Section 3: Word Play

60 marks (30% of competition) available in this Section – Available time is 60 + 20 minutes

INTRODUCTION

The provided workbook includes the SOWPODS list of 267,752 English language words (the meaning of SOWPODS is not important for the question, but it relates to a popular word-based board game). This List is the source of allowed words for the purpose of this Section.

TASK

Your task is to build a model that has the following functions:

When supplied with

i) An input string of 7 letters (e.g. **F I N A N C E**) or an input string of 6 letters and a wildcard;
ii) a value for N equal to 5, 6, 7 representing the length of the words; and
iii) a value for X (a positive integer)

your model should be able to identify:

1) How many unique words of length N from the List can be made using the input letters. (For clarity, the order of the letters can be rearranged, and each input letter can only be used once per word. So, if FINANCE was the input string and N is 5, INANE (2 N's) is allowed but FENCE (2 E's) is not. Also, count INANE once only, not twice.);

2) For a given value of X, the Xth word in an alphabetical sorted list of the words found in (1);

3) Which word from those found in (1) scores the highest amount of points when placed in its optimal spot on the Board (details on next page). If more than one word scores the maximum, give the word that would appear first in an alphabetical list of the highest scoring words; and

4) The score achieved from the optimal placement of the word in (3) above.

ASSESSMENT

After 60 minutes of development time, you will be given an answer sheet containing a list of 15 input strings each with its N value and its X value, and space to write your answers. You will then have an additional 20 minutes to continue work and to find and write down the values for items (1) to (4) above for each of the 15 input strings, for a total of 60 answers. All answers are worth 1 mark each. An example Question and its correct answers are provided on the next page to help you self-assess your model.

To make the questions more challenging, instead of 7 regular letters, **input strings 11 to 15 will contain 6 letters followed by one wildcard** (denoted by a question mark "?"). The wildcard can be used as any of the 26 letters when finding words from the List, and can be used as different letters for different words. For example, if the input string is "NUMBER?" and N is 5, both **R**ERUN and UN**D**ER are allowed. In the scoring, the wildcard character will have the same points value as the letter it represents. Also, there is no distinction between **R**ERUN and RE**R**UN. Count that word once only.

ADDITIONAL RESOURCES AND DEVELOPMENT HINTS

The provided workbook includes the worksheet 'Permutation' which contains all 5,040 permutations of ways to list the digits 1 through 7. You may find this useful.

Development Hint: Save often, and avoid double-clicking on the fill-handle box (the small square at the bottom right of a selected range) in order to apply a formula down a column containing tens of thousands of rows. Doing so has a tendency to freeze Excel. Use a different method to apply a formula to very large amounts of cells at once.
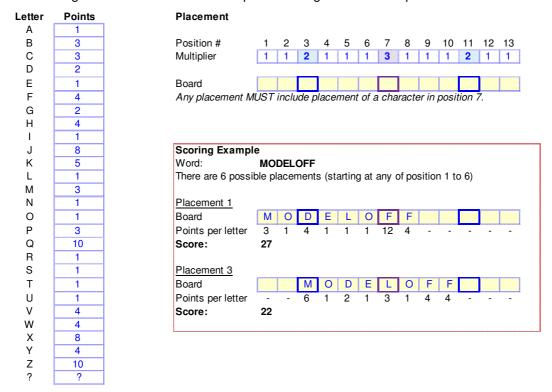
SCORING AND THE 'BOARD'

Each letter (A to Z) has been assigned a points value (from 1 to 10), and the wildcard will share the points value of the letter it represents. The points per letter can be found on the 'Scoring' worksheet of the provided workbook.

The Board is a 1 * 13 array of squares, with each square having a multiplier value of 1, 2 or 3. A word may be placed on the Board with 1 letter per 1 square starting in any position on the Board, provided that:

i)   The placement runs continuously from left to right;
ii)   The middle square (#7) is always occupied;
iii)   The whole word is placed and final letter does not extend past the end of the Board.

The 'Scoring' worksheet shows an example. An image of that example is included here.

Letter	Points
A	1
B	3
C	3
D	2
E	1
F	4
G	2
H	4
I	1
J	8
K	5
L	1
M	3
N	1
O	1
P	3
Q	10
R	1
S	1
T	1
U	1
V	4
W	4
X	8
Y	4
Z	10
?	?

