Busted Grooves

for three retuned, computer-driven pianos

by Kyle Gann

2017

Technical Specifications

The 33-pitch tuning of the three pianos (the same in every octave) is as follows, given first in the number of cents above E-flat, and then as ratios to the E-flat 1/1:

Piano	1		2		3	
D	1088	15/8	977	225/128	1044	117/64
Db	969	7/4	938	55/32	906	27/16
C	857	105/64	773	25/16	840	13/8
B	738	49/32	755	99/64	729	195/128
Bb	702	3/2	590	45/32	609	91/64
A	551	11/8	551	11/8	481	169/128
Ab	471	21/16	440	165/128	408	81/64
G	386	5/4	320	77/64	342	39/32
Gb	204	9/8	275	75/64	275	75/64
F	155	35/32	192	143/128	192	143/128
E	92	135/128	53	33/32	27	65/64
Eb	0	1/1	1103	121/64	1173	63/32

Note that no string needs to be raised higher than its natural tuning except for the B-flat on piano 1, which is 2¢ sharp (or if one prefers, 2¢ could be subtracted from all quantities).

For electronic realization of the piece, it can prove helpful to reconfigure the tuning as a reference pitch in cycles per second for each piano, and ratios derived from that standard:

Tuning pitch:	38.891 cps	36.7641 cps	38.2833 cps
D	15/8	225/121	13/7
Db	7/4	20/11	12/7
C	105/64	200/121	104/63
B	49/32	18/11	65/42
Bb	3/2	180/121	13/9
A	11/8	16/11	169/126
Ab	21/16	15/11	9/7
G	5/4	14/11	26/21
F#	9/8	150/121	25/21
F	35/32	13/11	143/126
E	135/128	12/11	65/63
Eb	1/1	1/1	1/1

In the configuration of certain tuning softwares, the following sequences might facilitate getting the required tuning:

Piano 1:
38.891 = Eb0
1/1, 135/128, 35/32, 9/8, 5/4, 21/16, 11/8, 3/2, 49/32, 105/64, 7/4, 15/8

Piano 2:
36.7641485 = Eb0
1/1, 12/11, 13/11, 150/121, 14/11, 15/11, 16/11, 180/121, 18/11, 200/121, 20/11, 225/121

Piano 3:
38.283333 = Eb0
1/1, 65/63, 143/126, 25/21, 26/21, 9/7, 169/126, 13/9, 65/42, 104/63, 12/7, 13/7

For purposes of analysis, the entire scale (which I refer to as my 8x8 scale) is given below, grouping its pitches into eight harmonic series' on the 1^{st}, 3^{rd}, 5^{th}, 7^{th}, 9^{th}, 11^{th}, 13^{th}, and 15^{th} harmonics of E-flat, and naming each pitch in a typographical equivalent of Ben Johnston's just-intonation notation:

Pitch name	Ratio	Cents	1/1	3/2	5/4	7/4	9/8	11/8	13/8	15/8
Db^^-	121/64	1103						11		
D	15/8	1088	15	5	3					1
Db13	117/64	1044					13		9	
C#+	225/128	977								15
Db7	7/4	969	7			1				
C^	55/32	938			11			5		
C+	27/16	906		9			3			
C7+	105/64	857				15				7
Cb13	13/8	840	13						1	
B	25/16	773			5					
Bb^	99/64	755					11	9		
Cb77+	49/32	738				7				
Bb13	195/128	729							15	13
Bb	3/2	702	3	1						
Bbb713	91/64	609				13			7	
A+	45/32	590		15	9		5			3
Ab^	11/8	551	11					1		
Abb1313	169/128	481							13	
Ab7+	21/16	471		7		3				
G^	165/128	440						15		11
G+	81/64	408					9			
G	5/4	386	5		1					
Gb13	39/32	342		13					3	
Gb7^	77/64	320				11		7		
F#+	75/64	275			15					5
F+	9/8	204	9	3			1			
Fb13^	143/128	192						13	11	
F7+	35/32	155			7	5				
E+	135/128	92					15			9
Eb^	33/32	53		11				3		
Eb13	65/64	27			13				5	
Eb	1/1	0	1							
Eb7+	63/32	1173				9	7			

In Johnston's notation, + raises a pitch by 81/80, # raises it by 25/24, b lowers it by 24/25, 7 lowers it by 35/36, ^ raises it by 33/32, 13 raises it by 65/64, and F-A-C, C-E-G, and G-B-D are all perfectly tuned 4:5:6 major triads.

A couple of notes on listening to *Hyperchromatica*:

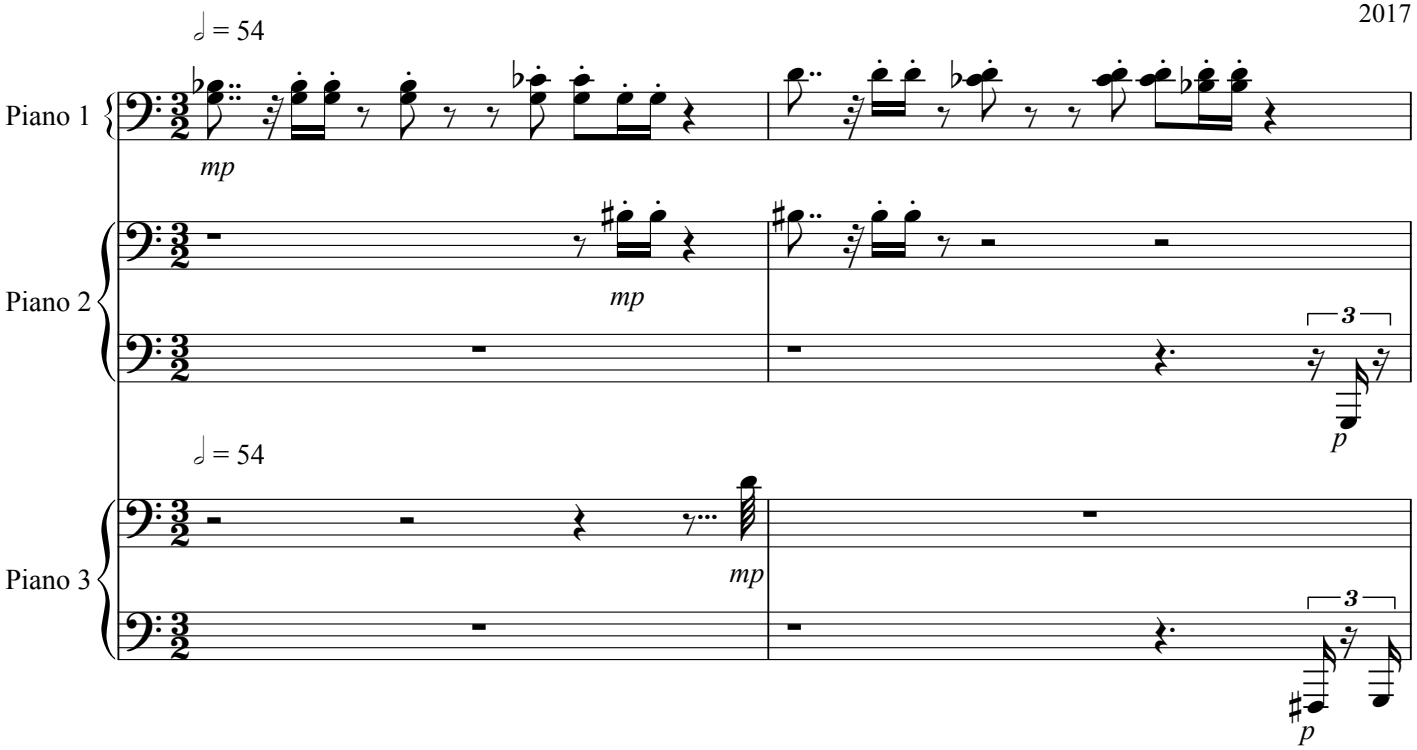
Some people think the piano sounds seem "funny" or "unreal." It is essential to the timbre of a normal piano that the intervals are slightly out of tune, and surrounded by the fuzziness of the resulting beats. Remove that out-of-tuneness and the piano can sound different than you're used to. It has always been common for me to play La Monte Young's *The Well-Tuned Piano* for people and have them respond, "Isn't that electronic?" "It sounds more like bells than a piano." Often one's unfamiliarity with pure tuning is misperceived as a deficiency in the piano sound. Relatedly, when I issued a disc of Disklavier music in 2005, people sometimes commented, "Too bad you couldn't use a real piano, because the electronic sounds are off-putting." In fact, the Disklavier *was* a real, acoustic piano, with pluckable strings. It was tuned to 18th-century well temperament, the notes went by *very* fast, and so the divergences from normalcy made people's brains convince them that it was an electronic piano, which was a false perception. Give yourself some time to listen to the pieces over and over, and you'll probably get used to them. I can guarantee, after hundreds of listenings myself, that the harmonies make their own purely-tuned sense, and that their logic sinks in once you can anticipate what's going to happen. One of the purposes of these pieces is to expand your musical perception.

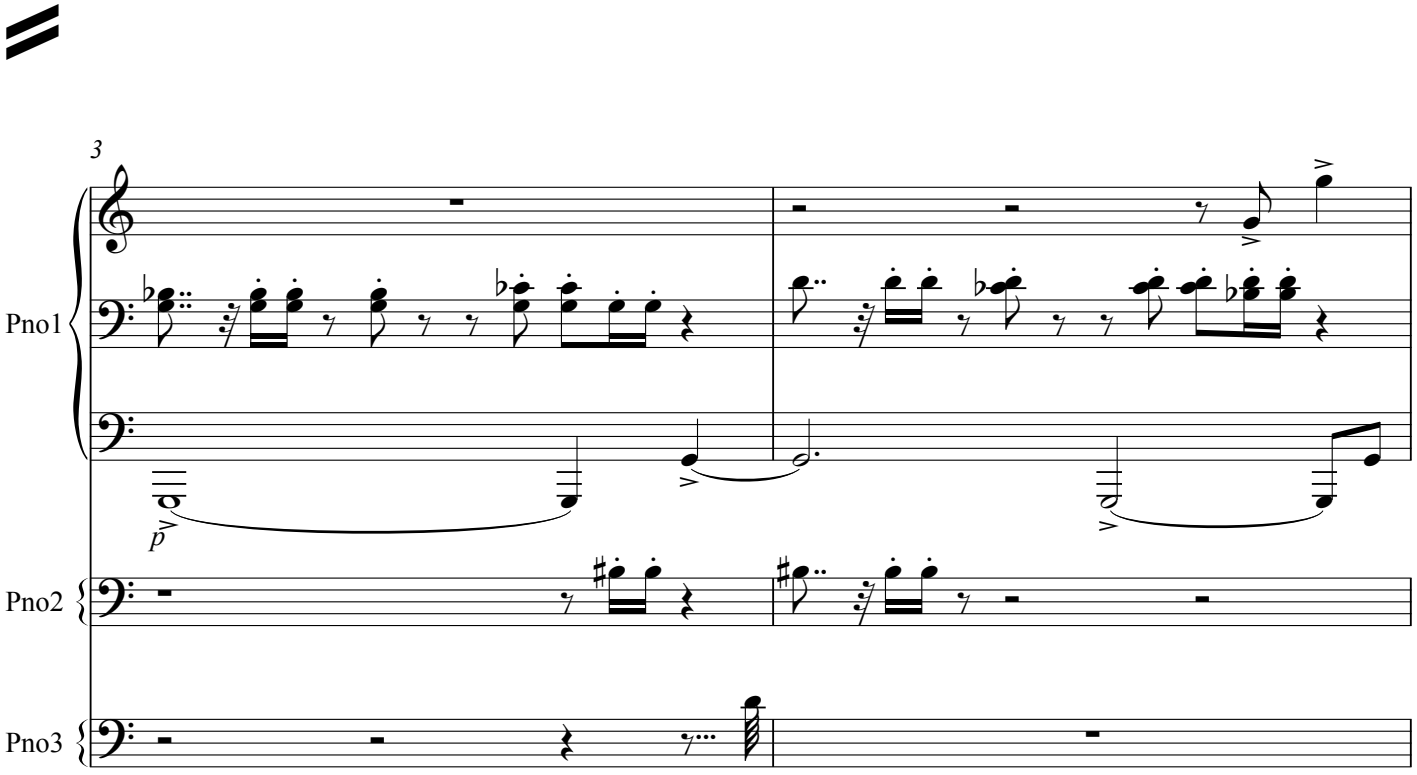
The Disklavier (computer-driven piano, the digital manifestation of the player piano) is a different medium than the human-played piano. One can, and must, write for it differently. With a couple of deliberate exceptions, these pieces are not playable by humans. The composer forbids performance by humans (which can't happen anyway), and will not cooperate with any such attempt. The computer-driven version is the final manifestation, and the only one contemplated or permitted. These pieces were written, after years of profound thought and experimentation, specifically for the Disklavier medium, without any compromise in what the music was intended to achieve. If it bothers you that the music you are listening to isn't being played by humans, there are millions of piano recordings made by humans; go listen to them. There is too much music in the world for anyone to waste time listening to any music wishing it were something other than what it is. This music is produced mechanically, for mechanical rhythmic capabilities that I savor. I make this music public on the chance that there might be a handful of other people on the planet for whom the possibilities opened up here in terms of rhythmic and harmonic language might more than compensate for the loss of a few habitual comforts. If you are not one of those rare people, you can do the composer a favor by moving on without comment. I guarantee you will not alter his mind on the matter.

