An Icelandic-English Dictionary and The Graphical Law

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Abstract

We study An Icelandic-English Dictionary, the Second Edition, brought out by the Oxford University Press, way back in the year 1957. We draw the natural logarithm of the number of head words, normalised, starting with a letter vs the natural logarithm of the rank of the letter, normalised. We find that the head words underlie a magnetisation curve. The magnetisation curve i.e. the graph of the reduced magnetisation vs the reduced temperature is the exact Onsager solution of the two dimensional Ising model in the the absence of external magnetic field.

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letter	A(A+A')	B	C	D	E	F	G	H	I(I+I'+J)	K	L	M	N	O(O+O')
number	945+434	1475	1	641	723	1741	1321	2453	459	1606	1268	1237	566	321+111
addenda	85	102	0	41	28	77	38	73	5+0+8	49	34	35	17	18
total	1464	1577	1	682	751	1818	1359	2526	472	1655	1302	1272	583	450
letter	P	Q	R	S	T	U(U+U')	V	X	Y(Y+Y')	Z	p	Æ	Ö	
number	324	1	1076	3945	859	428+219	1364	1	176+38	1	844	140	269	
addenda	6	0	26	90	12	11	12	0	1	0	10	0	0	
total	330	1	1102	4035	871	658	1376	1	215	1	854	140	269	

TABLE I. Icelandic head words: the first(fifth) row represents letters of the Icelandic alphabet,[1], in the serial order.

I. INTRODUCTION

In this paper, we turn to An Icelandic-English Dictionary, [1]. We go through the head words. We count all the head words of the dictionary,[1], one by one from the beginning to the end. We count the words appearing in the addenda. We could not count the words in the supplement. The result is the table, tableI. To visualise we plot the number of head words against the respective letters in the dictionary sequence, [1] , in the adjoining figure, fig.1.

Next we look for the graphical law. We have started considering magnetic field pattern in [2], in the languages we converse with. We have studied there, a set of natural languages, [2], and have found existence of a magnetisation curve under each language. We have termed this phenomenon as the Graphical Law. Then, we moved on to investigate, [3], into dictionaries of five disciplines of knowledge and found the existence of a curve of magnetisation under each discipline. This was followed by finding of the graphical law in the references from [4] to [106].

The planning of the paper is as follows. In the next section, we describe the Graphical Law analysis of the head words of An Icelandic-English Dictionary, [1]. In the section III, we give an introduction to the standard curves of magnetisation of Ising model. The section IV is Acknowledgment. The last section is Bibliography.

FIG. 1. The vertical axis is the number of the head words of An Icelandic-English Dictionary, [1]. The horizontal axis is the letters of the Icelandic alphabet. Letters are represented by the sequence number in the alphabet as it appears in the dictionary, [1].

II. THE GRAPHICAL LAW ANALYSIS

For the purpose of exploring graphical law, we assort the letters according to the number of head words, in the descending order, denoted by f and the respective rank, [117], denoted by k. k is a positive integer starting from one. Moreover, the minimum non-zero number of head words is one. The limiting rank is maximum rank, here it is twenty four. As a result both $\frac{lnf}{lnf_{max}}$ and $\frac{lnk}{lnk_{lim}}$ varies from zero to one. Then we tabulate in the adjoining table,II, and plot $\frac{lnf}{lnf_{max}}$ against $\frac{lnk}{lnk_{lim}}$ in the figure fig.2. We then ignore the letter with the highest number of head words, tabulate in the adjoining table,II,and redo the plot, normalising the lnfs with lnf_{n-max}, and starting from $k=2$ in the figure fig.3. Normalising the lnfs with lnf_{2n-max}, we tabulate in the adjoining table,II, and starting from $k=3$ we draw in the figure fig.4. Normalising the lnfs with lnf_{3n-max} we record in the adjoining table,II, and plot starting from $k=4$ in the figure fig.5. In this way we obtain figures up to the figure fig.12.

