{\cdot7915 \times 1\cdot78^2}{32\cdot03}} = \frac{\cdot97}{1\cdot806}$$

$$= \cdot537.$$

$$R = \sqrt{\left\{ \text{am log } 1\cdot2361 \times \frac{\Delta \cdot B \cdot 1\cdot33}{M \cdot 769 \times 3\cdot769 \cdot 30\cdot2 \times 33\cdot2} \right\}}$$

$$= \cdot010 \qquad \therefore \frac{A}{B} = 1\cdot03$$

$$A - B = \frac{9}{4\pi N} \times \frac{\cdot769}{3\cdot769} \times \frac{32\cdot03}{\cdot7915} \times \sqrt{\cdot00393}$$

$$= \text{am log } \overline{2}5\cdot7863.$$

$$\text{now } \mu = 1\cdot61 \times 10^{-18}$$

$$\frac{\mu^2}{RT(A-B)} = 105.$$

$$\theta_L = \text{alog } 1\cdot7336 \times \frac{\cdot7915 \times \cdot97 \times 1\cdot330}{32\cdot03 \times \cdot769^2 \times 3\cdot769^2}$$

$$= \cdot2056$$

$$\theta_B = \cdot00198.$$

Ethyl alcohol.

$\rho = .053$

$K_{20^\circ} = 25.8$ Abegg + Seitz – Landolt Tables.

β_{20° (Jyrr) = 113 $\quad n_{D\text{-}20^\circ} = 1.3623$

$$B_{D\text{-}20^\circ} = \frac{113 \times 10^{-6} \times .856 \times 3.856 \times 24.8 \times 27.8 \times .053}{\text{antilog } 3.6530 \times \pi \times 5.629}$$

$$= 3.95 \times 10^{-7}$$

(1) Pontier's (loc. cit.) value at 17° relative to $CS_2 = .238$. – using Cheaumont's value for $CS_2 = 3.226$

B for alcohol = $.768 \times 10^{-7}$.

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I $\frac{A}{B}$ from the depolarisation for the liquid

$\rho = \cdot 053$.

$\Delta = \cdot 7894$ $\beta = 113$ $n = 1\cdot 3623$ $n^2+2 = 3\cdot 856$

$M = 46\cdot 06$.

$$\therefore R = \sqrt{\left\{ \text{ant log } \bar{2}\cdot 1259 \times \frac{\cdot 7894 \times 113 \times 3\cdot 856^2}{46\cdot 06} \times \frac{\cdot 053}{5\cdot 629} \right\}}.$$

$= \cdot 0602$ $\frac{A}{B} = 1\cdot 19_2$ $\theta_R = \cdot 00362$ $\theta_{GL} = \cdot 00219$.

II. $\frac{A}{B}$ from the Kerr const for the liquid

In this case as the molec is polar ~~instead~~ according to Born's formula instead of B in our expression we will have to put

$$B' \quad \frac{B}{1 + \frac{\mu^2}{KT \cdot \frac{3}{2} \cdot \frac{M}{\Delta N}}}$$

μ = moment of molec.

K = Boltzmann's const $= 1\cdot 34 \times 10^{-16}$.

N = Avogadro no $= 6\cdot 062 \times 10^{23}$

$$\cancel{B' = \frac{\cdot 768}{1 + \frac{1\cdot 7^2 \times 10^{-36} \times 2\Delta}{1\cdot 34 \times 10^{-16} \times 293 \times 3}}}$$

Smyth's value for μ

now Smyth's value for $\mu = 1\cdot 70 \times 10^{-18}$.

calculated from Abegg & Seitz's data

$$B' = \frac{\cdot 768}{1 + \frac{1\cdot 7^2 \times 10^{-36} \times 2 \times \cdot 7894 \times 6\cdot 062 \times 10^{23}}{1\cdot 34 \times 10^{-16} \times 293 \times 3 \times 46\cdot 06}}$$

$$= \frac{\cdot 768}{1\cdot 509_5} = \cdot \cancel{480}\ 509 \quad (a.l.\ \cancel{T\cdot 6814}\ T\cdot 7066)$$

$$k = \sqrt{\left\{ a.l.\ 1\cdot 2361 \times \frac{\cdot 7894 \times \cancel{\cdot 480}\ \cdot 509 \times 1\cdot 3623}{46\cdot 06 \times \cdot 856 \times 3\cdot 856 \times 24\cdot 8 \times 27\cdot 8} \right\}}$$

