LETTER LENGTHS

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Define the length of a letter as the sum of the lengths of its component straight lines and arcs (ignoring details such as serifs). Thus, the length of V is a little more than twice the length of I in most fonts, as O is greater than C, and B and R both greater than P. To fix ideas, we define the uppercase letters as a combination of straight lines and arcs of circles. Nearly all the letters can be embedded in rectangles 2 units by 1 unit in size, except for C, O, W and Q, all of which require a square 2 units on a side. J can be placed in a narrower rectangle ½ unit by 2 units, and I requires no rectangle at all. Arcs of three different circle sizes are required: a half-circle of diameter 1 for D (3/4 of a circle for C and G), half-circles of diameter ½ for B, P, R, S and U (5/8 of two circles for S), and a half-circle of diameter ¼ for J. Here are the specific components for each letter:

A $\sqrt{17} + 0.5 = 4.62$

B $3.5 + \pi = 6.64$

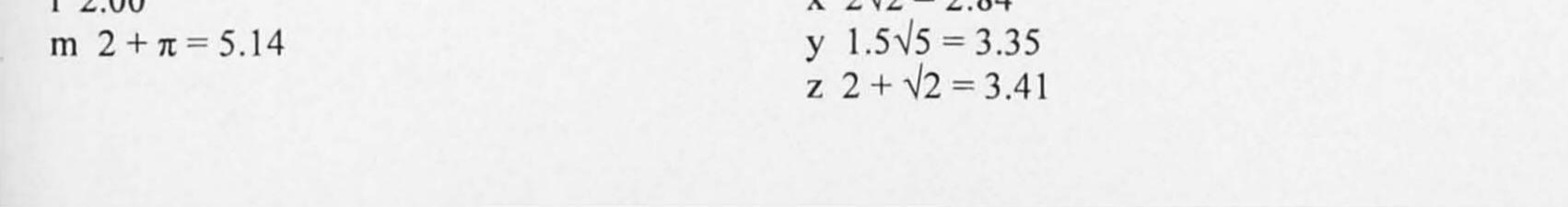C $0.75(2\pi) = 4.71$

D $2 + \pi = 5.14$

E 4.50

F 4.00

G $0.5 + 0.75(2\pi) = 5.21$

H 5.00

I 2.00

J $1.5 + 0.5(\pi/2) = 2.29$

K $2 + 2\sqrt{2} = 4.83$

L 3.00

M $\sqrt{5} + 4 = 6.24$

N $\sqrt{5} + 4 = 6.24$

O $2\pi = 6.28$

P $3 + 0.5\pi = 4.57$

Q $0.5 + 2\pi = 6.78$

R $3 + 0.5\pi + 0.5\sqrt{5} = 5.68$

S $2(0.625)\pi = 3.93$

T 3.00

U $3 + 0.5\pi = 4.57$

V $\sqrt{17} = 4.12$

W $\sqrt{17} + \sqrt{5} = 6.36$

X $2\sqrt{5} = 4.77$

Y $1 + \sqrt{5} = 3.24$

Z $2 + \sqrt{5} = 4.24$

Similarly, one can create idealized lowercase letters, contained in a square 1 unit on a side except for ascenders and descenders (w is contained in a rectangle of 2 units by 1 unit).

a $1.5 + 0.25\pi + \pi/2 = 3.86$

b $2 + \pi = 5.14$

c $0.75\pi = 2.36$

d $2 + \pi = 5.14$

e $0.875\pi + 1 = 3.75$

f $1.5 + 0.5(\pi/2) = 2.29$

g $1.5\pi + 1 = 5.71$

h $0.5\pi + 2.5 = 4.07$

i 1.00

j $1.5 + 0.5(\pi/2) = 2.29$

k $2 + \sqrt{5} = 4.24$

l 2.00

m $2 + \pi = 5.14$

n $1.5 + \pi/2 = 3.07$

o $\pi = 3.14$

p $2 + \pi = 5.14$

q $2 + \pi = 5.14$

r $1 + 0.375\pi = 2.18$

s $2 + \pi/2 = 3.57$

t $2 + 0.25(\pi/2) = 2.39$

u $1 + 0.5\pi = 2.57$

v $\sqrt{5} = 2.24$

w $2\sqrt{5} = 4.47$

x $2\sqrt{2} = 2.84$

y $1.5\sqrt{5} = 3.35$

z $2 + \sqrt{2} = 3.41$

We now present the shortest (sum of the letter lengths) and longest words of various lengths:

Shortest sum of letter lengths

IT 5, li 3
ILL 8, ill 5
TITI 10, fiji 6.58
FILII 13, filii 7.29
ILLITE 17.5, iritic 9.93
ILLICIT 19.71, illicit 11.75
TITLISTS 23.86, virility 15.16 `
ILLICITLY 25.95, illicitly 17.1
CIVILITIES 31.26, incivility 19.41
TITTILATIVE 34.24, crucifixion 23.81
DIVISIBILITY 39.07, incivilities 24.38
STYLISTICALLY 42.67, viticulturist 27.66
DIVISIBILITIES 46.26, viticulturists 31.23
INTELLIGIBILITY 50.83, invincibilities 33.59
CAPITALISTICALLY 56.02, antimilitaristic 38.21
INTELLIGIBILITIES 58.02, incorrigibilities 41.49
SUBSTITUTABILITIES 66.33, antivivisectionist 43.04
ANTIVIVISECTIONISTS 71.62, antivivisectionists 46.61
ANTIINSTITUTIONALIST 74.67, antiinstitutionalist 48.73
ANTIINSTITUTIONALISTS 78.6, antiinstitutionalists 52.3

Longest sum of letter lengths

BO 12.92, ad 9
BOB 19.56, gag 15.28
BOOB 25.84, gamp 19.85
BROWN 31.2, gaged 24.17
BOOBOO 38.4, gagged 29.88
MOONBOW 44.32, baggage 33.74
GOMBROON 48.85, baggages 37.31
BONDWOMAN 54.04, goddammed 42.16
MARROWBONE 58.52, sandbagged 44.95
WONDERWOMAN 63.94, hedgehopped 48.8
RHODODENDRON 67.6, sphygmograph 51.08
MONOCHROMATOR 72.53, sphygmography 54.43
NONHOMOGENEOUS 77.79, sledgehammered 56.95
NONCONTEMPORARY 79.8, sphygmographies 59.4
BRONCHOPNEUMONIA 86.09, sphygmomanometer 62.54
HOMOGENEOUSNESSES 86.06, sphygmomanometers 66.11
NONINTERCHANGEABLE 89.22, absentmindednesses 66.3
COUNTERDEMONSTRATOR 85.57, disacknowledgements 69.12
COUNTERDEMONSTRATORS 99.5, electroencephalogram 67.6
COUNTERDEMONSTRATIONS 102.06, hyperaggressivenesses 75.11