k	lnk	lnk/lnk_{lim}	f	lnf	lnf/lnf_{max}	lnf/lnf_{n-max}	lnf/lnf_{2n-max}	lnf/lnf_{3n-max}	lnf/lnf_{4n-max}	lnf/lnf_{5n-max}	lnf/lnf_{6n-max}	lnf/lnf_{7n-max}	lnf/lnf_{8n-max}	lnf/lnf_{9n-max}	lnf/$lnf_{10n-max}$
1	0	0	4035	8.303	1	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank
2	0.69	0.217	2526	7.834	0.944	1	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank
3	1.10	0.346	1818	7.505	0.904	0.958	1	Blank	Blank	Blank	Blank	Blank	Blank	Blank	Blank
4	1.39	0.437	1655	7.412	0.893	0.946	0.988	1	Blank	Blank	Blank	Blank	Blank	Blank	Blank
5	1.61	0.506	1577	7.363	0.887	0.940	0.981	0.993	1	Blank	Blank	Blank	Blank	Blank	Blank
6	1.79	0.563	1464	7.289	0.878	0.930	0.971	0.983	0.990	1	Blank	Blank	Blank	Blank	Blank
7	1.95	0.613	1376	7.227	0.870	0.923	0.963	0.975	0.982	0.991	1	Blank	Blank	Blank	Blank
8	2.08	0.654	1359	7.215	0.869	0.921	0.961	0.973	0.980	0.990	0.998	1	Blank	Blank	Blank
9	2.20	0.692	1302	7.172	0.864	0.915	0.956	0.968	0.974	0.984	0.992	0.994	1	Blank	Blank
10	2.30	0.723	1272	7.148	0.861	0.912	0.952	0.964	0.971	0.981	0.989	0.991	0.997	1	Blank
11	2.40	0.755	1102	7.005	0.844	0.894	0.933	0.945	0.951	0.961	0.969	0.971	0.977	0.980	1
12	2.48	0.780	871	6.770	0.815	0.864	0.902	0.913	0.919	0.929	0.937	0.938	0.944	0.947	0.966
13	2.56	0.805	854	6.750	0.813	0.862	0.899	0.911	0.917	0.926	0.934	0.936	0.941	0.944	0.964
14	2.64	0.830	751	6.621	0.797	0.845	0.882	0.893	0.899	0.908	0.916	0.918	0.923	0.926	0.945
15	2.71	0.852	682	6.525	0.786	0.833	0.869	0.880	0.886	0.895	0.903	0.904	0.910	0.913	0.931
16	2.77	0.871	658	6.489	0.782	0.828	0.865	0.875	0.881	0.890	0.898	0.899	0.905	0.908	0.926
17	2.83	0.890	583	6.368	0.767	0.813	0.849	0.859	0.865	0.874	0.881	0.883	0.888	0.891	0.909
18	2.89	0.909	472	6.157	0.742	0.786	0.820	0.831	0.836	0.845	0.852	0.853	0.858	0.861	0.879
19	2.94	0.925	450	6.109	0.736	0.780	0.814	0.824	0.830	0.838	0.845	0.847	0.852	0.855	0.872
20	3.00	0.943	330	5.799	0.698	0.740	0.773	0.782	0.788	0.796	0.802	0.804	0.809	0.811	0.828
21	3.04	0.956	269	5.595	0.674	0.714	0.746	0.755	0.760	0.768	0.774	0.775	0.780	0.783	0.799
22	3.09	0.972	215	5.371	0.647	0.686	0.716	0.725	0.729	0.737	0.743	0.744	0.749	0.751	0.767
23	3.14	0.987	140	4.942	0.595	0.631	0.658	0.667	0.671	0.678	0.684	0.685	0.689	0.691	0.705
24	3.18	1	1	0	0	0	0	0	0	0	0	0	0	0	0