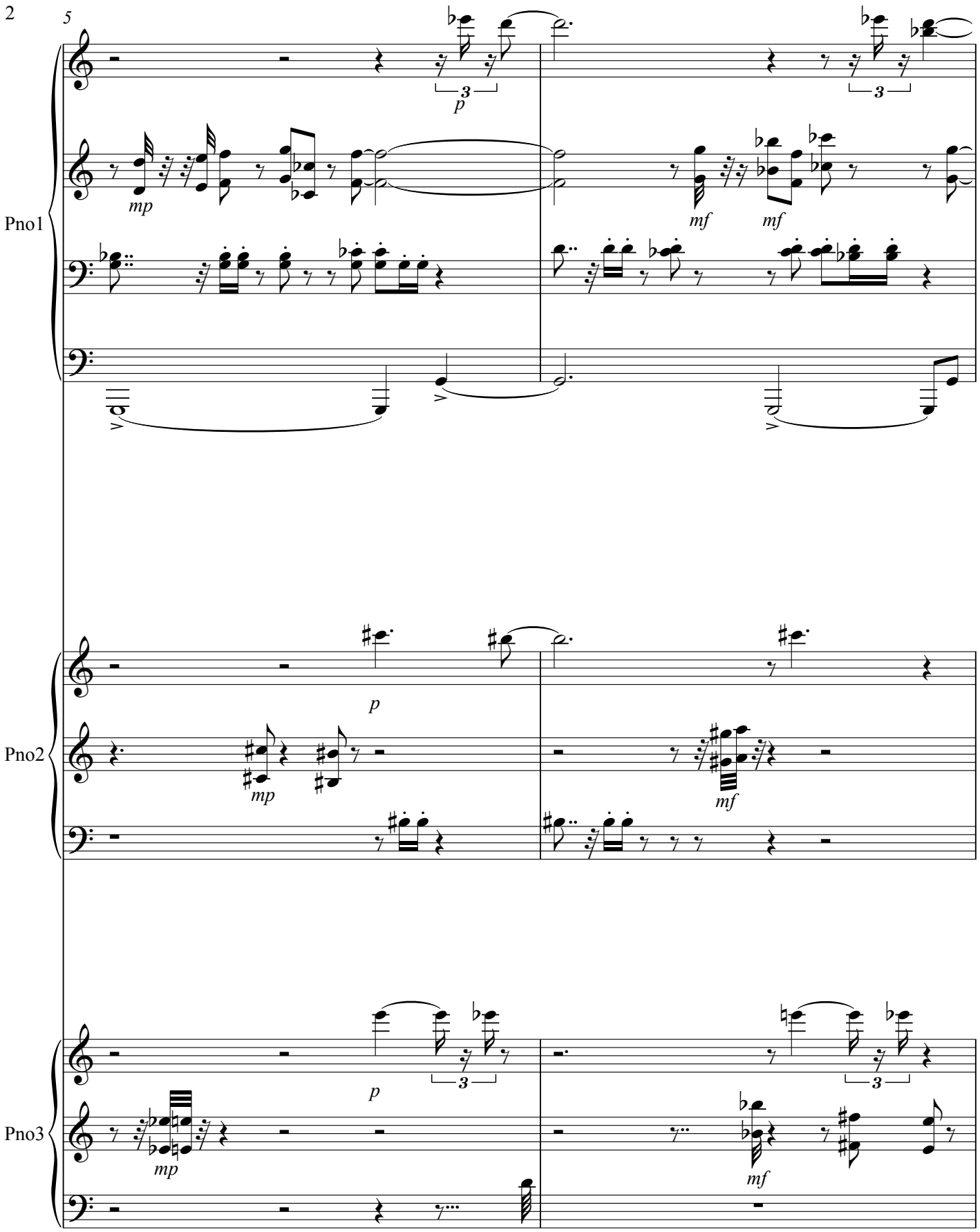
- Kyle Gann

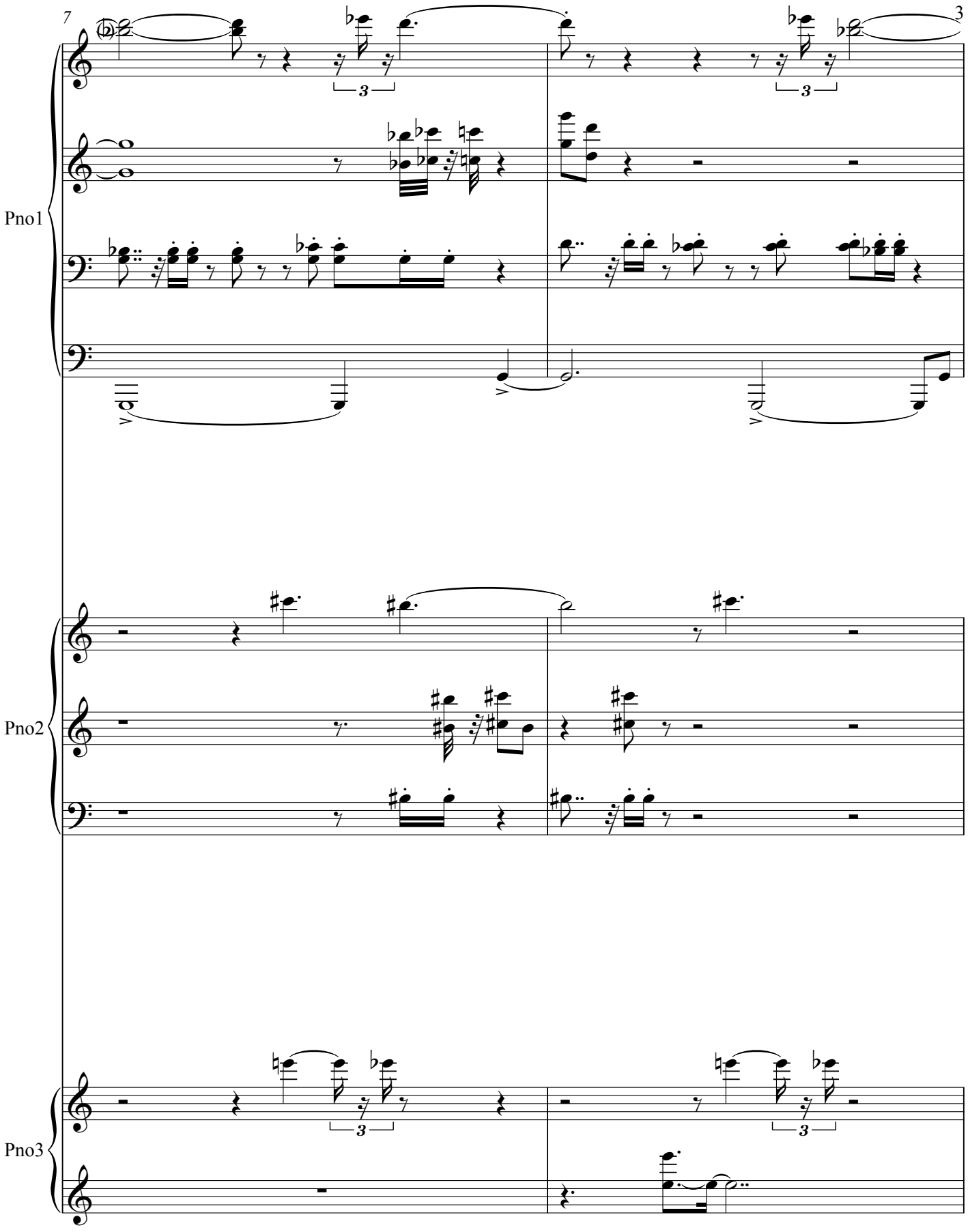
Busted Grooves

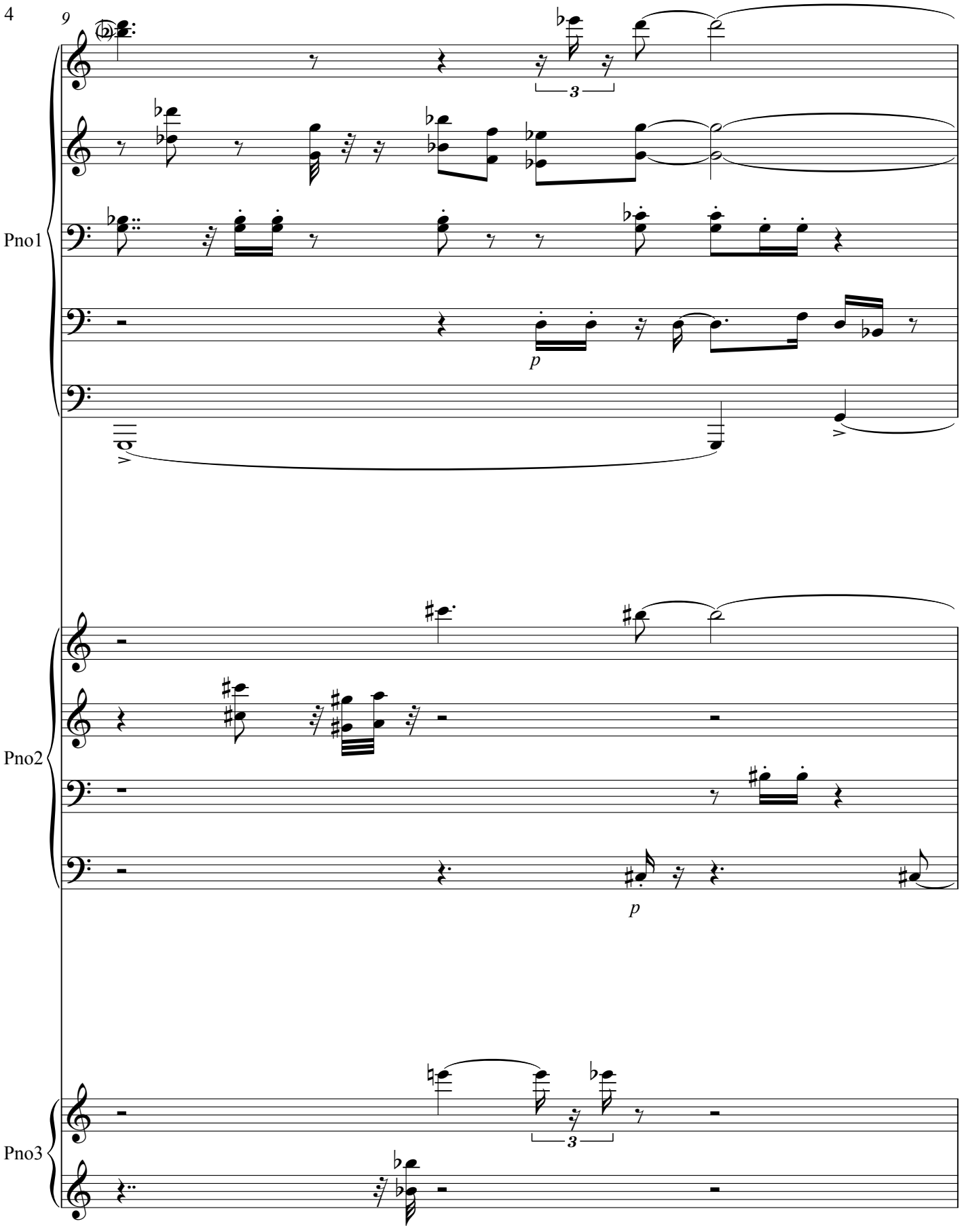
Kyle Gann
2017






5
Pno1
Pno2
Pno3
mp
p
mf
3


7
3
Pno1
Pno2
Pno3

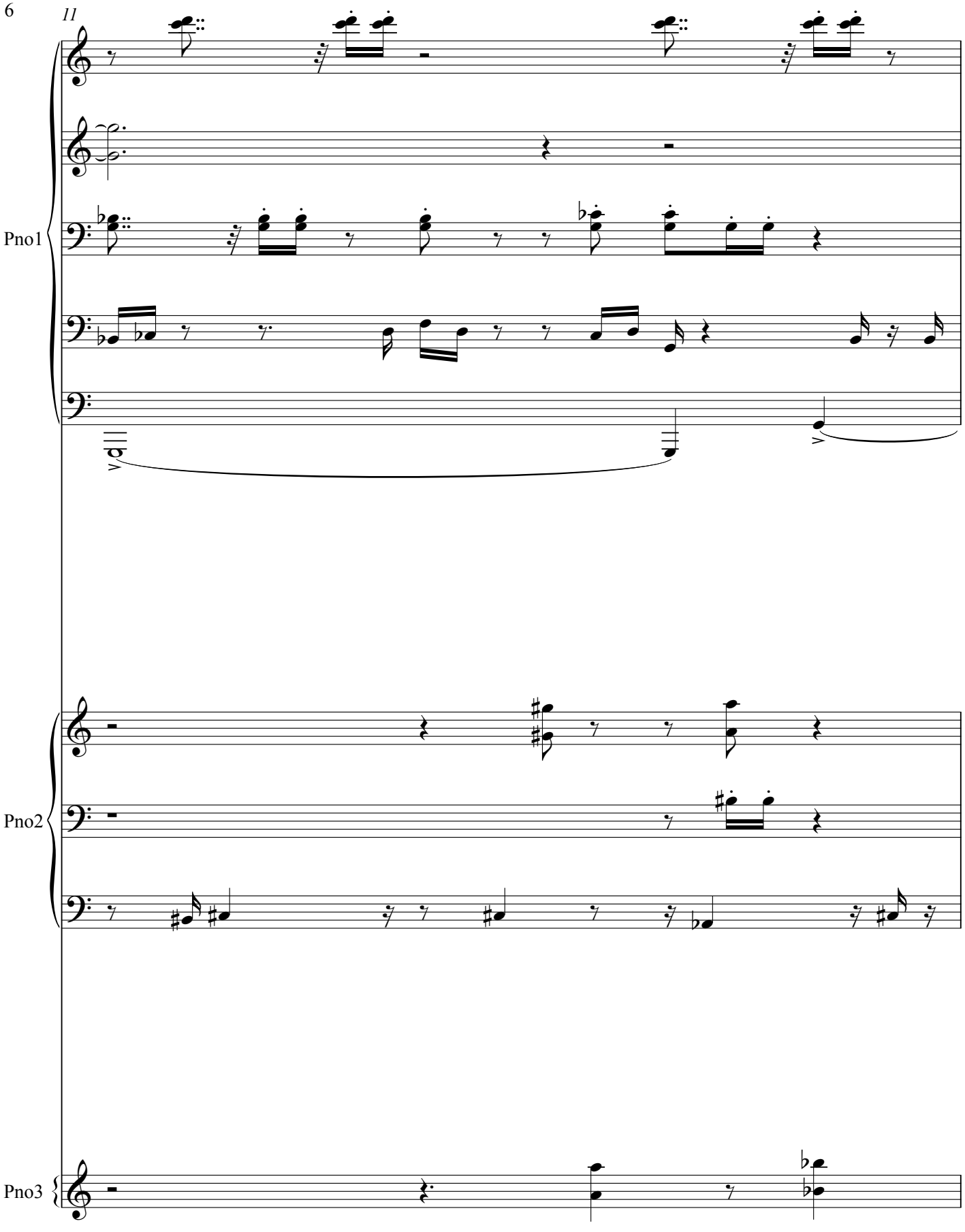

9
Pno1
p
Pno2
p
Pno3

10

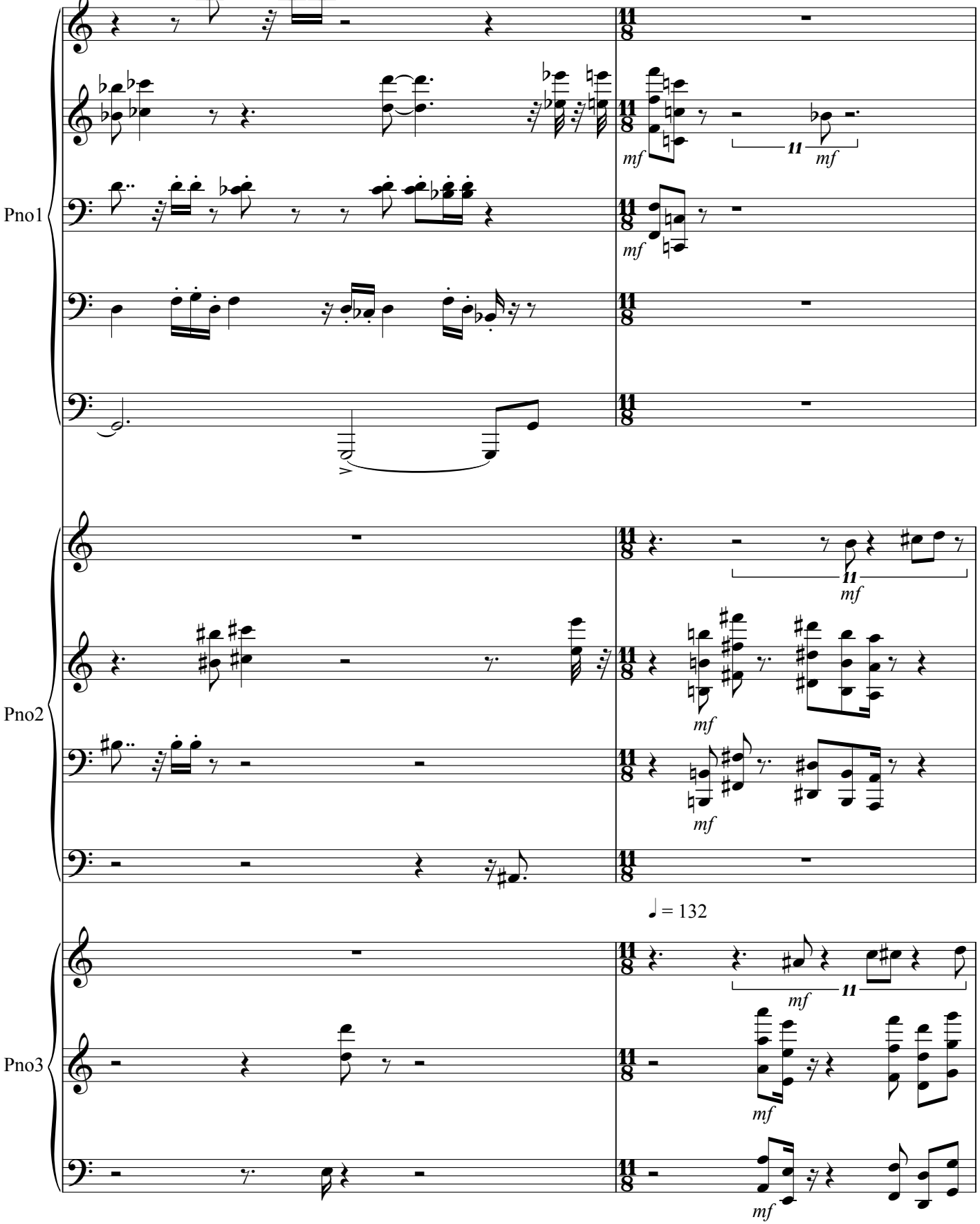
Pno1

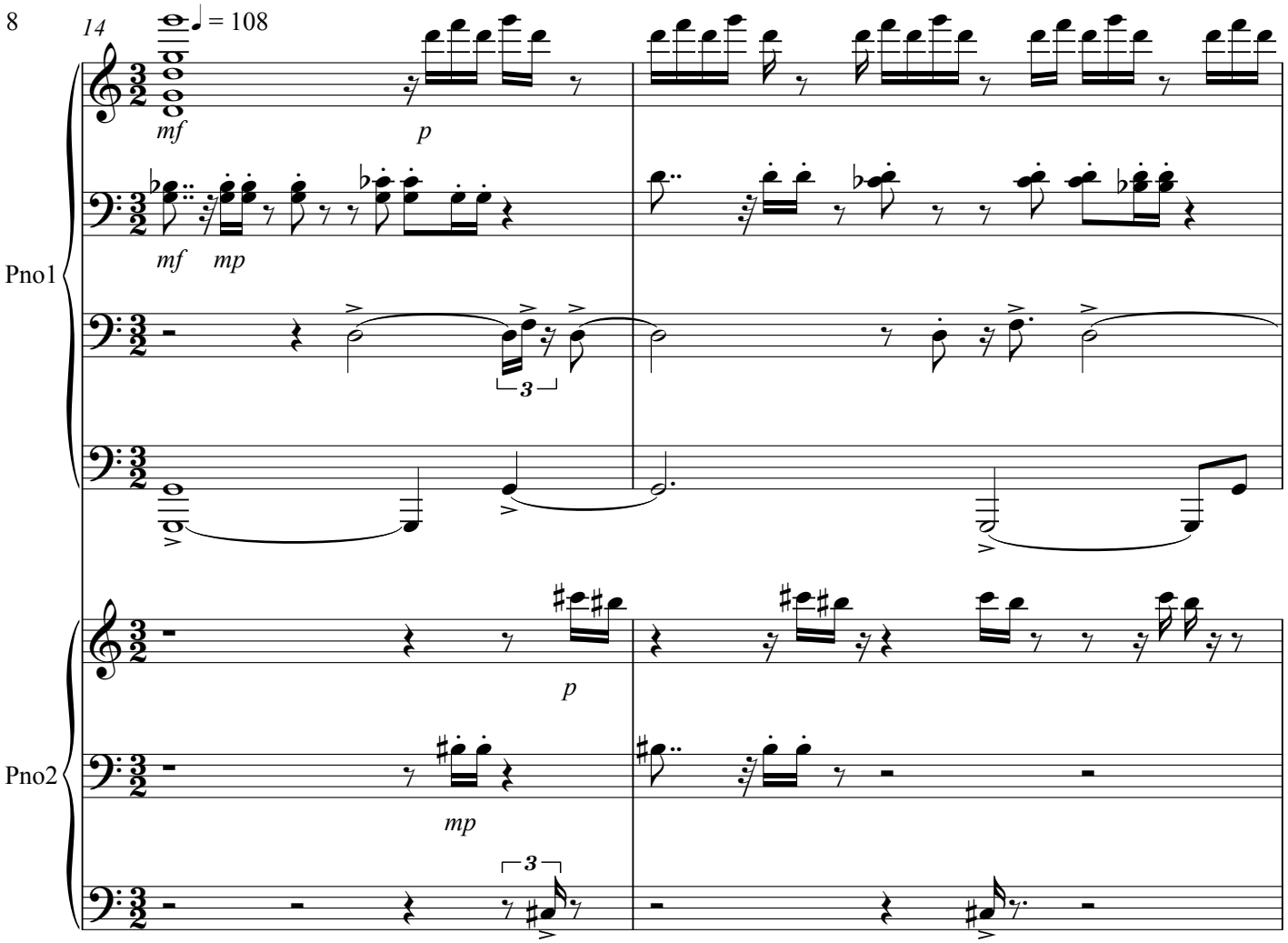
Pno2

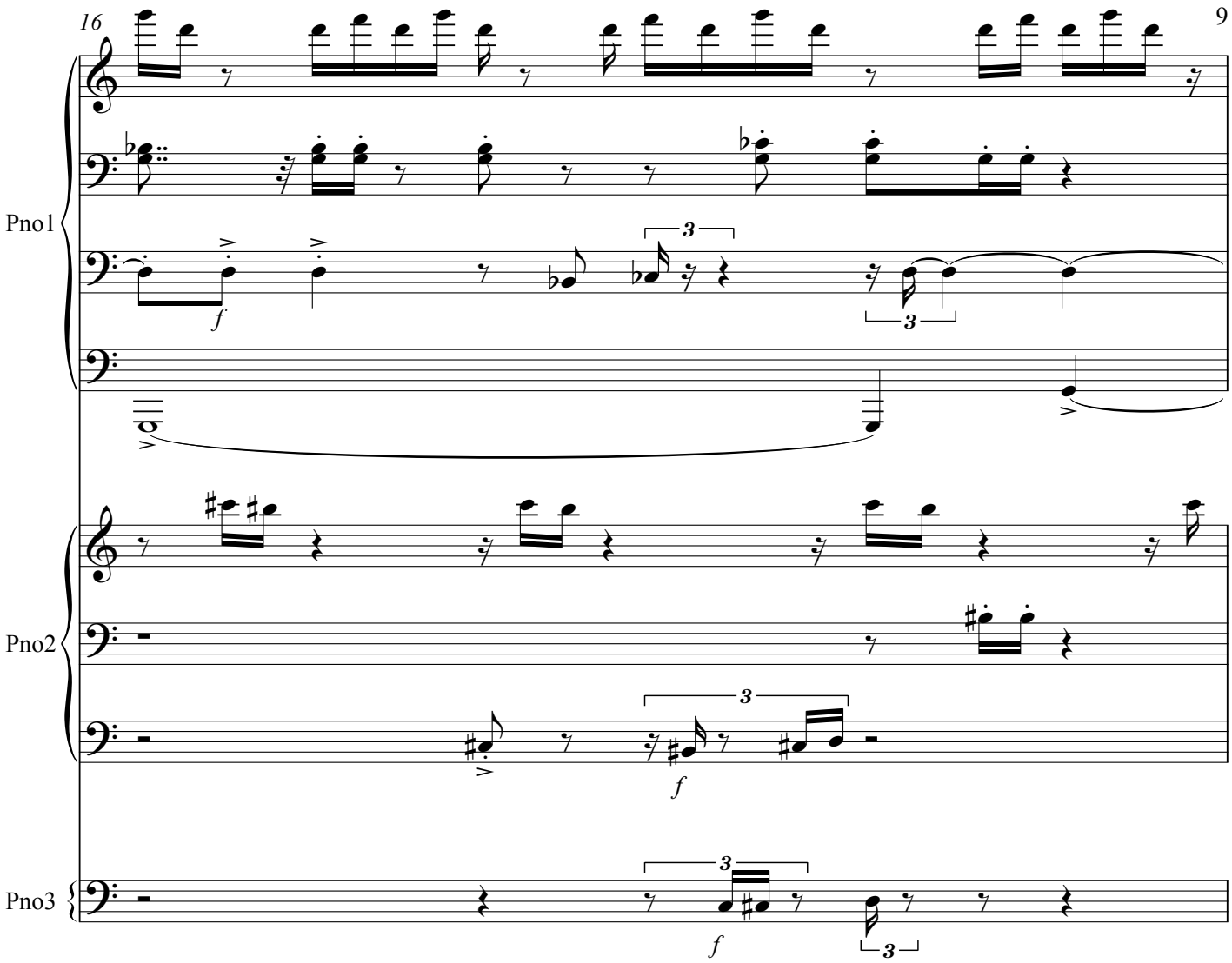
Pno3

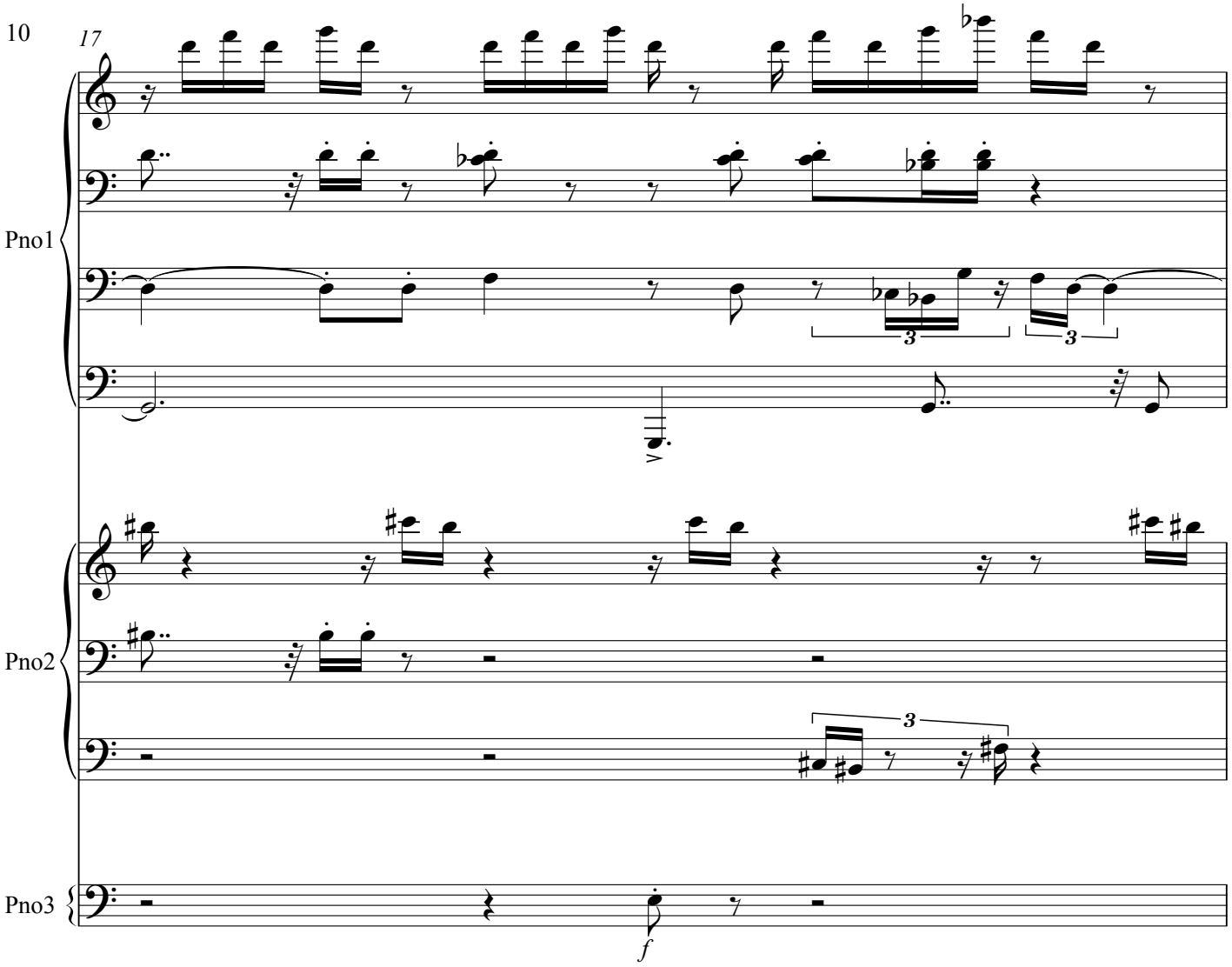

11
Pno1
Pno2
Pno3

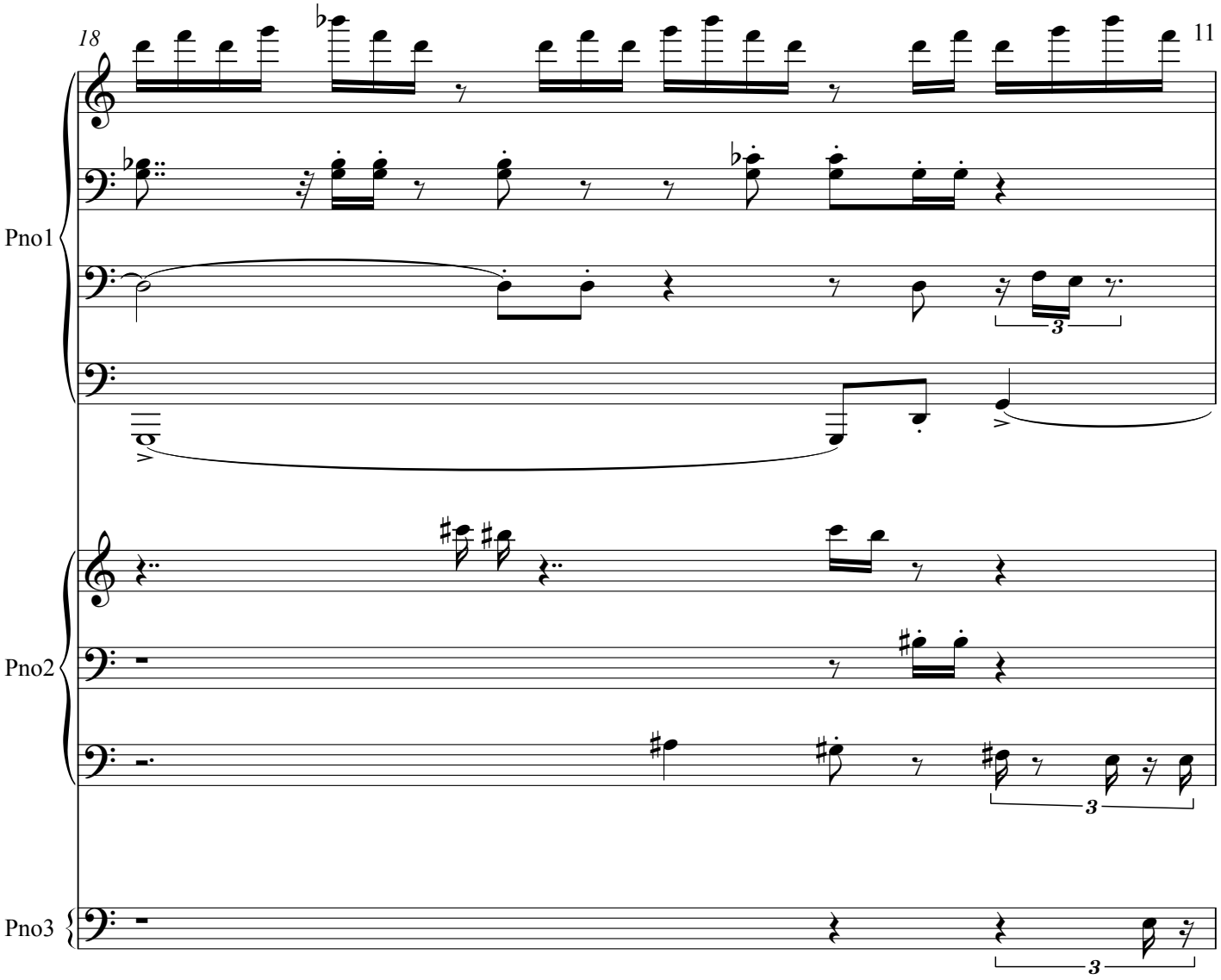
♩ = 132

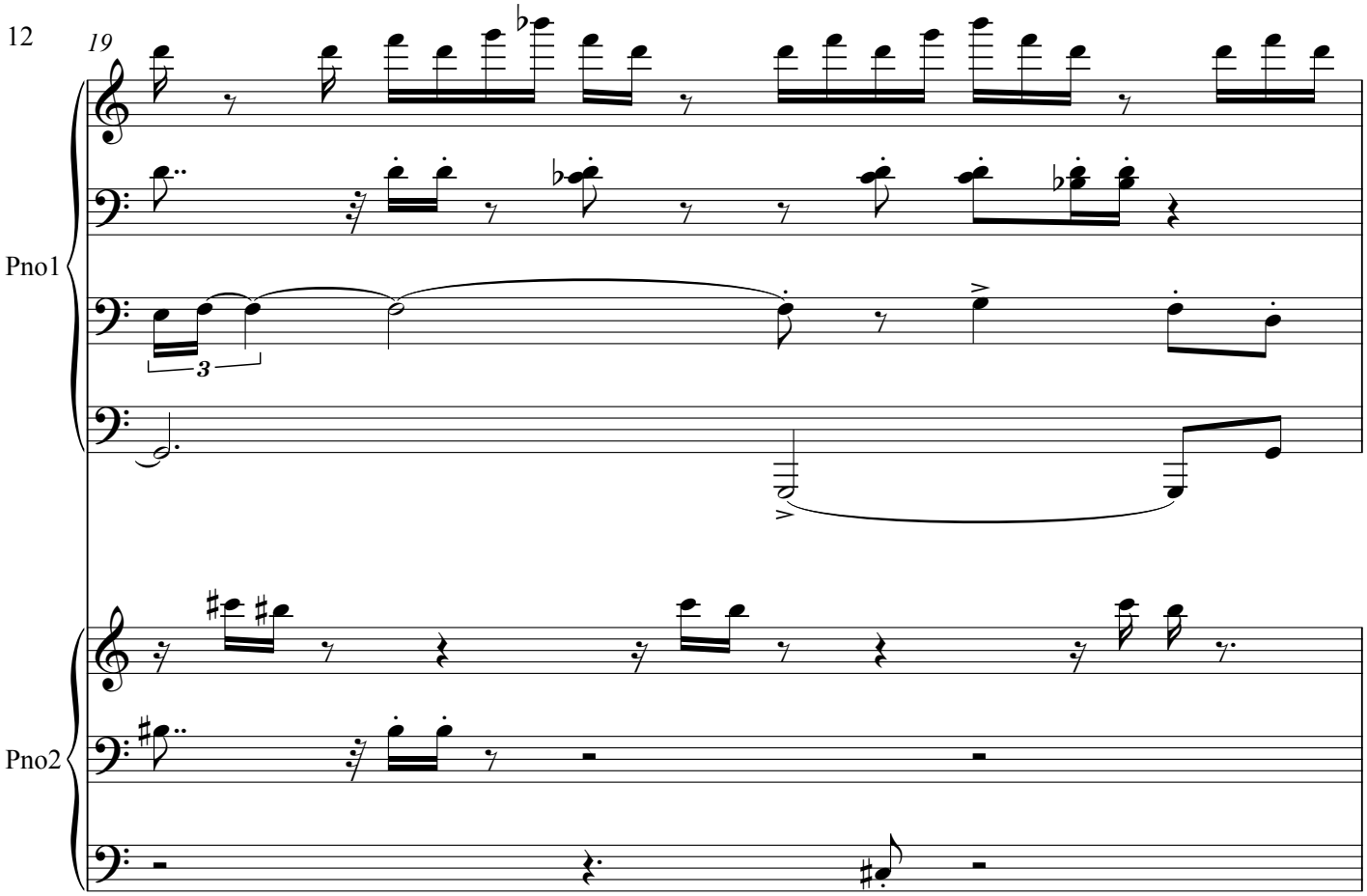


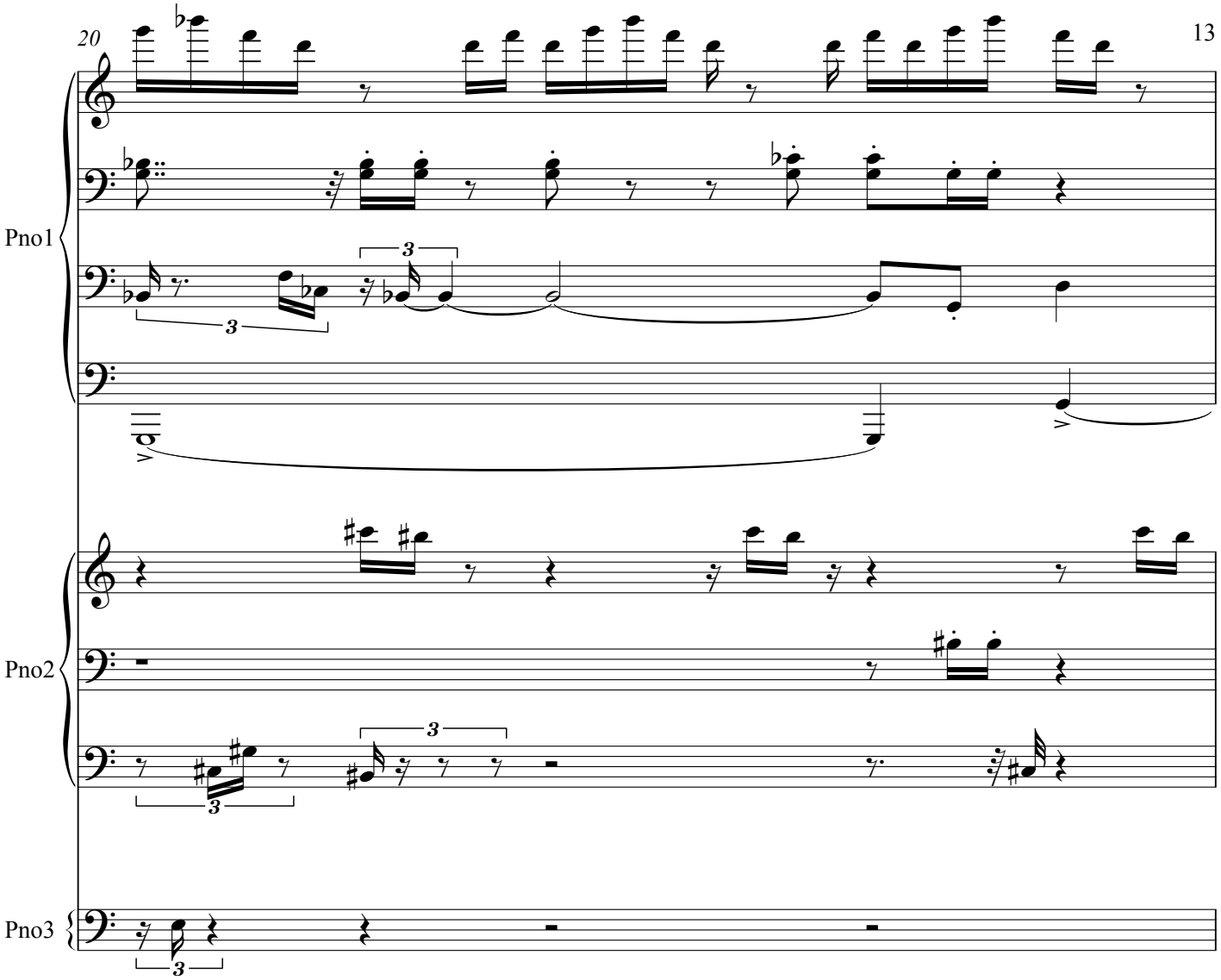

