

QUEEN'S-MOVE TEXT

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Most words are queen-graphable; each different letter can be placed on a chessboard in such a way that a chess queen can spell out the word in legal moves (no jumping over one letter to reach another, though). As Leonard Gordon demonstrated in the August 1996 Word Ways, one can use the same queen graph to spell out different words. How many different words? Since it is obviously easier to queen-graph short words, this question should be answered as a function of word length. One way to proceed is to take the commonest n-letter words in the english language, adding them one at a time until a single queen-graph no longer suffices. According to Kucera and Francis's *Computational Analysis of Present-Day American English*, the commonest two-letter words, excluding abbreviations like Mr. and spelled-out expressions like OK or TV, are: OF, TO, IN, IS, HE, IT, AS, ON, BE, AT, BY, OR, AN, WE, NO, IF, SO, UP, DO, MY, ME, US, GO, AM, DE, OH and DU. (DE and DU are usually found in names.) Using Dan Tilque's queen-graphing program, one finds that the first 26 words (through OH) can be accommodated in the first graph below. A more meaningful measure of difficulty is provided by the number of different letter-pair connections, which is 25 (NO and ON use the same pair of letters).

TAMYG	D.L	LDSV	B.O..U	G.F	ABCDE
I..N.B	BUN.AW	I.A	A..W.L	...D	FGHIJ
S..ODE	FOT.HS	M.BW...	CF...D	CO.A.T	KLMNOZ
PUPRHW	YR.EIM	O.EH.T	IHT.	B.R.N.	PQRST
		FRNY	.E.Y	USEY.	UVWXY
			R	V..	
				H	

Turning to three-letter words, the Kucera list is THE, AND, WAS, FOR, HIS, HAD, NOT, ARE, BUT, ONE, YOU, HER, ALL, SHE, HIM, HAS, WHO, OUT. Adding new letter-pairs one at a time, one can queen-graph everything through the WH of WHO, again a total of 25 different pairs (second graph).

For four-letter words, consider THAT, WITH, THIS, FROM, HAVE, THEY, WERE, BEEN, WHEN, WILL, MORE, SAID, WHAT, INTO, THAN, THEM. Again, 25 different letter-pairs can be accommodated, the IN of INTO being the first to fail (third graph).

Finally, five-letter words can go as far as YE in YEARS using the list WHICH, THERE, WOULD, THEIR, ABOUT, OTHER, COULD, THESE, FIRST, AFTER, YEARS (fourth graph).

What about running text? The start of Lincoln's Gettysburg Address can be queen-graphed for 7+ words and 23 different letter-pairs, including the OU but not the UG in BROUGHT: Fourscore and seven years ago our fathers brou'ght forth... (fifth graph). Checking Leonard Gordon's queen-graphable proverbs in the August 1996 Word Ways, the one with the largest number of different letter-pairs (30) is: Misery acquaints a man with strange bedfellows.

In theory, a total of 113 different letter-pairs can be accommodated in a queen graph (arrange letters in a five-by-five array with the 26th letter in the middle of one edge). This represents over one-third of the $325 = (676-26)/2$ possible bigrams, but probably not enough to generate understandable text. How should the letters be arranged in the five-by-five array to maximize understandability?

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