TABLE II. Icelandic head words: ranking, natural logarithm, normalisations

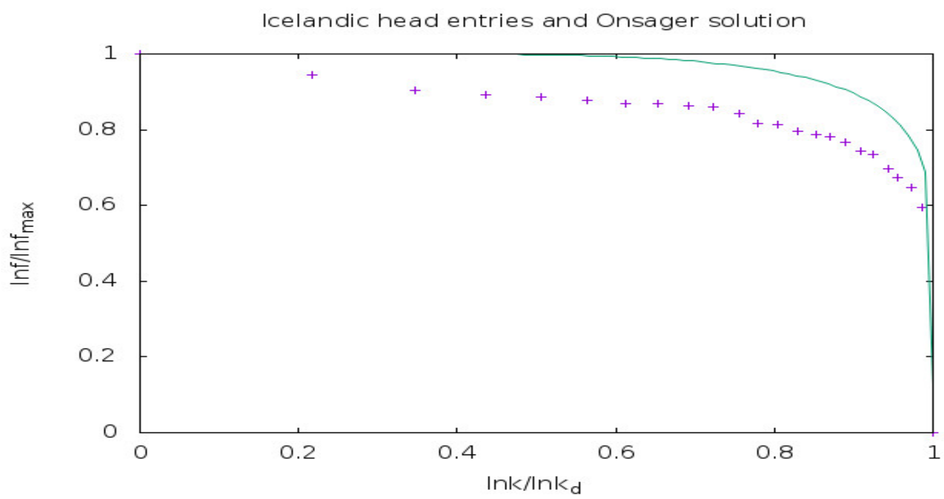

FIG. 2. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the head words of the Icelandic language. The reference curve is the Onsager solution.

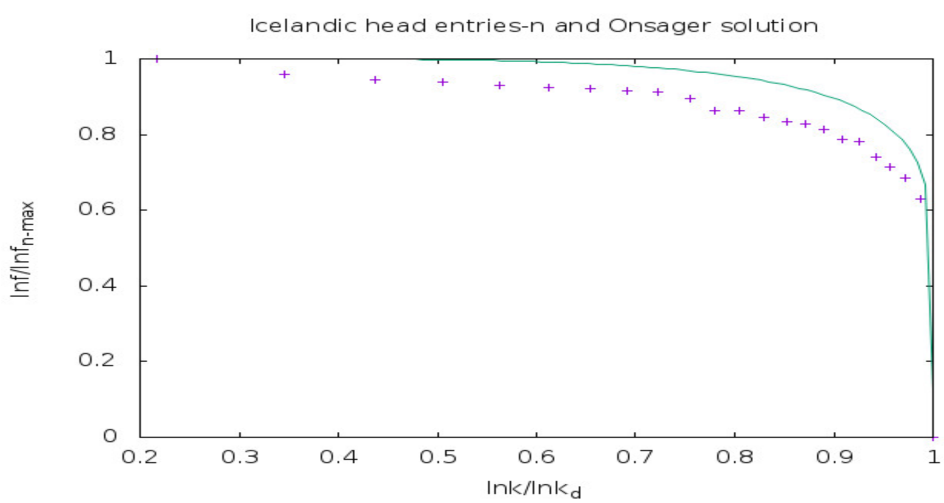

FIG. 3. Vertical axis is $\frac{lnf}{lnf_{n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the head words of the Icelandic language. The reference curve is the Onsager solution.