$$= \cdot 00948.$$

$$\frac{A}{B} = 1\cdot 03$$

III $\frac{A}{B}$ from ρ for vapour $\rho = \cdot 017$

$$k = \sqrt{\frac{\cdot 085}{5\cdot 881}} \qquad \theta = \cdot 0145.$$

$$\frac{A}{B} = 1\cdot 41$$

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$\frac{19-1}{19+2}\sqrt{\frac{5}{2}}$

$$A-B = \frac{9}{4\pi}\cdot\frac{\cdot856}{3.856}\cdot\frac{46.06}{\cdot7894}\cdot\sqrt{\frac{\cdot00219}{12.78}}$$

$$= \text{a.l. } \overline{25}\cdot8492$$

Zaki $\mu = 1.64\times10^{-8}$

$$\frac{\mu^2}{RT(A-B)} = 95.$$

$$\theta_L = \text{alog } 1.7336\times\frac{\cdot7894\times\cdot768\times1.3623}{46.06\times\cdot856^2\times3.856^2}$$

$$= \cdot0891$$

$$\theta_B = \cdot0_3\overline{95}.$$

Propyl alcohol.

$\rho = \cdot 071$

$K_{20^\circ} = 22 \cdot 2$ (Abegg & Seitz) — Landolt-Börn.

$n_{D\text{-}20^\circ} = 1 \cdot 385_4$.

$\beta_{20^\circ} = 98 \cdot 5$

$$B_{D\text{-}20^\circ} = \frac{98 \cdot 5 \times 10^{-6} \times \cdot 920 \times 3 \cdot 920 \times 21 \cdot 2 \times 24 \cdot 2 \times \cdot 071}{\text{antilog } 3 \cdot 65\,30 \times n \times 5 \cdot 503}$$

$$= 3 \cdot 77 \times 10^{-7}$$

Observed values

(1) Schmidt's value -65^- gives $B = -2 \cdot 10 \times 10^{-7}$.

(2) The value -78 quoted in Kauffmann's table gives $B = -2 \cdot 52 \times 10^{-7}$

Calculation of $\frac{A}{B}$

III from depolarisation for vapour

Gausau's $\rho = \cdot 020$ gives $\frac{A}{B} = 1\cdot 45$. $\theta = \cdot 0171$

I from depolarisation for liquid

$\rho = \cdot 071$ $\Delta = \cdot 8035$ $\beta = 98\cdot 5$

$n = 1\cdot 385_4$ $n^2+2 = 3\cdot 920$. $M = 60\cdot 06$

$$k = \sqrt{\left\{ \text{anly } \bar{2}\cdot 1259 \times \frac{\cdot 8035 \times 98\cdot 5 \times 3\cdot 920^2 \times \cdot 071}{60\cdot 06 \times 5\cdot 503} \right\}}$$

$= \cdot 0591$ $\therefore \frac{A}{B} = 1\cdot 19$ $\theta_R = \cdot 00349$ $\theta_{el} = \cdot 00205$.

II ~~from depolarisation for vapo~~
from the Kerr const for the liquid

From data of Abegg & Seitz for variation of dielec const of liquid into temp Smyth calculate the moment of molec to be $1\cdot 71 \times 10^{-18}$ Of course value slightly low owing to molecular aggregation

$$B' \times 10^7 = \frac{2.52}{1 + \text{anlog } 1.0125 \times \frac{.8035 \times 1.71^2}{60.06}}$$

$$= \frac{2.52}{1.403} = 1.80 \times 10$$

$$R = \sqrt{\left\{ \text{an log } 1.2361 \times \frac{\Delta . B \times 1.385_4}{M \times .920 \times 3.920 \times 21.2 \times 24.2} \right\}}$$

$$= .0557 \quad \therefore \frac{A}{B} = \underline{\underline{1.18}}$$

$$A - B = \frac{9}{4\pi N} \; 17.52 \times \sqrt{.00205}$$

$$= \text{al. } \overline{25}.9718$$

$$\text{Taking } \mu = 1.66 \times 10^{-18}$$

$$\frac{\mu^2}{RT(A-B)} = 73.$$

$$\theta_L = \text{alog } 1.7336 \times \frac{.8035 \times 2.52 \times 1.385_4}{60.06 \times .920^2 \times 3.920^2}$$

$$= .1945$$

$$\theta_B = .00270.$$

Isopropyl alcohol.

