Oxford Concise Dictionary Of Mathematics, Penguin Dictionary of Mathematics and the graphical law

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Abstract

We study the Oxford Concise Dictionary Of Mathematics by C. Clapham and J. Nicholson and the Penguin Dictionary of Mathematics By D. Nelson, separately. We draw the natural logarithm of the number of entries, normalised, starting with a letter vs the natural logarithm of the rank of the letter, normalised for both the dictionaries. We conclude that both the Dictionaries can be characterised by BP(4,$\beta H = 0$) i.e. a magnetisation curve for the Bethe-Peierls approximation of the Ising model with four nearest neighbours with $\beta H = 0$, in the absence of external magnetic field, H. β is $\frac{1}{k_B T}$ where, T is temperature and k_B is the tiny Boltzmann constant.

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I. INTRODUCTION

"Let us learn mathematics well!"—a common pledge.

The evolution of the branch of mathematics is probably synonymous with the evolution of the human civilisation. We cannot go a single step without using the knowledge of mathematics, willy-nilly. Emergence of dictionary of this branch hence is natural. We consider two dictionaries of this branch of knowledge. Oxford concise dictionary of mathematics,[1], and Penguin dictionary of mathematics,[2] are approximately of the same dimensions. We study these two. We study these two from the graphical law perspective. The result is this article. We have started considering magnetic field pattern in [3], in the languages we converse with. We have studied there, a set of natural languages, [3] and have found existence of a magnetisation curve under each language. We have termed this phenomenon as graphical law.

Then, we moved on to investigate into, [4], dictionaries of five disciplines of knowledge and found existence of a curve magnetisation under each discipline. This was followed by finding of the graphical law behind the bengali language,[5] and the basque language[6]. This was pursued by finding of the graphical law behind the Romanian language, [7], five more disciplines of knowledge, [8], Onsager core of Abor-Miri, Mising languages,[9], Onsager Core of Romanised Bengali language,[10], the graphical law behind the Little Oxford English Dictionary, [11], the Oxford Dictionary of Social Work and Social Care, [12], the Visayan-English Dictionary, [13], Garo to English School Dictionary, [14], Mursi-English-Amharic Dictionary, [15] and Names of Minor Planets, [16], A Dictionary of Tibetan and English, [17], Khasi English Dictionary, [18], Turkmen-English Dictionary, [19], Websters Universal Spanish-English Dictionary, [20], A Dictionary of Modern Italian, [21], Langenscheidt's German-English Dictionary, [22], Essential Dutch dictionary by G. Quist and D. Strik, [23], Swahili-English dictionary by C. W. Rechenbach, [24], Larousse Dictionnaire De Poche for the French, [25], the Onsager's solution behind the Arabic, [26], the graphical law behind Langenscheidt Taschenwörterbuch Deutsch-Englisch / Englisch-Deutsch, Völlige Neubearbeitung, [27], the graphical law behind the NTC's Hebrew and English Dictionary by Arie Comey and Naomi Tsur, [28], the graphical law behind the Oxford Dictionary Of Media and Communication, [29], respectively.

We describe how a graphical law is hidden within the Oxford Concise Dictionary Of Mathematics and the Penguin Dictionary of Mathematics in this article. The planning of the paper is as follows. We give an introduction to the standard curves of magnetisation of Ising model in the section II. In the section III, we describe the analysis of the entries of the Oxford Concise Dictionary Of Mathematics, [1]. In the section IV, we describe the analysis of the entries of the Penguin Dictionary Of Mathematics, [2]. In the section V, we compare the two dictionaries. The section VI is the Acknowledgment. The last section is Bibliography.

II. MAGNETISATION

A. Bragg-Williams approximation

Let us consider a coin. Let us toss it many times. Probability of getting head or, tale is half i.e. we will get head and tale equal number of times. If we attach value one to head, minus one to tale, the average value we obtain, after many tossing is zero. Instead let us consider a one-sided loaded coin, say on the head side. The probability of getting head is more than one half, getting tale is less than one-half. Average value, in this case, after many tossing we obtain is non-zero, the precise number depends on the loading. The loaded coin is like ferromagnet, the unloaded coin is like para magnet, at zero external magnetic field. Average value we obtain is like magnetisation, loading is like coupling among the spins of the ferromagnetic units. Outcome of single coin toss is random, but average value we get after long sequence of tossing is fixed. This is long-range order. But if we take a small sequence of tossing, say, three consecutive tossing, the average value we obtain is not fixed, can be anything. There is no short-range order.

Let us consider a row of spins, one can imagine them as spears which can be vertically up or, down. Assume there is a long-range order with probability to get a spin up is two third. That would mean when we consider a long sequence of spins, two third of those are with spin up. Moreover, assign with each up spin a value one and a down spin a value minus one. Then total spin we obtain is one third. This value is referred to as the value of long-range order parameter. Now consider a short-range order existing which is identical with the long-range order. That would mean if we pick up any three consecutive spins, two will be up, one down. Bragg-Williams approximation means short-range order is identical with long-range order, applied to a lattice of spins, in general. Row of spins is a lattice of one dimension.

Now let us imagine an arbitrary lattice, with each up spin assigned a 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,[30], 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. The difference $\triangle E$ of energy if we flip an up spin to down spin is, [31], $2\epsilon\gamma\bar{\sigma} + 2H$, where γ is the number of nearest neighbours of a spin. According to Boltzmann principle, $\frac{N_-}{N_+}$ equals $exp(-\frac{\triangle E}{k_B T})$, [32]. In the Bragg-Williams approximation,[33], $\bar{\sigma} = L$, considered in the thermal average sense. Consequently,

$$ln\frac{1+L}{1-L} = 2\frac{\gamma\epsilon L + H}{k_B T} = 2\frac{L + \frac{H}{\gamma\epsilon}}{\frac{T}{\gamma\epsilon/k_B}} = 2\frac{L+c}{\frac{T}{T_c}} \tag{1}$$

where, $c = \frac{H}{\gamma\epsilon}$, $T_c = \gamma\epsilon/k_B$, [34]. $\frac{T}{T_c}$ is referred to as reduced temperature.
Plot of L vs $\frac{T}{T_c}$ or, reduced magentisation vs. reduced temperature is used as reference curve. In the presence of magnetic field, $c \neq 0$, the curve bulges outward. Bragg-Williams is a Mean Field approximation. This approximation holds when number of neighbours interacting with a site is very large, reducing the importance of local fluctuation or, local order, making the long-range order or, average degree of freedom as the only degree of freedom of the lattice. To have a feeling how this approximation leads to matching between experimental and Ising model prediction one can refer to FIG.12.12 of [31]. W. L. Bragg was a professor of Hans Bethe. Rudolf Peierls was a friend of Hans Bethe. At the suggestion of W. L. Bragg, Rudolf Peierls following Hans Bethe improved the approximation scheme, applying quasi-chemical method.