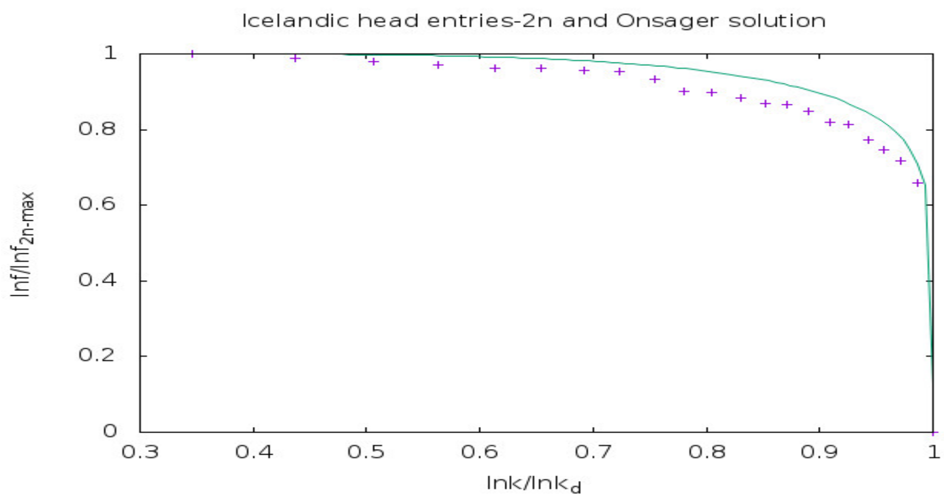

FIG. 4. Vertical axis is $\frac{lnf}{lnf_{2n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the head words of the Icelandic language. The reference curve is the Onsager solution.

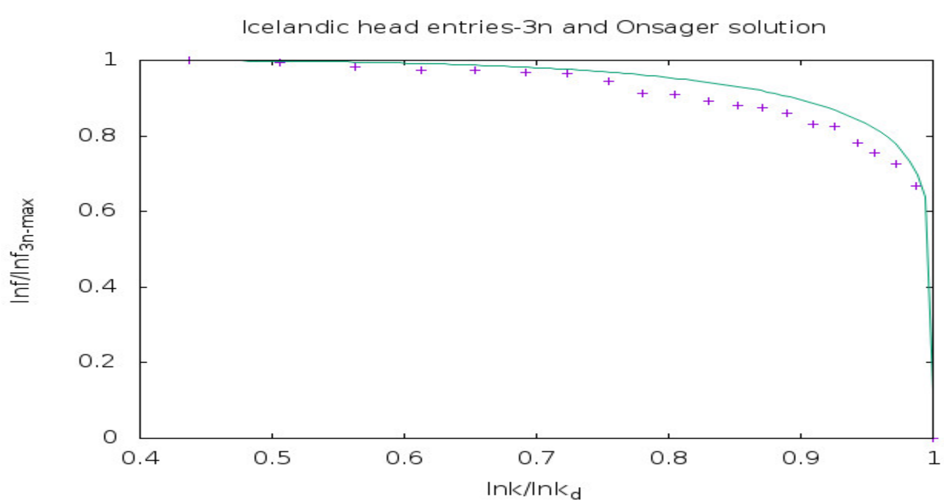

FIG. 5. Vertical axis is $\frac{lnf}{lnf_{3n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the head words of the Icelandic language. The reference curve is the Onsager solution.

