SHIFTGRAMS

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Take a word (for example, MUSIC), shift each letter n steps along
the alphabet arranged in a circle with A following Z (for example, M
eight steps to U, U eight steps to C, S eight steps to A, I eight steps to
Q, C eight steps to K) , and rearrange the resulting letters to form
another word (for example, UCAQK to QUACK). Howard Bergerson,
writing under a pseudonym, christened QUACK a shiftgram of MUSIC
in "Sea-Changed Words" in the February 1969 Word Ways. (MUSIC is,
of course, a shiftgram of QUACK, achieved by shifting 26 - 8 = 18 spa­
ces.) Multiple shiftgrams are possible (the earlier article exhibited
the triple WHORLS, TAXIED, POLITE); however, the theoretical max­
imum of 26 shiftgrams of a word is impossible to achieve for words of
four or fewer letters because of the paucity of vowels (AEIOUY used
four times apiece takes care of at most 24 words), and equally impos­
sible for words of five or more letters because of the sparseness of
words. Transpositions are special cases of shiftgrams when the num­
bber n of steps equals zero, and alphabetic letter shifts (for example,
CHEER to JOLLY) are special cases of shiftgrams when the final ar­
rangement of letters is unnecessary (for details on these, see the edi­
tor's article in the November 1979 Word Ways).

It is rather surprising that no articles on shiftgrams have appeared
in Word Ways since their introduction by Bergerson. This note presents
the results of my investigation of the problem, based on boldface entries
First, I exhibit shiftgrams for nine-letter words starting with each let­
ter of the alphabet in turn (can the examples for Q and X be improved?):

areophane + 4 = silverite
c stabbed + 3 = highflier
cablegram + 2 = decociting
deplaster + 15 = spaghetti
enrapture + 13 = rechanger
Fabrikoid + 3 = ungrilled
gasometry + 20 = amusingly
harvesty + 13 = refueling
inhumanly + 6 = tetragons
jackshaft + 8 = skipbrain
Kellaways + 8 = mitigates
lingberry + 13 = elevatory
metatatic + 11 = expellent
ervature + 13 = rehearing
outweapon + 14 = dochicks
plexiform + 18 = thinkable
quadrants + 26 = squadron
ransacked + 4 = overweigh
straphead + 11 = scalloped
tegulated + 7 = bankshall
uncharily + 6 = exorating
viperfish + 22 = bandoleer
wanhopey + 4 = particles
xerates + 26 = exornates
yaghourts + 20 = ollbanums
Zephaniah + 4 = delimiter

Shifting gears, is it possible to find examples of each step size, from
1 through 26:

watermen
flasking +
bookable +
partaker +
zampognag
Quisling +
begotten +
folkways +
figurize +
quibbled +
Dedanite +
wishbone +
banhopper +

This list can in synchrony be
with no entr

amhran +
became +
Cabiri + 3
daekon +
dendeive + 5
dfaucal + 6
gambit +
hallah + 8
infers + 9
jadery + 1
Khatti + 1
loggia + 1
morga + 1

ziarat + 1
yercum +
xeroma +
wachna +
vidduy + 5
Uchean +
Tabeal +
saddhu +
recule + 9
Quiche +
packet + 1
oafish + 1
nafta + 1
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This list can immediately be reduced to only 14 examples because
the first entry is both a 1-shift and a 25-shift, the second entry is
both a 2-shift and a 24-shift, etc. (note that the 13-shift and the 26-
shift are not paired).