$\rho = \cdot 050$.

~~$K_{\text{about } 19^\circ} = 19 \cdot 2$ Löwe – Landolt Tables~~

$K_{\text{about } 20^\circ} = \text{about } 26$. Löwe – Landolt Tables

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$n_{20^\circ} = 1 \cdot 3776$
$\quad\quad\quad 1 \cdot 3813$ $\quad\quad 1 \cdot 378$

$\beta_{20^\circ} = 105$.

$$B_{D-20^\circ} = \frac{105 \times 10^{-6} \times \cdot 900 \times 3 \cdot 900 \times 25 \times 28 \times \cdot 050}{\text{anti log. } 3 \cdot 6530 \times n \times 5 \cdot 65}$$

$$= 3 \cdot 68 \times 10^{-7}$$

observed values

Schmidt's value 73 gives $B = 2 \cdot 35_5$

Calculation of $\frac{A}{B}$

III from depolarisation for vapour

Lorenz $\rho = .019$ gives $\frac{A}{B} = 1.44$ $\theta = .0162$

I from depolarisation for liquid

$\rho = .050$ $\Delta = .7887$ $\beta = 105$

$n^2 = 1.378$ $n^2+2 = 3.900$ $M = 60.06$

$$R = \sqrt{\left\{ a.\log \bar{2}.1259 \times \frac{.7887 \times 105 \times 3.900^2 \times .05}{60.06 \times 5.65} \right\}}$$

$= .0498$ $\therefore \frac{A}{B} = 1.13.$

$\theta_R = .00248$

$\theta_{GL} = .00147.$

n — Butyl alcohol.

$\rho = \cdot 093$

$K_{\text{about } 19^\circ} = 19 \cdot 2$ Löwe. — Landolt Talle

$1 + 20^\circ = \theta$

$n_{20^\circ} = 1 \cdot 3992$

$P_{20^\circ} = 92.$

$$B_{D\text{-}20^\circ} = \frac{92 \times 10^{-6} \times \cdot 958 \times 3 \cdot 958 \times 18 \cdot 2 \times 21 \cdot 2 \times \cdot 093}{\text{anti log } 3 \cdot 6530 \cdot n = 5 \cdot 349}$$

$= 3 \cdot 72 \times 10^{-7}$

Obsd value

Leiser's value -113 quoted by Berghoff

gives $B = -3 \cdot 65 \times 10^{-7}$

Calculation of $\frac{A}{B}$

III. from depolarisation for vapour

equation, $\rho = .028$ gives $\frac{A}{B} = 1.55$ $\theta = .0241$

I from depolarisation for liquid

$\rho = .093$ $\therefore \Delta = .8042$ $\beta = 92$

$\therefore n = 1.3992$ $n^2 + 2 = 3.958$ $M = 74.08$

$$R = \left\{ \text{an. log } \bar{2}.1259 \times \frac{.8042 \times 92 \times 3.958^2 \times .093}{74.08 \times 5.349} \right.$$

$= .0603$ $\therefore \frac{A}{B} = 1.19$

$\theta_R = .00364$

$\theta_{RL} = .00209$

Isobutyl alcohol

$\rho = \cdot 073$

~~K abs 19° = 157.5 Sörensen (Sandoff-Bornstein)~~

$K_{20°} = 20 \cdot 0$ Alegg + Seitz (Sandoff-Bornstein)

$n_{17 \cdot 5} = 1 \cdot 3968$
$n_{25 \cdot 6} = 1 \cdot 3940$ } $n_{20°} = 1 \cdot 396$

$\beta_{20°} = 99 \cdot 5$

$$B_{D-20°} = \frac{99 \cdot 5 \times 10^{-6} \times \cdot 949 \times 3 \cdot 949 \times 19 \cdot 0 \times 22 \cdot 0 \times \cdot 073}{\text{antilog } 3 \cdot 6530 \cdot n \times 5 \cdot 489}$$

$3 \cdot 30 \times 10^{-7}$

Obsd values

Schmidt's value – mo gros $B = -3 \cdot 58 \times 10^{-7}$

154 .808 18
794 - 1

Calculation of $\frac{A}{B}$

III from depolarisation for vapour.