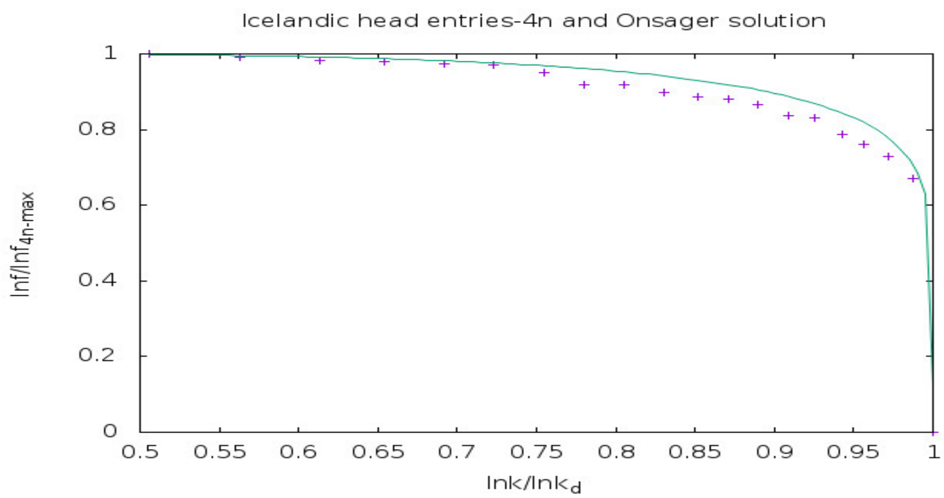

FIG. 6. Vertical axis is $\frac{lnf}{lnf_{4n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the head words of the Icelandic language. The reference curve is the Onsager solution.

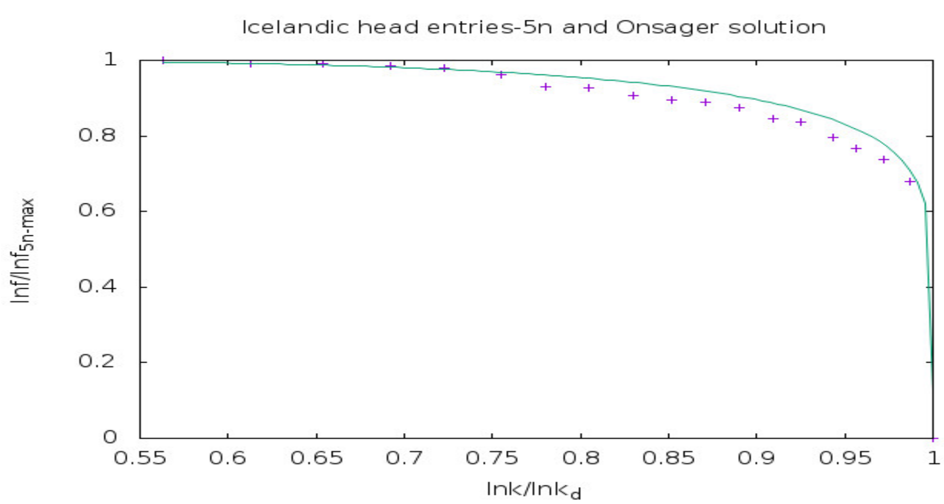

FIG. 7. Vertical axis is $\frac{lnf}{lnf_{5n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the head words of the Icelandic language. The reference curve is the Onsager solution.

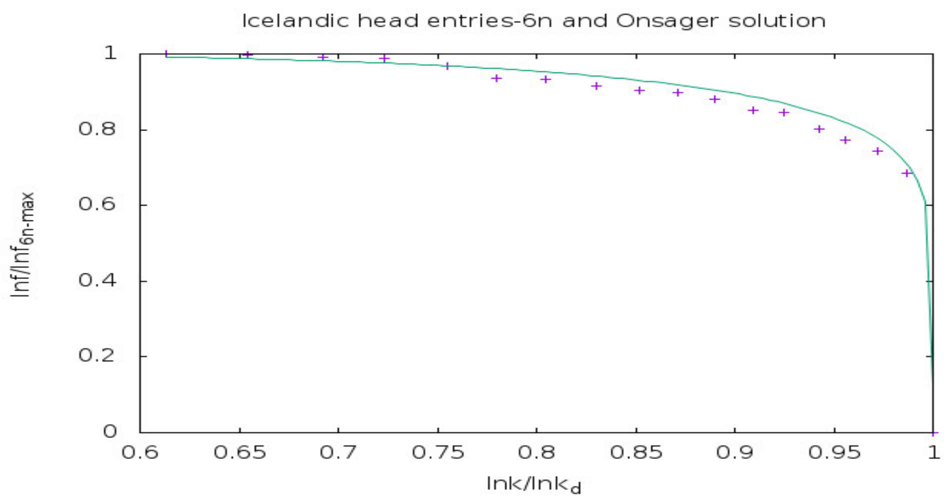

FIG. 8. Vertical axis is $\frac{lnf}{lnf_{6n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the head words of the Icelandic language. The reference curve is the Onsager solution.