Placement

Position #	1	2	3	4	5	6	7	8	9	10	11	12	13
Multiplier	1	1	2	1	1	1	3	1	1	1	2	1	1

Board

Any placement MUST include placement of a character in position 7.

Scoring Example
Word: **MODELOFF**
There are 6 possible placements (starting at any of position 1 to 6)

Placement 1

Board	M	O	D	E	L	O	F	F					
Points per letter	3	1	4	1	1	1	12	4	-	-	-	-	-
Score:	27												

Placement 3

Board			M	O	D	E	L	O	F	F			
Points per letter	-	-	6	1	2	1	3	1	4	4	-	-	-
Score:	22												

EXAMPLE QUESTION

This is the format that each of the 15 cases on the Question and Answer sheet will have, to be provided after 60 minutes of development time. The underlined values are the answers that you will need to give.

Question #	Input string	N (word length)	Value of X
16 (Example)	**FINANCE**	**6**	**3**
# of words	7	**Xth word in list**	ENCINA
Highest Scoring Word	FIANCE	**Highest Score**	22

Answer all questions by writing on the provided Question and Answer Sheet

Your Name:

QUESTIONS AND ANSWERS

All Questions are worth 4 marks each (1 mark per item per question)

Question #	Input string	N (word length)	Value of X
1	ABILITY	5	1
# of words		Xth word in list	
Highest Scoring Word		Highest Score	

Question #	Input string	N (word length)	Value of X
2	BARRIER	5	7
# of words		Xth word in list	
Highest Scoring Word		Highest Score	

Question #	Input string	N (word length)	Value of X
3	MASTERS	6	2
# of words		Xth word in list	
Highest Scoring Word		Highest Score	

Question #	Input string	N (word length)	Value of X
4	LANTERN	6	3
# of words		Xth word in list	
Highest Scoring Word		Highest Score	

Question #	Input string	N (word length)	Value of X
5	BIRDMAN	6	3
# of words		Xth word in list	
Highest Scoring Word		Highest Score	

Your Name:

Question #	Input string	N (word length)	Value of X
6	MINIBAR	5	9
# of words		Xth word in list	
Highest Scoring Word		Highest Score	

Question #	Input string	N (word length)	Value of X
7	SCANTER	7	4
# of words		Xth word in list	
Highest Scoring Word		Highest Score	

Question #	Input string	N (word length)	Value of X
8	ARCSECN	6	3
# of words		Xth word in list	
Highest Scoring Word		Highest Score	

Question #	Input string	N (word length)	Value of X
9	GRATING	5	12
# of words		Xth word in list	
Highest Scoring Word		Highest Score	

Question #	Input string	N (word length)	Value of X
10	DECIMAL	7	4
# of words		Xth word in list	
Highest Scoring Word		Highest Score	

Your Name:	

Question #	Input string	N (word length)	Value of X
11	ABACUS?	5	38
# of words		Xth word in list	
Highest Scoring Word		Highest Score	

Question #	Input string	N (word length)	Value of X
12	SPREAD?	6	192
# of words		Xth word in list	
Highest Scoring Word		Highest Score	

Question #	Input string	N (word length)	Value of X
13	SHEETS?	6	50
# of words		Xth word in list	
Highest Scoring Word		Highest Score	

Question #	Input string	N (word length)	Value of X
14	EXAMPL?	5	29
# of words		Xth word in list	
Highest Scoring Word		Highest Score	

Question #	Input string	N (word length)	Value of X
15	FINISH?	5	18
# of words		Xth word in list	
Highest Scoring Word		Highest Score	

Answers

Q	# of words	Xth word	Highest Word	Highest Score
1	7	ALIBI	BIALY	21
2	8	RARER	BARER	14
3	20	ASSERT	MARSES	15
4	7	LANNER	ALTERN	9
5	3	RIBAND	MINBAR	17
6	14	INARM	ABRIM	16
7	7	RECANTS	CANTERS	16
8	9	CANERS	ARCSEC	17
9	14	TANGI	AGING	12
10	6	DECLAIM	CLAIMED	21
11	108	BASIC	SQUAB	36
12	249	SCARED	ZERDAS	37
13	82	STEEDS	KESHES	24
14	115	FLAME	XYLEM	36
15	47	HINTS	INFIX	32