14
♩ = 108
mf
p
mf
mp
3
Pno1
p
mp
3
Pno2

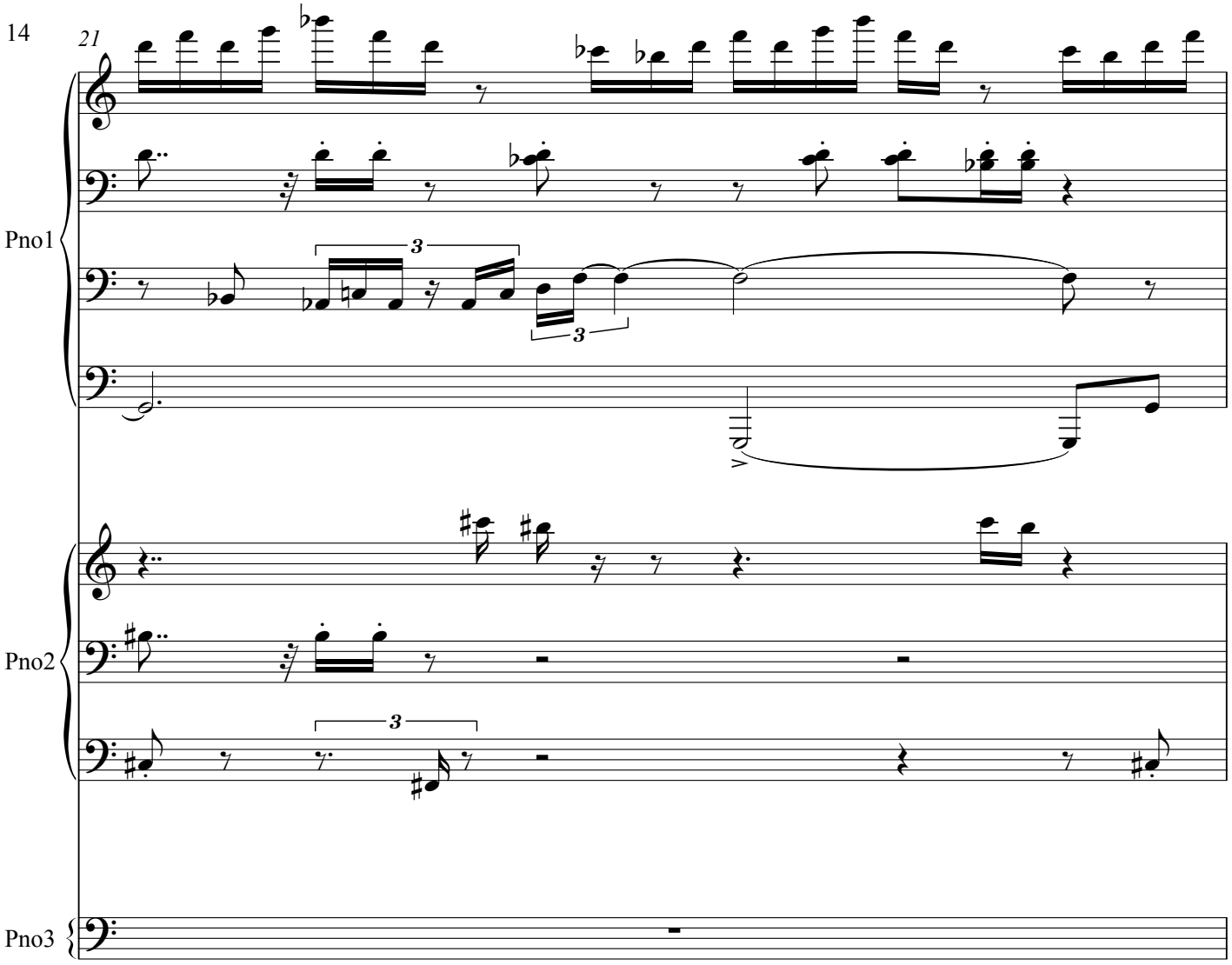

16
Pno1
Pno2
Pno3
f
f
f
3
3
3
3


17
Pno1
Pno2
Pno3
3
3
3
f

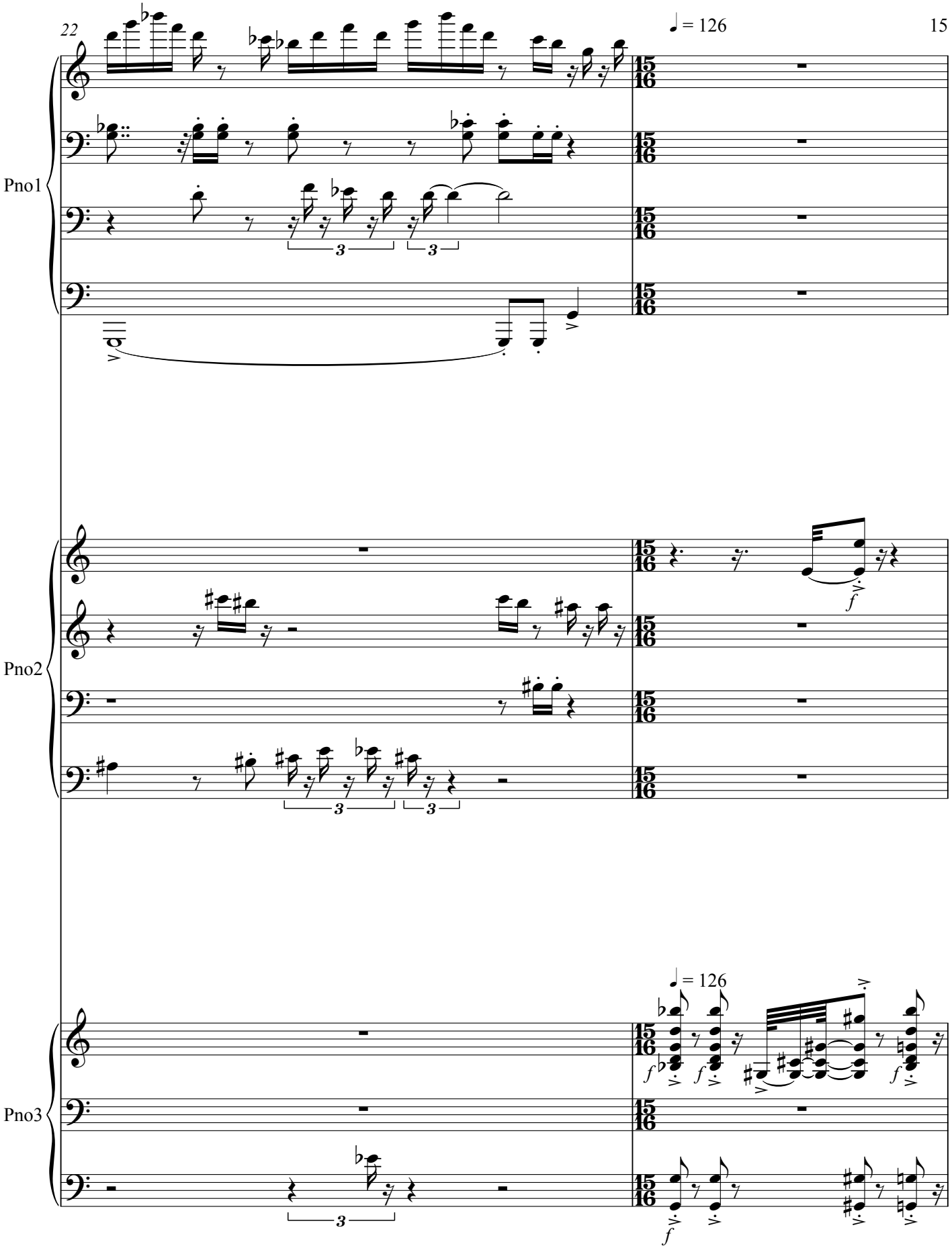

18
11
Pno1
Pno2
Pno3

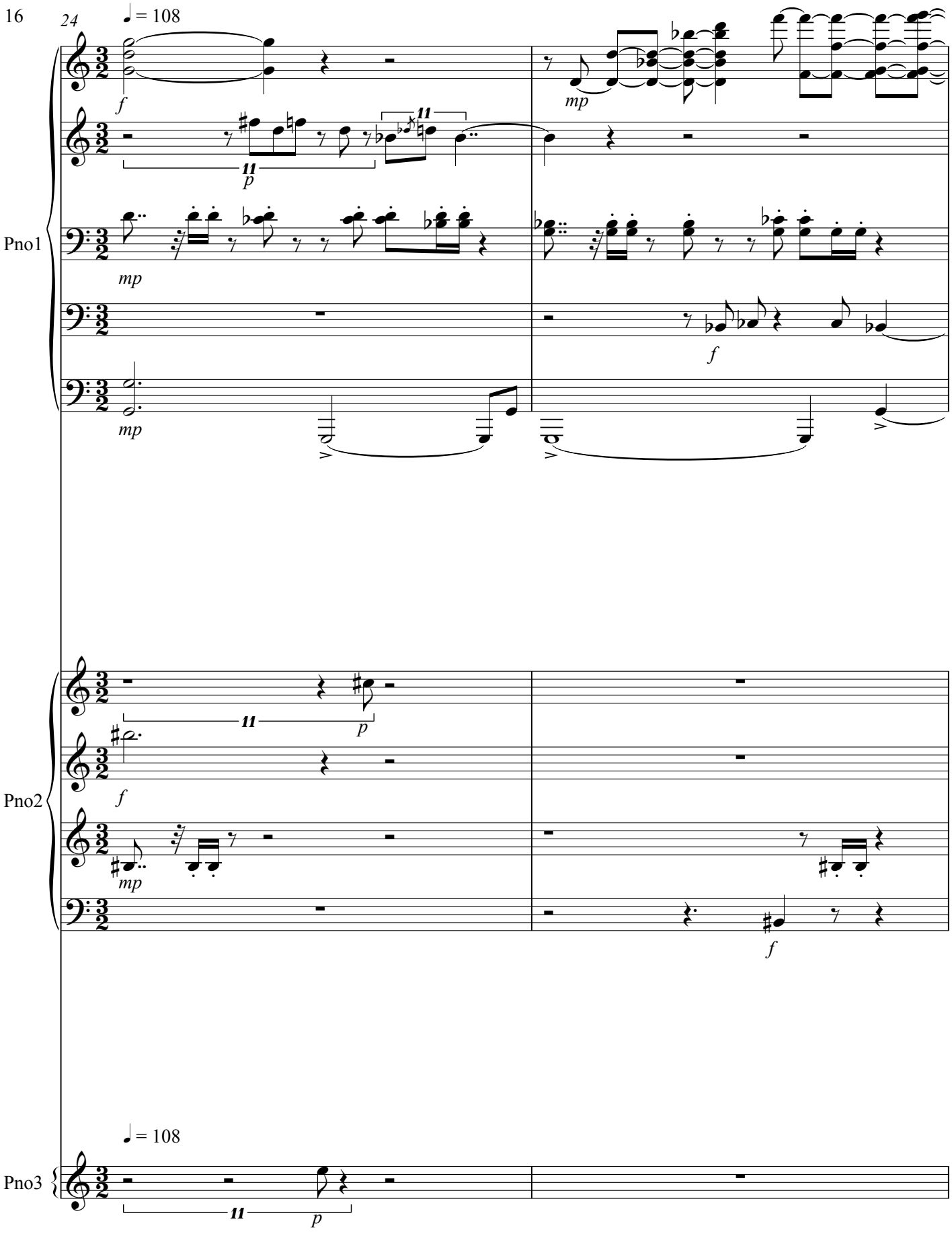

19
Pno1
Pno2

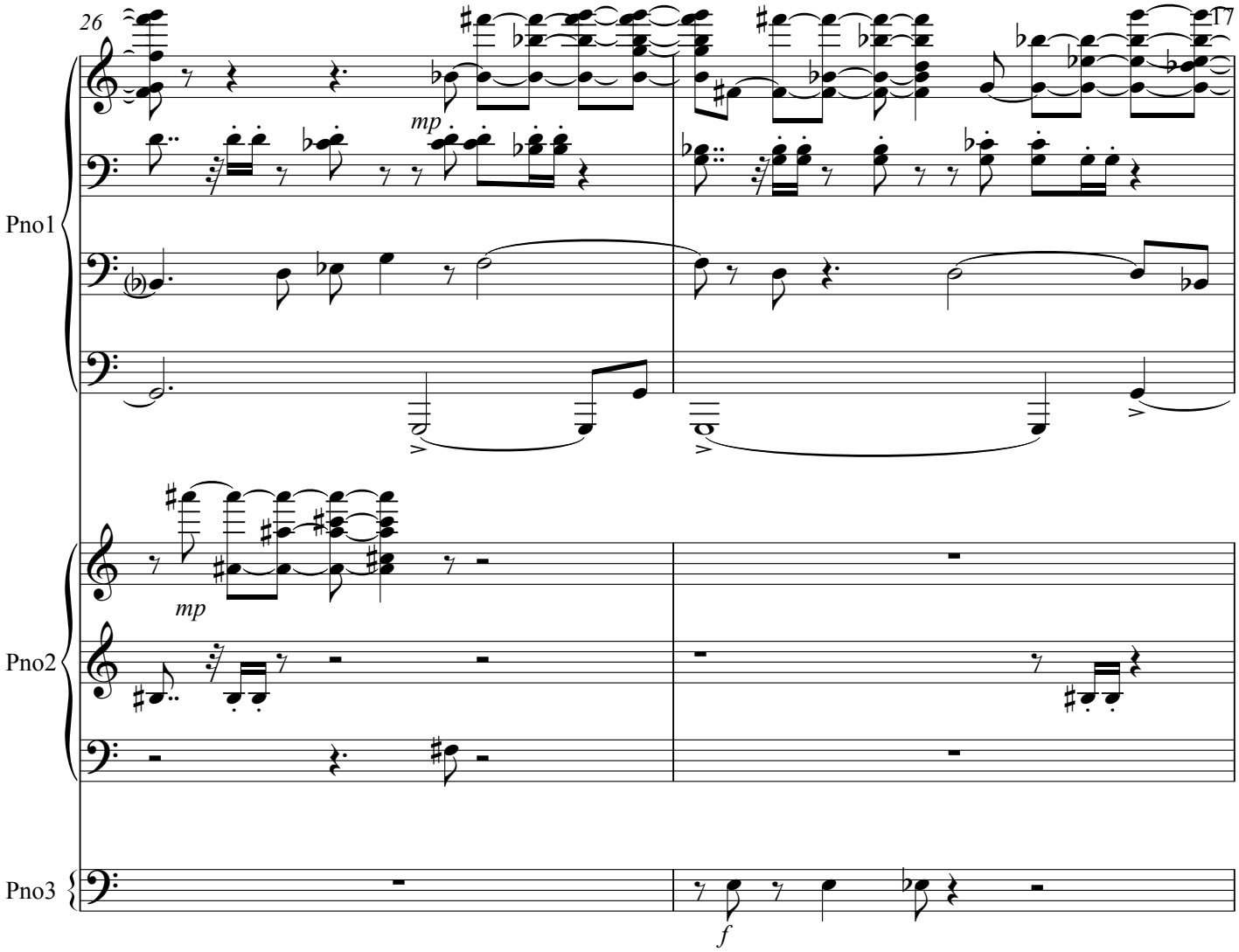

20
Pno1
Pno2
Pno3

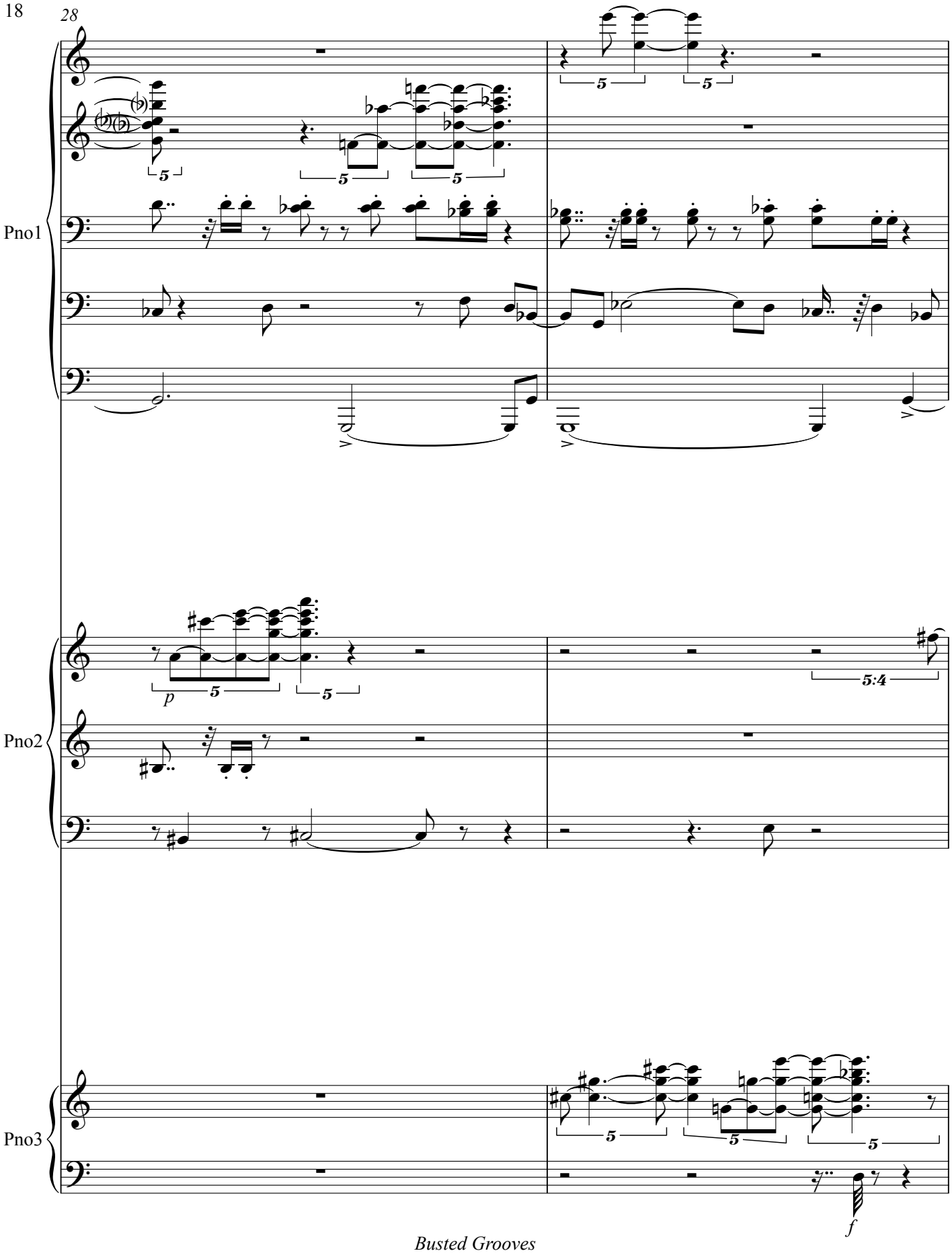

21
Pno1
Pno2
Pno3

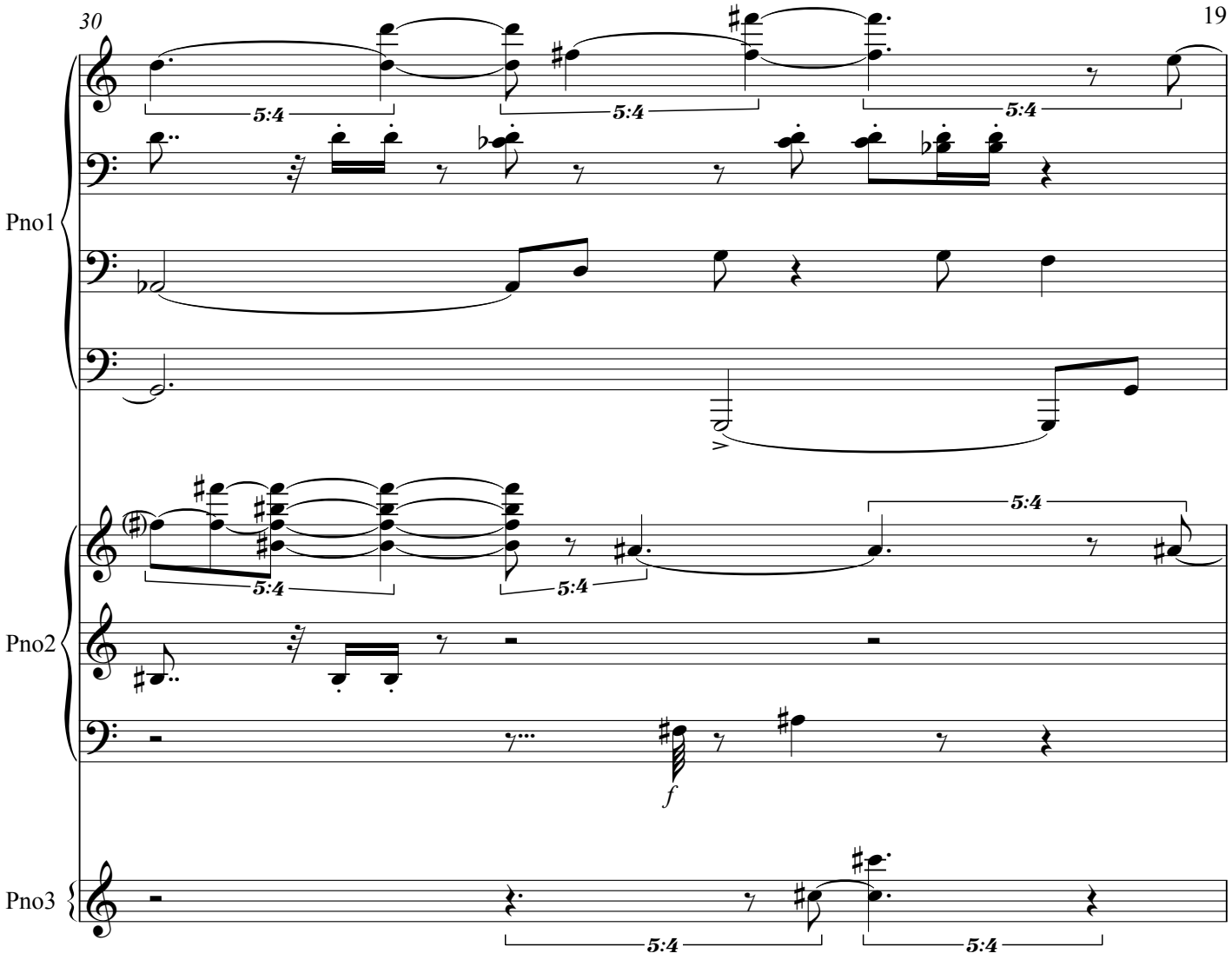
♩ = 126

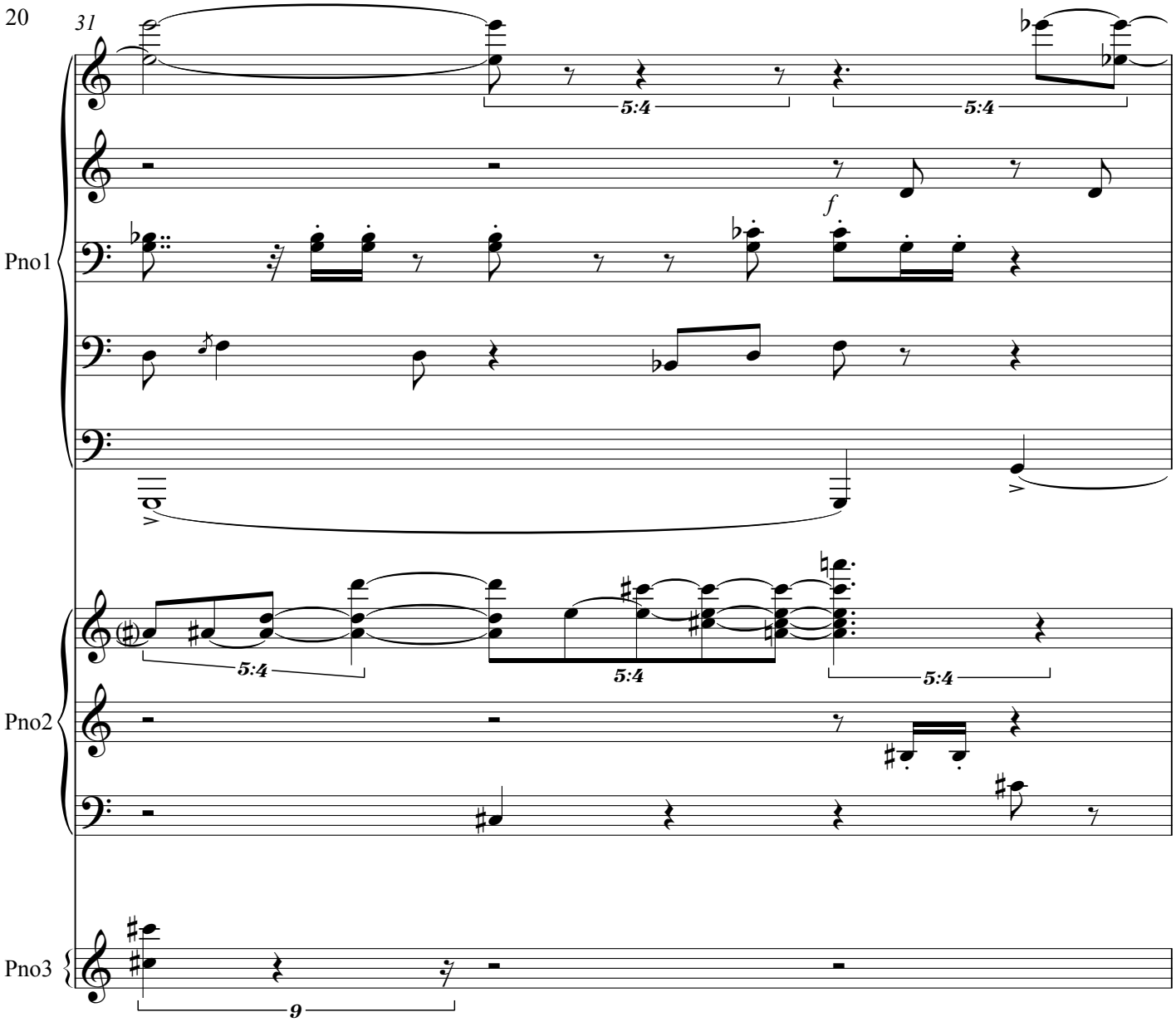


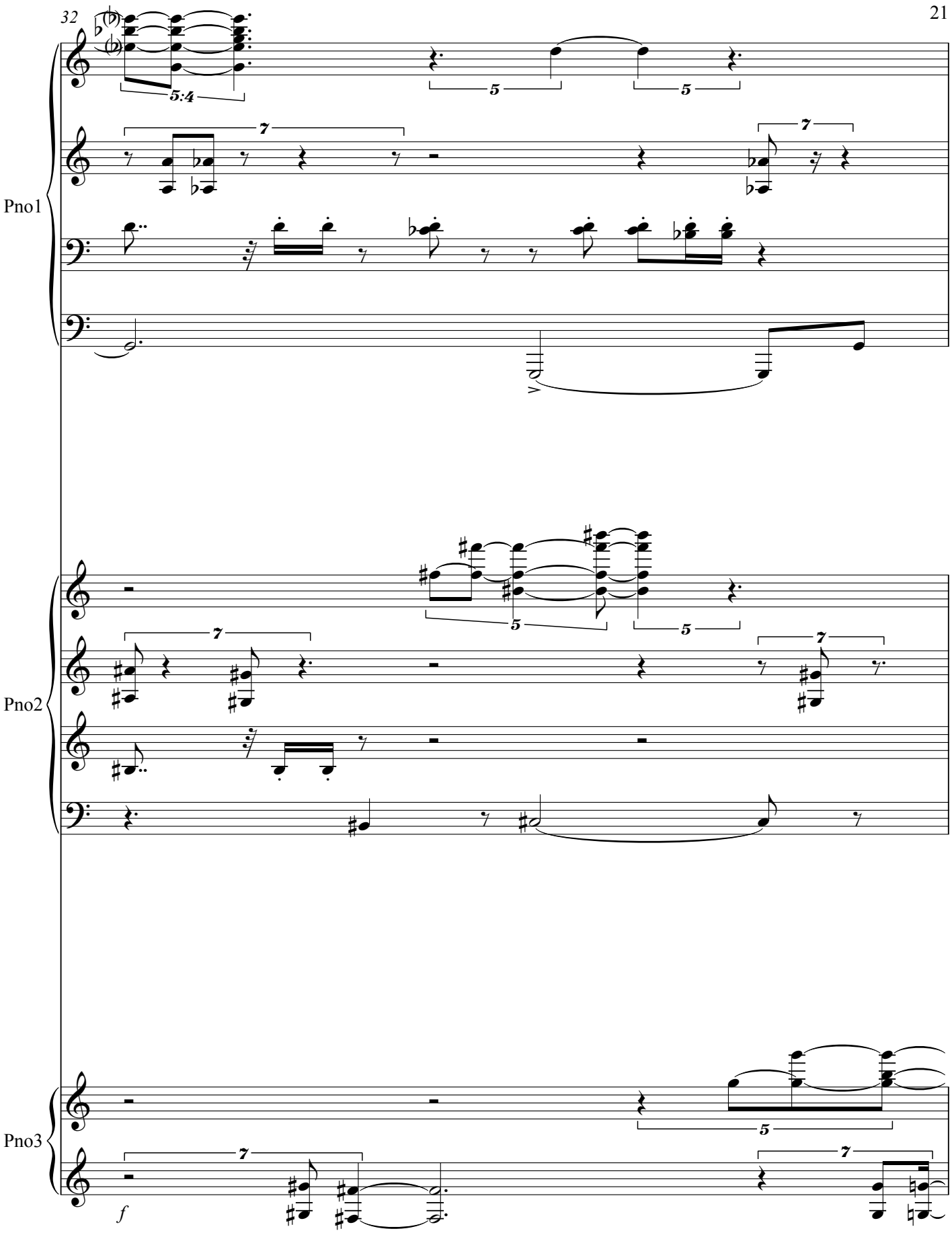

24
♩ = 108
Pno1
Pno2
Pno3
11
f
p
mp

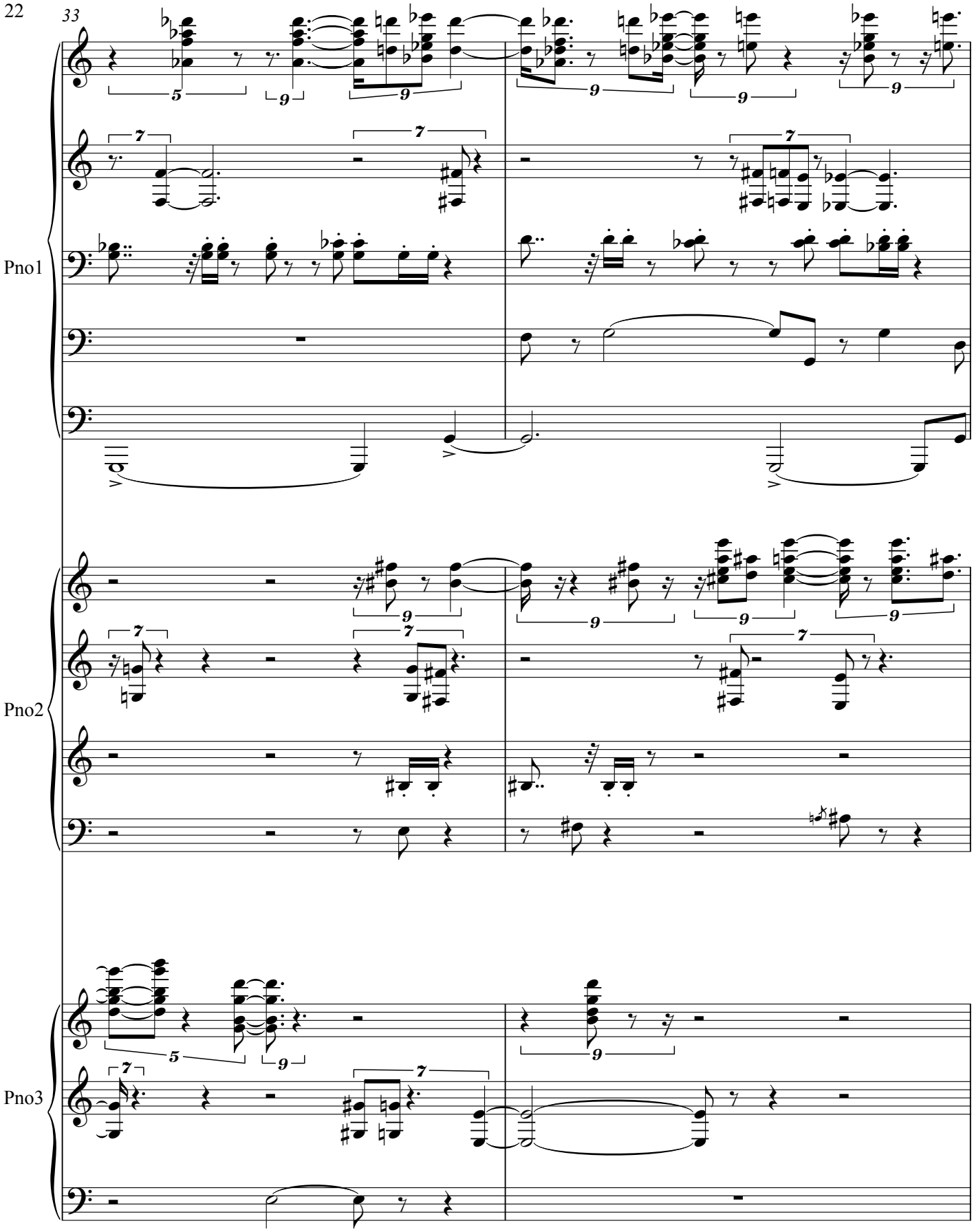