B. Bethe-peierls approximation in presence of four nearest neighbours, in absence of external magnetic field

In the approximation scheme which is improvement over the Bragg-Williams, [30],[31],[32],[33],[34], due to Bethe-Peierls, [35], reduced magnetisation varies with reduced temperature, for γ

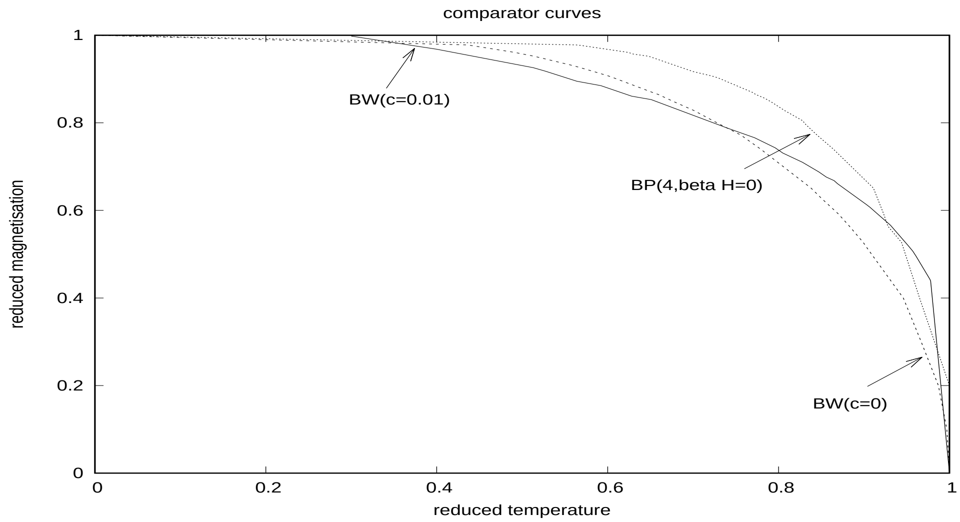

FIG. 1. Reduced magnetisation vs reduced temperature curves for Bragg-Williams approximation, in absence(dark) of and presence(inner in the top) of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$, and Bethe-Peierls approximation in absence of magnetic field, for four nearest neighbours (outer in the top).

neighbours, in absence of external magnetic field, as

$$\frac{ln\frac{\gamma}{\gamma-2}}{ln\frac{factor-1}{factor^{\frac{\gamma-1}{\gamma}}-factor^{\frac{1}{\gamma}}}} = \frac{T}{T_c}; factor = \frac{\frac{M}{M_{max}}+1}{1-\frac{M}{M_{max}}}. \tag{2}$$

$ln\frac{\gamma}{\gamma-2}$ for four nearest neighbours i.e. for $\gamma = 4$ is 0.693. For a snapshot of different kind of magnetisation curves for magnetic materials the reader is urged to give a google search "reduced magnetisation vs reduced temperature curve". In the following, we describe data s generated from the equation(1) and the equation(2) in the table, I, and curves of magnetisation plotted on the basis of those data s. BW stands for reduced temperature in Bragg-Williams approximation, calculated from the equation(1). BP(4) represents reduced temperature in the Bethe-Peierls approximation, for four nearest neighbours, computed from the equation(2). The data set is used to plot fig.1. Empty spaces in the table, I, mean corresponding point pairs were not used for plotting a line.

BW	BW(c=0.01)	BP(4,βH = 0)	reduced magnetisation
0	0	0	1
0.435	0.439	0.563	0.978
0.439	0.443	0.568	0.977
0.491	0.495	0.624	0.961
0.501	0.507	0.630	0.957
0.514	0.519	0.648	0.952
0.559	0.566	0.654	0.931
0.566	0.573	0.7	0.927
0.584	0.590	0.7	0.917
0.601	0.607	0.722	0.907
0.607	0.613	0.729	0.903
0.653	0.661	0.770	0.869
0.659	0.668	0.773	0.865
0.669	0.676	0.784	0.856
0.679	0.688	0.792	0.847
0.701	0.710	0.807	0.828
0.723	0.731	0.828	0.805
0.732	0.743	0.832	0.796
0.756	0.766	0.845	0.772
0.779	0.788	0.864	0.740
0.838	0.853	0.911	0.651
0.850	0.861	0.911	0.628
0.870	0.885	0.923	0.592
0.883	0.895	0.928	0.564
0.899	0.918		0.527
0.904	0.926	0.941	0.513
0.946	0.968	0.965	0.400
0.967	0.998	0.965	0.300
0.987		1	0.200
0.997		1	0.100
1	1	1	0

TABLE I. Reduced magnetisation vs reduced temperature data s for Bragg-Williams approximation, in absence of and in presence of magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$, and Bethe-Peierls approximation in absence of magnetic field, for four nearest neighbours .

C. Bethe-peierls approximation in presence of four nearest neighbours, in presence of external magnetic field

In the Bethe-Peierls approximation scheme , [35], reduced magnetisation varies with reduced temperature, for γ neighbours, in presence of external magnetic field, as

$$\frac{ln\frac{\gamma}{\gamma-2}}{ln\frac{factor-1}{e^{\frac{2\beta H}{\gamma}}factor^{\frac{\gamma-1}{\gamma}}-e^{-\frac{2\beta H}{\gamma}}factor^{\frac{1}{\gamma}}}} = \frac{T}{T_c}; factor = \frac{\frac{M}{M_{max}}+1}{1-\frac{M}{M_{max}}}. \quad (3)$$

Derivation of this formula Ala [35] is given in the appendix of [8].