Gaussian $\rho = .018$ gives $\frac{A}{B} = 1.42$

$\theta = .0153$.

I from depolarisation for liquid

$\rho = .073$ $\Delta = .798$ $\beta = 99.5$

$n = 1.396$ $n^2+2 = 3.949$ $M = 74.08$

$$k = \sqrt{\left\{ \text{antlog } \bar{2}.1259 \times \frac{.798 \times 99.5 \times 3.949^2 \times .073}{74.08 \times 5.489} \right\}}$$

$= .0545$ $\therefore \frac{A}{B} = 1.17$

$\theta_l = .00297$

$\theta_{sl} = .00171$

Trimethyl ~~alcohol~~ carbinol

$\rho = \cdot 041$

Kabrt$_{19°}$ = 11·4 Löwe — Landolt Tables.

$n_{20°} = 1 \cdot 3878$

~~Iso Amyl~~

$\beta_{20°} = 111$

$$B_{D-20°} = \frac{111 \times 10^{-6} \times \cdot 927 \times 3 \cdot 927 \times 10 \cdot 4 \times 13 \cdot 4 \times \cdot 041}{\text{anti log } 3 \cdot 6530 \times n \times 5 \cdot 713}$$

$$= \cdot 647 \times 10^{-7}$$

Obsd values

~~Leiser's value~~ The value quoted in Kauffman's book 154 gives $B = 4 \cdot 97 \times 10^{-7}$

Calculation of $\frac{A}{B}$.

I from depolarisation for liquid

$\rho = \cdot 041$ $\quad \Delta = \cdot 7887$ $\quad \beta = 111$

$n = 1 \cdot 3878$ $\quad n^2+2 = 3 \cdot 927$ $\quad M = 74 \cdot 08$

$$R = \sqrt{\left\{ \text{antlg } \bar{2} \cdot 1259 \times \frac{\cdot 7887 \times 111 \times 3 \cdot 927^2 \times \cdot 041}{74 \cdot 08 \times 5 \cdot 713} \right\}}$$

$= \cdot 0418$ $\quad \therefore \frac{A}{B} = 1 \cdot 13$

Iso Amyl alcohol (inactive)

$\rho = 1.098$

for $\lambda = 91$ cm^{-1} $K_{18^\circ} = 5.7$ Rudolfer (Landolt Tabl.

For amyl alcohol $K_{20^\circ} = 16.0$ Hagg & Seitz "

Iso amyl alcohol $n_{17.8^\circ} = 1.4084$ n_{20° 1.4075.

$\beta_{20^\circ} = 100.$

$$B_{D\text{-}20^\circ} = \frac{100 \times 10^{-6} \times .980 \times 3.980 \times 15.0 \times 18.0 \times .098}{\text{anti log } 3.6530 \times n \cdot 5.314}$$

$$= 3.07 \times 10^{-7}$$

Old value

Schmidt's value -89 gives $B = -2.87 \times 10^{-7}$

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Calculation of $\frac{A}{B}$.

Allyl alcohol

$\rho = \cdot 296$

K_{15° [for λ = about 1200 cm^{-1}] = 21.6 Thurning Landolt Tabl

$\beta^{\circ}_{20^\circ} = 95^\circ$

no exptal data for B.

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Calculation of $\frac{A}{B}$.

III from depolarisation for vapour.

Gausan's value $\rho = \cdot 052$ gives $\frac{A}{B} = 1 \cdot 82$

$\theta = \cdot 046$

I from depolarisation for liquid

$\rho = \cdot 296$ $\Delta = \cdot 8549$ $\beta = 95$

$n =$ ~~n^2+2~~ : $M = 58 \cdot 05$

molecular refraction =

$CH_2 = CH \cdot CH_2 \cdot OH$.