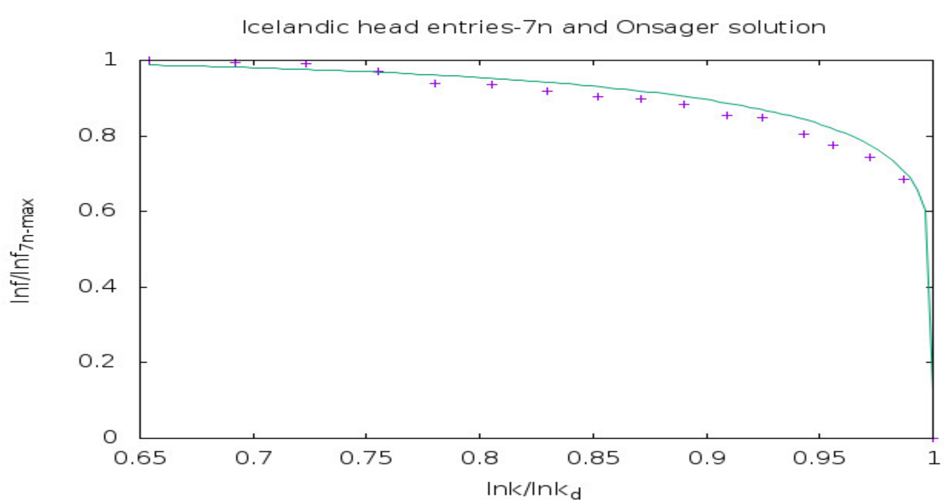

FIG. 9. Vertical axis is $\frac{lnf}{lnf_{7n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the head words of the Icelandic language with the fit curve being the Onsager solution.

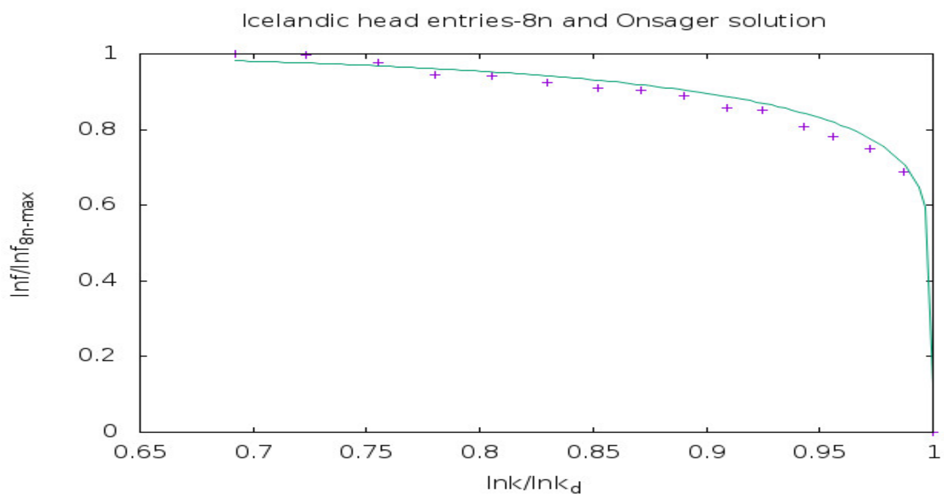

FIG. 10. Vertical axis is $\frac{lnf}{lnf_{8n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the head words of the Icelandic language with the fit curve being the Onsager solution.