26
17
Pno1
mp
Pno2
mp
Pno3
f

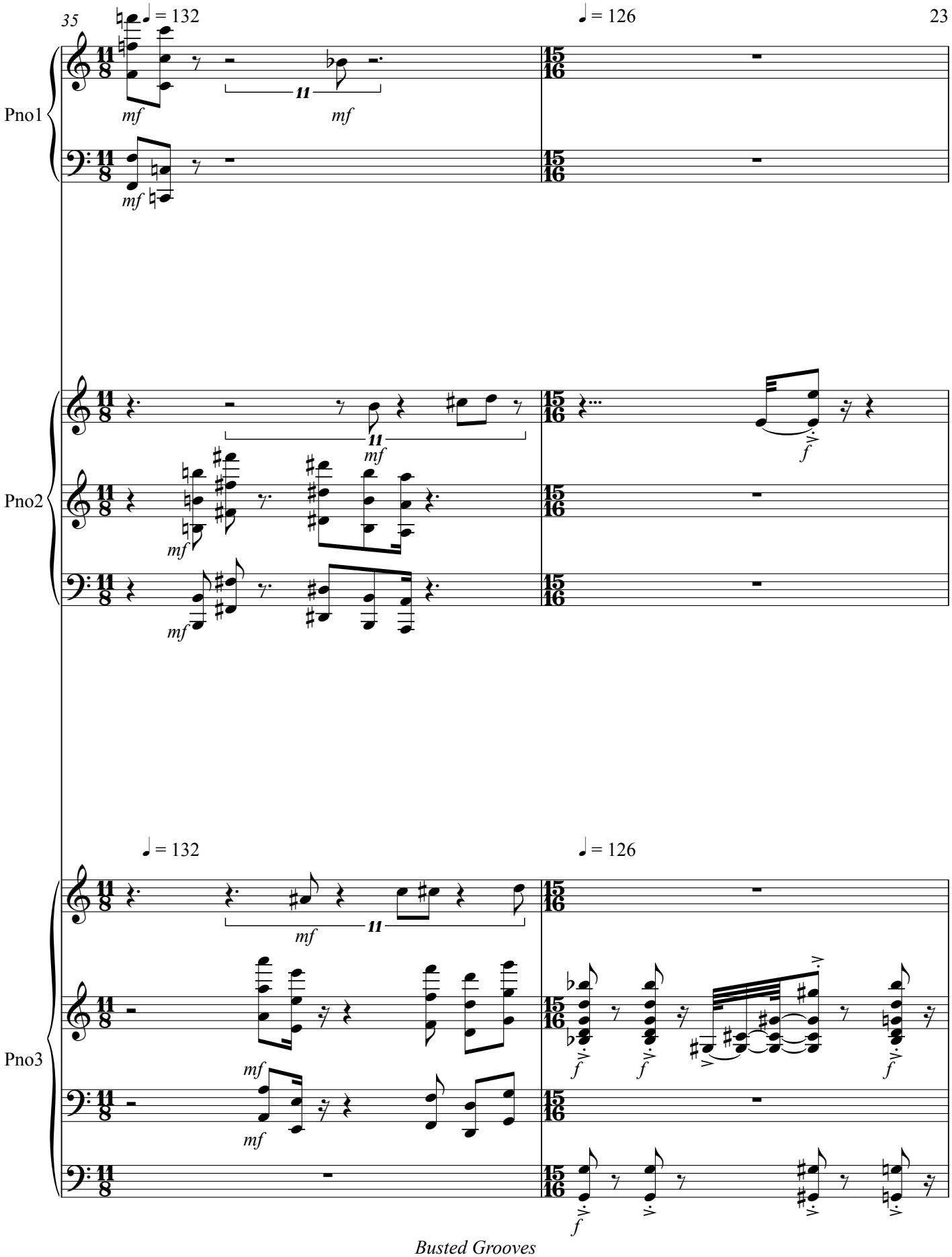

28
Pno1
Pno2
Pno3
p
5:4
f

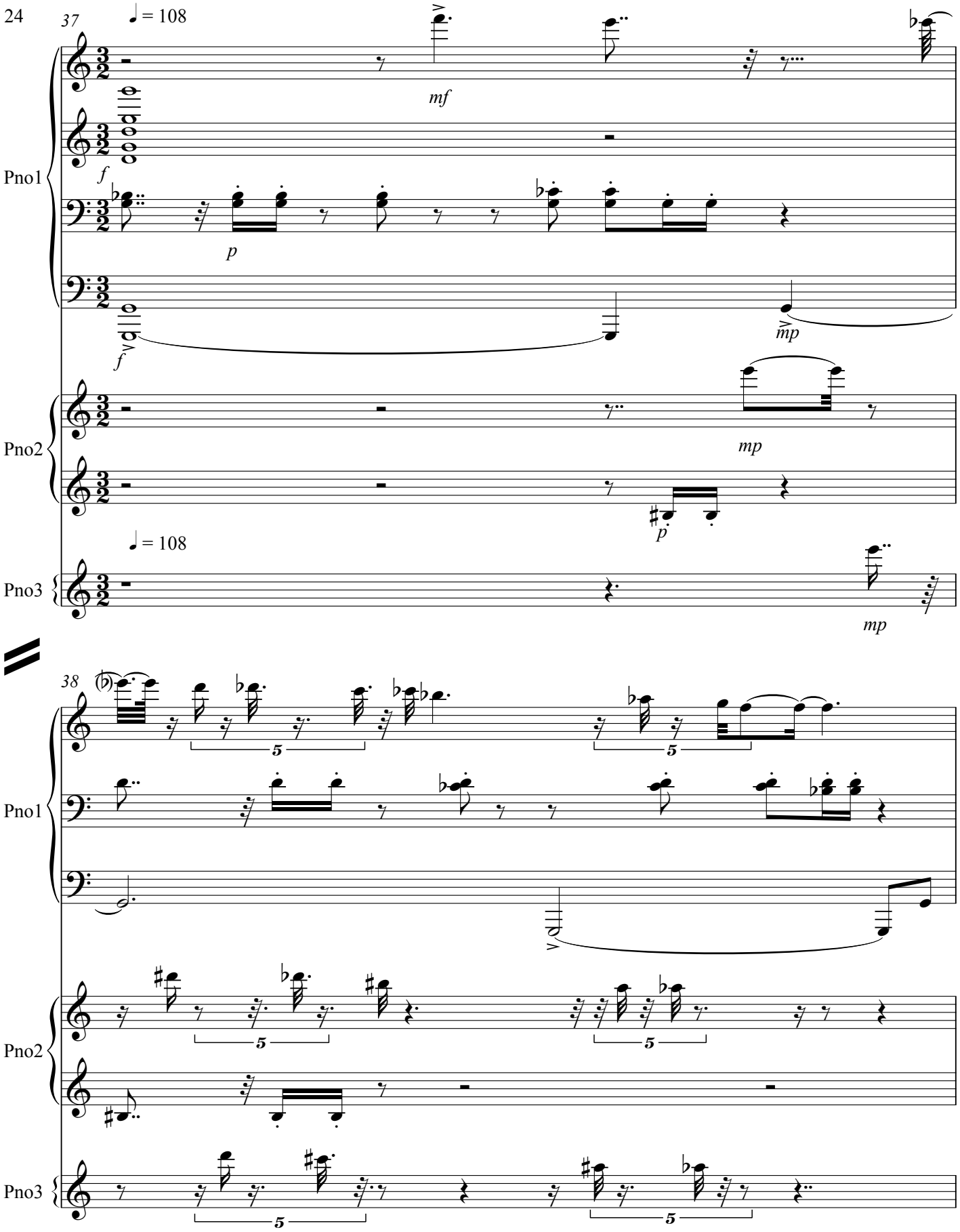

30
Pno1
Pno2
Pno3
5:4
5:4
5:4
5:4
5:4
5:4
5:4
f

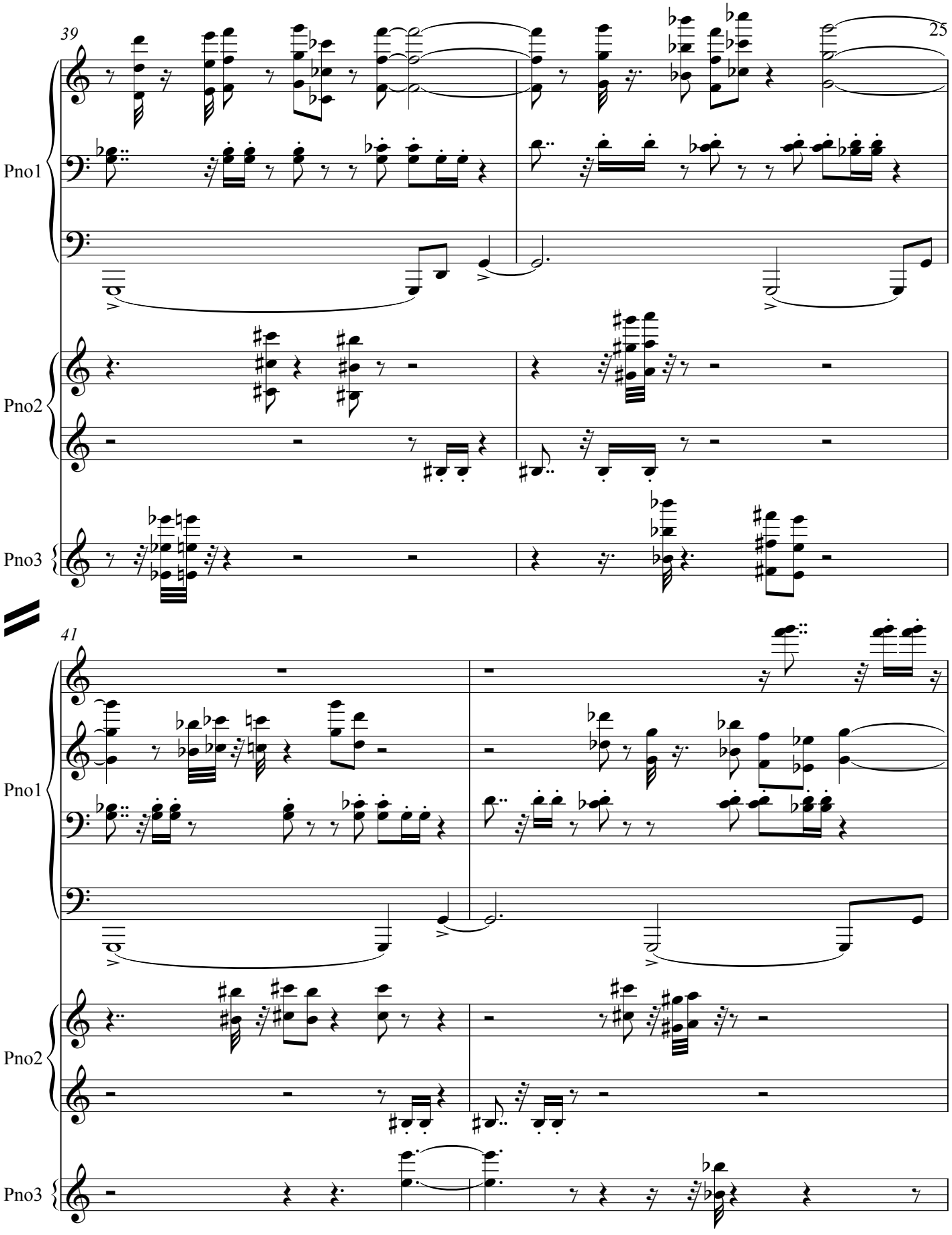

31
Pno1
Pno2
Pno3
5:4
5:4
f
5:4
5:4
5:4
9

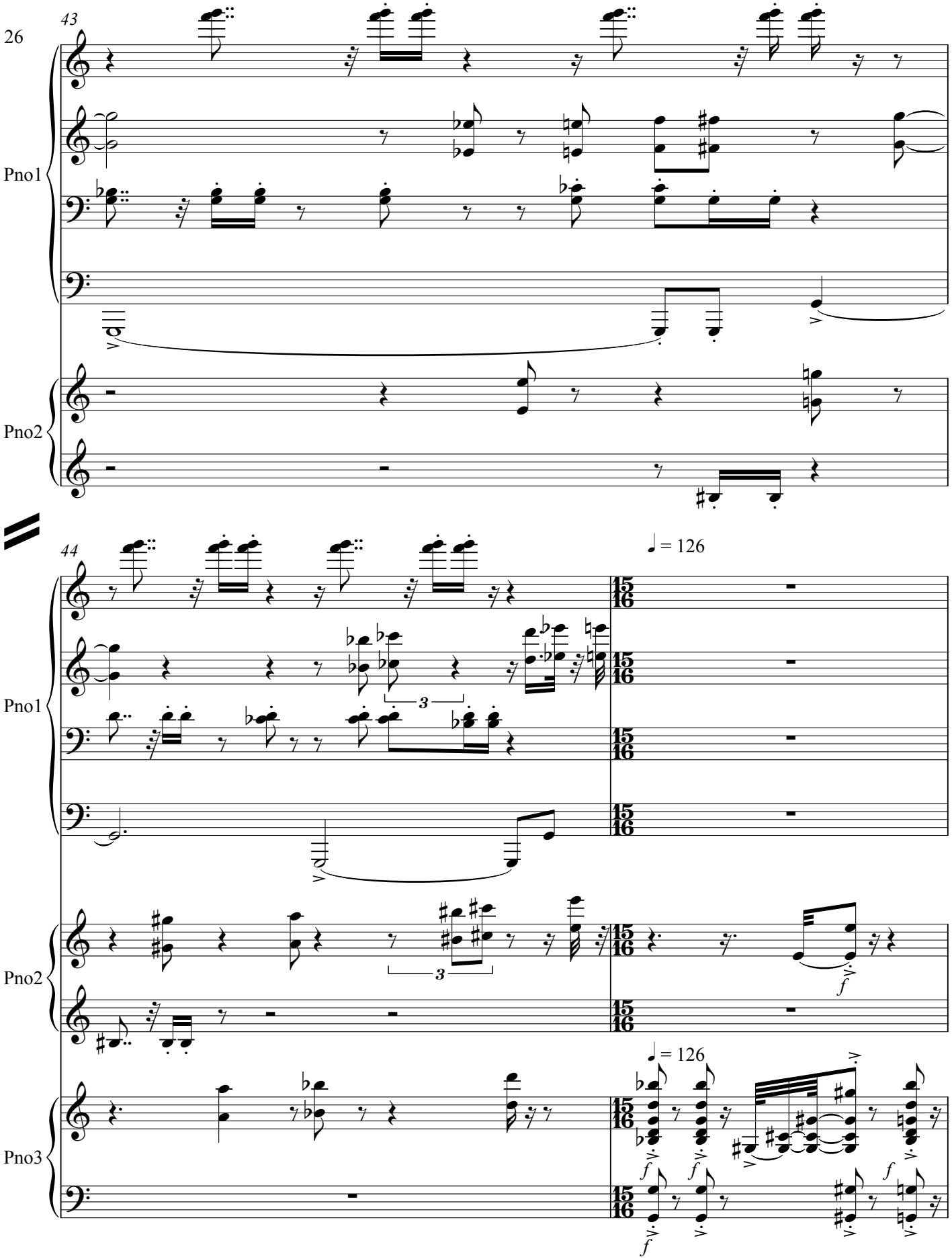

32
Pno1
Pno2
Pno3
5:4
7
5
f

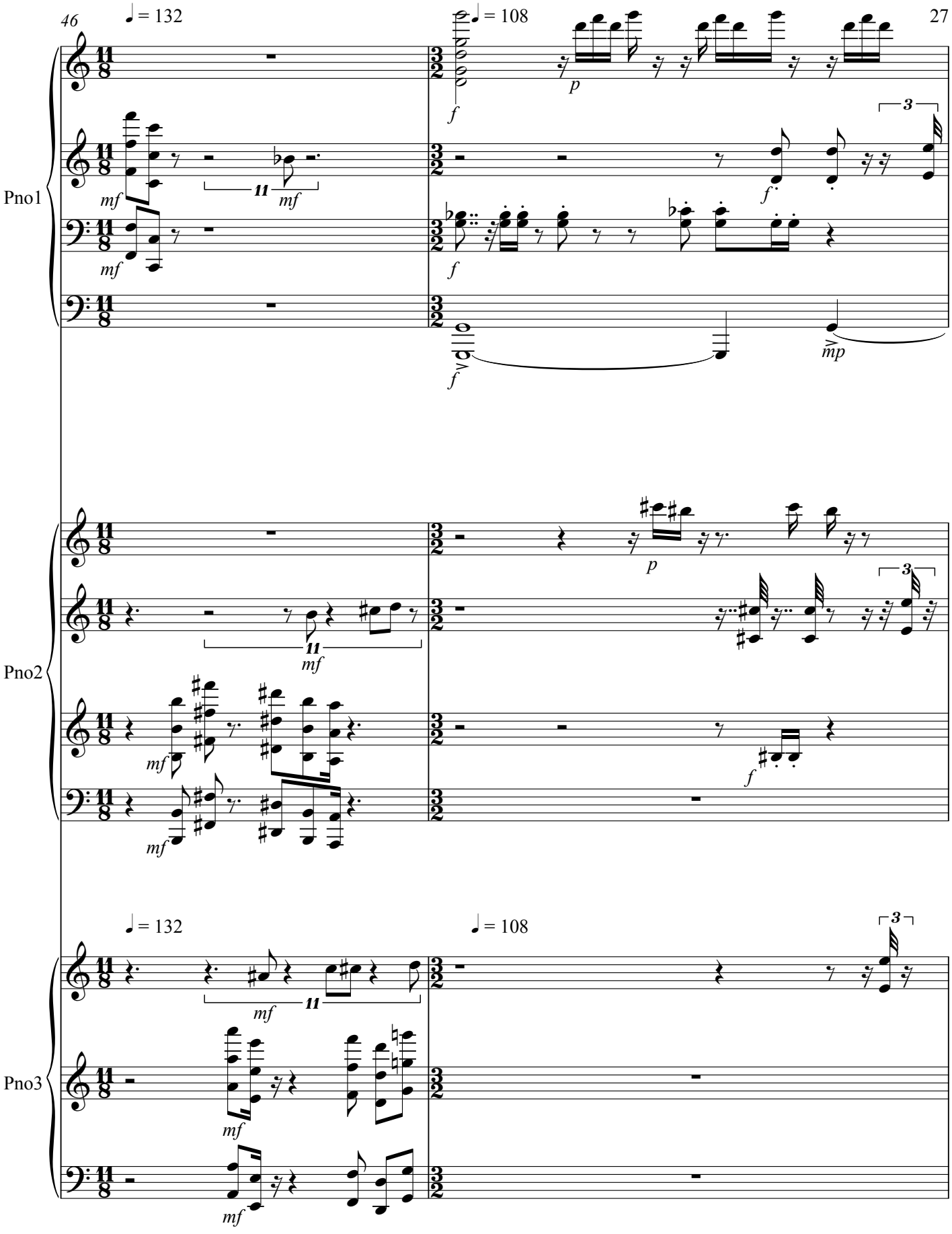

33
Pno1
Pno2
Pno3

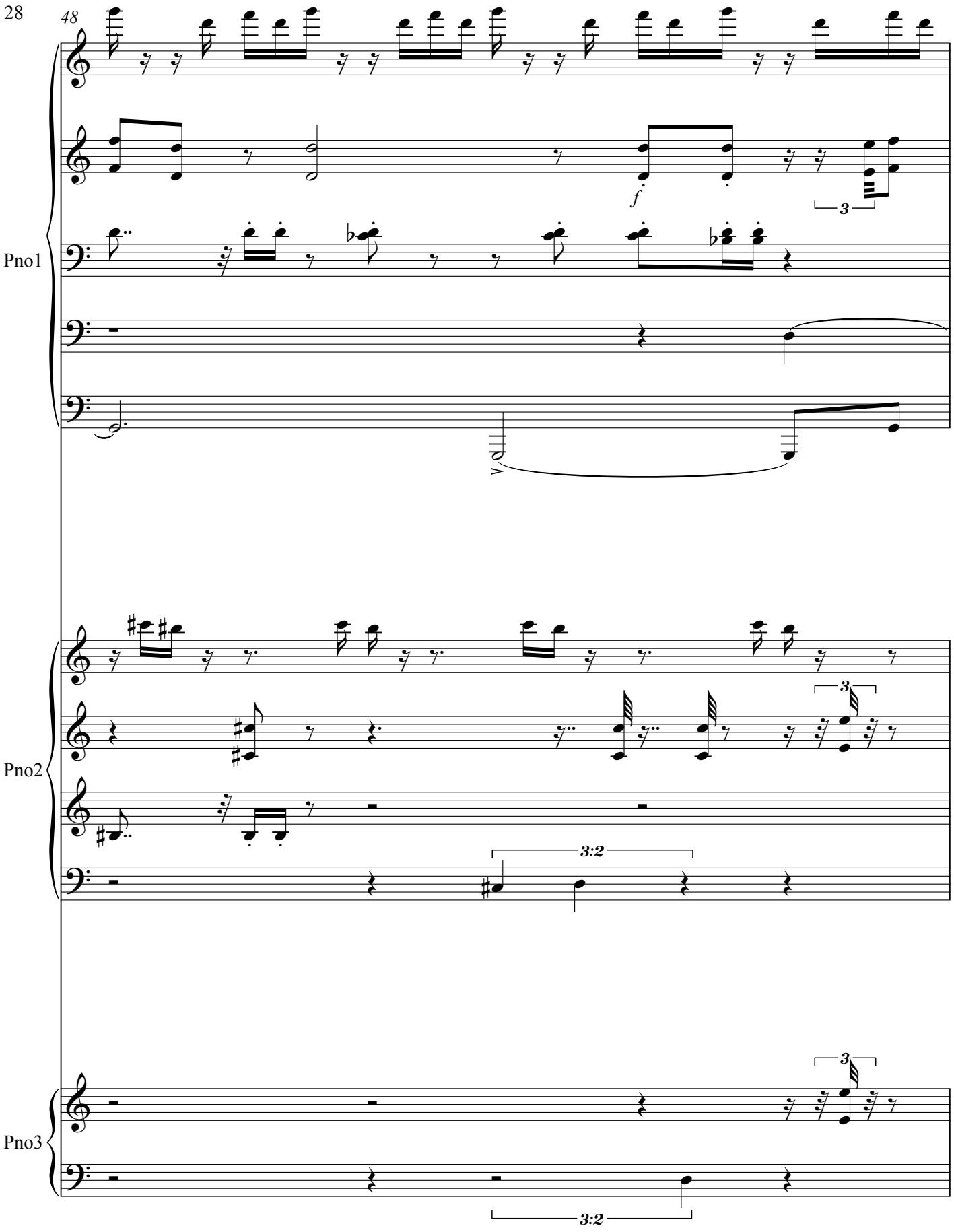

♩ = 132
♩ = 126
Pno1
Pno2
Pno3
11
mf
f

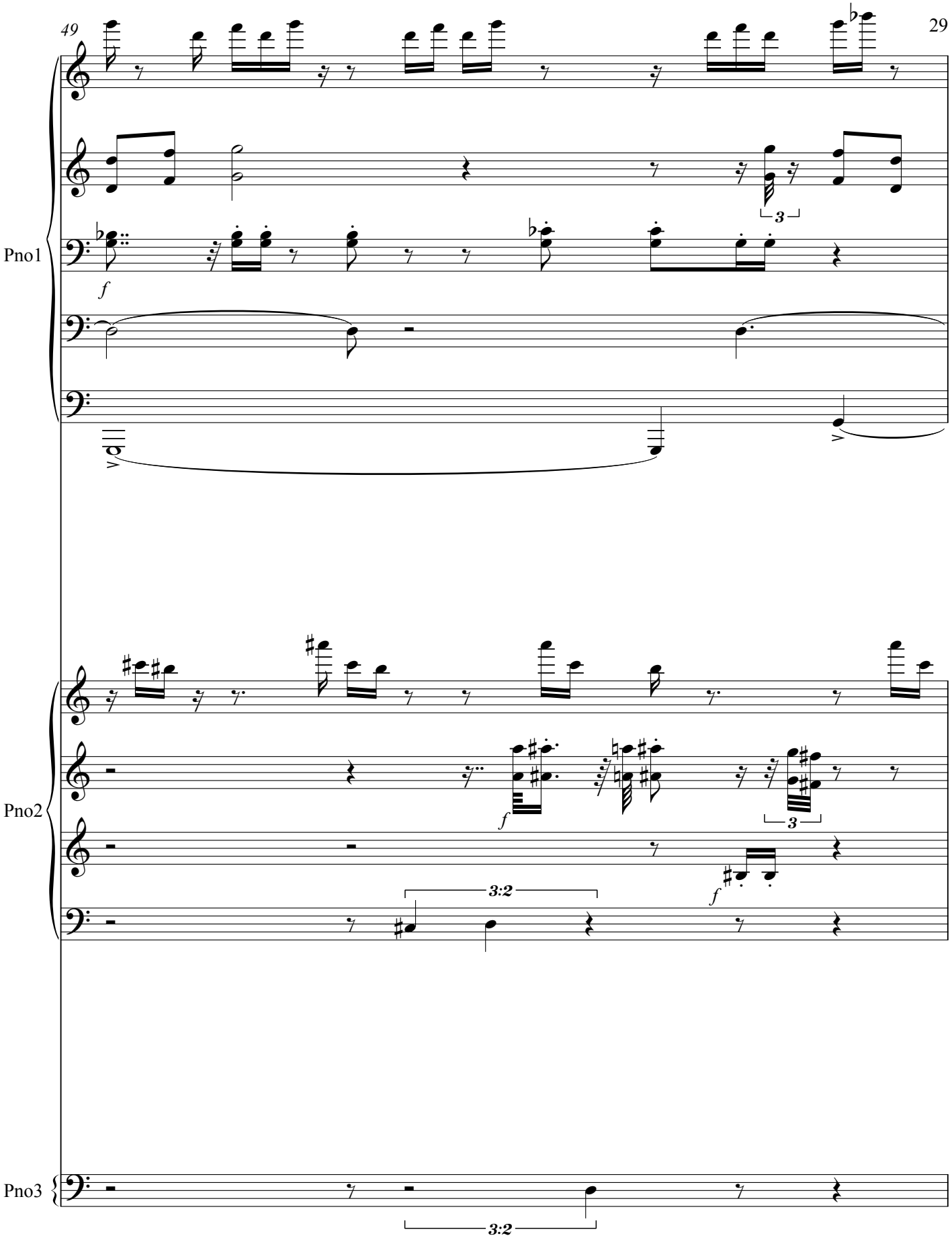

37
♩ = 108
mf
Pno1
f
p
f
mp
Pno2
mp
p
♩ = 108
Pno3
mp
38
Pno1
5
5
Pno2
5
5
Pno3
5
5