4·618
4·618
2·418
1·100
1·100
1·525
1·733
17·112

$\therefore \frac{n^2-1}{n^2+2} = \frac{M}{\Delta} = 17 \cdot 11$

$= \frac{17 \cdot 11 \times \cdot 8549}{58 \cdot 05}$

$= \cdot 2520$

$\therefore n_{D^2} = \frac{1 \cdot 504}{\cdot 7480} = 2 \cdot 010$

$n^2 + 2 = 4 \cdot 010.$

$\theta_R = \text{anti.log } \bar{2} \cdot 1259 \times \frac{\cdot 8549 \times 95 \times 4 \cdot 010^2 \times \cdot 296}{58 \cdot 05 \times 3 \cdot 928}$

$= \cdot 0227$

$\theta_G = \cdot 0127.$

Benzyl alcohol

$\rho = .62$

$\kappa_{20^\circ} = 13.0$ } Walden
$\lambda_{20^\circ} = .012$ } Landolt-Talk

$n_{22.1} = 1.5394$ $\quad$ $n_{20^\circ} = 1.5403$

$\beta_{20^\circ} = 55$

$$B_{D-20^\circ} = \frac{55 \times 10^{-6} \times 1.369 \times 4.369 \times 12.0 \times 15.0 \times .62}{\text{anti log } 3.6530 \times n \times 1.66}$$

$= 32.0 \times 10^{-7}$

Obsd value

the value quoted in Kauffmann's book -477 gives $B = -15.39 \times 10^{-7}$.

Calculation of $\frac{A}{B}$

I from depolarisation for liquid

$\rho = .62$ $\quad \Delta = 1.043$ $\quad \beta = 55$

$n = 1.5403$ $\quad n^2+2 = 4.369$ $\quad M = 108.06$

$$k = \left\{ \text{anly } \overline{2}.1259 \times \frac{1.043 \times 55 \times 4.369^2 \times .62}{108.06 \times 1.66} \right\}$$

$= .225$ $\quad \therefore \frac{A}{B} = 1.865$

Propyl formate

$\rho = \cdot 210$

$IC_{23\cdot1} = 9\cdot01_6$. Landolt + Jahn (Landolt-Jahn)

$P_{20^\circ} = 100$

The exptl value of molecular refraction for Ethyl formate = 17·92 ∴ M_D for Propyl formate = $\frac{17\cdot92}{4\cdot62}$ / $22\cdot54$

Molec. wt = 88·06 $\quad \delta_{20^\circ} = \cdot 9058$.

$$\frac{n_D^2 - 1}{n^2 + 2} = \frac{22\cdot54 \times \cdot 9058}{88\cdot06} = \cdot 2318.$$

$$n^2 = \frac{1\cdot4636}{\cdot 7682} = 1\cdot905$$

$$n^2 + 2 = 3\cdot905$$

No exptal data for D_3.

Calculation of $\frac{A}{B}$

III from depolarisation for vapour

Gases $\rho = .035$ gives $\frac{A}{B} = 1.63$. $\theta = .0304$

I from depolarisation for liquid

$\rho = .210$ $\Delta = .9058$ $\beta = 100$

$M = 88.06$

$n^2 + 2 =$

$$\theta_R = \text{anti log } \bar{2}.1259 \times \frac{.9058 \times 100 \times 3.905^2 \times \frac{.210}{.035}}{88.06 \times 4.53}$$

$= .00971$

$\theta_{GL} = .00573$

Ethyl acetate.

$\rho = \cdot 233$ ~~[illegible]~~ Mesh $\cdot 228$ adopt $\cdot 230$

$K_{20^\circ} = 6 \cdot 11$
$\alpha_{20^\circ} = \cdot 0025$ } Löwe – Landolt Tables.

$\beta_{20^\circ} = 114 \cdot 7$ (Tyrer)

$n_{20^\circ} = 1 \cdot 3726$ 111 =

$$B_{D-20^\circ} = \frac{114 \cdot 7 \times 10^{-6} \times \cdot 885 \times 3 \cdot 885 \times 5 \cdot 11 \times 8 \cdot 11 \times \cdot 230}{\text{anti log } 3 \cdot 6530 \times n \cdot 4 \cdot 39}$$

$1 \cdot 38 \times 10^{-7}$

obsd values ~~Leiser's~~ The value given in Kauffmann's book 52 gives $B = 1 \cdot 68 \times 10^{-7}$

178 I $\frac{A}{B}$ from ρ for liquid

ethyl acetate contd

$\rho = \cdot 230$

$\Delta = \cdot 9005 \quad \beta = 114 \cdot 7 \quad n^2 + 2 = 3 \cdot 885 ; M = 88 \cdot 06.$

$$k = \sqrt{\left\{ \text{an.log } \bar{2} \cdot 1259 \times \frac{\cdot 9005 \times 114 \cdot 7 \times 3 \cdot 885^2}{88 \cdot 06} \times \frac{\cdot 23}{4 \cdot 39} \right\}}$$

$\theta_2 = \cdot 0124$

$\theta_G = \cdot 0074$

$= \cdot 111 \qquad \frac{A}{B} = 1 \cdot 38$

II $\frac{A}{B}$ from Kerr const for liquid.