$ln\frac{\gamma}{\gamma-2}$ for four nearest neighbours i.e. for $\gamma = 4$ is 0.693. For four neighbours,

$$\frac{0.693}{ln\frac{factor-1}{e^{\frac{2\beta H}{\gamma}}factor^{\frac{\gamma-1}{\gamma}}-e^{-\frac{2\beta H}{\gamma}}factor^{\frac{1}{\gamma}}}} = \frac{T}{T_c}; factor = \frac{\frac{M}{M_{max}}+1}{1-\frac{M}{M_{max}}}. \quad (4)$$

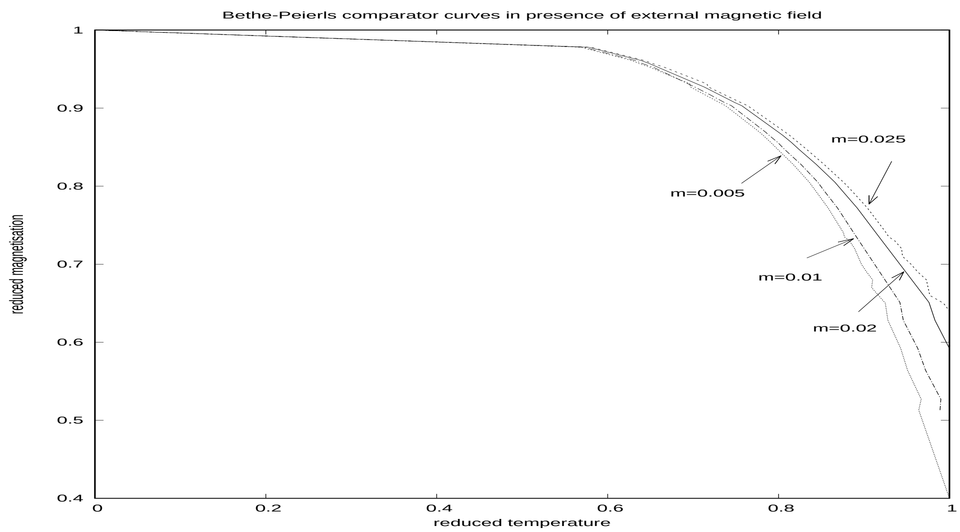

FIG. 2. Reduced magnetisation vs reduced temperature curves for Bethe-Peierls approximation in presence of little external magnetic fields, for four nearest neighbours, with $\beta H = 2m$.

In the following, we describe data s in the table, II, generated from the equation(4) and curves of magnetisation plotted on the basis of those data s. BP(m=0.03) stands for reduced temperature in Bethe-Peierls approximation, for four nearest neighbours, in presence of a variable external magnetic field, H, such that $\beta H = 0.06$. calculated from the equation(4). BP(m=0.025) stands for reduced temperature in Bethe-Peierls approximation, for four nearest neighbours, in presence of a variable external magnetic field, H, such that $\beta H = 0.05$. calculated from the equation(4). BP(m=0.02) stands for reduced temperature in Bethe-Peierls approximation, for four nearest neighbours, in presence of a variable external magnetic field, H, such that $\beta H = 0.04$. calculated from the equation(4). BP(m=0.01) stands for reduced temperature in Bethe-Peierls approximation, for four nearest neighbours, in presence of a variable external magnetic field, H, such that $\beta H = 0.02$. calculated from the equation(4). BP(m=0.005) stands for reduced temperature in Bethe-Peierls approximation, for four nearest neighbours, in presence of a variable external magnetic field, H, such that $\beta H = 0.01$. calculated from the equation(4). The data set is used to plot fig.2. Similarly, we plot fig.3. Empty spaces in the table, II, mean corresponding point pairs were not used for plotting a line.

BP(m=0.03)	BP(m=0.025)	BP(m=0.02)	BP(m=0.01)	BP(m=0.005)	reduced magnetisation
0	0	0	0	0	1
0.583	0.580	0.577	0.572	0.569	0.978
0.587	0.584	0.581	0.575	0.572	0.977
0.647	0.643	0.639	0.632	0.628	0.961
0.657	0.653	0.649	0.641	0.637	0.957
0.671	0.667		0.654	0.650	0.952
	0.716			0.696	0.931
0.723	0.718	0.713	0.702	0.697	0.927
0.743	0.737	0.731	0.720	0.714	0.917
0.762	0.756	0.749	0.737	0.731	0.907
0.770	0.764	0.757	0.745	0.738	0.903
0.816	0.808	0.800	0.785	0.778	0.869
0.821	0.813	0.805	0.789	0.782	0.865
0.832	0.823	0.815	0.799	0.791	0.856
0.841	0.833	0.824	0.807	0.799	0.847
0.863	0.853	0.844	0.826	0.817	0.828
0.887	0.876	0.866	0.846	0.836	0.805
0.895	0.884	0.873	0.852	0.842	0.796
0.916	0.904	0.892	0.869	0.858	0.772
0.940	0.926	0.914	0.888	0.876	0.740
	0.929			0.877	0.735
	0.936			0.883	0.730
	0.944			0.889	0.720
	0.945				0.710
	0.955			0.897	0.700
	0.963			0.903	0.690
	0.973			0.910	0.680
				0.909	0.670
	0.993			0.925	0.650
		0.976	0.942		0.651
	1.00				0.640
		0.983	0.946	0.928	0.628
		1.00	0.963	0.943	0.592
			0.972	0.951	0.564
			0.990	0.967	0.527
				0.964	0.513
			1.00		0.500
				1.00	0.400
					0.300
					0.200
					0.100
					0