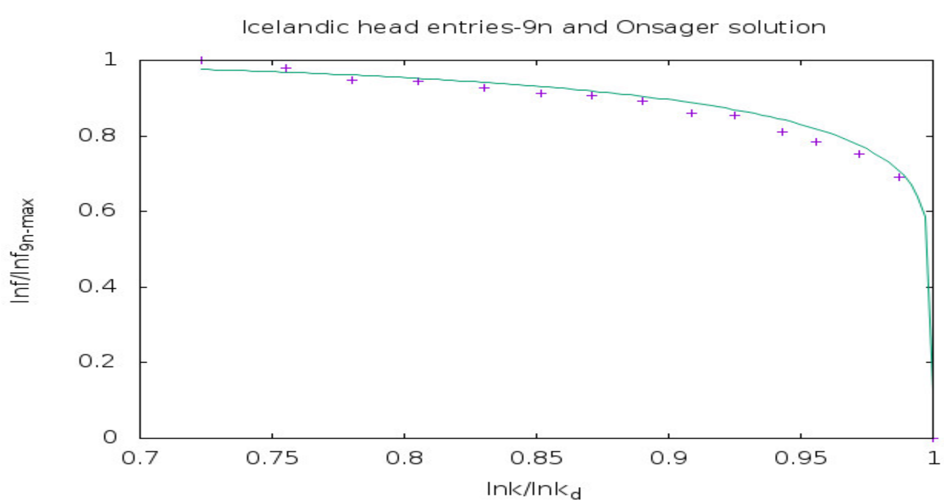

FIG. 11. Vertical axis is $\frac{lnf}{lnf_{9n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the head words of the Icelandic language with the fit curve being the Onsager solution.

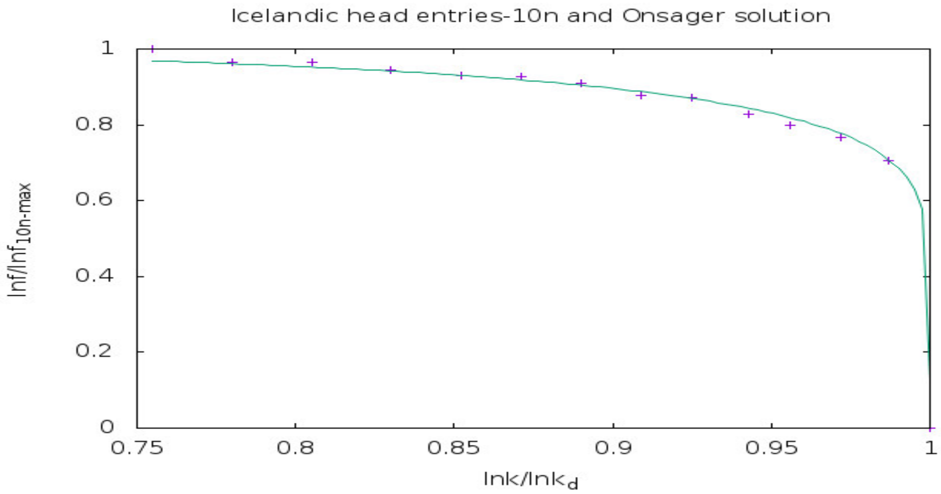

FIG. 12. Vertical axis is $\frac{lnf}{lnf_{10n-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the head words of the Icelandic language with the fit curve being the Onsager solution of the Ising Model.

A. conclusion

From the figures (fig.2-fig.12), we observe that there is a curve of magnetisation, behind the head words of the Icelandic language,[1]. The magnetisation curve i.e. the graph of the reduced magnetisation vs the reduced temperature is the exact Onsager solution of the two dimensional Ising model in the the absence of external magnetic field Moreover, the associated correspondence is,

$$\frac{lnf}{lnf_{10n-max}} \longleftrightarrow \frac{M}{M_{max}},$$
$$lnk \longleftrightarrow T.$$

k corresponds to temperature in an exponential scale, [118].