$B = 1 \cdot 68 \times 10^{-7}$

$$k = \sqrt{\left\{ \text{an.log } \overset{1 \cdot 7336}{\cancel{1 \cdot 2561}} \times \frac{\cdot 9005 \times 1 \cdot 68 \times 1 \cdot 3726}{88 \cdot 06 \times \cdot 885 \times 3 \cdot 885 \times 5 \cdot 11 \times 8 \cdot 11} \right\}}$$

$= \cdot 0534 \qquad \frac{A}{B} = 1 \cdot 17. \qquad \cdot 238$

$\theta = \cdot 0090$

III $\frac{A}{B}$ from vapour. $\rho = \cdot 034$

$\theta = \frac{\cdot 170}{5 \cdot 762} = \cdot 0295.$

$= 2.$

IV no data for Kerr const for vapour

Acetone.

$\rho = 0.236$ Gans's value 17.0; adopt 20.

$K_{20°} = 21.5$
$\alpha_{20°} = 0.0046$ } Walden — Landolt-Tables

Kauffmann [Ann. der Phys. 70, 238, 1923] gives the following values

t	K
19.5	22.65
30.2	21.19

$K_{20°} = 22.58$

$n_{20°} = 1.3593$

$\beta_{20°} = 120$

$$B_{D\text{-}20°} = \frac{120 \times 10^{-6} \times .848 \times 3.848 \times 21.58 \times 24.58 \times .20}{\text{anti log } 3.6530 \times n \times 4.60}$$

$$= 14.77 \times 10^{-7}$$

Obs'd value

The value 505 given in Kauffmann's book gives $B = 16.29 \times 10^{-7}$.

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Calculation of $\frac{A}{B}$

·336

III from depolarisation for vapour

$\theta = \frac{\cdot 240}{5664} = \cdot 0424$

Lorentz $\rho = \cdot 048$ gives $\frac{A}{B} = 1 \cdot 78$.

I from depolarisation for liquid.

$\rho = \cdot 20 \qquad \Delta = \cdot 7920 \qquad \beta = 120$

$n = 1 \cdot 3593 \qquad n^2 + 2 = 3 \cdot 848 \qquad M = 58 \cdot 05$

$$R = \left\{ \text{anti log } \bar{2} \cdot 1259 \times \frac{\cdot 7920 \times 120 \times 3 \cdot 848^2 \times \cdot 20}{58 \cdot 05 \times 4 \cdot 6} \right\}$$

$= \cdot 119.$ $\qquad \therefore \frac{A}{B} = 1 \cdot 40_5$

$\theta_R = \cdot 0141$

$\theta_{GL} = \cdot 0086.$

$$A - B = \frac{9}{4\pi N} \cdot 16 \cdot 15 \sqrt{\cdot 0086}$$

$= \text{anti log } \bar{24} \cdot 2478$

taking $\mu = 2 \cdot 61 \times 10^{-18}$

$$\frac{\mu^2}{RT(A-B)} = 958$$

$=$

$$\theta_L = \text{anlog } 1.7336 \times \frac{.7920 \times 16.29 \times 1.3593}{58.05 \times .848^2 \times 3.848^2}$$

$$= \cancel{2.707} \; 1.537$$

$$\theta_B = .0016.$$

Diethyl Ketone.

$P = 18$

$K_{15°}$ (for $\lambda = 73$ cm) $= 17.0$ Drude Landolt Zeit.

$n_{16.6°} = 1.394$ $n_{20°} = 1.392$.

$\beta_{20°} = 97$

No expt'al data for B.

Water.

$\rho = .085$ add/n .07

K_{18}. Turner $= 81.1$ [Kauffmann's book].