TABLE II. Bethe-Peierls approx. in presence of little external magnetic fields

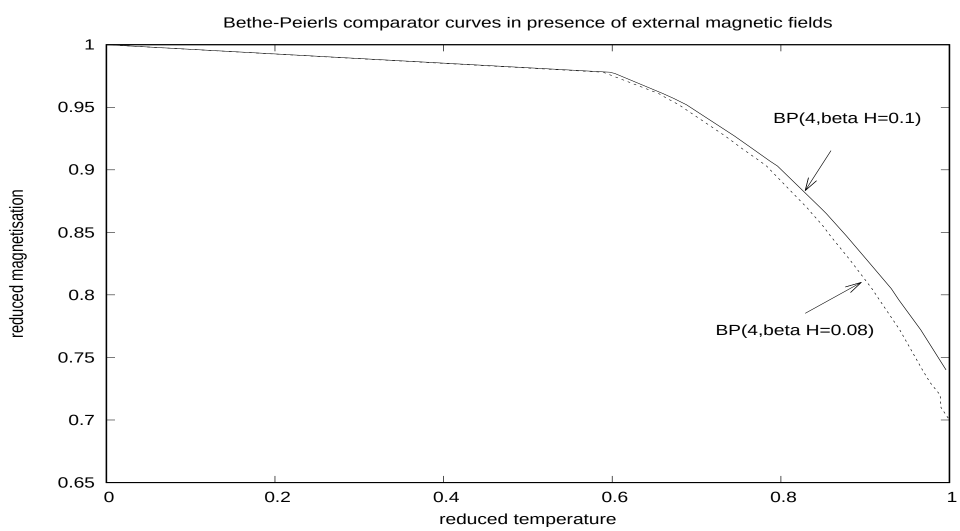

FIG. 3. Reduced magnetisation vs reduced temperature curves for Bethe-Peierls approximation in presence of little external magnetic fields, for four nearest neighbours, with $\beta H = 2m$.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
254	152	410	200	171	124	81	102	172	20	38	143	167	98	77	225	37	179	275	139	36	41	26	2	3	17

TABLE III. Concise mathematics dictionary words

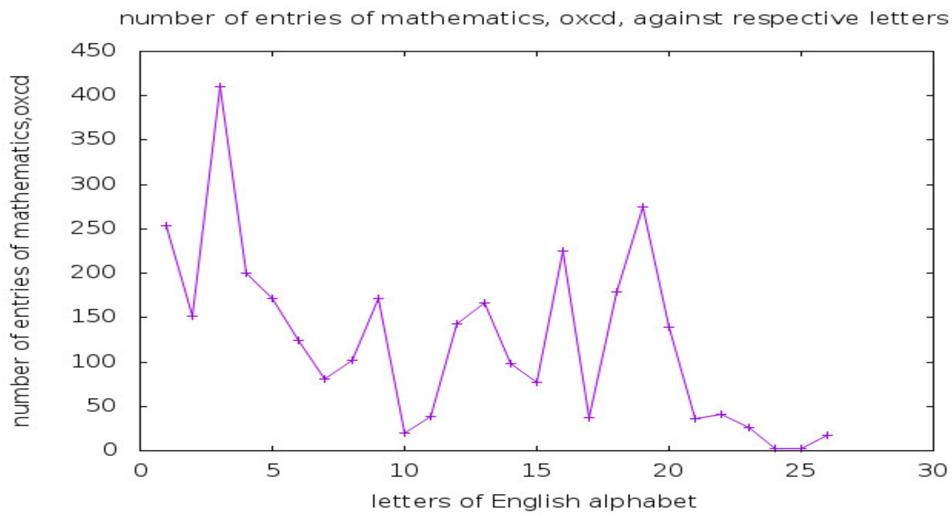

FIG. 4. Vertical axis is number of words in the concise mathematics dictionary,[1]. Horizontal axis is the letters of the English alphabet. Letters are represented by the sequence number in the alphabet.

III. ANALYSIS OF THE OXFORD CONCISE MATHEMATICS DICTIONARY

We count the words, strictly speaking entries, of the concise mathematics dictionary,[1], one by one from the beginning to the end, starting with different letters. The result is the table, III. Highest number of entries, four hundred ten, start with the letter C followed by words numbering two hundred seventy five beginning with S, two hundred fifty four with the letter A etc. To visualise we plot the number of words again respective letters in the dictionary sequence,[1] in the adjoining figure, fig.4. For the purpose of exploring graphical law, we assort the letters according to the number of words, in the descending order, denoted by f and the respective rank, denoted by k. k is a positive integer starting from one. Moreover, we attach a limiting rank, k_{lim}, and a limiting number of words. The limiting rank is maximum rank plus one, here it is twenty seven and the limiting number of words is one. 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, IV, and plot $\frac{lnf}{lnf_{max}}$ against $\frac{lnk}{lnk_{lim}}$ in the figure fig.5. We then ignore the letter with the highest

k	lnk	lnk/lnk_{lim}	f	lnf	lnf/lnf_{max}	lnf/$lnf_{next-max}$	lnf/lnf_{nnmax}	lnf/lnf_{nnnmax}
1	0	0	410	6.016	1	Blank	Blank	Blank
2	0.69	0.209	275	5.617	0.934	1	Blank	Blank
3	1.10	0.333	254	5.537	0.920	0.986	1	Blank
4	1.39	0.421	225	5.416	0.900	0.964	0.978	1
5	1.61	0.488	200	5.298	0.881	0.943	0.957	0.978
6	1.79	0.542	179	5.187	0.862	0.923	0.937	0.958
7	1.95	0.591	172	5.147	0.856	0.916	0.930	0.950
8	2.08	0.630	171	5.142	0.855	0.915	0.929	0.949
9	2.20	0.667	167	5.118	0.851	0.911	0.924	0.945
10	2.30	0.697	152	5.024	0.835	0.894	0.907	0.928
11	2.40	0.727	143	4.963	0.825	0.884	0.896	0.916
12	2.48	0.752	139	4.934	0.820	0.878	0.891	0.911
13	2.56	0.776	124	4.820	0.801	0.858	0.871	0.890
14	2.64	0.800	102	4.625	0.769	0.823	0.835	0.854
15	2.71	0.821	98	4.585	0.762	0.816	0.828	0.847
16	2.77	0.839	81	4.394	0.730	0.782	0.794	0.811
17	2.83	0.858	77	4.344	0.722	0.773	0.785	0.802
18	2.89	0.876	41	3.714	0.617	0.661	0.671	0.686
19	2.94	0.891	38	3.638	0.605	0.648	0.657	0.672
20	3.00	0.909	37	3.611	0.600	0.643	0.652	0.667
21	3.04	0.921	36	3.584	0.596	0.638	0.647	0.662
22	3.09	0.936	26	3.258	0.542	0.580	0.588	0.602
23	3.14	0.952	20	2.996	0.498	0.533	0.541	0.553
24	3.18	0.964	17	2.833	0.471	0.504	0.512	0.523
25	3.22	0.976	3	1.099	0.183	0.196	0.198	0.203
26	3.26	0.988	2	0.693	0.115	0.123	0.125	0.128
27	3.30	1	1	0	0	0	0	0

TABLE IV. Concise dictionary of mathematics words: ranking,natural logarithm,normalisations

of words, tabulate in the adjoining table, IV, and redo the plot, normalising the lnfs with next-to-maximum $lnf_{next-max}$, and starting from $k = 2$ in the figure fig.6. Normalising the lnfs with next-to-next-to-maximum $lnf_{nextnext-max}$, we tabulate in the adjoining table, IV, and starting from $k = 3$ we draw in the figure fig.7. Normalising the lnfs with next-to-next-to-next-to-maximum $lnf_{nextnextnext-max}$ we record in the adjoining table, IV, and plot starting from $k = 4$ in the figure fig.8.