Can one generate a list exhibiting both alphabetic and step variation
in synchrony? Two constraints together are more difficult to satisfy
than either one alone; I was able to achieve it for six-letter words, but
with no entries for either X or Y:

watermen + 1 = snuffbox
flasking + 2 = chipmunk
bookable + 3 = deerhorn
partaker + 4 = exvotive
zampogna + 5 = truffles
Quisling + 6 = motorway
begotten + 7 = alluvian
folkways + 8 = sweating
figurize + 9 = raindrop
quibbled + 10 = novellas
Dedanite + 11 = polytope
wishbone + 12 = quantize
bangster + 13 = frontage
megapode + 14 = crusados
lanced + 15 = practist
subraces + 16 = quirkish
runnable + 17 = versicle
Mameluco + 18 = mugweeds
habitual + 19 = abutment
beckling + 20 = wheyface
indrafts + 21 = vadinomy
sageship + 22 = lacewood
Heliodor + 23 = toilable
conjunct + 24 = Marshall
repuffed + 25 = decoated
bestiary + 26 = sybarite

1 through 26, for eight-letter words? No trouble at all:

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flasking + 2 = chipmunk
bookable + 3 = deerhorn
partaker + 4 = exvotive
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amhran + 1 = bobins
came + 2 = cagged
Cabiri + 3 = fulled
daekon + 4 = hosier
davide + 5 = jinjas
faucal + 6 = riggal
gambit + 7 = hatpin
hallah + 8 = pitpit
invers + 9 = wabron
jedery + 10 = kinbot
Khatti + 11 = svelte
loggia + 12 = saxsum
morgan + 13 = tanzeh
ziarat + 1 = jubbas
yercum + 2 = towage
xeroma + 3 = purdah
wachna + 4 = regale
vidduy + 5 = dizain
Uchean + 6 = taking
Tabeal + 7 = Shilba
Seidani + 8 = polytope
recule + 9 = unland
Quiche + 10 = somare
Packet + 11 = Plevna
Oafish + 12 = mature
Naftha + 13 = sugann
naique + 14 = bowsie
oarlpa + 15 = gapped
polyve + 16 = befoul
quandy + 17 = purple
rotte + 18 = fylgia
Saliba + 19 = battle
tamper + 20 = jungly
unison + 21 = pidjin
vagile + 22 = chawer
welwel + 23 = tibbit
Zaarah + 26 = Hazara

madefy + 14 = stroma
lactyl + 15 = parian
kobird + 16 = hearty
Jaakan + 17 = barrer
Ilav + 18 = sandal
hafnul + 19 = gyrate
giggit + 20 = Carina
fitful + 21 = pagoda
effer + 22 = banaba
deflux + 23 = brucia
circot + 24 = gramza
befist + 25 = dazer
alerce + 26 = cereal
Curiously, a complete list of six-letter words was possible by reversing the alphabet with respect to step size.

If one insists on both words beginning with the same alphabetical letter, the following nearly-complete list of six-letter words results:

- Abiner + 13 = avenor
- baktun + 7 = Brahui
- calden + 17 = curvet
- Danize + 4 = dirhem
- eggcup + 24 = encase
- faured + 14 = fortis
- Gabdes + 14 = groups
- hagbut + 13 = hognut
- icerya + 10 = imbosk
- jarfly + 9 = Joshua
- kernos + 22 = kojang
- lampit + 18 = lashed
- mabuti + 18 = metals

A curiosity noted in passing was TANGER + 13 = TANGER, an identity shiftgram, possible only for shiftgrams of step size 13. Note that Q employs a step size of 26, so that the two words are transpositions; it is desirable to avoid this special case if possible.

Suppose that one considers alphabetic letter shifts only. It is possible to find an alphabetical list of six-letter examples for all letters but Q and Y (and the inferred reformed spelling 'arizer' to match J):

- aphtha + 19 = Tiamat
- banian + 4 = ferner
- caddaw + 8 = killie
- dionym + 6 = joutes
- elated + 15 = lapits
- farrel + 13 = sneery
- gadder + 22 = cazzan
- Hadith + 11 = sloces
- iddats + 11 = tooled
- jarina + 17 = arizer
- kernel + 23 = ganjah
- ledder + 22 = hazzan
- manful + 7 = thumbs

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orphan + 13 = becuna
pyrryl + 24 = rattan
reefer + 9 = annona
sappan + 4 = wetter
Tillim + 6 = zorros
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