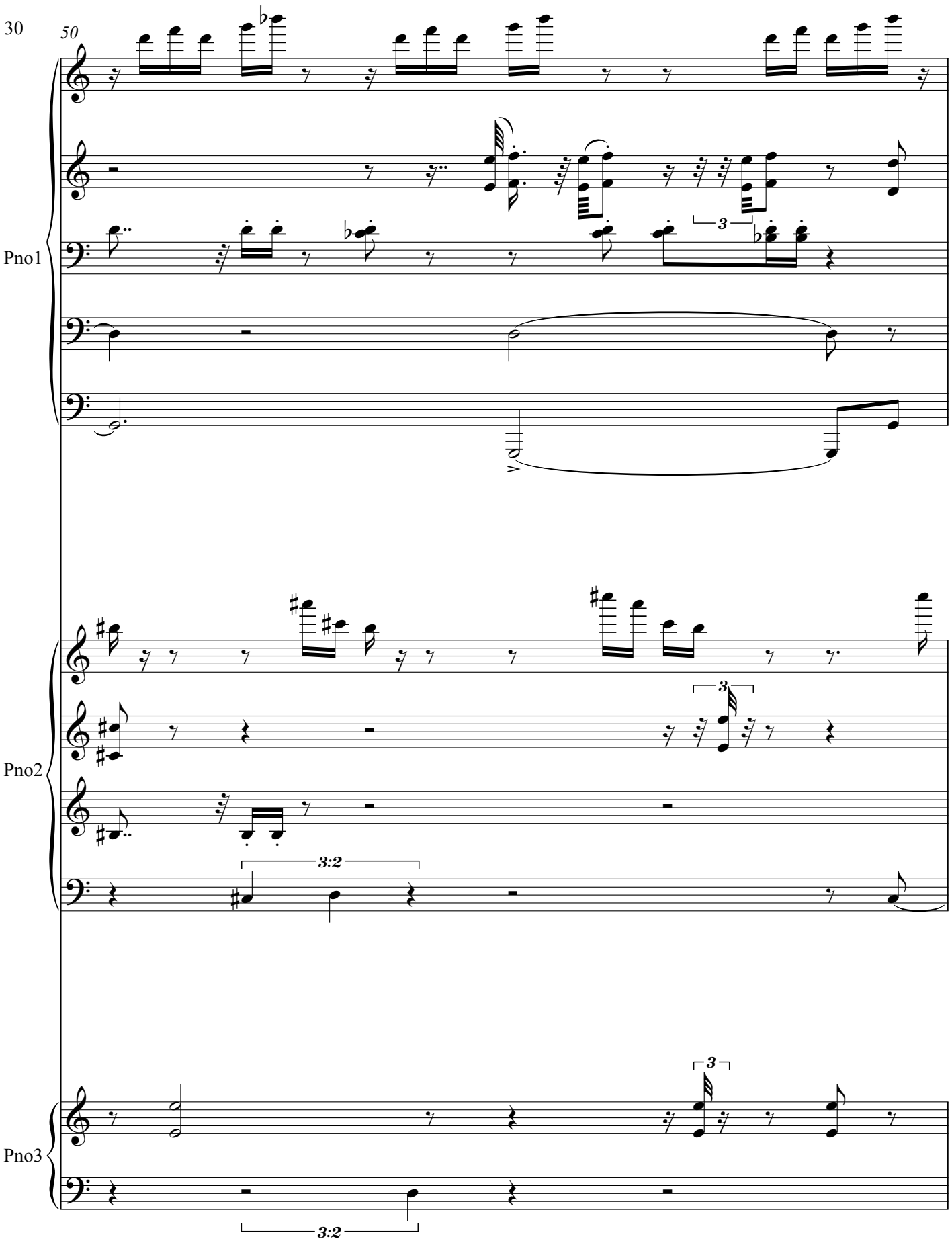

39
Pno1
Pno2
Pno3
41
Pno1
Pno2
Pno3

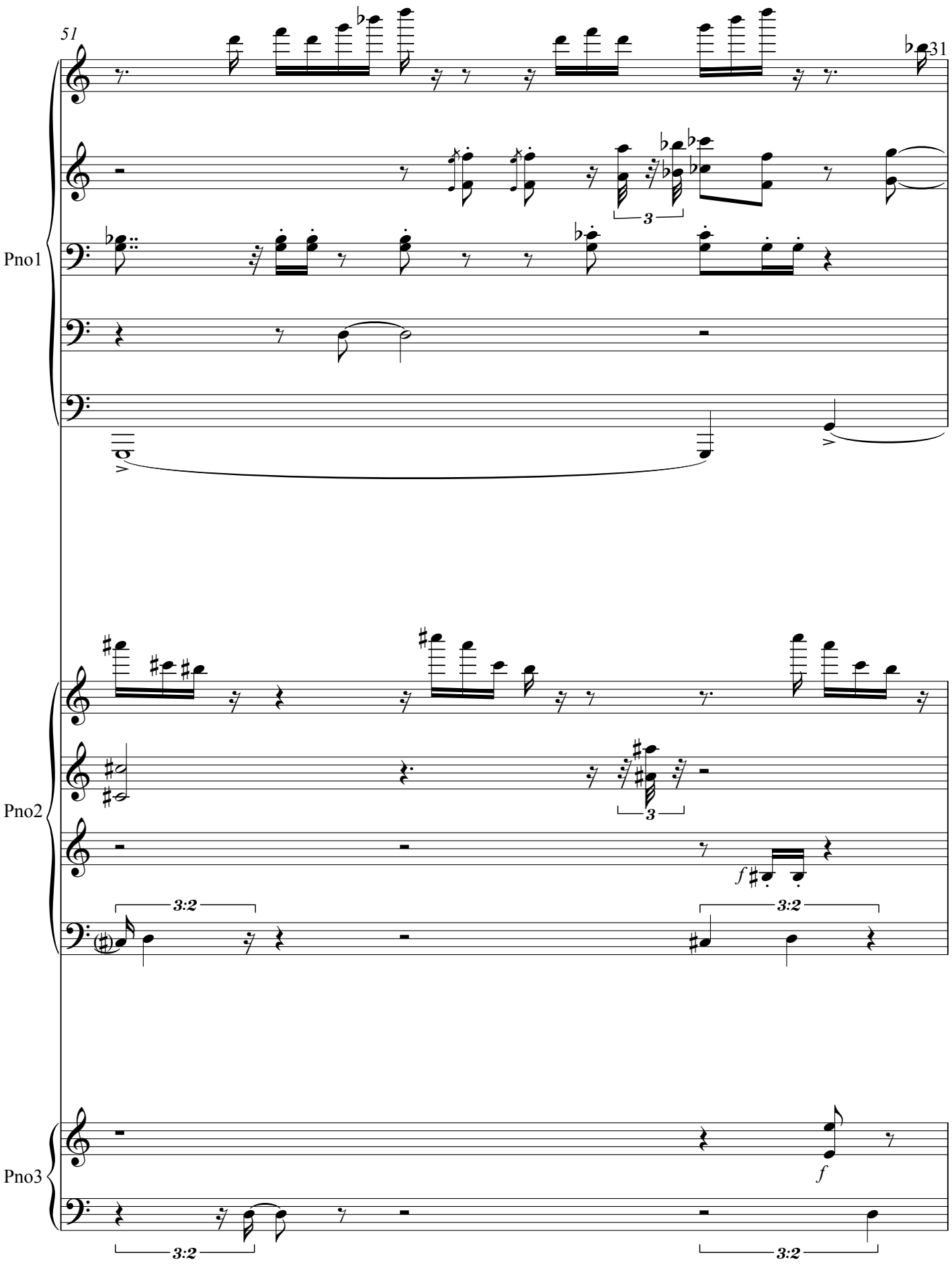

43
Pno1
Pno2
44
♩ = 126
15/16
3
3
f
♩ = 126
Pno3
f

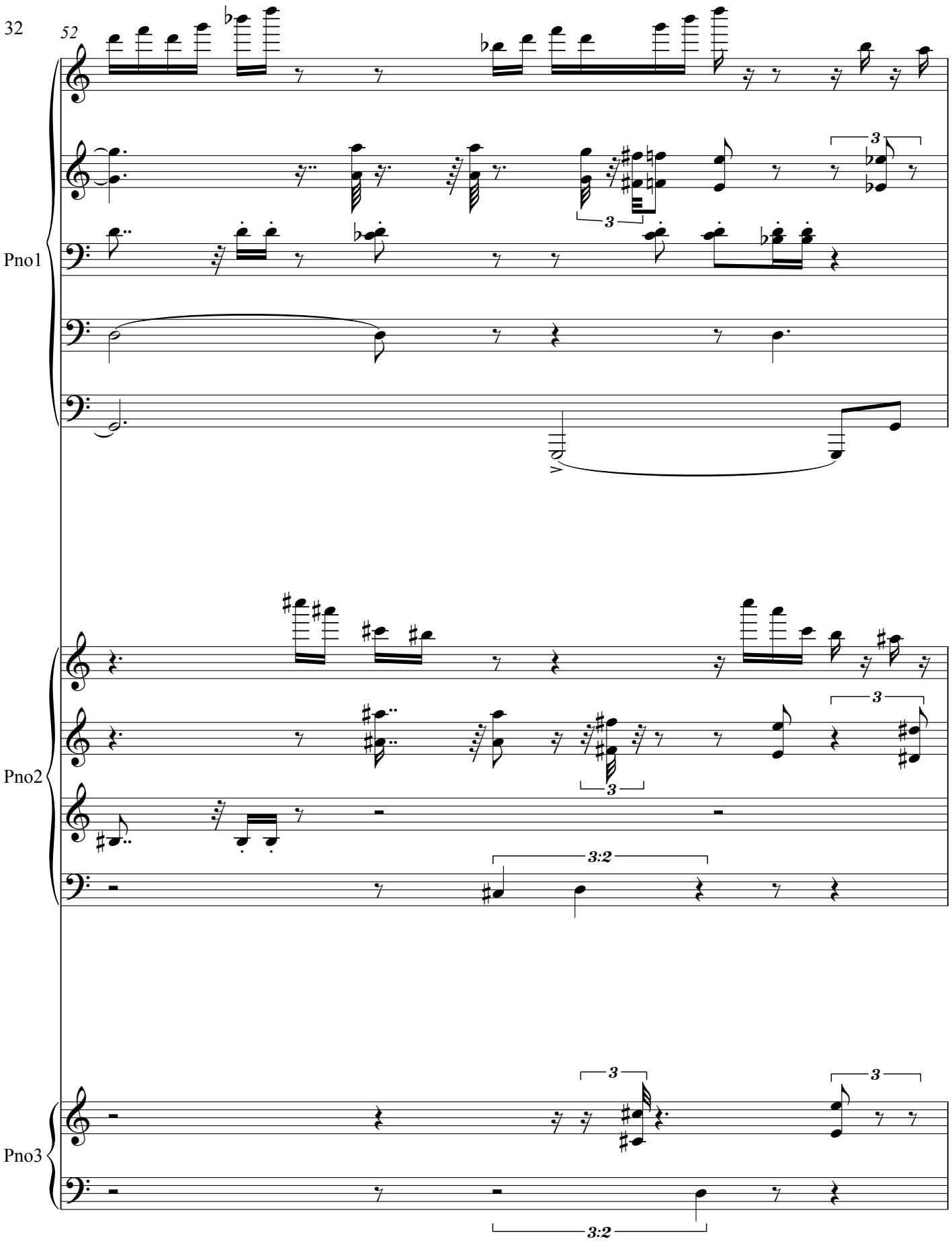

♩ = 132
♩ = 108
27
Pno1
Pno2
Pno3
11
3
mf
f
p
mp

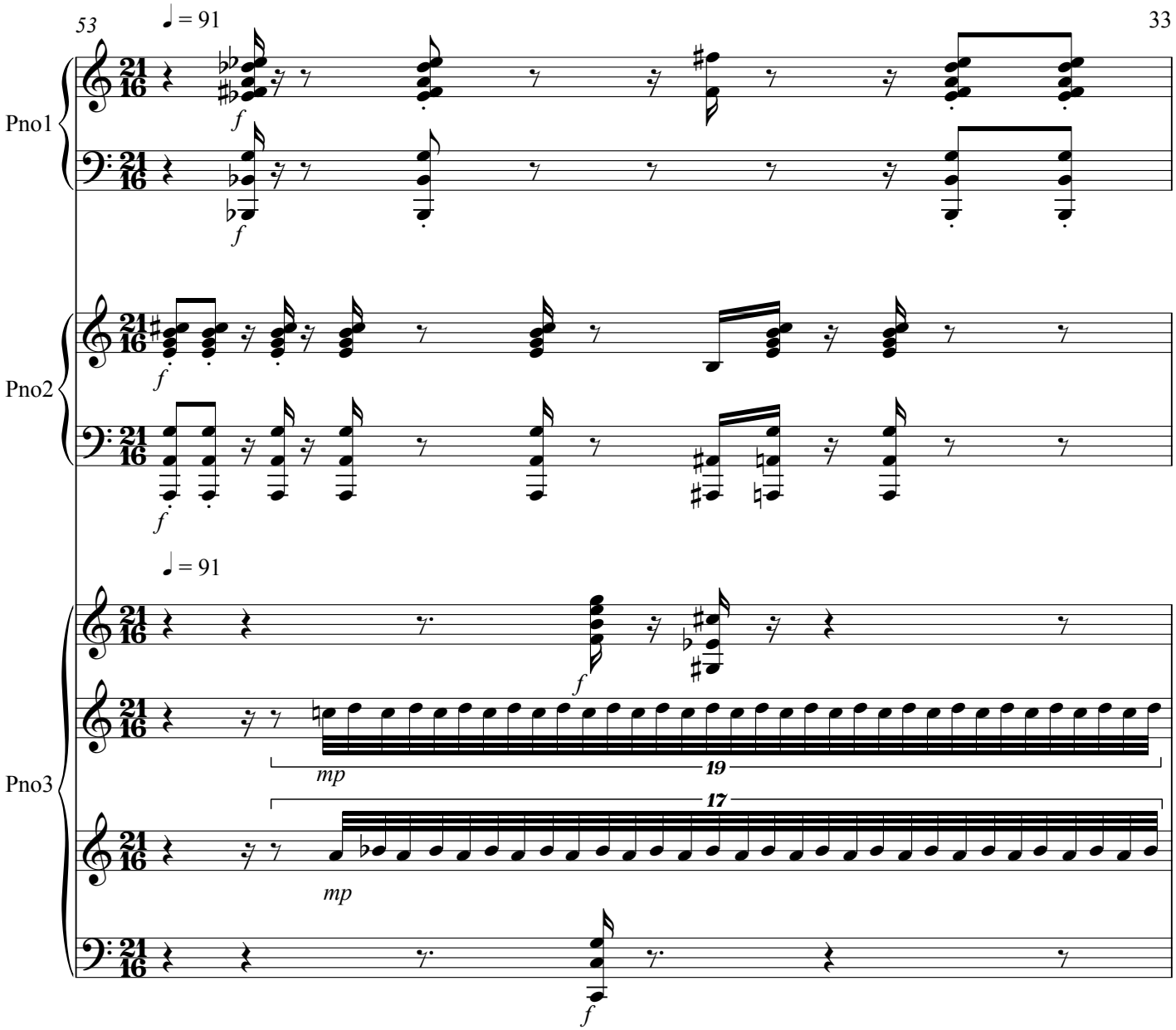

48
Pno1
f
3
Pno2
3
3:2
Pno3
3
3:2

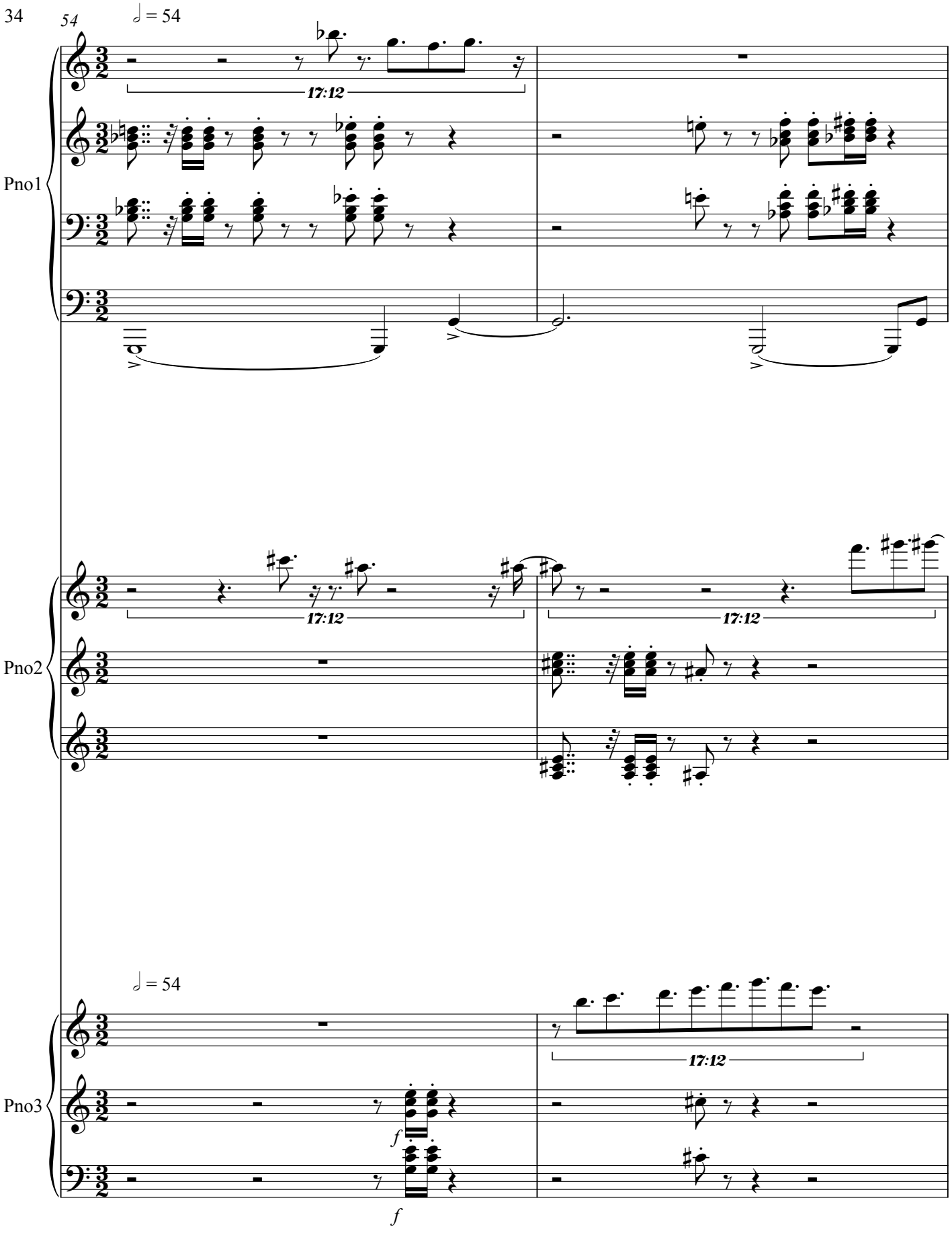

49
Pno1
f
Pno2
f
3
3:2
f
3
3:2
Pno3

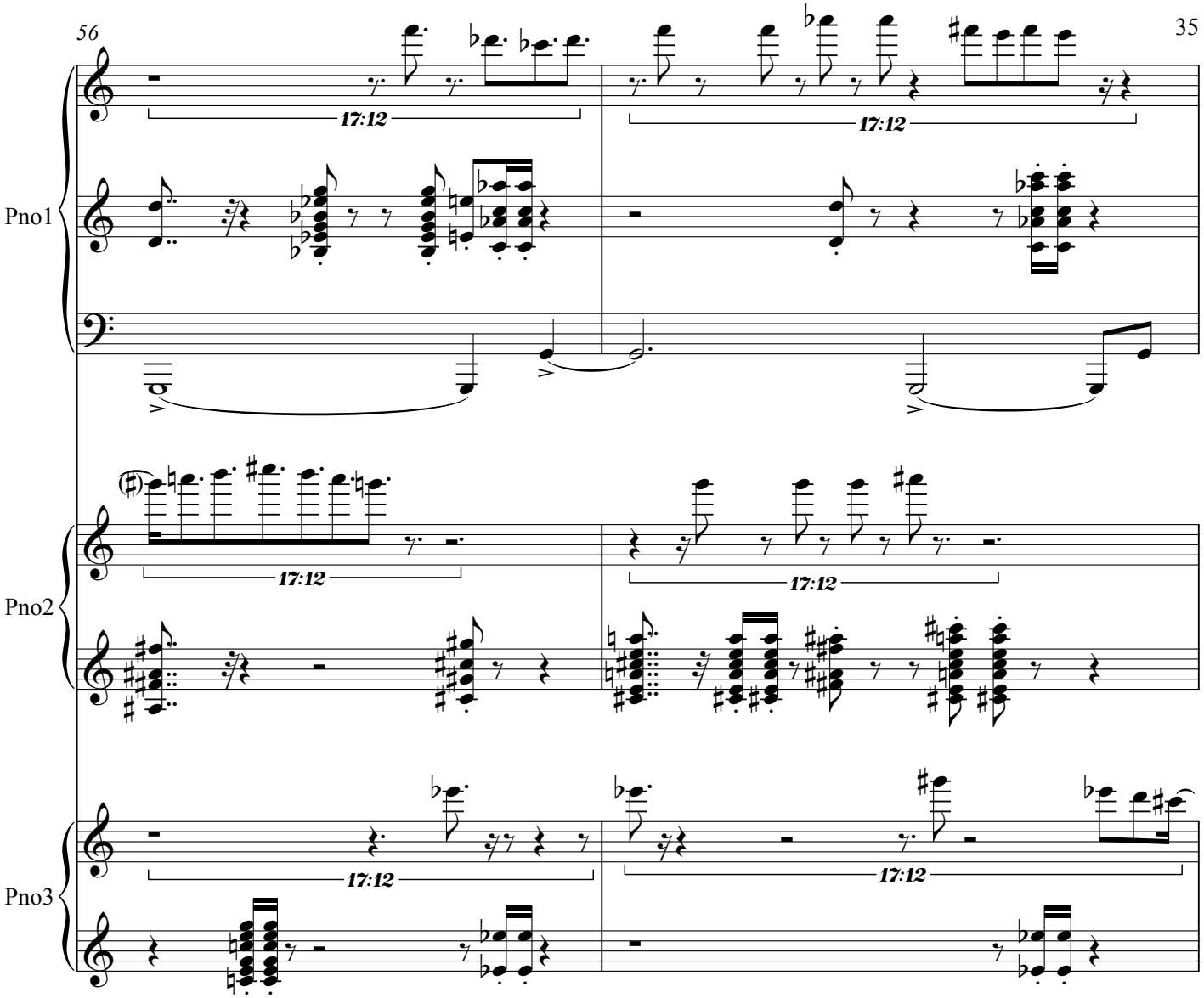

50
Pno1
Pno2
Pno3
3
3
3:2
3
3:2

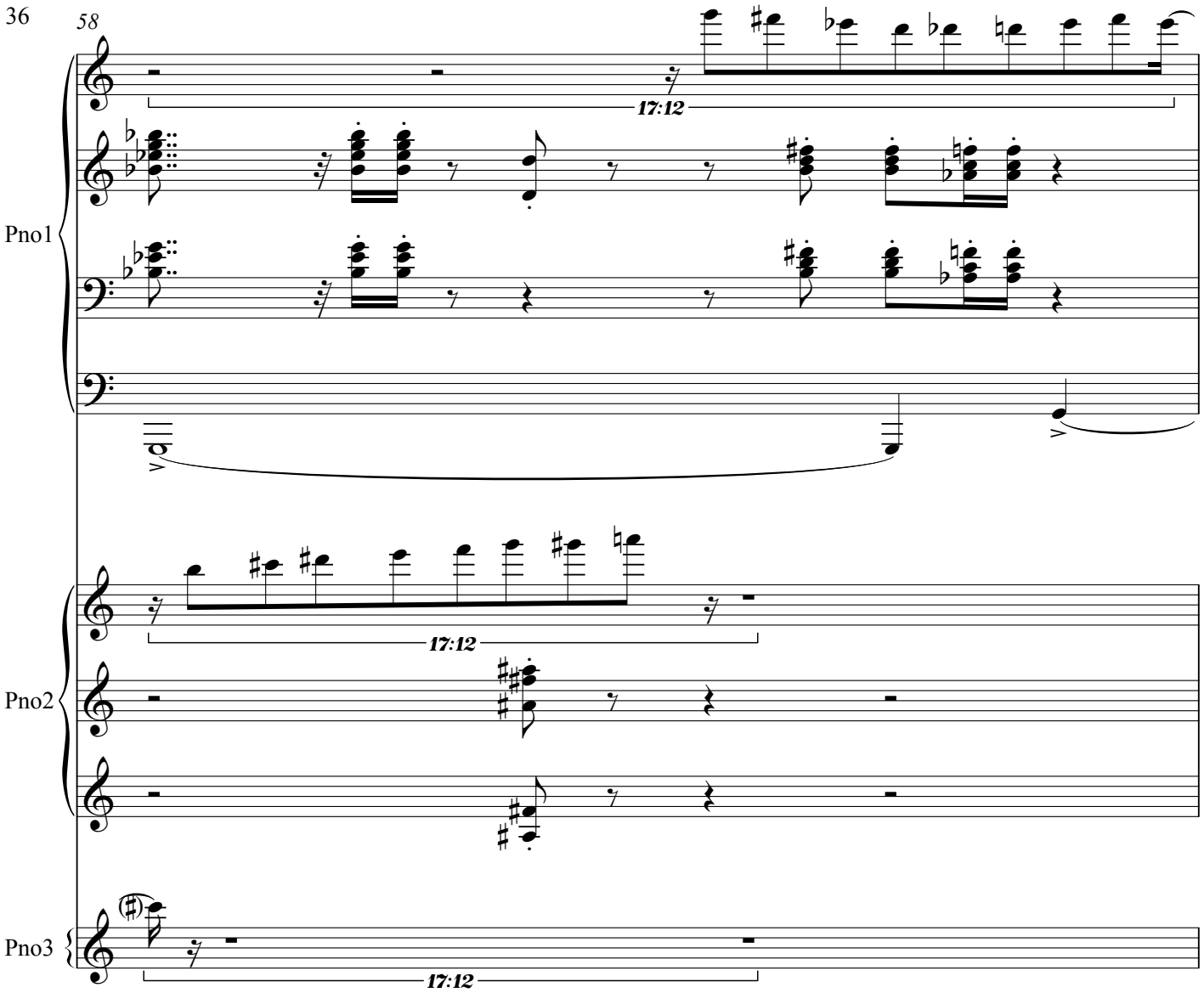

51
31
Pno1
Pno2
Pno3
3
3
3:2
3:2
3:2
3:2
f
f

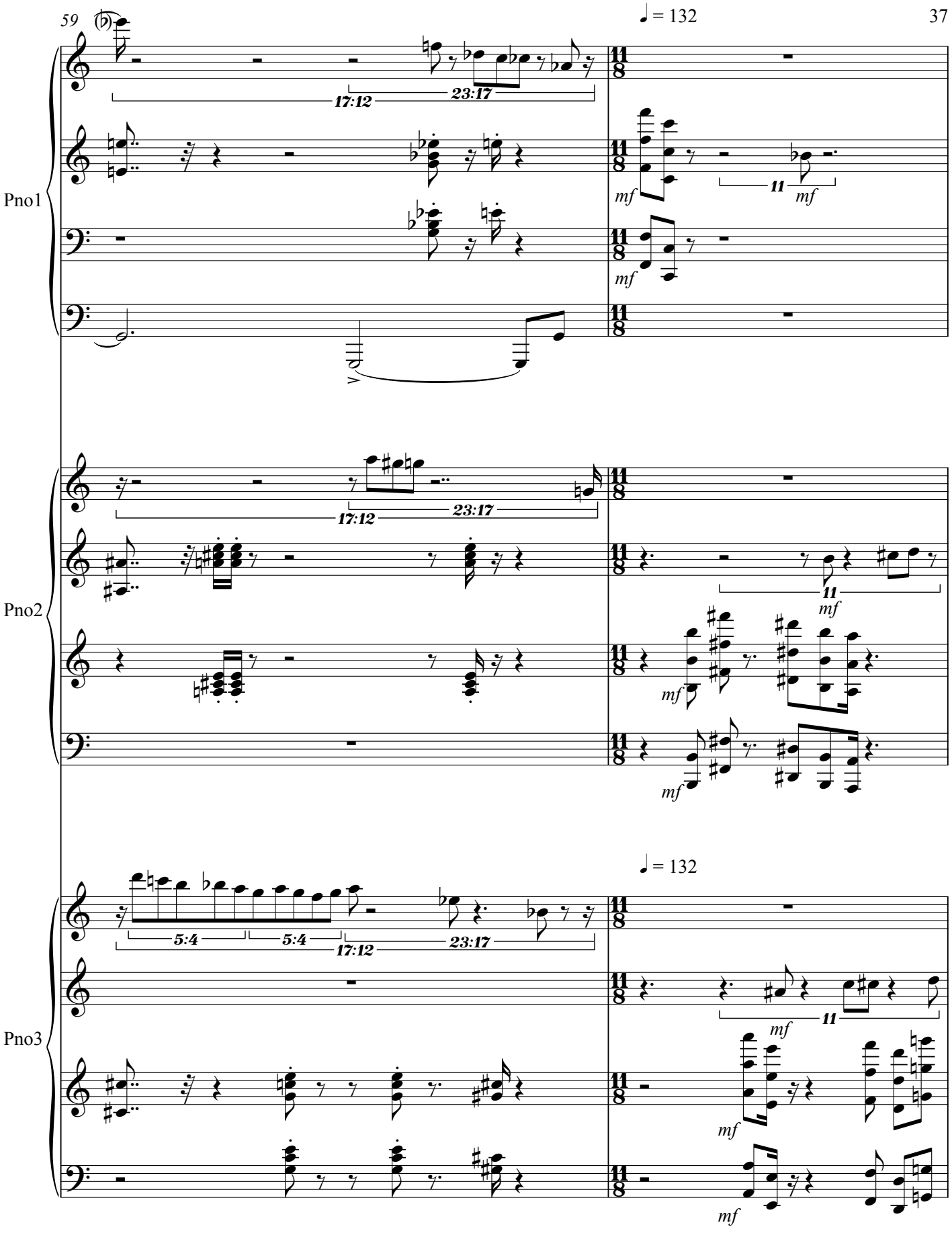

52
Pno1
Pno2
Pno3
3
3
3
3
3:2
3
3
3:2

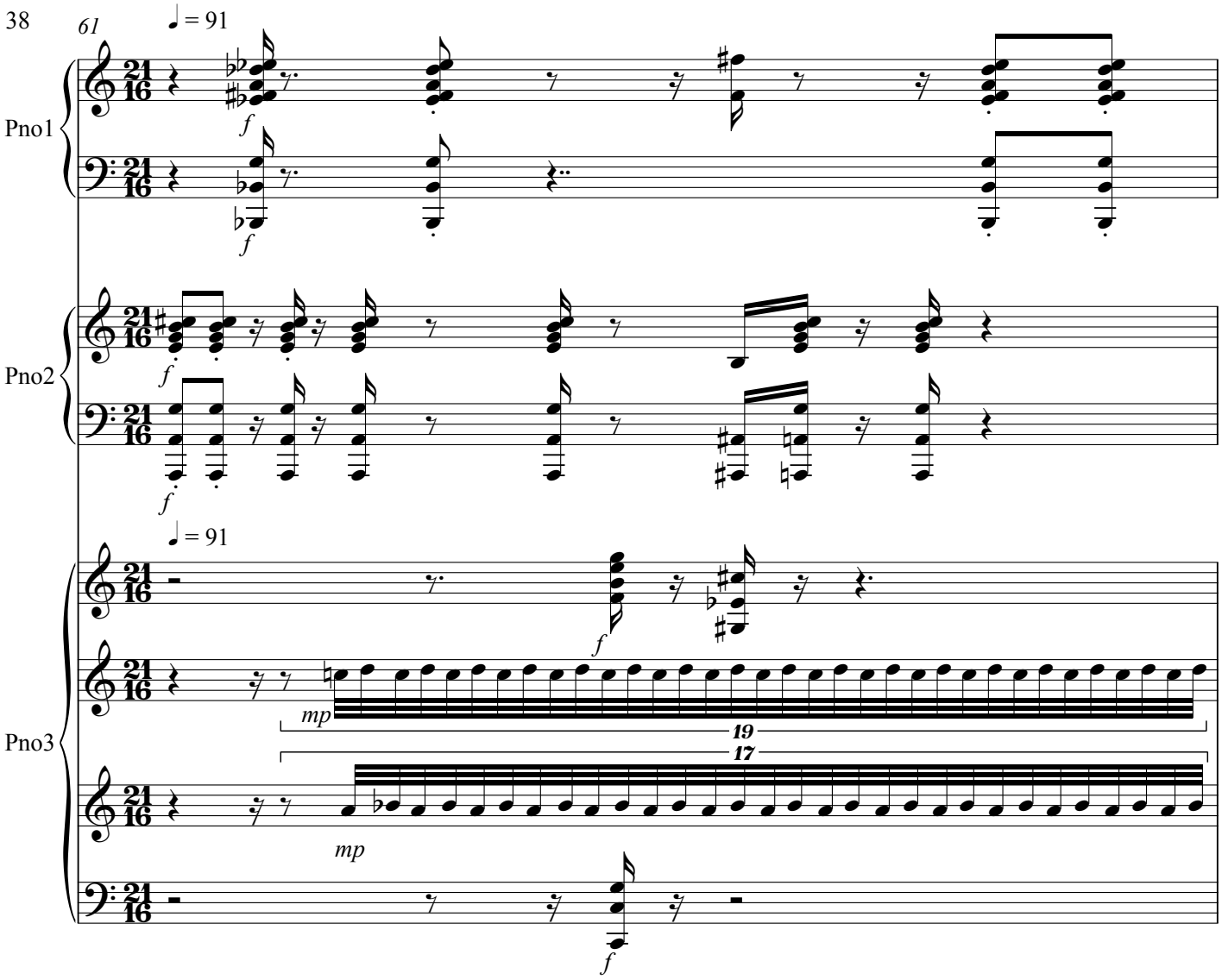

♩ = 91
33
Pno1
Pno2
Pno3
21/16
f
mp
19
17

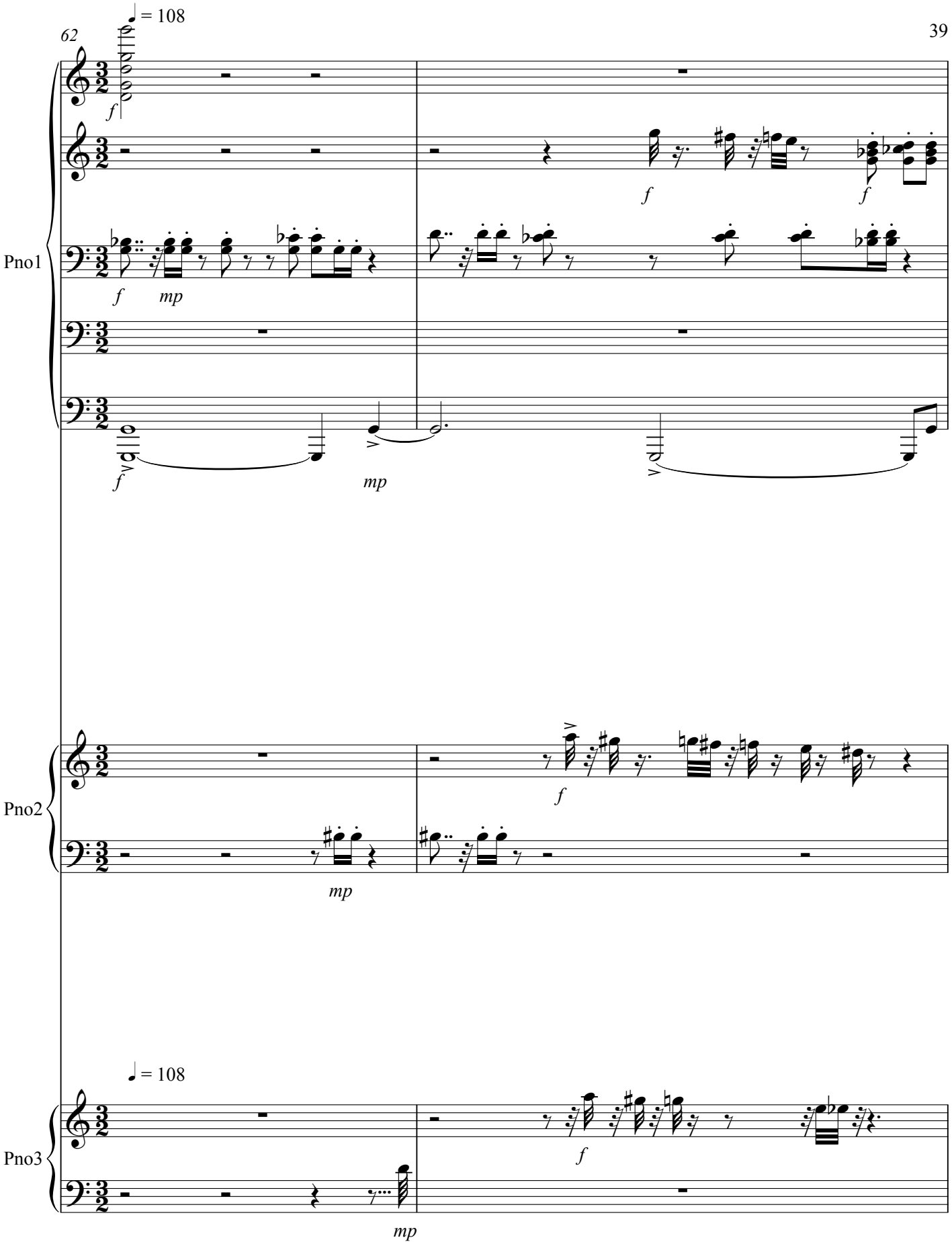

54
♩ = 54
17:12
Pno1
Pno2
Pno3
f

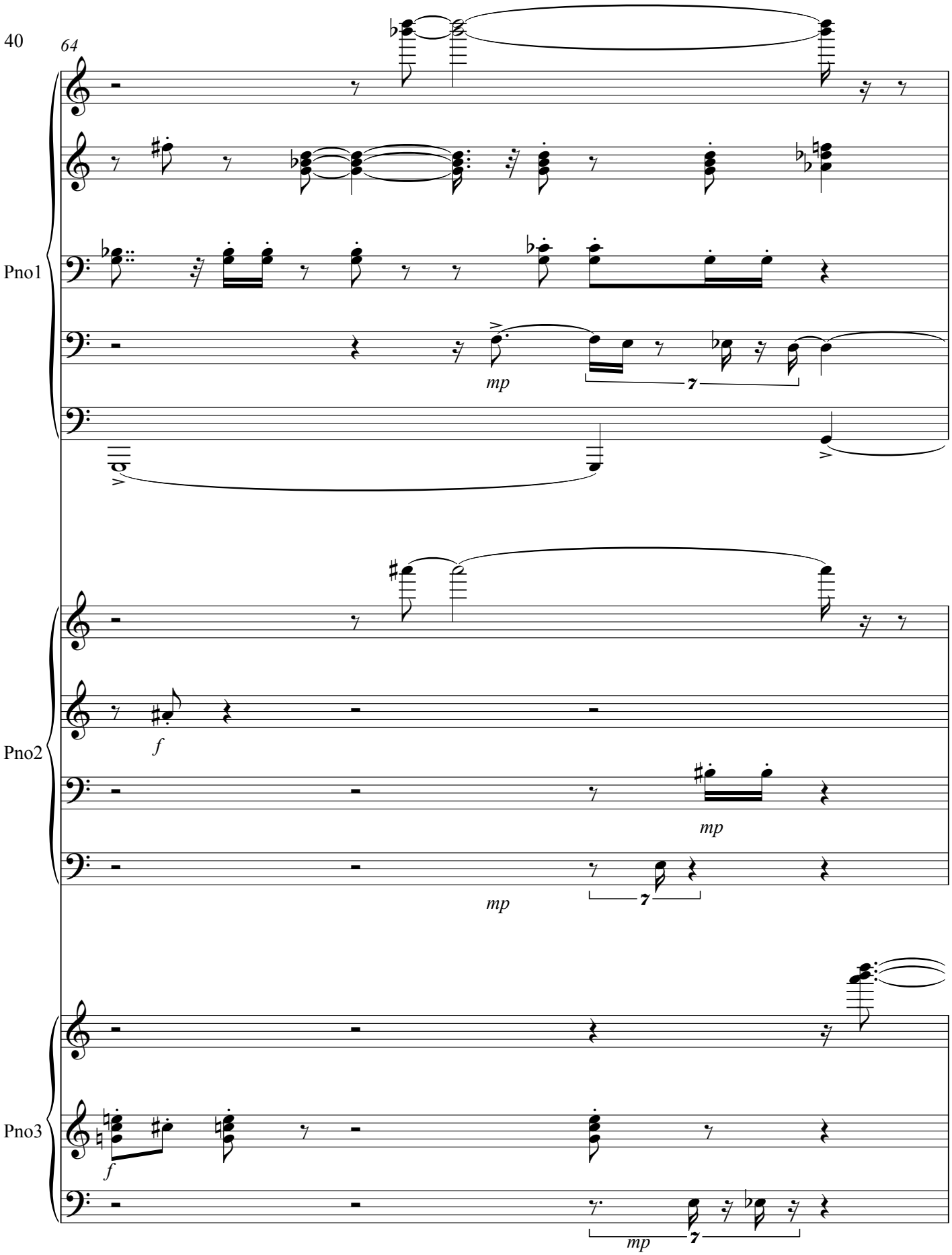

Pno1
17:12
17:12
Pno2
17:12
17:12
Pno3
17:12
17:12

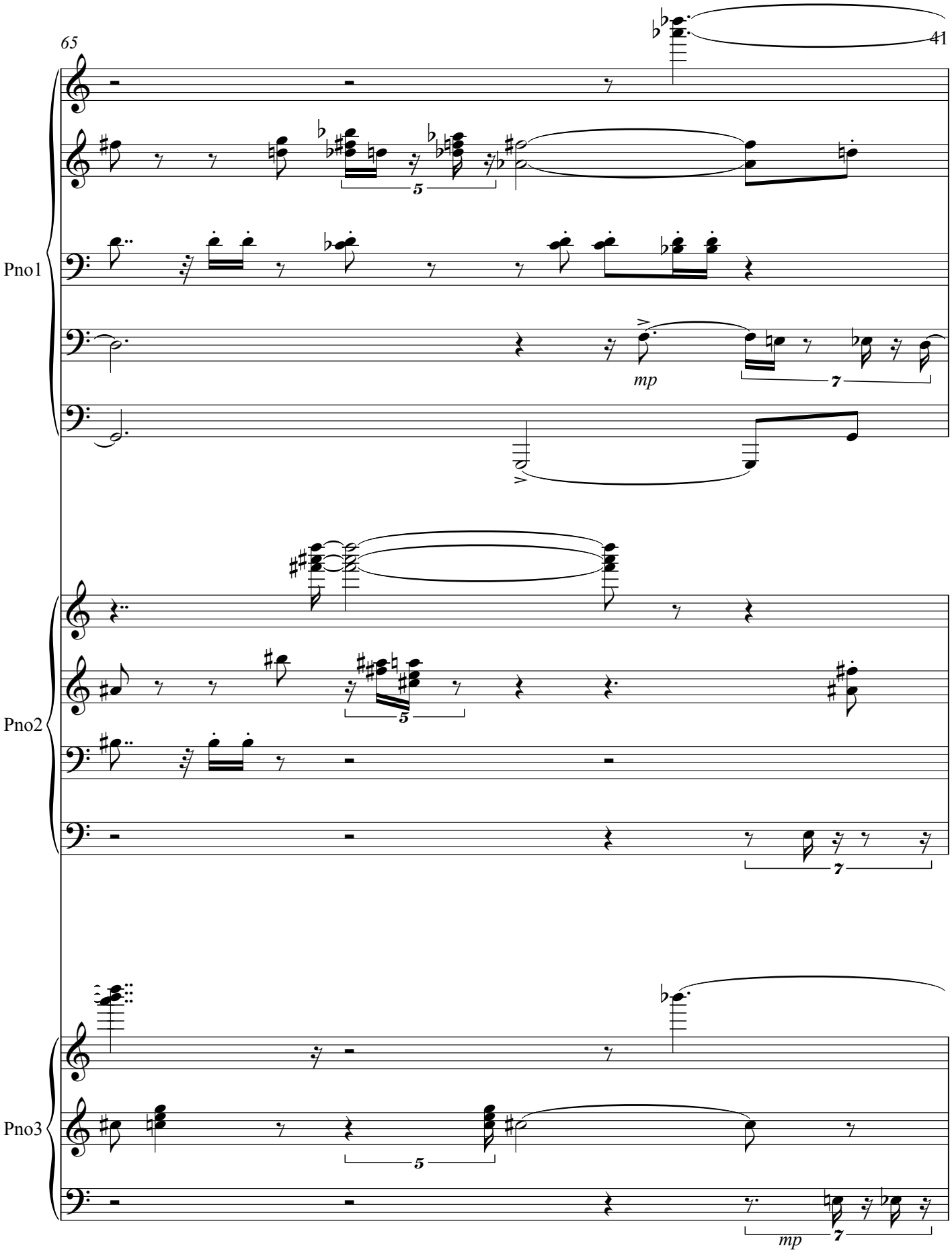