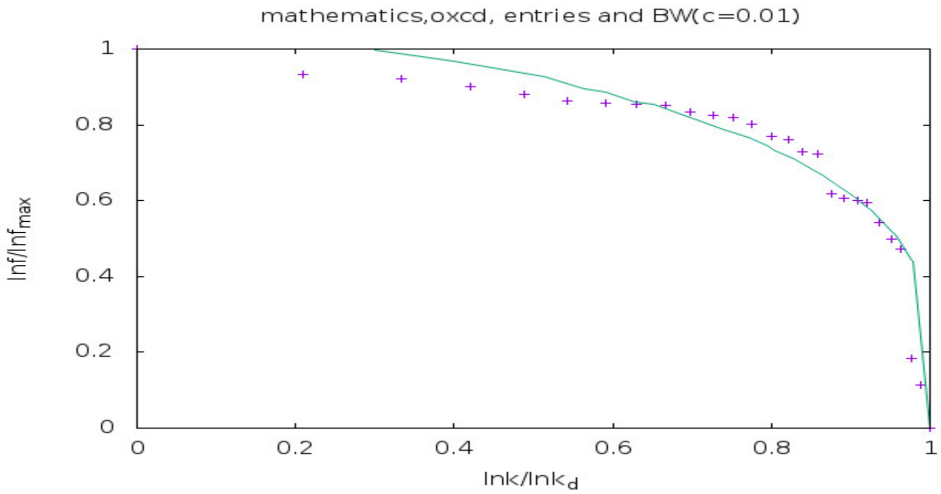

FIG. 5. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the concise mathematics dictionary with the fit curve being the Bragg-Williams curve in presence of in the presence of external magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$.

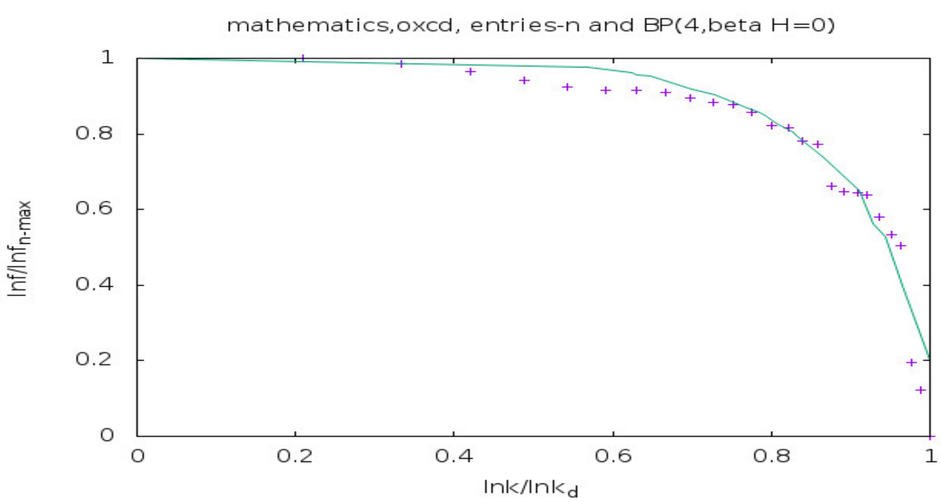

FIG. 6. Vertical axis is $\frac{lnf}{lnf_{next-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the concise mathematics dictionary with the fit curve being the Bethe-Peierls curve in presence of four nearest neighbours.

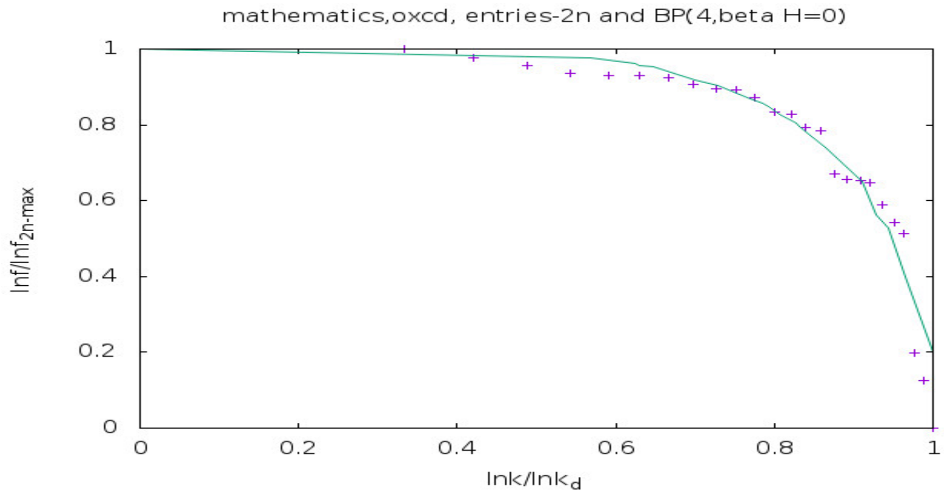

FIG. 7. Vertical axis is $\frac{lnf}{lnf_{nextnext-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the concise mathematics dictionary with the fit curve being the Bethe-Peierls curve in presence of four nearest neighbours.