$K_{20°} = 80.5$ (Walden)

$\beta_{20°}$ (Tyrr) $= 46.45$

$n_{20°} = 1.3330$.

$$B_{D-20°} = \frac{46.45 \times 10^{-6} \times .777 \times 3.777 \times 80.1 \times 83.1 \times .07}{\text{antilog } 3.6530 \times n \times 5.51}$$

$$= 19.22 \times 10^{-7}$$

Observed values

(1) Pauthenier [Journ de Phys T. II 384, 1921] gets for the value relative to ~~at~~ CS_2 at 17°, 1.23 ∴ using Chaumont's value for $B_{D-20°}$ for CS_2 ~~1.20~~

∴ $B = 3.97 \times 10^{-7}$

Calculation of A/B.

I from the depolarisation for the liquid.

$f = \cdot 07$ $\quad \Delta = \cdot 9982$ $\quad \beta = 46 \cdot 45$ (molecular)

$n = 1 \cdot 333$ $\quad n^2 + 2 = 3 \cdot 777$ $\quad M = 18 \cdot 016$

$$R = \left\{ \text{anti-log } \bar{2} \cdot 1259 \times \frac{\cdot 9982 \times 46 \cdot 45 \times 3 \cdot 777^2 \times \cdot 07}{18 \cdot 016 \times 5 \cdot 51} \right\}$$

$\theta_R = \cdot 00623$

$\theta_A = \cdot 00393$

$= \cdot 0789$ $\quad \therefore \frac{A}{B} = 1 \cdot 26$

II from Kerr const- for liquid

Jona's value (from vapour) for the moment of the molec $= 1 \cdot 87 \times 10^{-18}$.

$$B' \times 10^7 = \frac{3 \cdot 97}{1 + \text{anti-log } 1 \cdot 0125 \cdot \cdot 9982 \times 1 \cdot 87^2 \cdot 01 \times 18 \cdot 016}$$

$$= \frac{3 \cdot 97}{2 \cdot 994} = 1 \cdot 32_6$$

$$\therefore R = \left\{ \text{anti-log } 1 \cdot 2361 \times \frac{\Delta \, B \times 1 \cdot 333}{M \times \cdot 777 \times 3 \cdot 777 \times 80 \cdot 1 \times 83 \cdot 1} \right\}$$

$= \quad \therefore \frac{A}{B} = 1.00.$

$$A - B = \frac{9}{4\pi N} \cdot \frac{\cdot 777}{3.777} \cdot \frac{18.016}{\cdot 9982} \cdot \sqrt{\cdot 00393}$$

$$= \overline{24} \cdot 0158 \quad \overline{25} \cdot 4393.$$

Taking $\mu = 1.87 \times 10^{-18}$

$$\frac{\mu^2}{RT(A-B)} = 316.$$

$$\theta_L = \text{antilog } 1.7336 \times \frac{\cdot 9982 \times 3.97 \times 1.333}{18.016 \times \cdot 777^2 \times 3.777^2}.$$

$= 1.845.$

$\theta_B = \cdot 00583.$

Electrical moment of molec.

methyl ether ♎ 1·3. (Smyth)

methylene chloride ♎ 1·65 "

Refs for the elec. moment of molec.

(1) J. J. Thomson – for Frank Inst. – Elec. in Chemistry 195, 758, 1923.

(2) " Phil mg. 27. 1914.

(3) Falkenhagen Phys Zeit 23, 87, 1922

(4) Smyth Phil mg 45 849 1923
47. 1924

(5) Jona Phys Zeits 20, 14, 1919

(6) Riegger – Ann der Phys 59, 753, 1919

(7) Gans & Isnardi Phys Zeits 22, 230, 1921

(8) Isnardi Zeits f. Phys. 9, 152, 1922

(9) Lertes " 6, 257, 1921

Derivation of β from Eqn. of State for calc. anisotropy at diff. temps for Benzene + CS_2 — Ref. Van Laar Proc. Amster. Academy 27, 897, 1924.

See — Ibid p 165

cyclohexane no compressibility data — derive if possible from eqn of State.

Write to K.R.R for ρ_1 for cyclohexane

General remarks on dipole type — Ann. der Phys. 59, 759.

(12) Smyth — Phil. Mag. 45, 863, 1923 — on molecular aggregation