58
17:12
Pno1
17:12
Pno2
Pno3
17:12

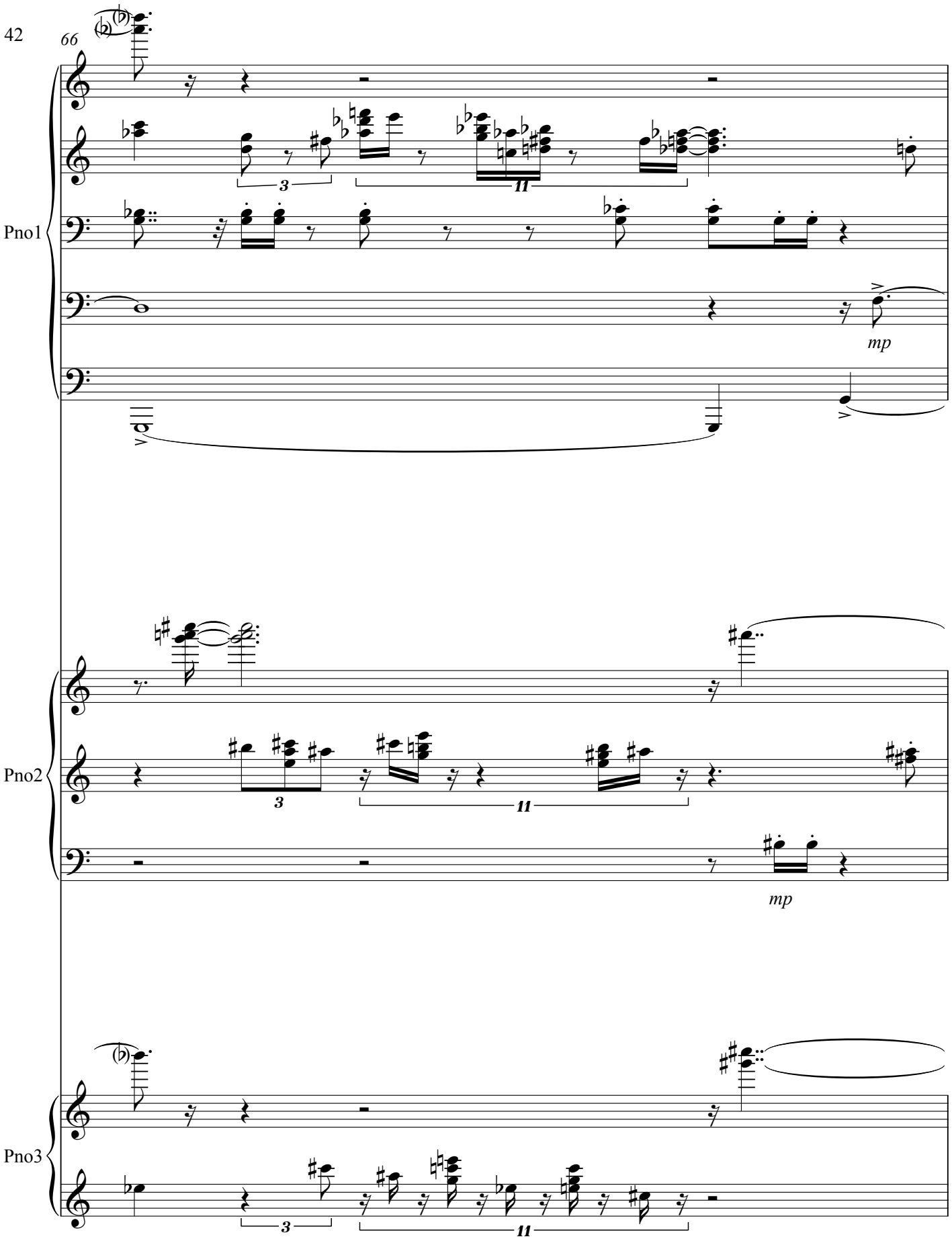

♩ = 132
17:12
23:17
11
mf
Pno1
Pno2
Pno3
5:4
5:4

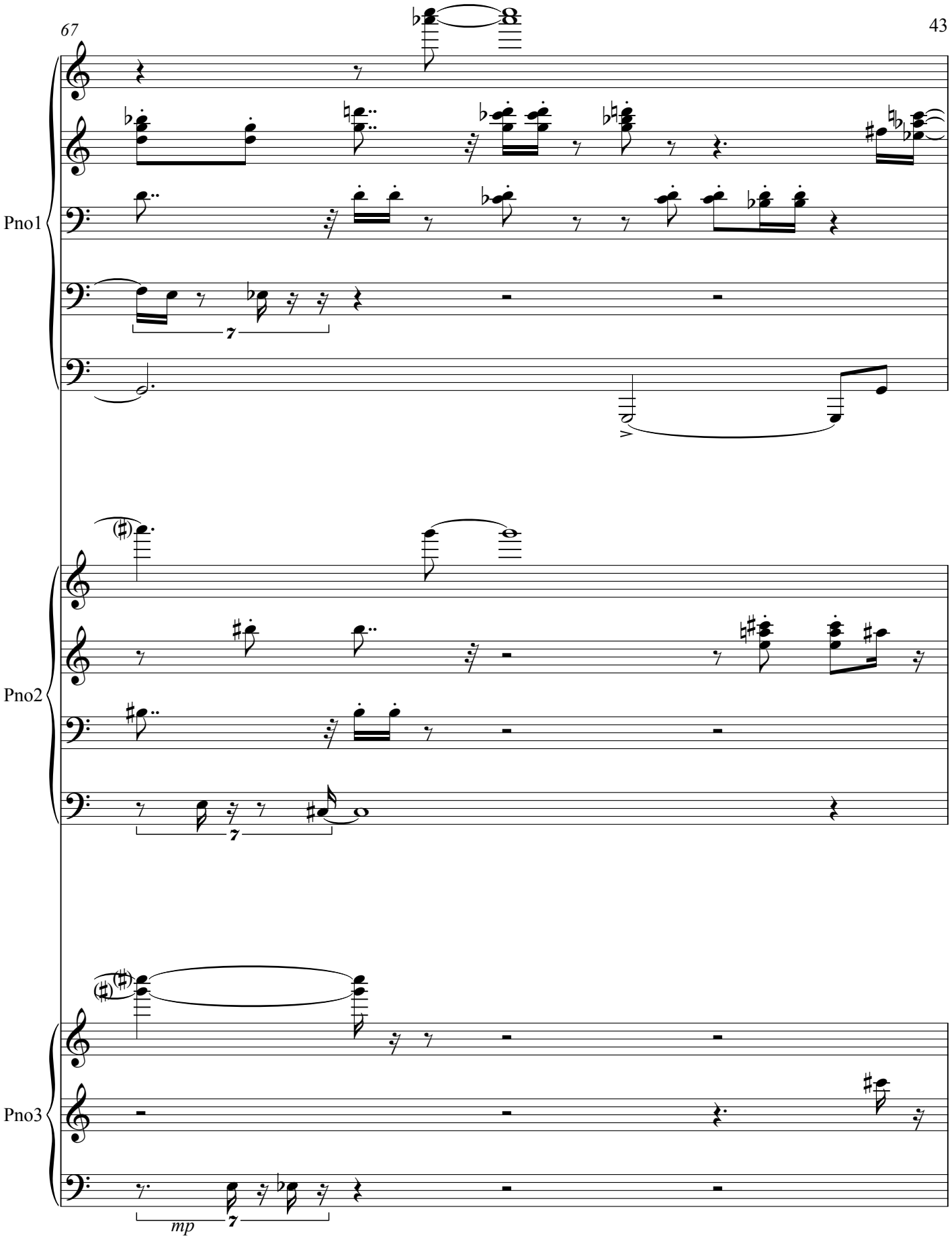

61
♩ = 91
Pno1
Pno2
Pno3
♩ = 91
19
17

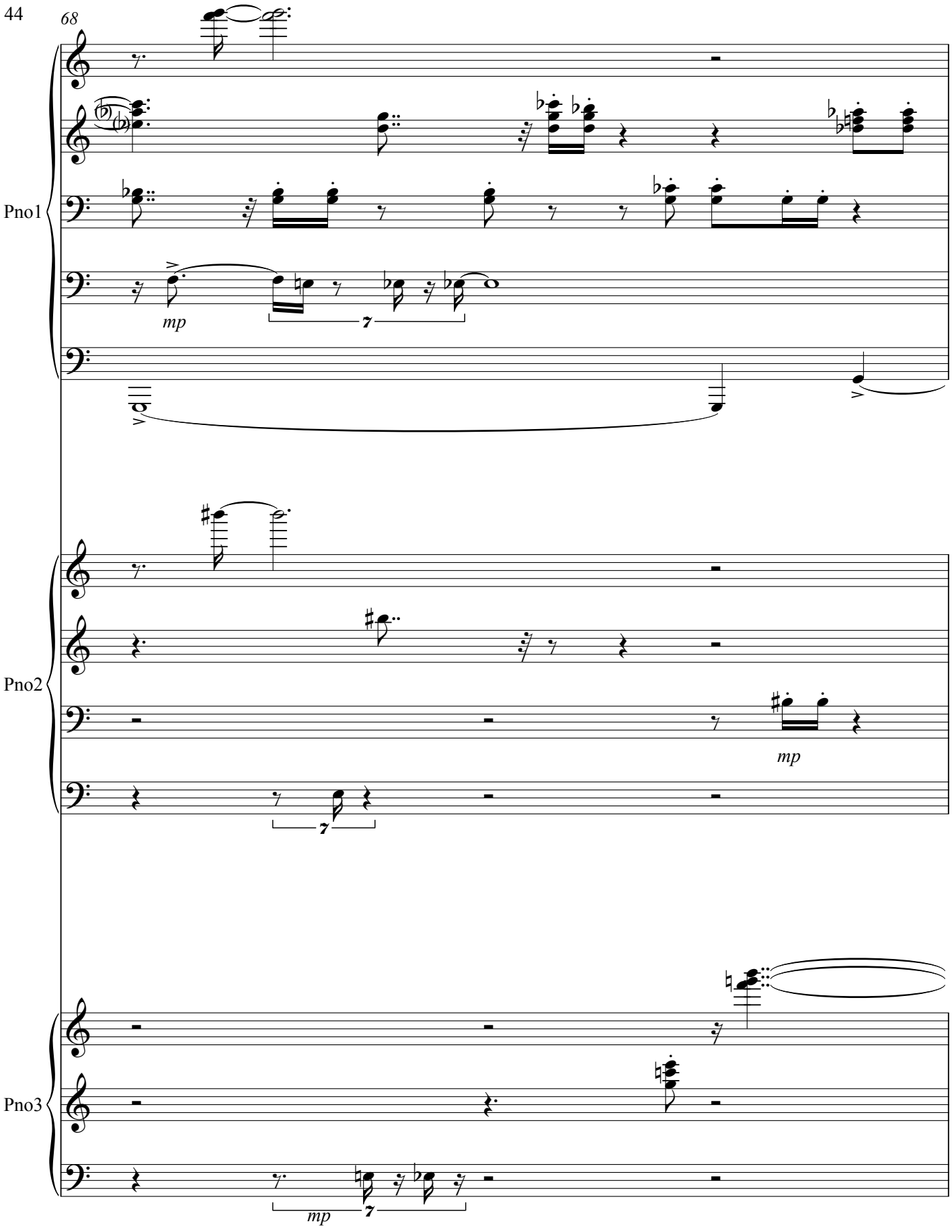

62
♩ = 108
Pno1
Pno2
Pno3
♩ = 108


64
Pno1
mp
7
Pno2
f
mp
mp
7
Pno3
f
mp
7

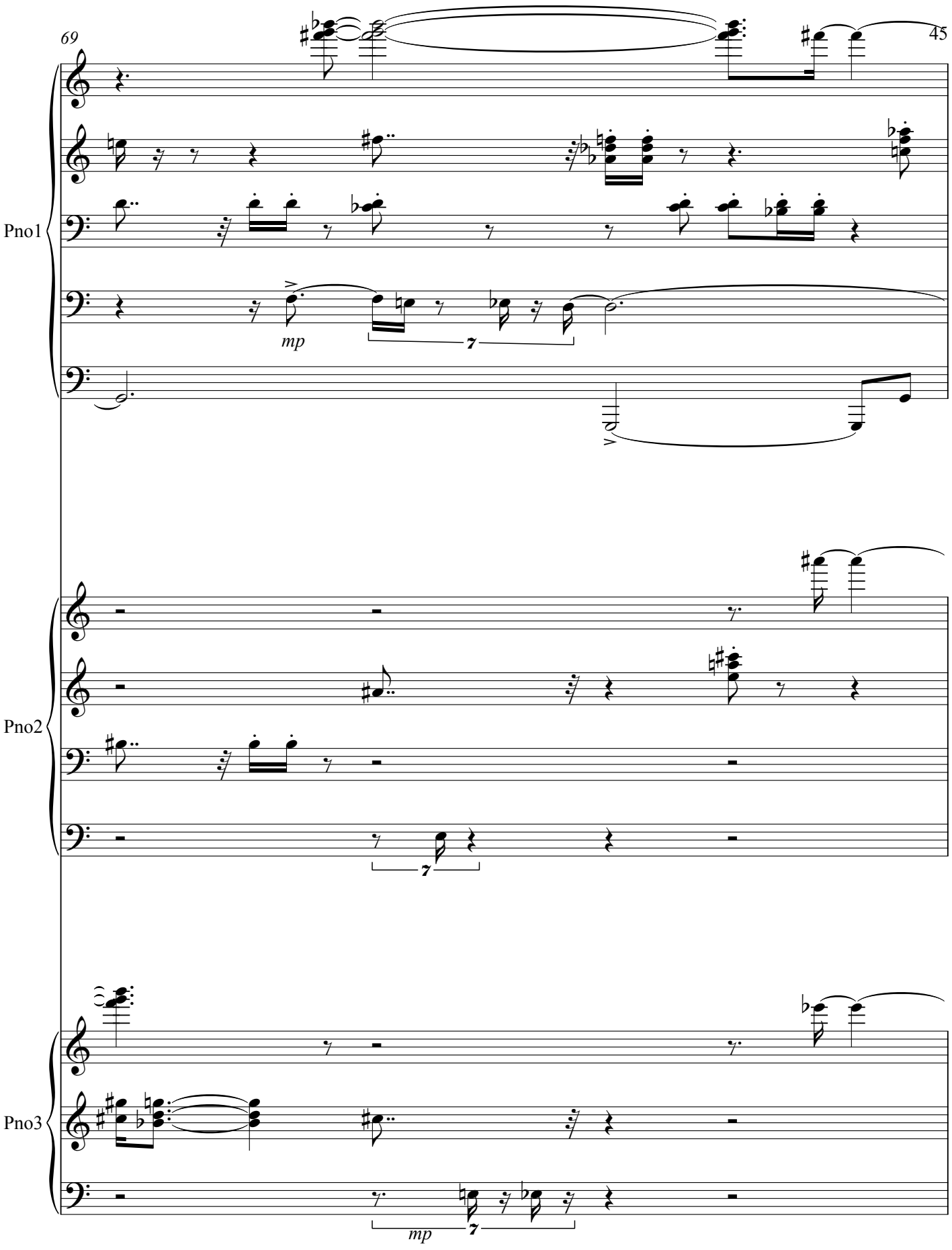

65
Pno1
mp
Pno2
Pno3
mp

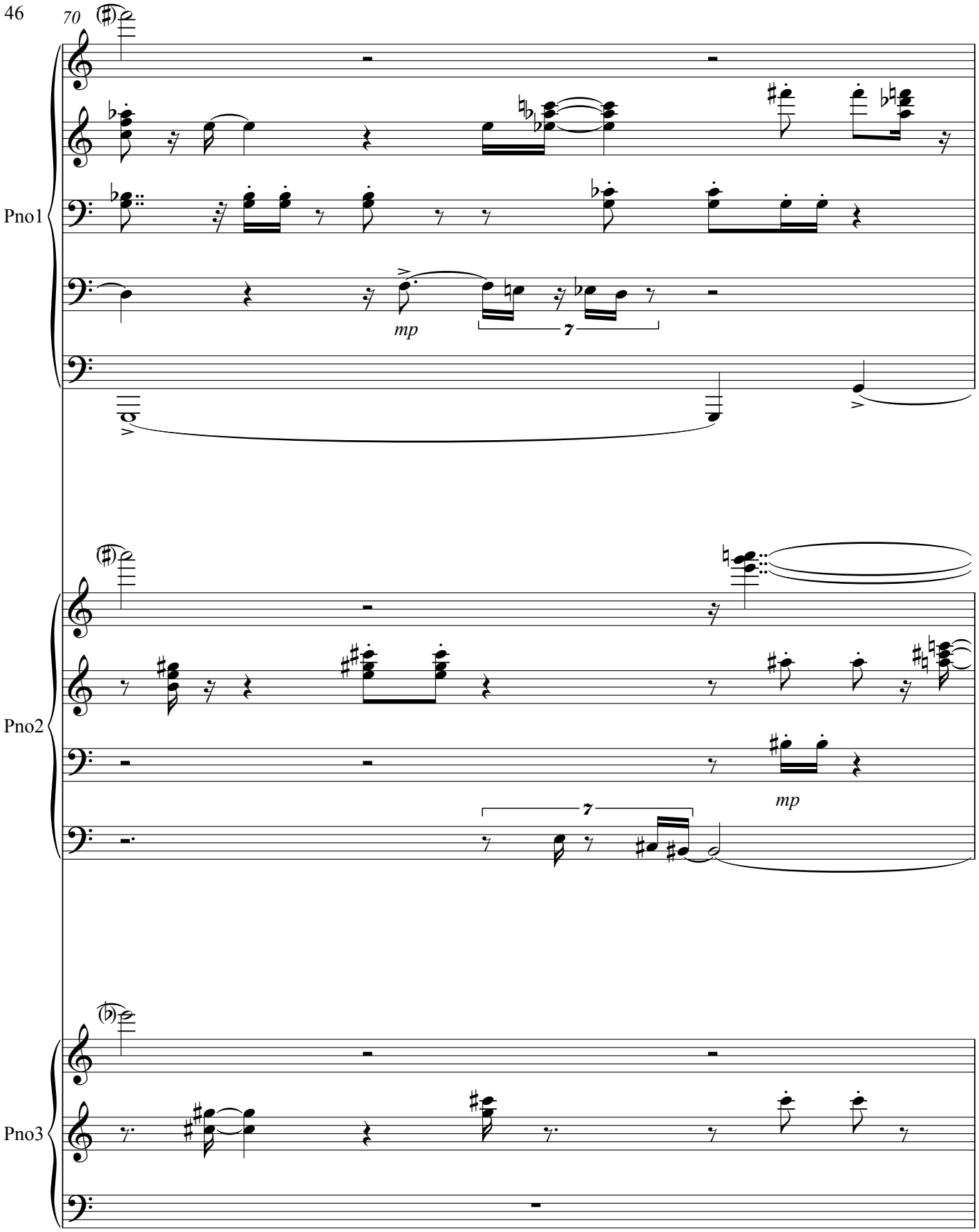

66
Pno1
mp
Pno2
mp
Pno3


67
Pno1
Pno2
Pno3
7
7
mp
7


68
Pno1
mp
7
Pno2
mp
7
Pno3
mp
7

69




70
Pno1
mp
7
Pno2
mp
7
Pno3

71

Pno1

mp

7

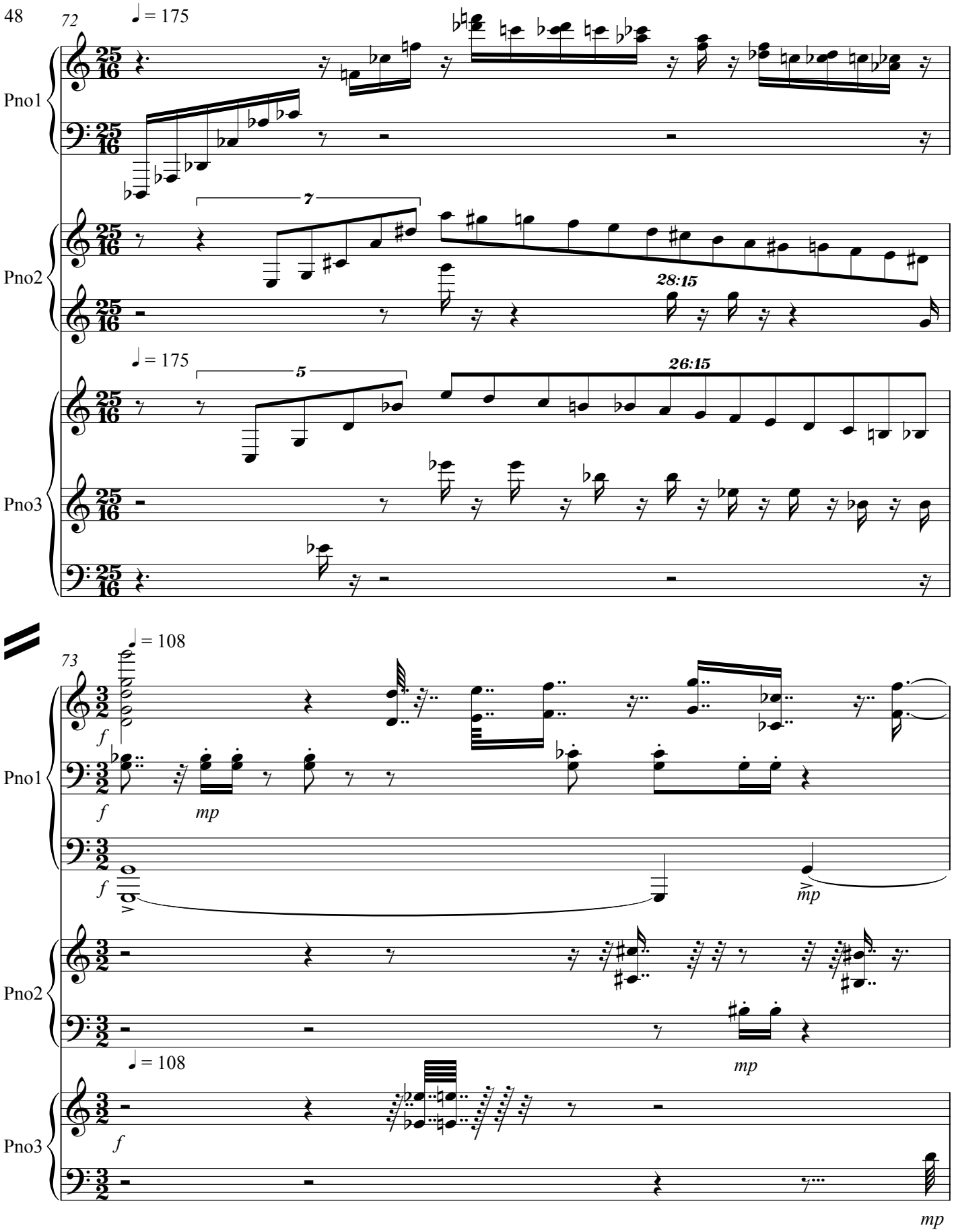
Pno2

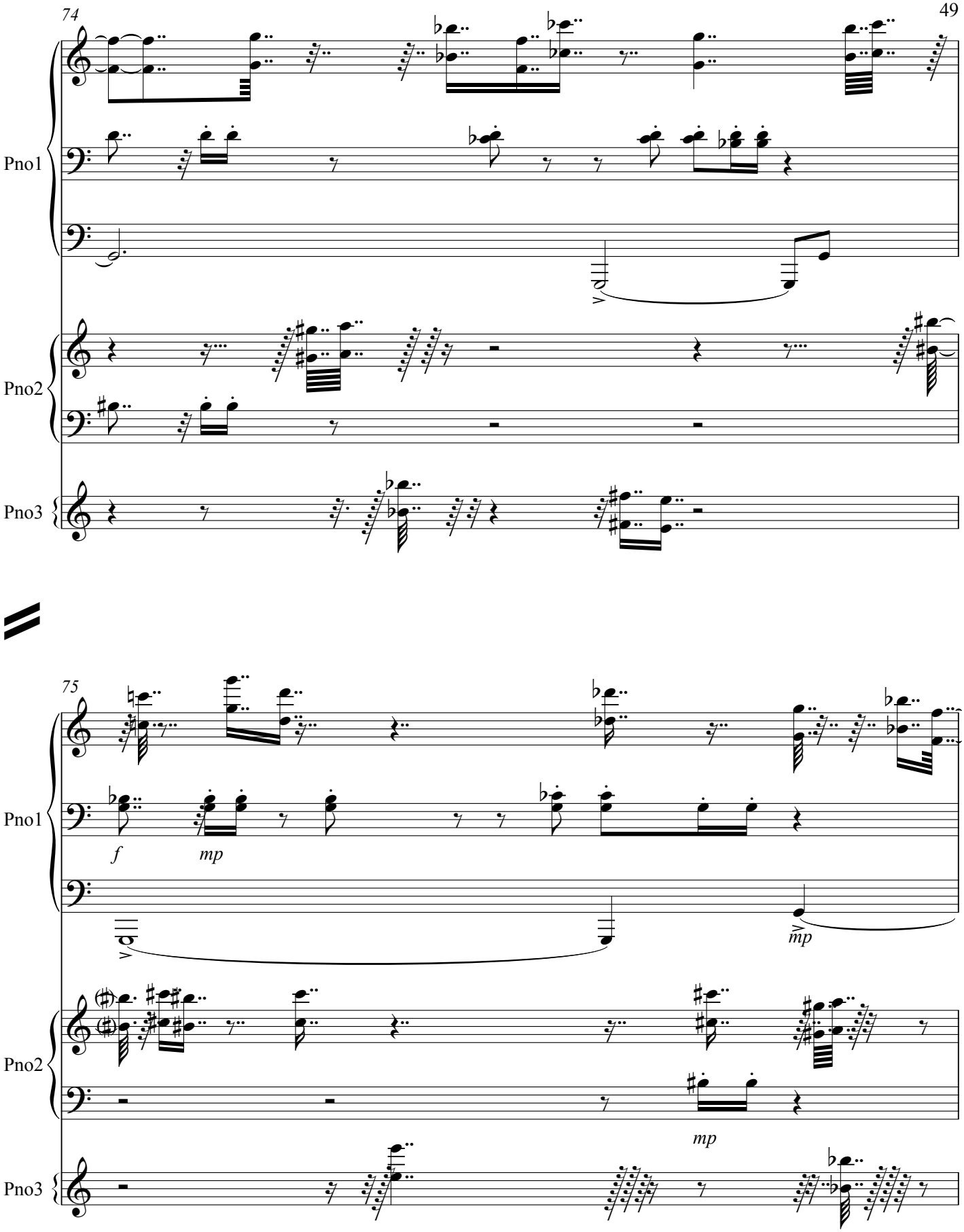
7

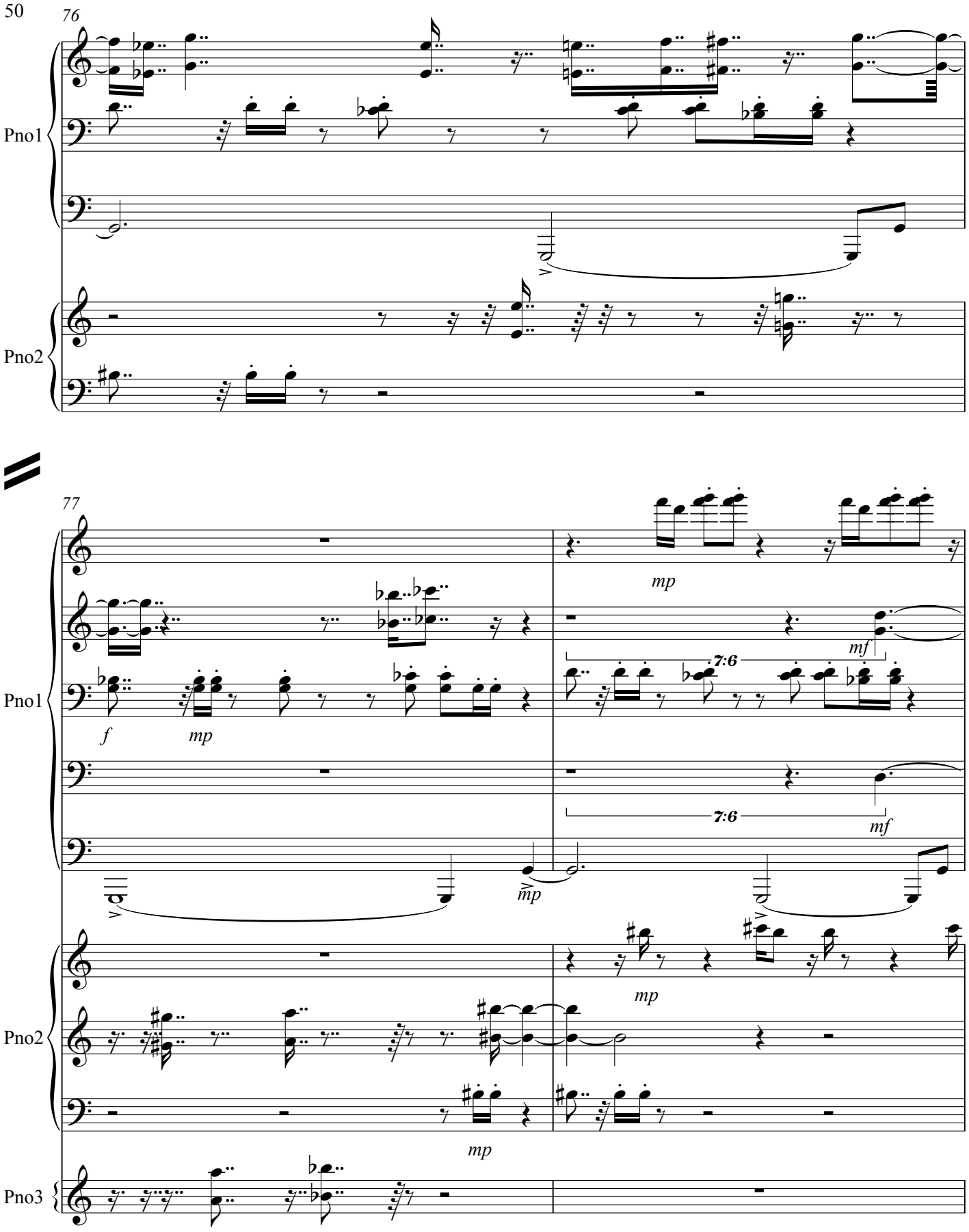
Pno3

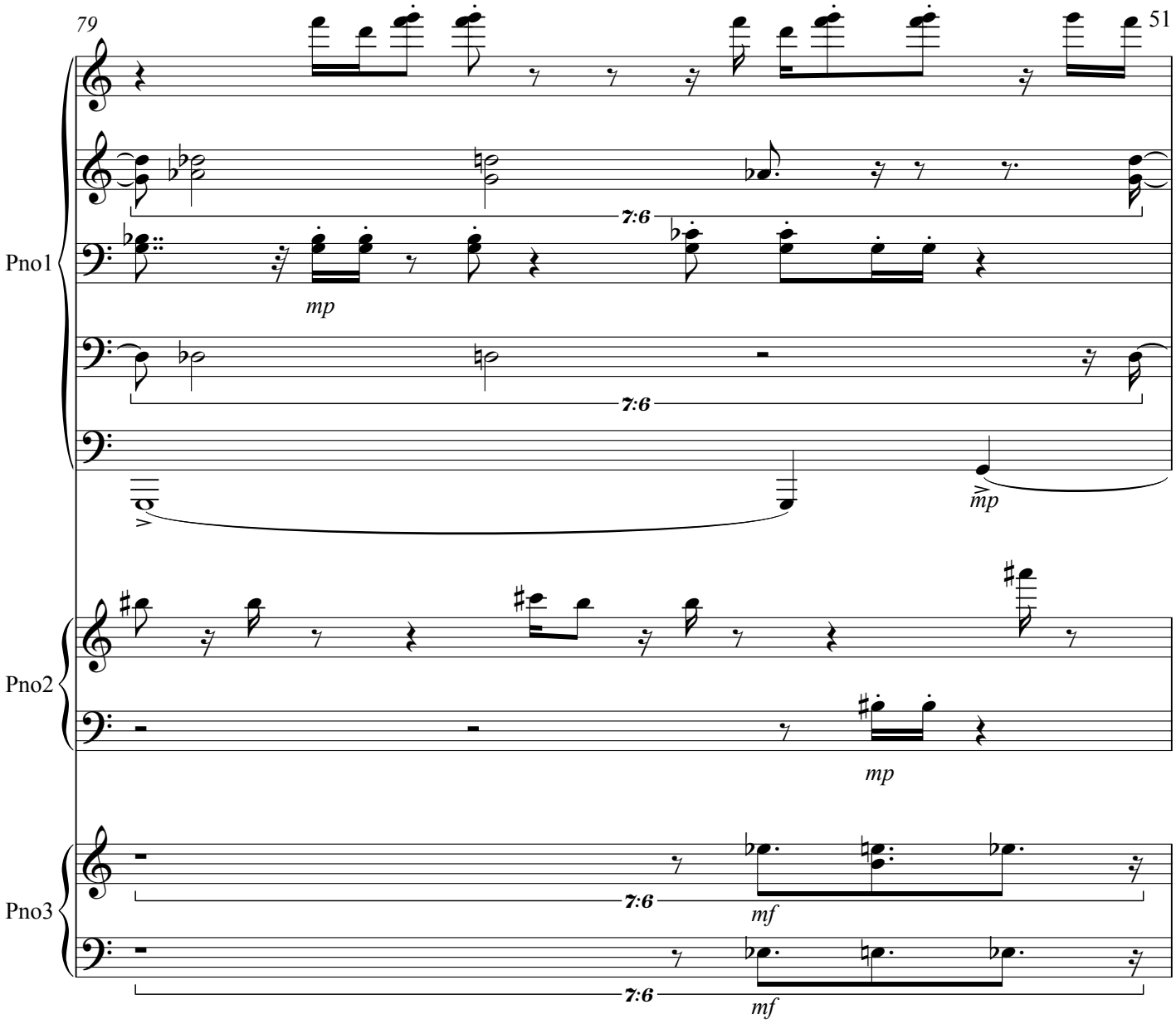
mp

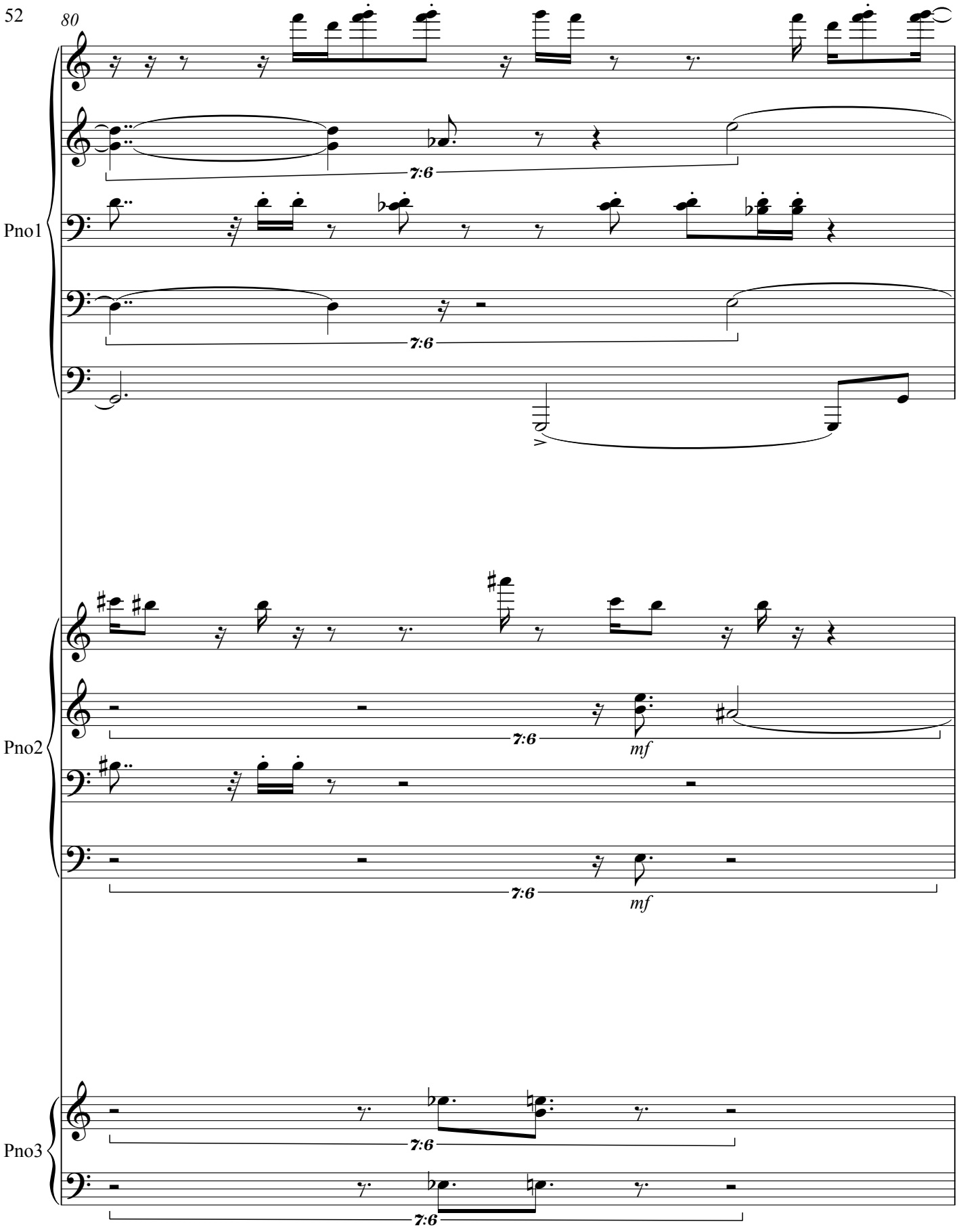
7

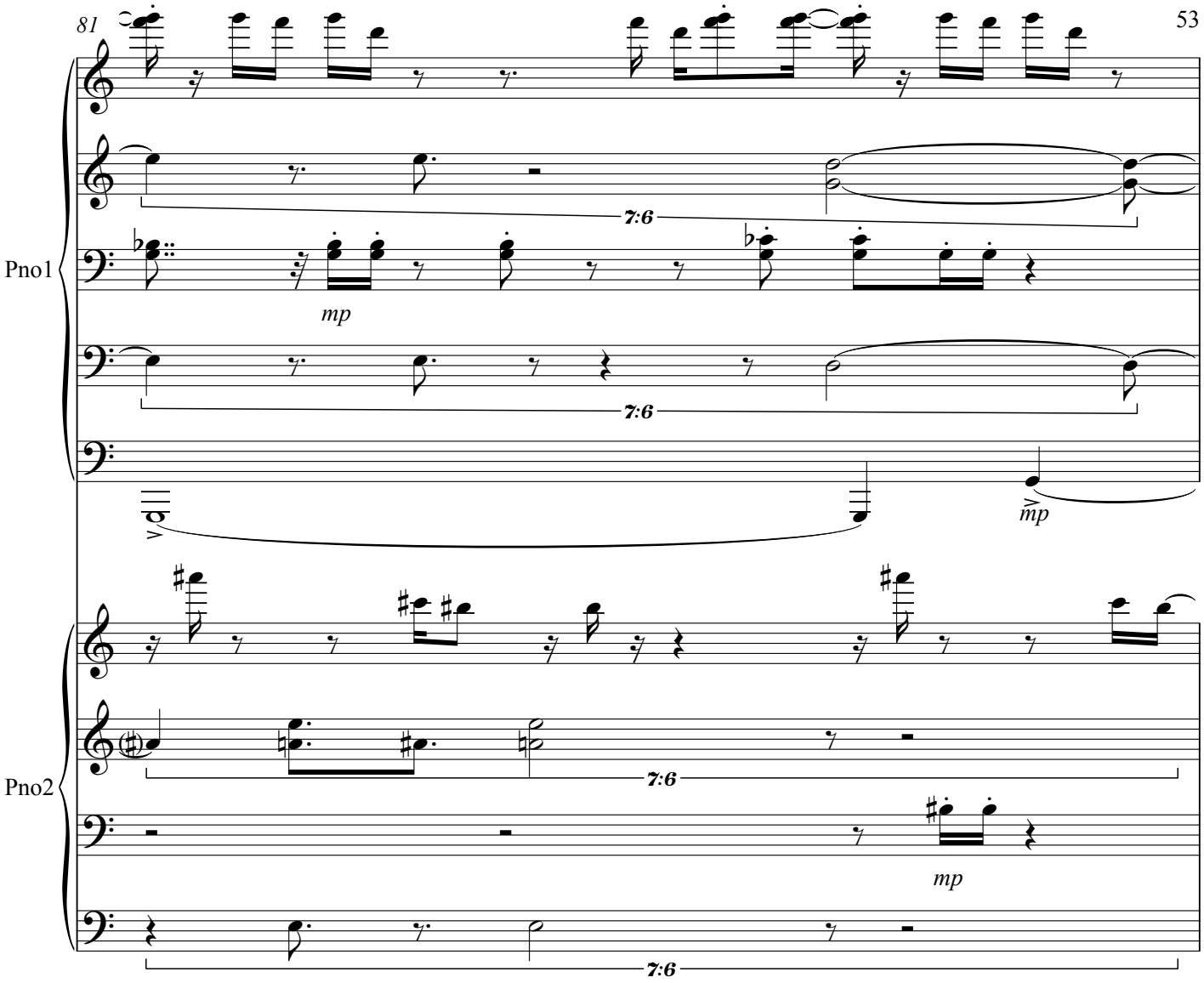

72
♩ = 175
Pno1
Pno2
Pno3
7
28:15
♩ = 175
5
26:15
73
♩ = 108
f
mp
♩ = 108
f
mp
mp