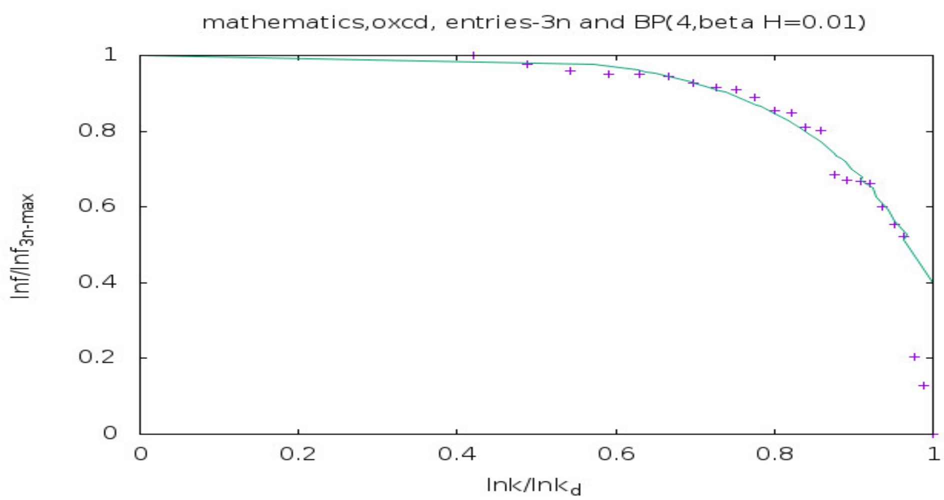

FIG. 8. Vertical axis is $\frac{lnf}{lnf_{nextnextnext-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the concise mathematics dictionary with the fit curve being the Bethe-Peierls curve in the presence of four nearest neighbours, in the presence of little external magnetic field, m=0.005 or, $\beta H = 0.01$.

A. conclusion

From the figures (fig.5-fig.8), we observe that there is a curve of magnetisation, behind words of concise mathematics dictionary. This is magnetisation curve in the Bethe-Peierls approximation with four nearest neighbours. Moreover, the associated correspondance is,

$$\frac{lnf}{lnf_{next-max}} \longleftrightarrow \frac{M}{M_{max}},$$

$$lnk \longleftrightarrow T.$$

k corresponds to temperature in an exponential scale, [37]. As temperature decreases, i.e. lnk decreases, f increases. The letters which are recording higher entries compared to those which have lesser entries are at lower temperature. As the subject of mathematics develops, the letters like ...A, S, C which get enriched more and more, fall at lower and lower temperatures. This is a manifestation of cooling effect, as was first observed in [38], in another way.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
239	157	500	234	199	152	121	138	189	18	47	190	222	120	108	313	44	214	337	168	43	57	48	3	14	23

TABLE V. Penguin mathematics dictionary words

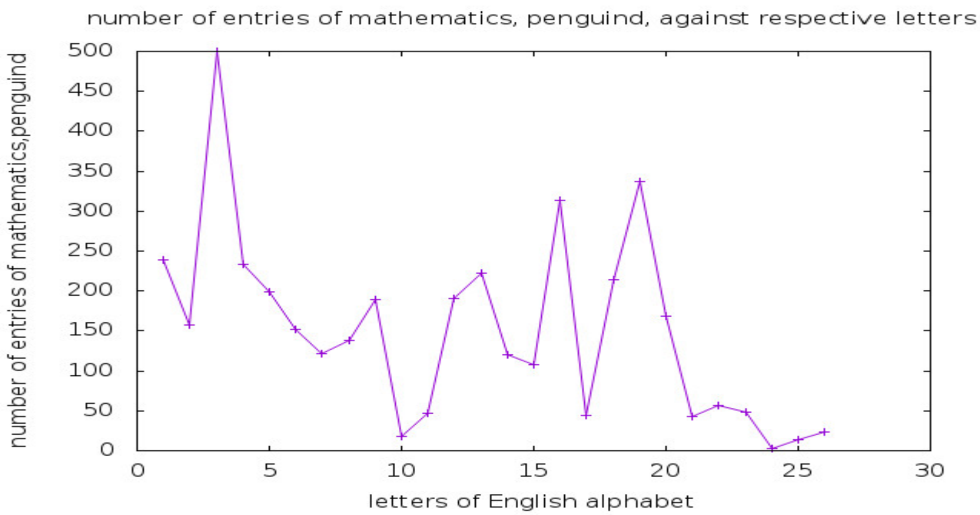

FIG. 9. Vertical axis is number of words in the penguin mathematics dictionary,[2]. Horizontal axis is the letters of the English alphabet. Letters are represented by the sequence number in the alphabet.

IV. ANALYSIS OF THE PENGUIN MATHEMATICS DICTIONARY

We count the words, strictly speaking entries, of the penguin mathematics dictionary,[2], one by one from the beginning to the end, starting with different letters. The result is the table, V. Highest number of words, five hundred, start with the letter C followed by words numbering three hundred thirty seven beginning with S, three hundred thirteen with the letter P etc. To visualise we plot the number of words again respective letters in the dictionary sequence,[2] in the adjoining figure, fig.9. For the purpose of exploring graphical law, we assort the letters according to the number of words, in the descending order, denoted by f and the respective rank, denoted by k. k is a positive integer starting from one. Moreover, we attach a limiting rank, k_{lim}, and a limiting number of words. The limiting rank is maximum rank plus one, here it is twenty seven and the limiting number of words is one. 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, VI, and plot $\frac{lnf}{lnf_{max}}$ against $\frac{lnk}{lnk_{lim}}$ in the figure fig.10. We then ignore