III. APENDIX: MAGNETISATION

The two dimensional Ising model, [107], in the absence of external magnetic field is prototype of an Ising model. In case of square lattice of planar spins, one spin interacts with four other nearest neighbour spins i.e. on an average to another one spin. Below a certain ambient temperature, denoted as T_c, the two dimensional array of spins reduces to a planar magnet with magnetic moment per site varying as a function of $\frac{T}{T_c}$. This function was inferred, [113], by Lars Onsager way back in 1948 and thoroughly deduced thereafter by C.N.Yang, [116]. This function we are referring to as Onsager solution. Moreover, systems, [114], showing behaviour like Onsager solution is rare to come across. Graphically, the Onsager solution appears as in fig.1.

To have a comprehension, let us imagine an arbitrary lattice, with each up spin assigned a

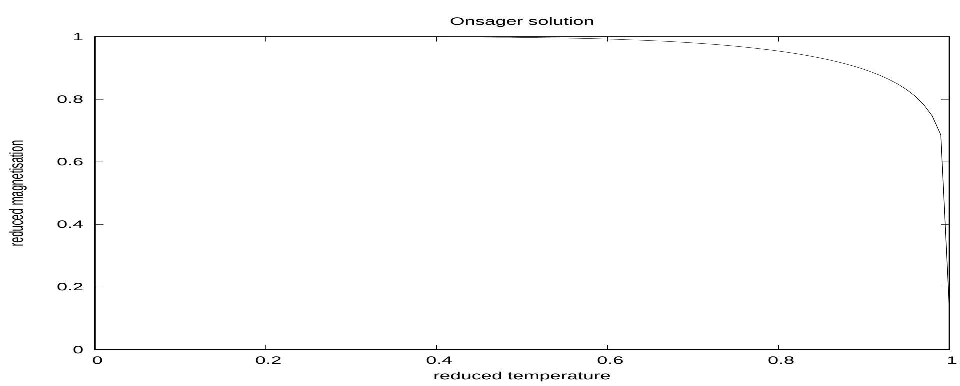

FIG. 13. Reduced magnetisation vs reduced temperature curves for exact solution of two dimensional Ising model, due to Onsager, in the the absence of external magnetic field

value one and a down spin a value minus one, with an unspecified long-range order parameter defined as above by $L = \frac{1}{N}\Sigma_i\sigma_i$, where σ_i is i-th spin, N being total number of spins. L can vary from minus one to one. $N = N_+ + N_-$, where N_+ is the number of up spins, N_- is the number of down spins. $L = \frac{1}{N}(N_+ - N_-)$. As a result, $N_+ = \frac{N}{2}(1 + L)$ and $N_- = \frac{N}{2}(1 - L)$. Magnetisation or, net magnetic moment , M is $\mu\Sigma_i\sigma_i$ or, $\mu(N_+ - N_-)$ or, μNL, $M_{max} = \mu N$. $\frac{M}{M_{max}} = L$. $\frac{M}{M_{max}}$ is referred to as reduced magnetisation. Moreover, the Ising Hamiltonian,[107], for the lattice of spins, setting μ to one, is $-\epsilon\Sigma_{n.n}\sigma_i\sigma_j - H\Sigma_i\sigma_i$, where n.n refers to nearest neighbour pairs.

At a temperature T, below a certain temperature called phase transition temperature, T_c, for the two dimensional Ising model in the absence of external magnetic field i.e. for H equal to zero, the exact, unapproximated, Onsager solution gives reduced magnetisation as a function of reduced temperature as, [113], [115], [116], [112],

$$\frac{M}{M_{max}} = [1 - (sinh\frac{0.8813736}{\frac{T}{T_c}})^{-4}]^{1/8}.$$

and appears as in fig.13.

IV. ACKNOWLEDGMENT

The author would like to thank the National Library(Government of India), Kolkata, to allow us to use An Icelandic-English Dictionary, [1], in its premises. We have used gnuplot for plotting the figures in this paper.

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