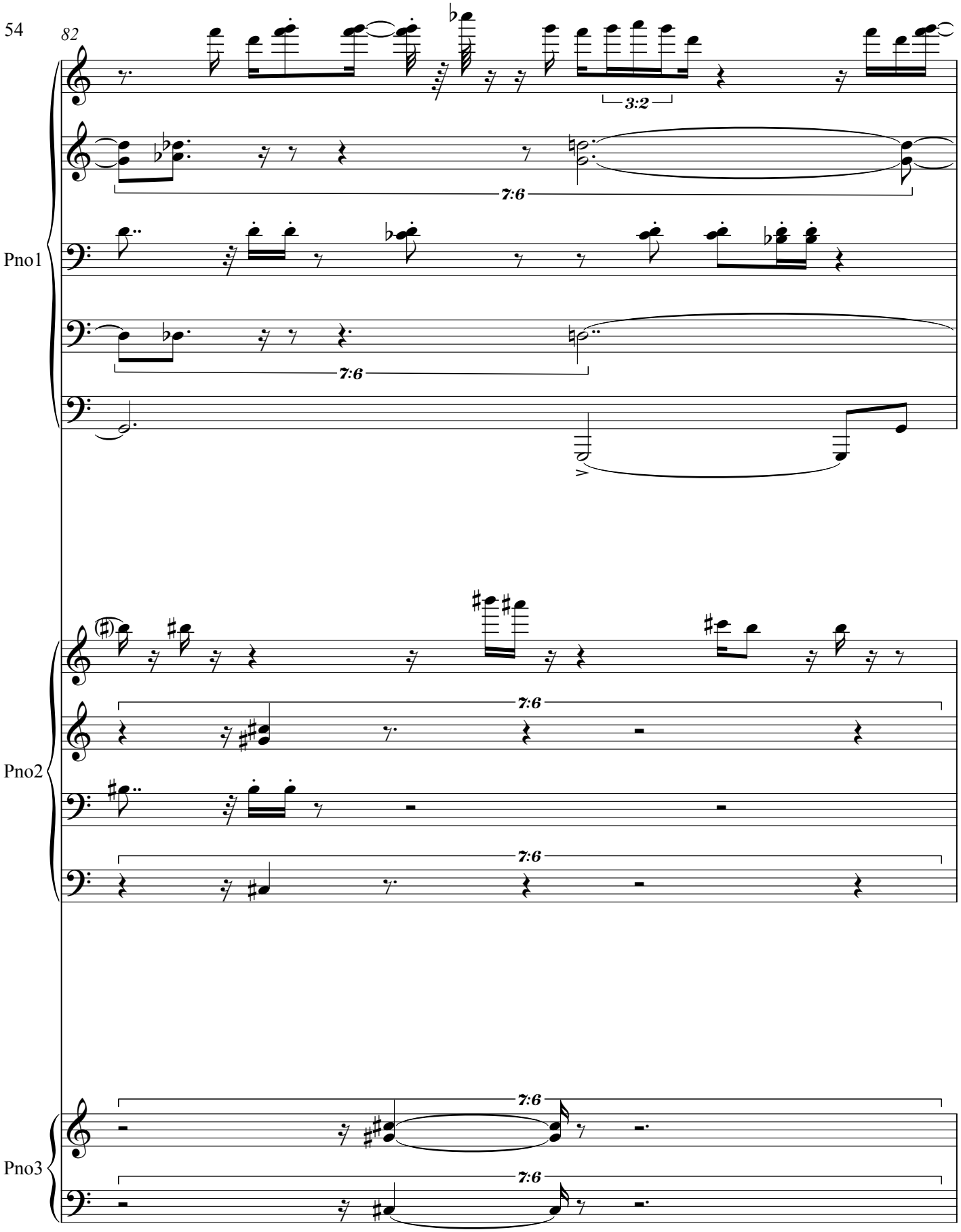

74
Pno1
Pno2
Pno3
75
Pno1
f
mp
mp
Pno2
mp
Pno3

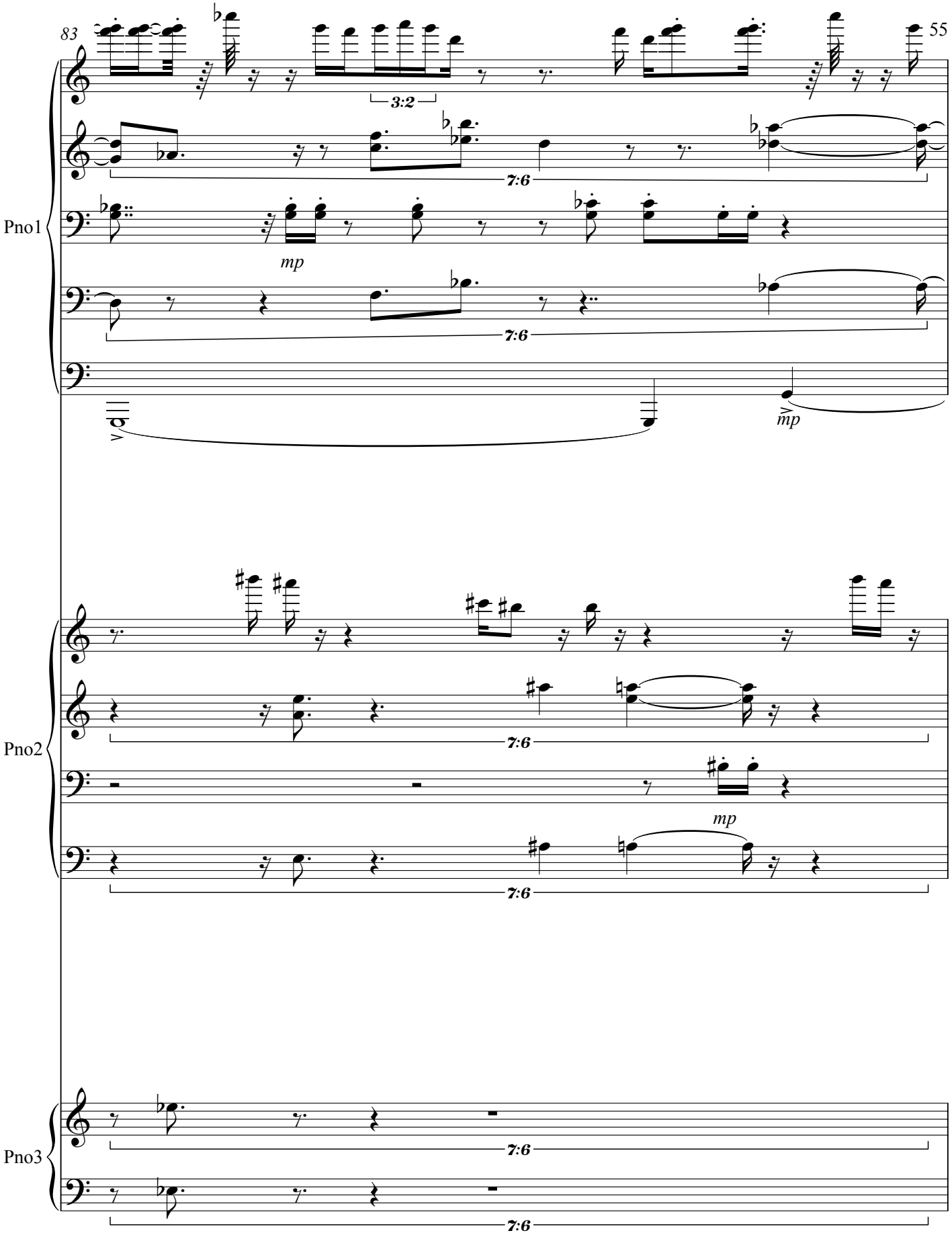

76
Pno1
Pno2
77
Pno1
Pno2
Pno3
f
mp
mf
7:6
mp

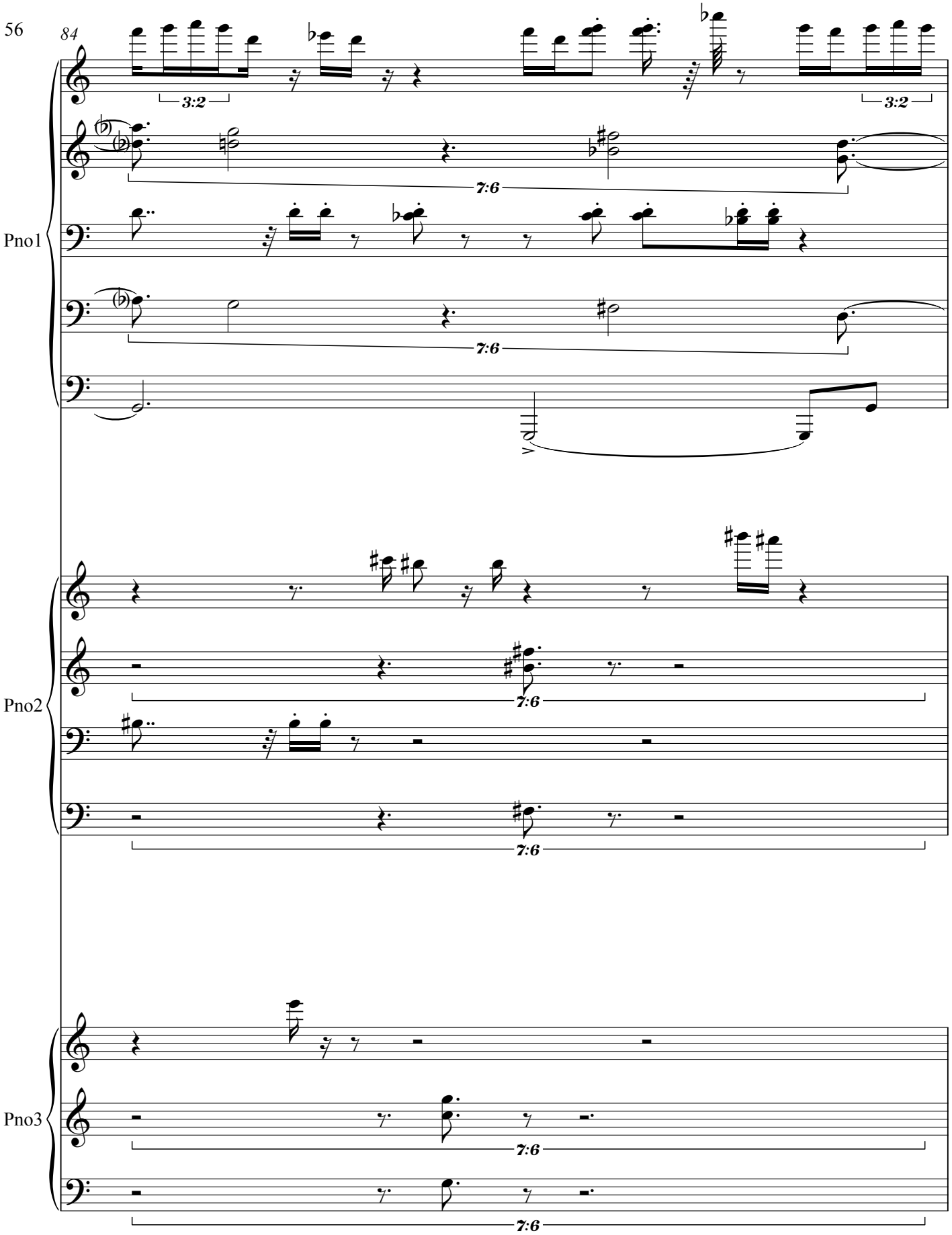

Pno1
7:6
mp
7:6
mp
Pno2
mp
Pno3
7:6
mf
7:6
mf

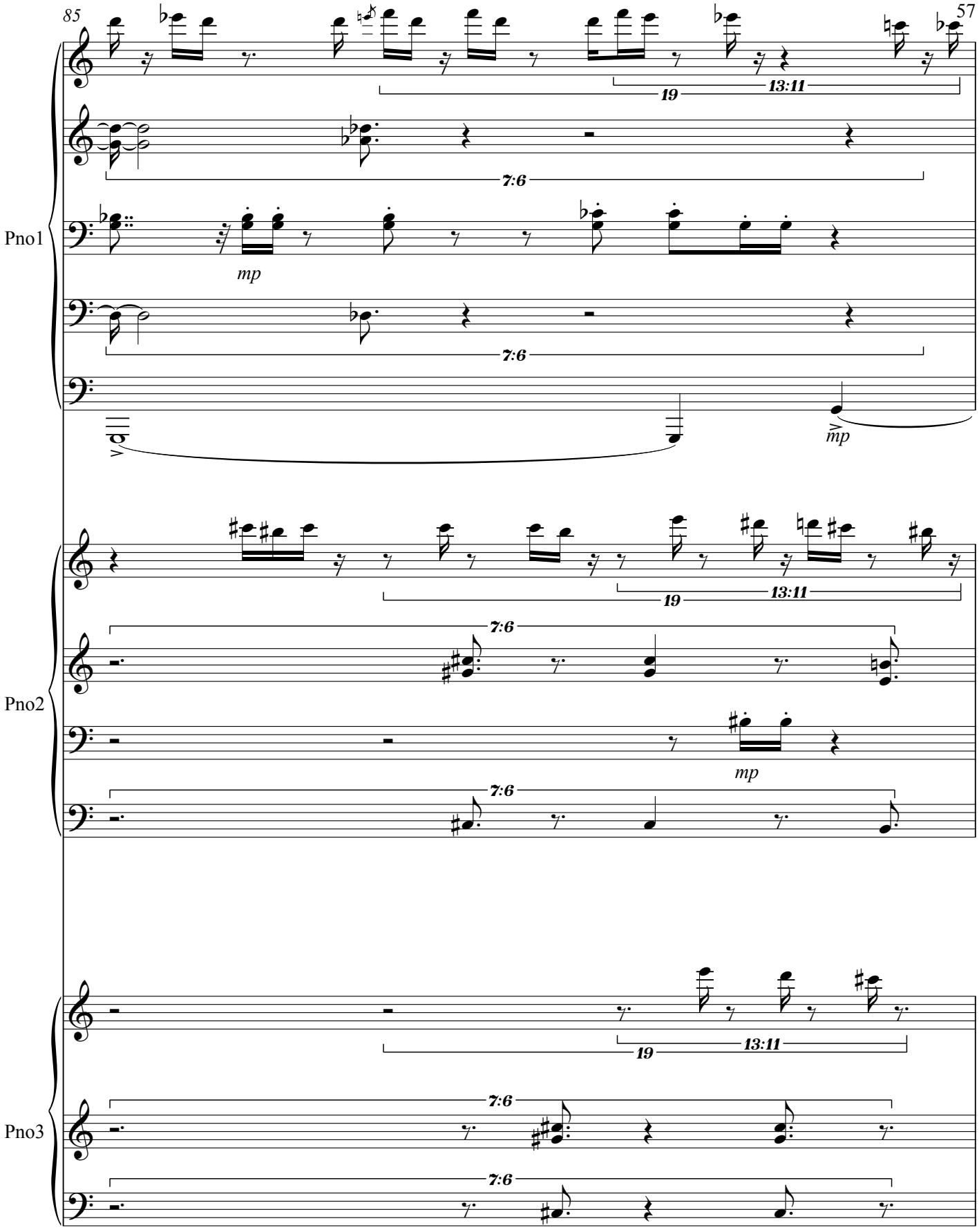

80
Pno1
7:6
7:6
Pno2
7:6
mf
7:6
mf
Pno3
7:6
7:6

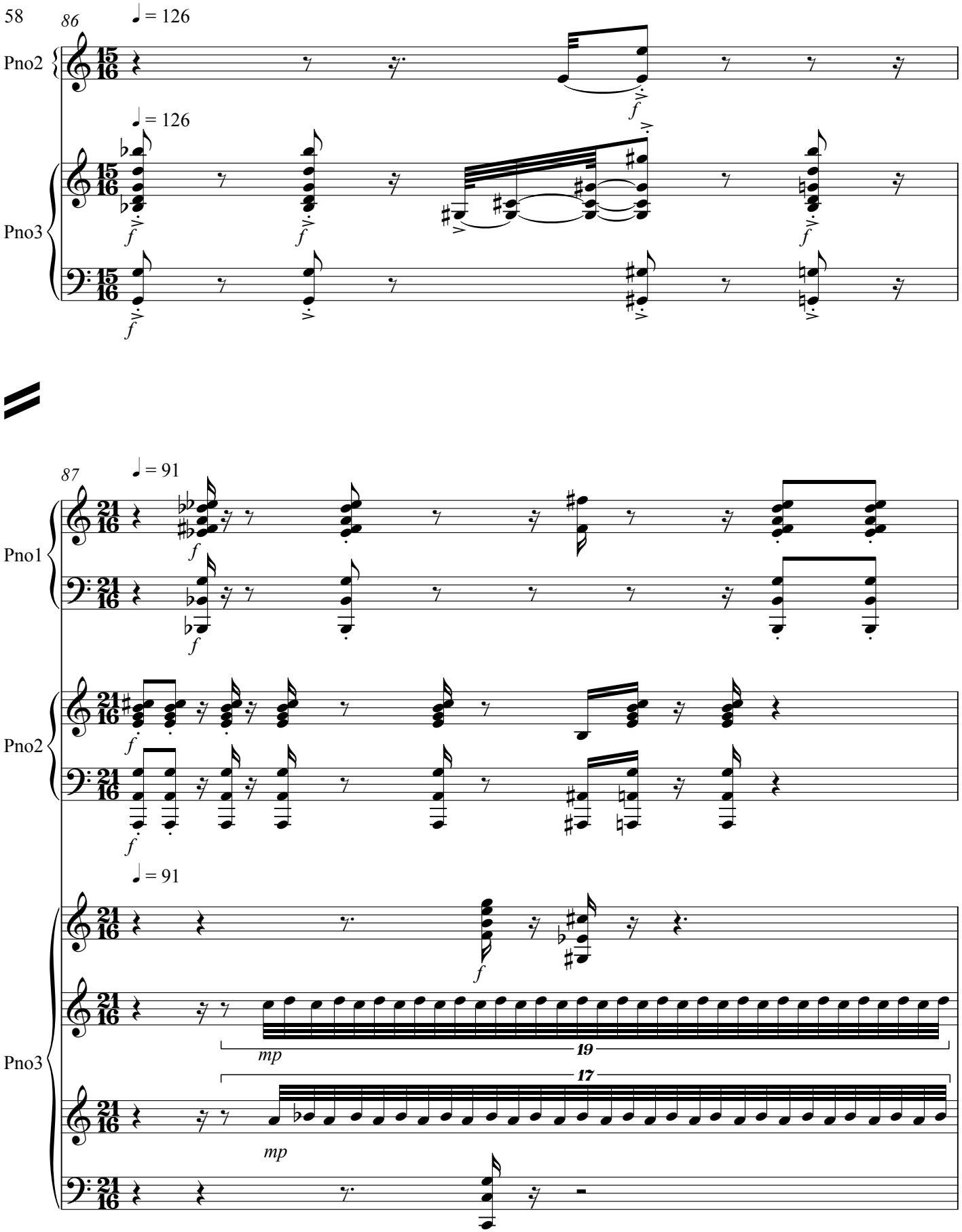

81
Pno1
Pno2
7:6
mp
7:6
mp
7:6
mp
7:6

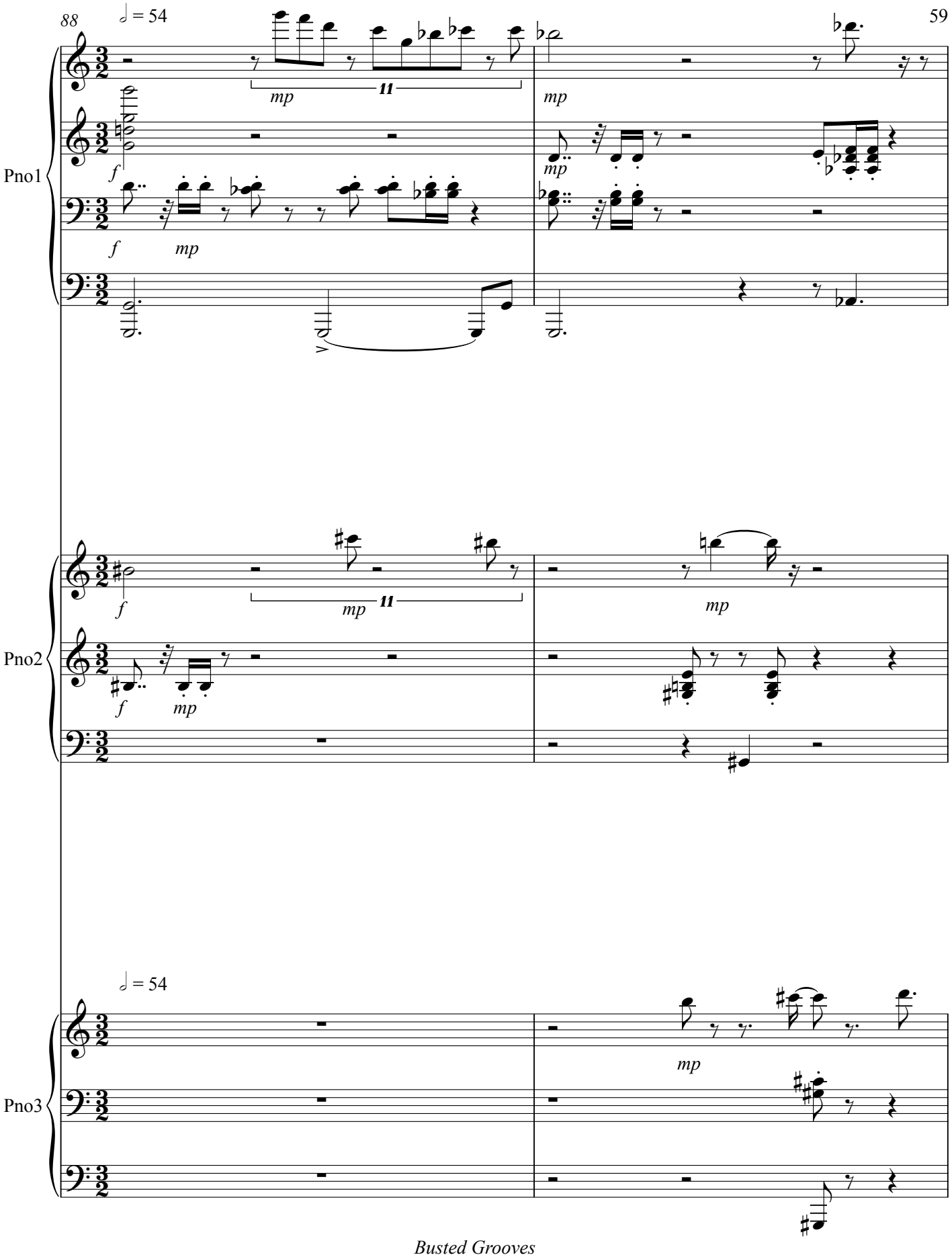

82
3:2
7:6
7:6
Pno1
7:6
7:6
Pno2
7:6
7:6
Pno3

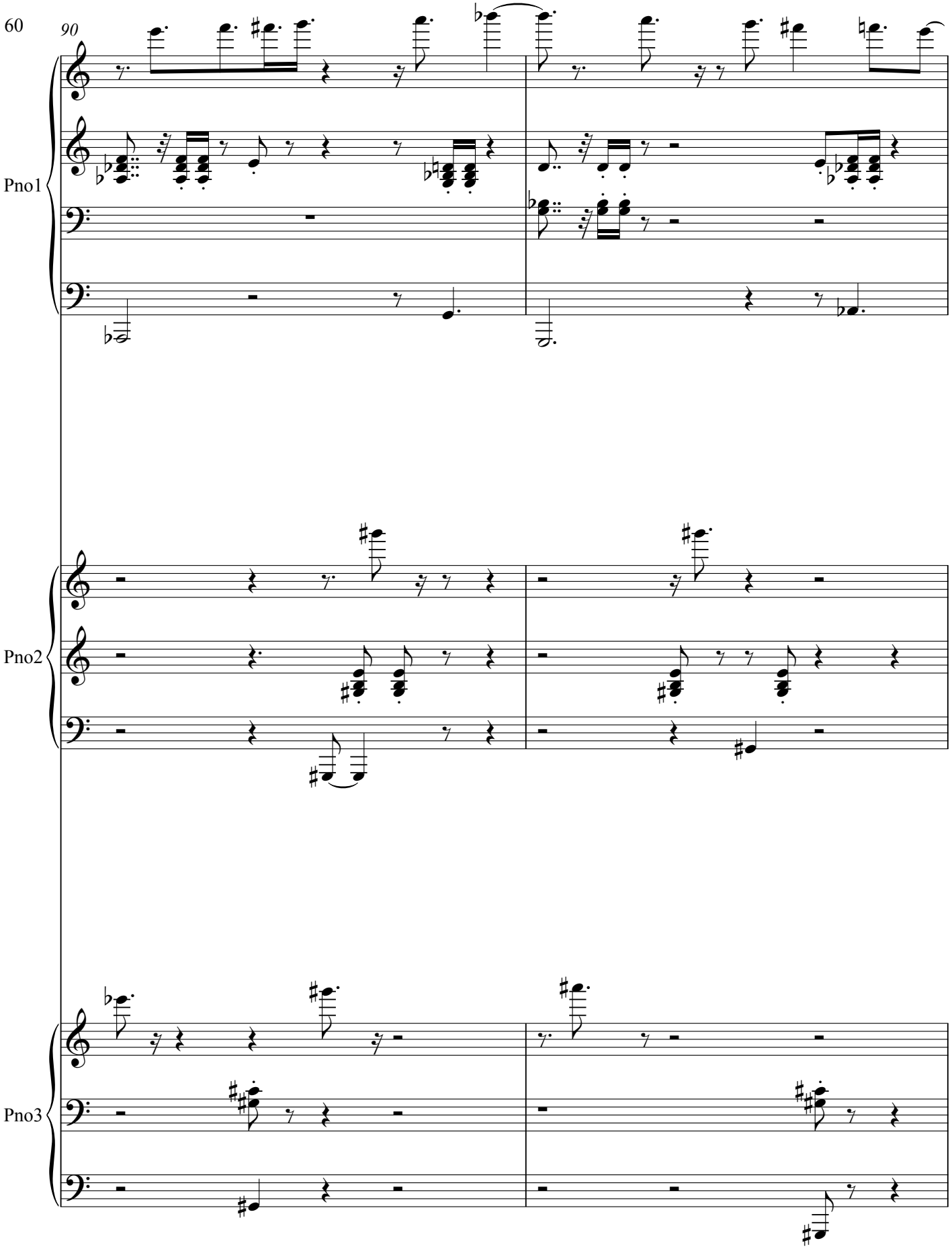

83
55
3:2
7:6
Pno1
mp
mp
Pno2
mp
Pno3

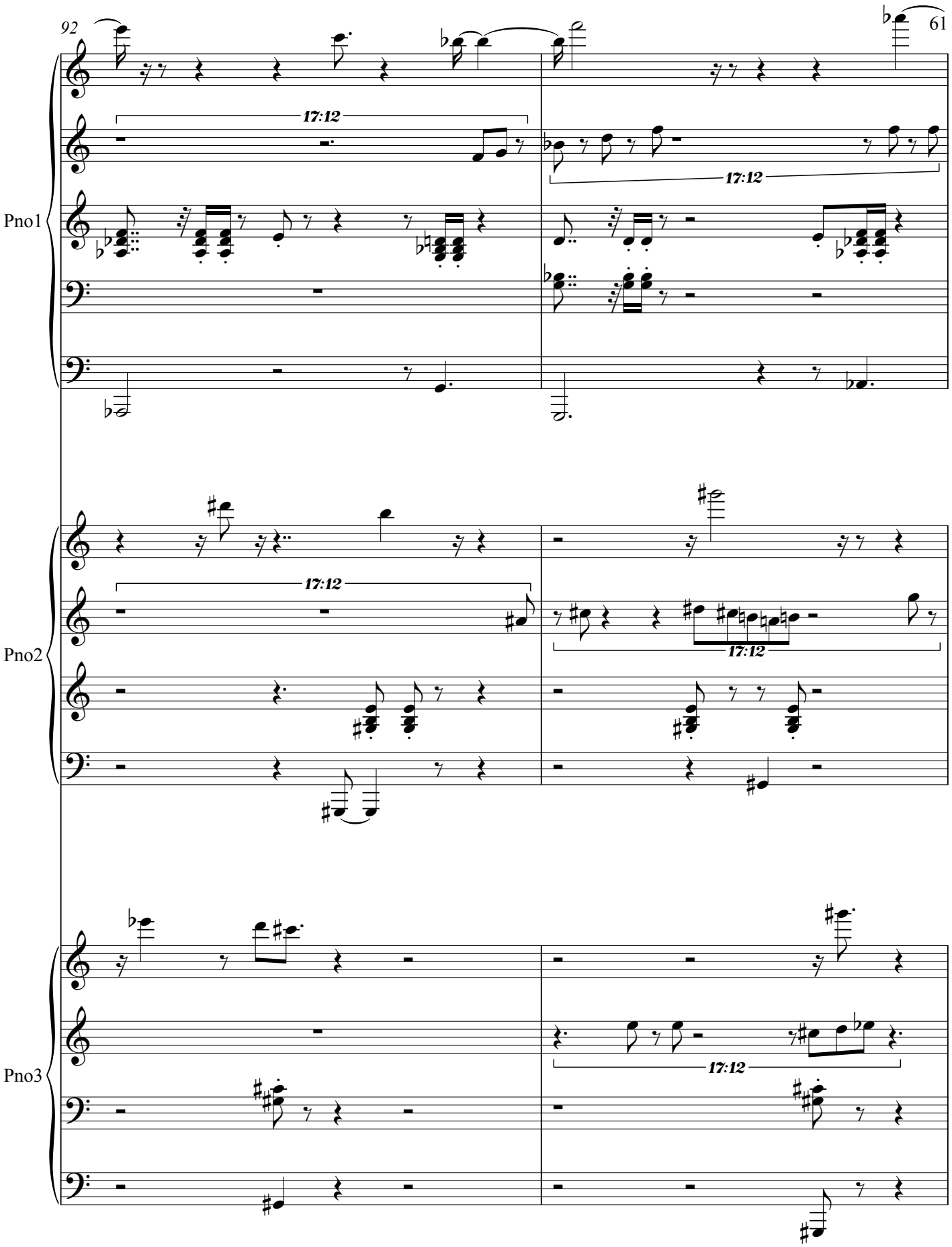

84
3:2
3:2
7:6
7:6
Pno1
Pno2
7:6
7:6
Pno3
7:6

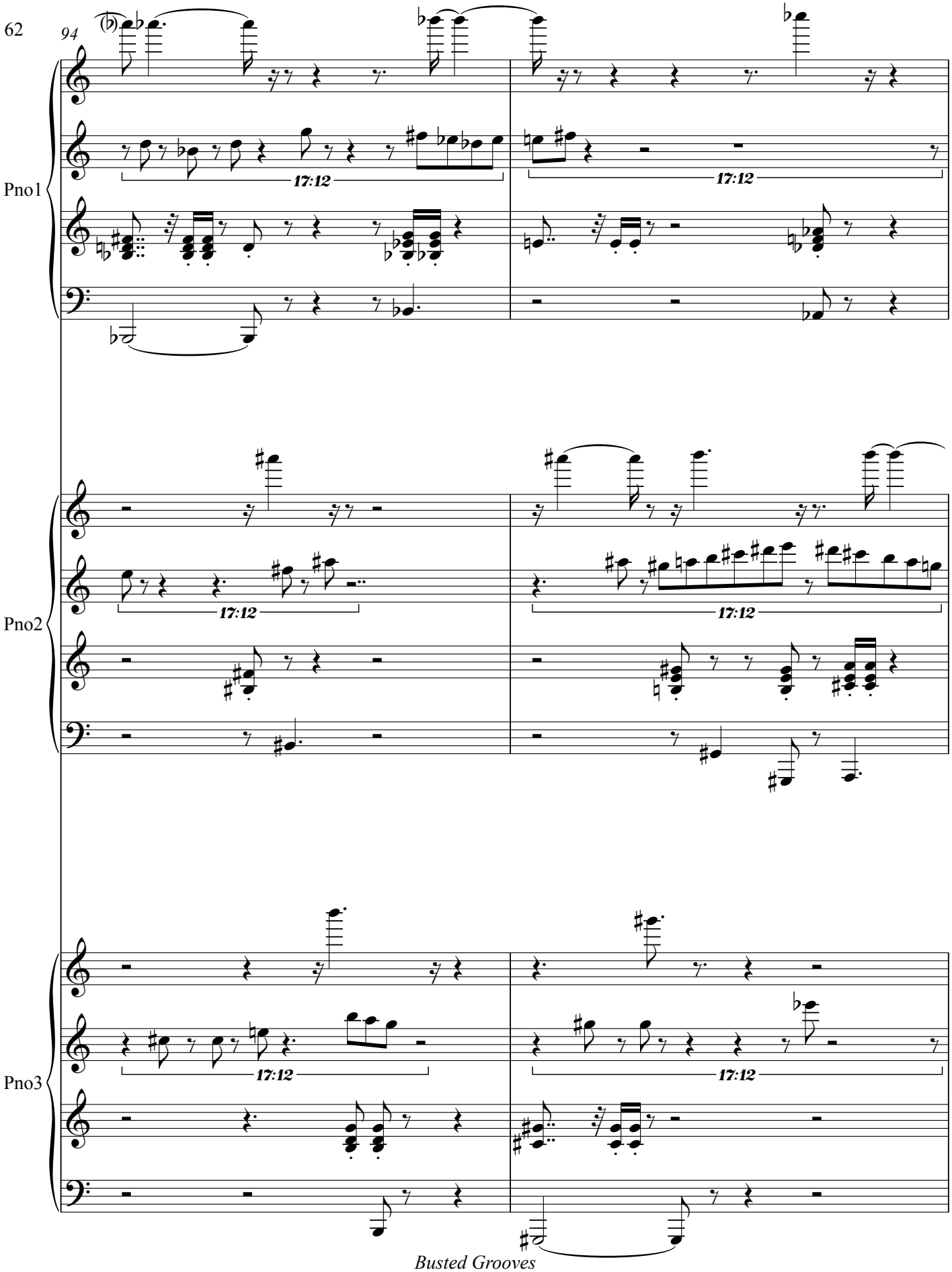

85