k	lnk	lnk/lnk_{lim}	f	lnf	lnf/lnf_{max}	lnf/$lnf_{next-max}$	lnf/lnf_{nnmax}	lnf/lnf_{nnnmax}
1	0	0	500	6.215	1	Blank	Blank	Blank
2	0.69	0.209	337	5.820	0.936	1	Blank	Blank
3	1.10	0.333	313	5.746	0.925	0.987	1	Blank
4	1.39	0.421	239	5.476	0.881	0.941	0.953	1
5	1.61	0.488	234	5.455	0.878	0.937	0.949	0.996
6	1.79	0.542	222	5.403	0.869	0.928	0.940	0.987
7	1.95	0.591	214	5.366	0.863	0.922	0.934	0.980
8	2.08	0.630	199	5.293	0.852	0.909	0.921	0.967
9	2.20	0.667	190	5.247	0.844	0.902	0.913	0.958
10	2.30	0.697	189	5.242	0.843	0.901	0.912	0.957
11	2.40	0.727	168	5.124	0.824	0.880	0.892	0.936
12	2.48	0.752	157	5.056	0.814	0.869	0.880	0.923
13	2.56	0.776	152	5.024	0.808	0.863	0.874	0.917
14	2.64	0.800	138	4.927	0.793	0.847	0.857	0.900
15	2.71	0.821	121	4.796	0.772	0.824	0.835	0.876
16	2.77	0.839	120	4.787	0.770	0.823	0.833	0.874
17	2.83	0.858	108	4.682	0.753	0.804	0.815	0.855
18	2.89	0.876	57	4.043	0.651	0.695	0.704	0.738
19	2.94	0.891	48	3.871	0.623	0.665	0.674	0.707
20	3.00	0.909	47	3.850	0.619	0.662	0.670	0.703
21	3.04	0.921	44	3.784	0.609	0.650	0.659	0.691
22	3.09	0.936	43	3.761	0.605	0.646	0.655	0.687
23	3.14	0.952	23	3.135	0.504	0.539	0.546	0.572
24	3.18	0.964	18	2.890	0.465	0.497	0.503	0.528
25	3.22	0.976	14	2.639	0.425	0.453	0.459	0.482
26	3.26	0.988	3	1.099	0.177	0.189	0.191	0.201
27	3.30	1	1	0	0	0	0	0

TABLE VI. Penguin mathematics dictionary words: ranking,natural logarithm,normalisations

the letter with the highest of words, tabulate in the adjoining table, VI, and redo the plot, normalising the lnfs with next-to-maximum $lnf_{nextmax}$, and starting from $k = 2$ in the figure fig.11. Normalising the lnfs with next-to-next-to-maximum $lnf_{nextnextmax}$, we tabulate in the adjoining table, VI, and starting from $k = 3$ we draw in the figure fig.12. Normalising the lnfs with next-to-next-to-next-to-maximum $lnf_{nextnextnextmax}$ we record in the adjoining table, VI, and plot starting from $k = 4$ in the figure fig.13.

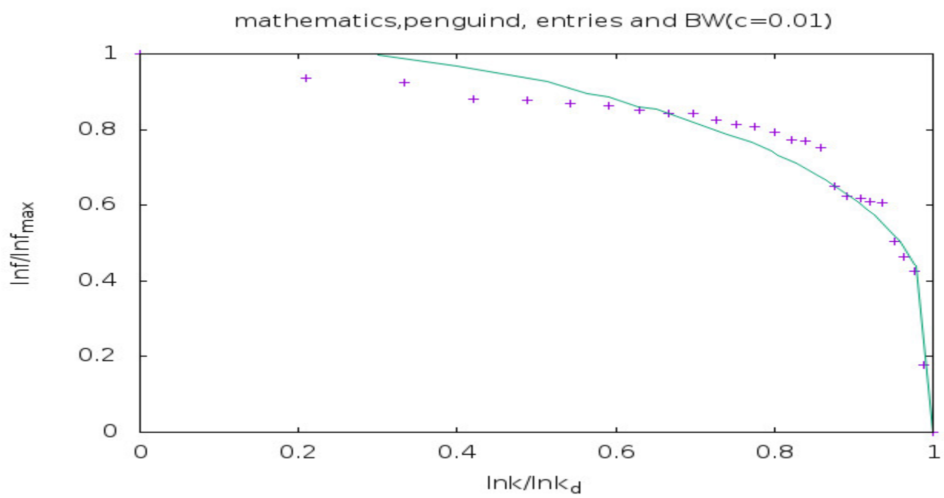

FIG. 10. Vertical axis is $\frac{lnf}{lnf_{max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the penguin mathematics dictionary with the fit curve being the Bragg-Williams curve in presence of in the presence of external magnetic field, $c = \frac{H}{\gamma\epsilon} = 0.01$.

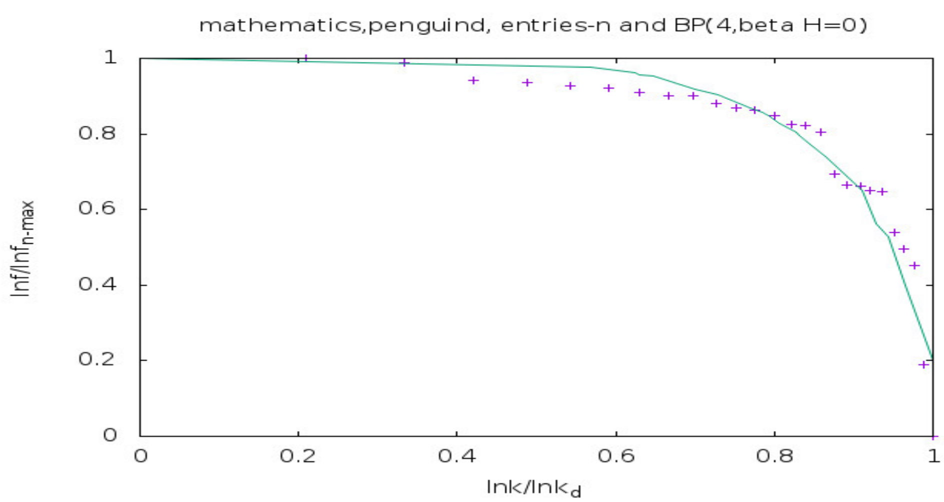

FIG. 11. Vertical axis is $\frac{lnf}{lnf_{next-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the penguin mathematics dictionary the fit curve being the Bethe-Peierls curve in presence of four nearest neighbours.

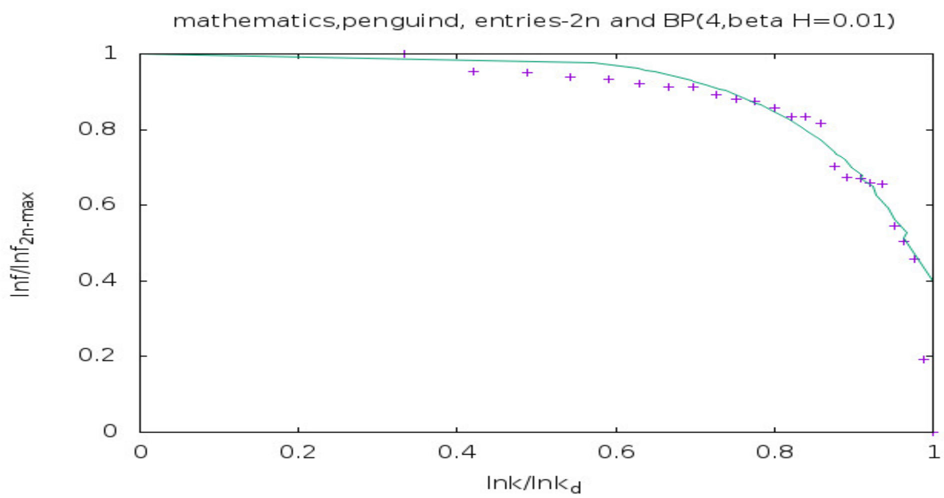

FIG. 12. Vertical axis is $\frac{lnf}{lnf_{nextnext-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the penguin mathematics dictionary with the fit curve being the Bethe-Peierls curve in the presence of four nearest neighbours, in the presence of little external magnetic field, m=0.005 or, $\beta H = 0.01$.

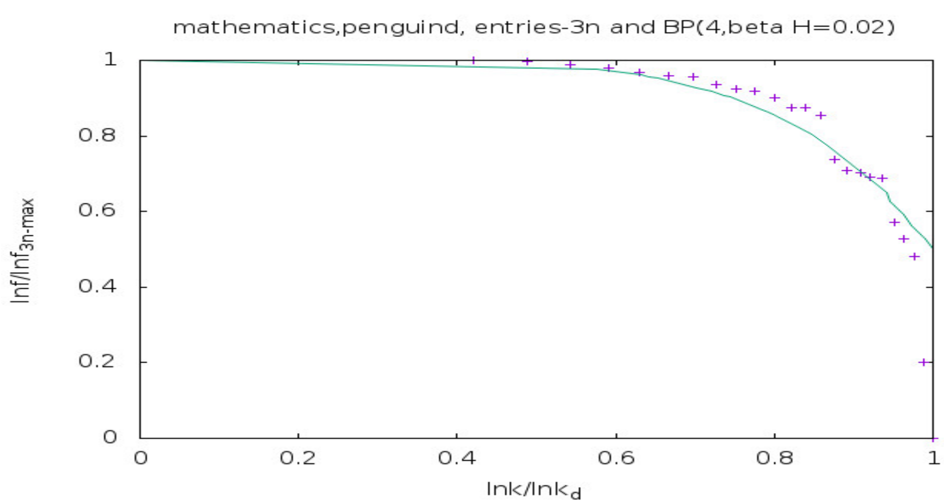

FIG. 13. Vertical axis is $\frac{lnf}{lnf_{nextnextnext-max}}$ and horizontal axis is $\frac{lnk}{lnk_{lim}}$. The + points represent the words of the penguin mathematics dictionary with the fit curve being the Bethe-Peierls curve in the presence of four nearest neighbours, in the presence of little external magnetic field, m=0.01 or, $\beta H = 0.02$.

A. conclusion

From the figures (fig.10-fig.13), we observe that there is a curve of magnetisation, behind the words of penguin mathematics dictionary. This is Bethe-Peierls curve in presence of four nearest neighbours. Moreover, the associated correspondance is,

$$\frac{lnf}{lnf_{next-max}} \longleftrightarrow \frac{M}{M_{max}},$$

$$lnk \longleftrightarrow T.$$

k corresponds to temperature in an exponential scale, [37]. As temperature decreases, i.e. lnk decreases, f increases. The letters which are recording higher entries compared to those which have lesser entries are at lower temperature. As the subject of mathematics develops, the letters like ....P, S, C which get enriched more and more, fall at lower and lower temperatures. This is a manifestation of cooling effect, as was first observed in [38], in another way.

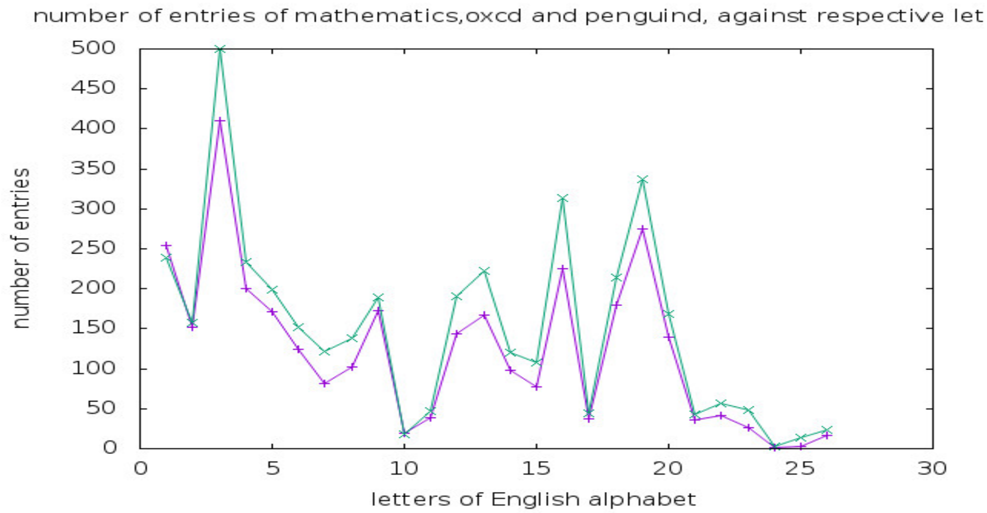

FIG. 14. Vertical axis is number of entries and horizontal axis is respective letters. Letters are represented by the number in the alphabet or, dictionary sequence,[1, 2].

V. COMPARISON BETWEEN TWO MATHEMATICS DICTIONARIES

We notice that the maxima fall on the same letters for both the dictionaries. Moreover, as we have observed in the previous two subsections, that the sets of graphs are similar. Both the dictionaries underlie the same magnetisation curve. It will be interesting to find that the same pattern continues if we take a third mathematics dictionary.

VI. ACKNOWLEDGMENT

We have used gnuplot for plotting the figures in this paper.

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