57
Pno1
Pno2
Pno3
19
13:11
7:6
mp

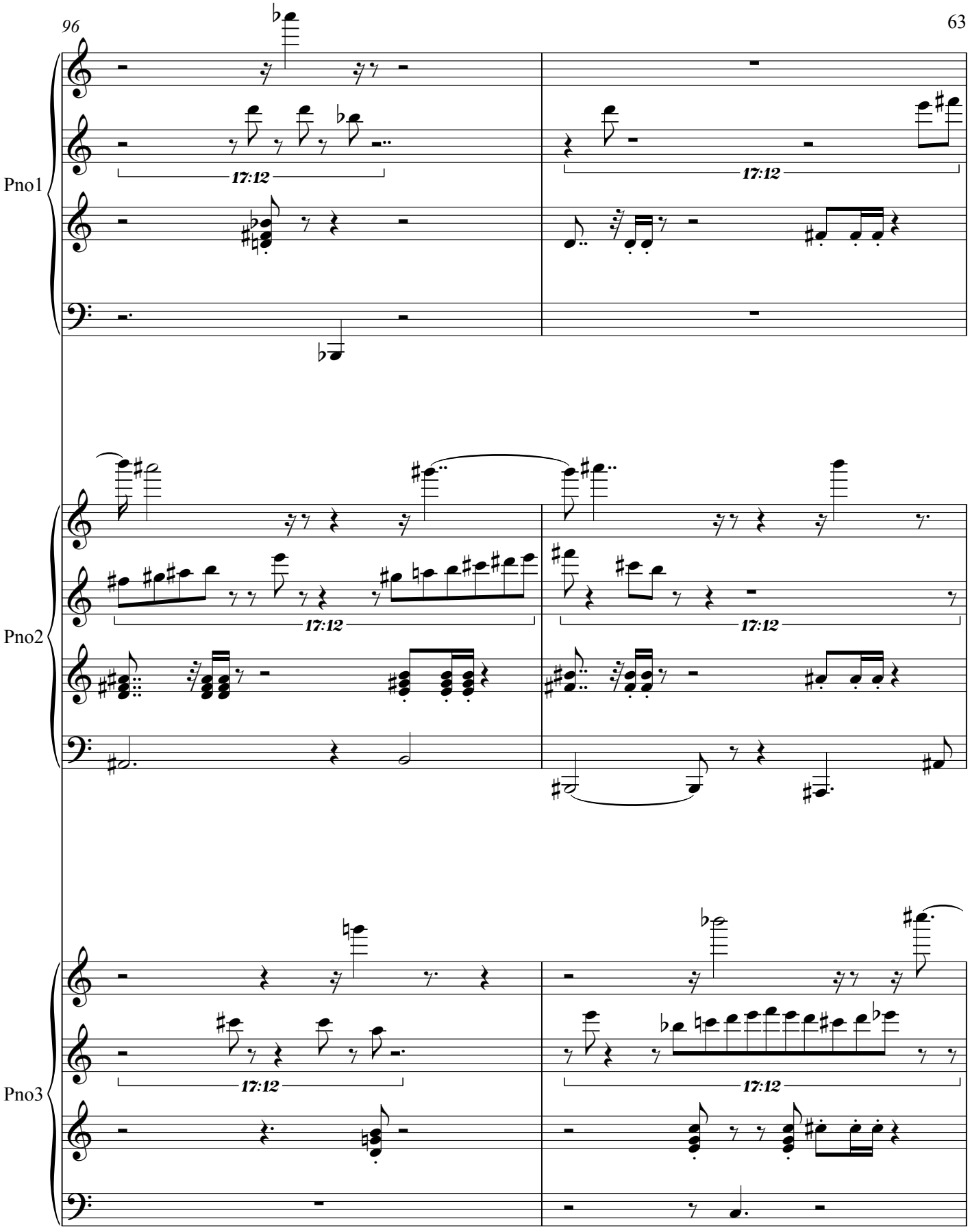

86
♩ = 126
Pno2
♩ = 126
Pno3
87
♩ = 91
Pno1
Pno2
♩ = 91
Pno3
mp
19
17
mp


♩ = 54
11
mp
f
Pno1
Pno2
Pno3


90
Pno1
Pno2
Pno3


Pno1
17:12
17:12
Pno2
17:12
17:12
Pno3
17:12


94
Pno1
Pno2
Pno3
17:12
17:12
17:12
17:12
17:12
17:12


Pno1
17:12
17:12
Pno2
17:12
17:12
Pno3
17:12
17:12

98

Pno1

17:12

17:12

Pno2

17:12

17:12

p

p

p

Pno3

17:12

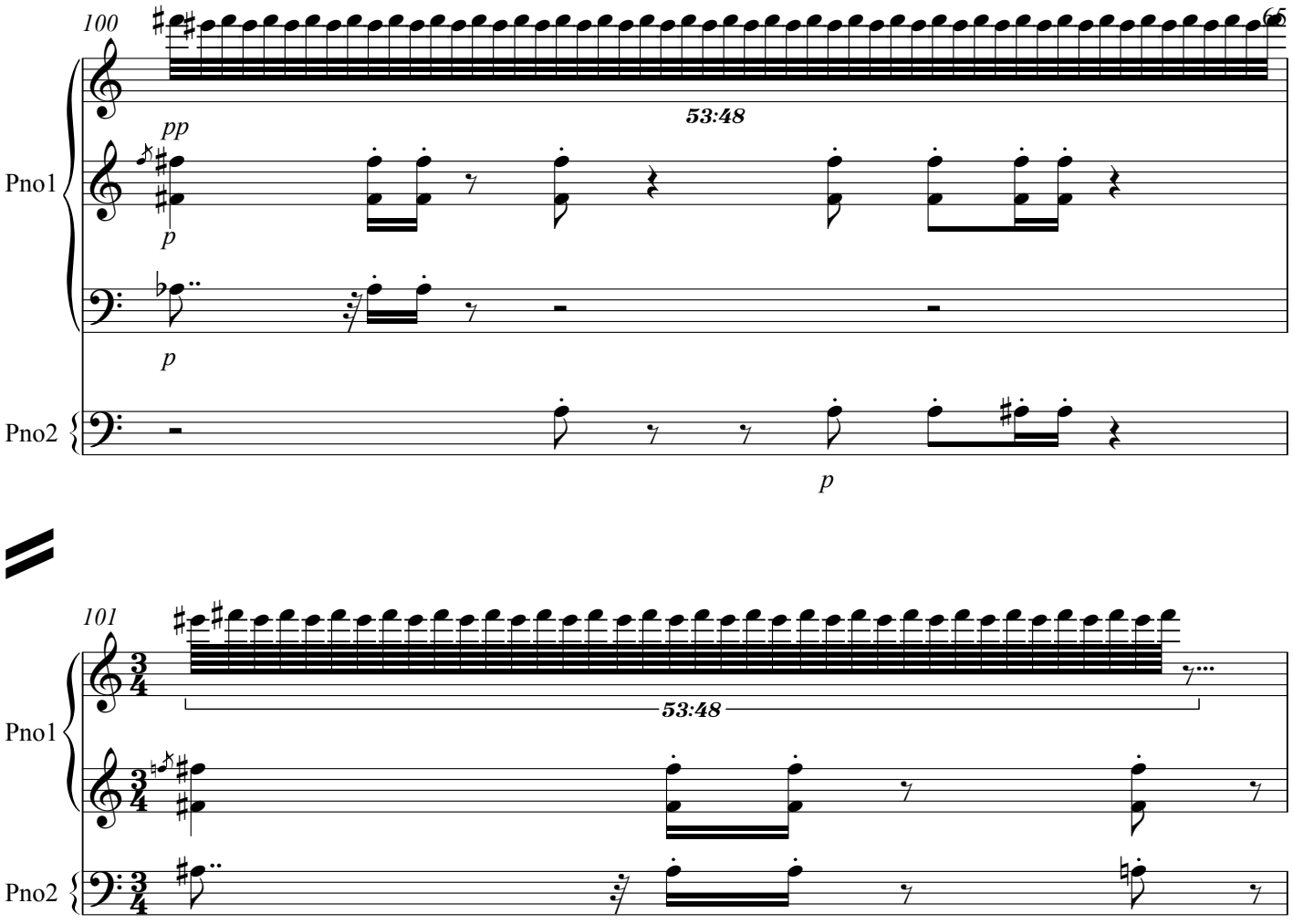
17:12

p

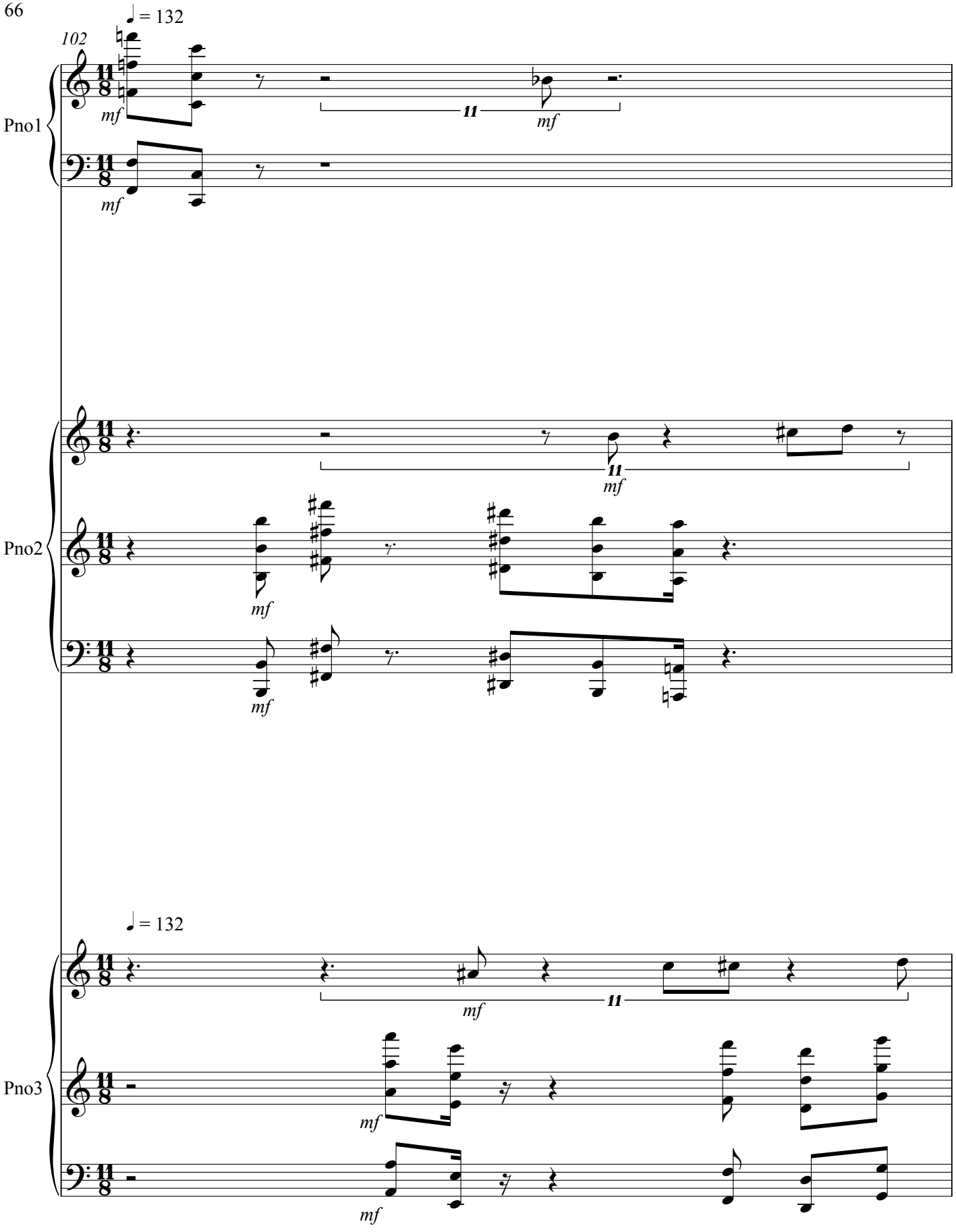
p

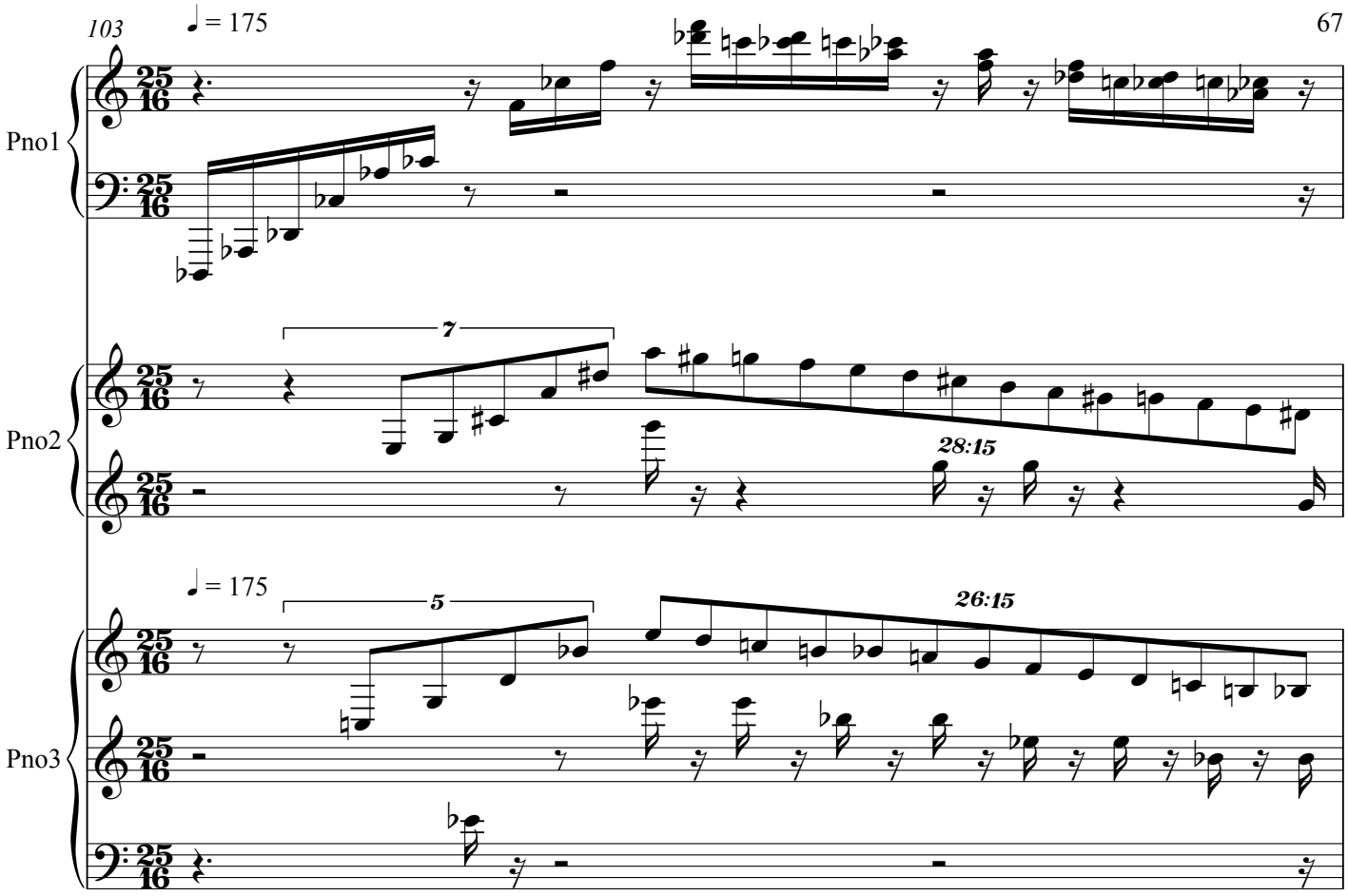
mp

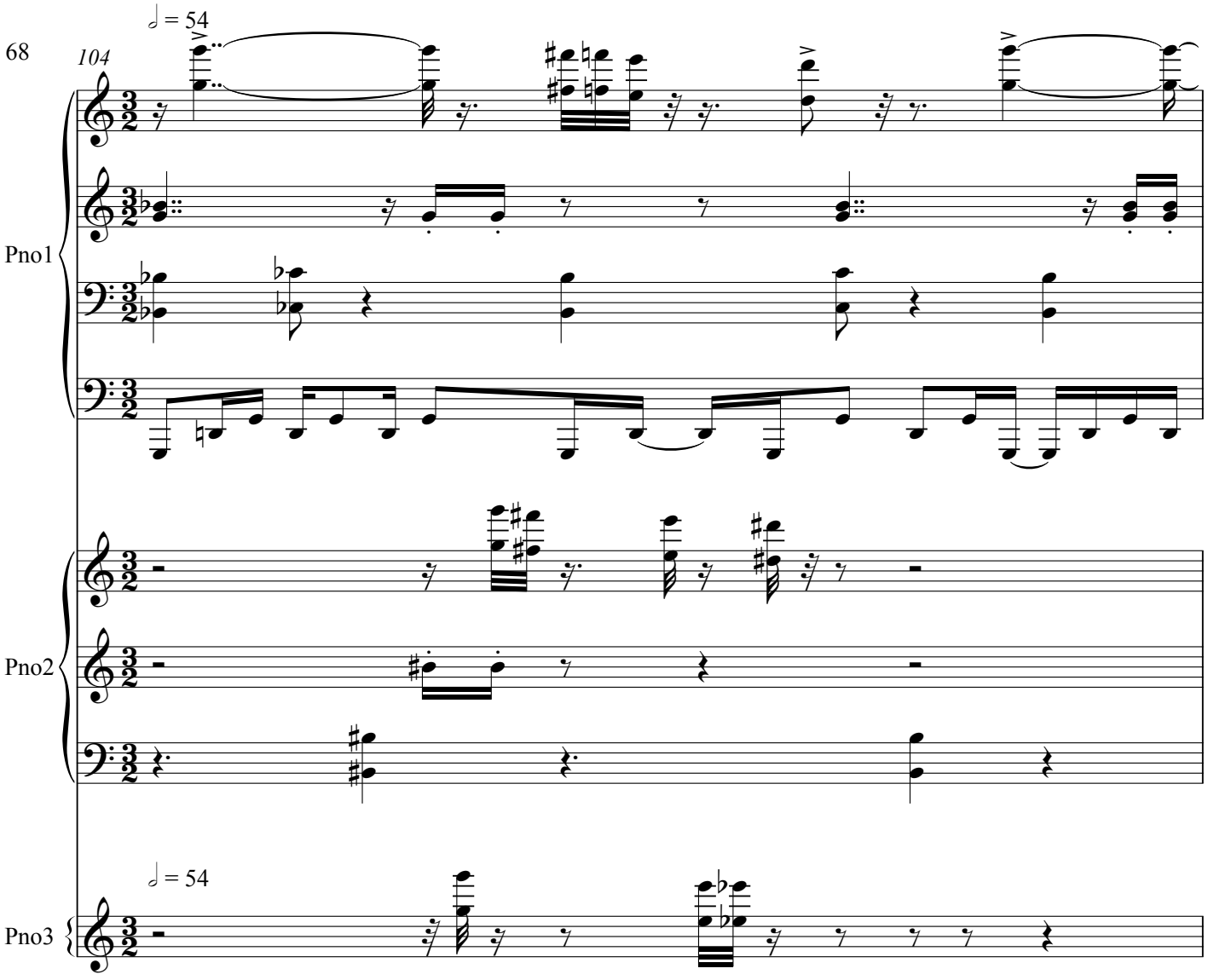
p

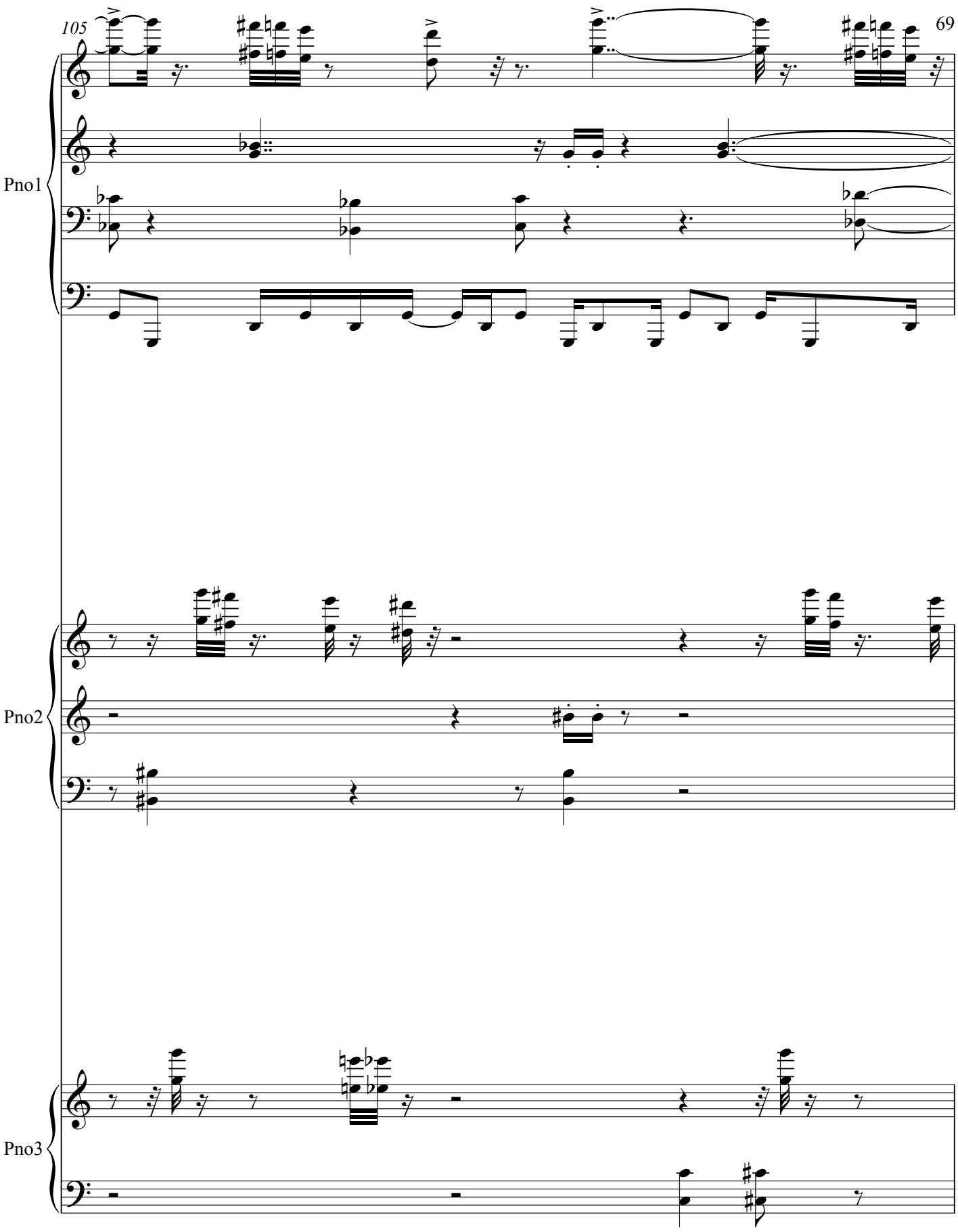

100
53:48
pp
p
Pno1
p
Pno2
p

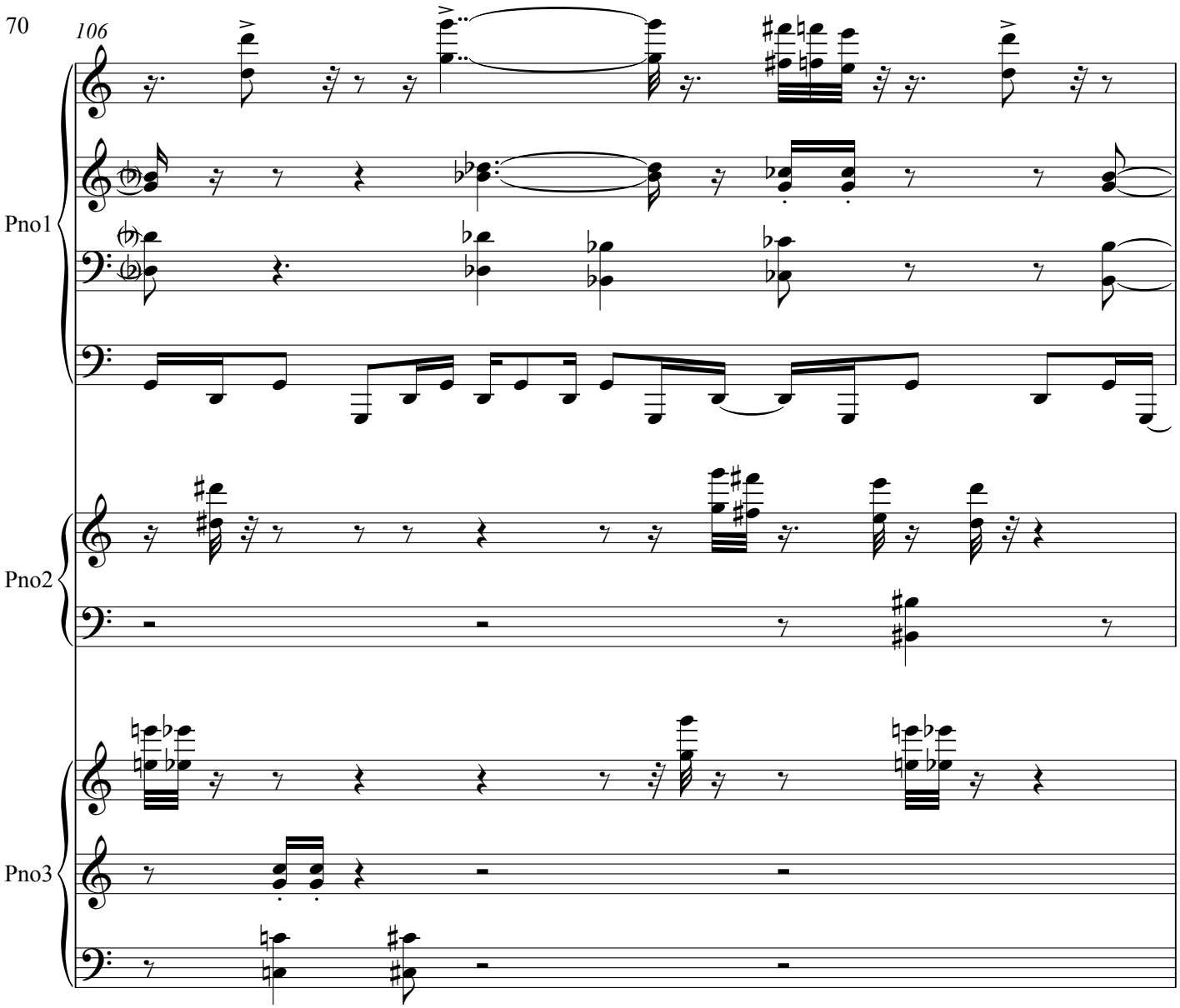
101
53:48
Pno1
Pno2

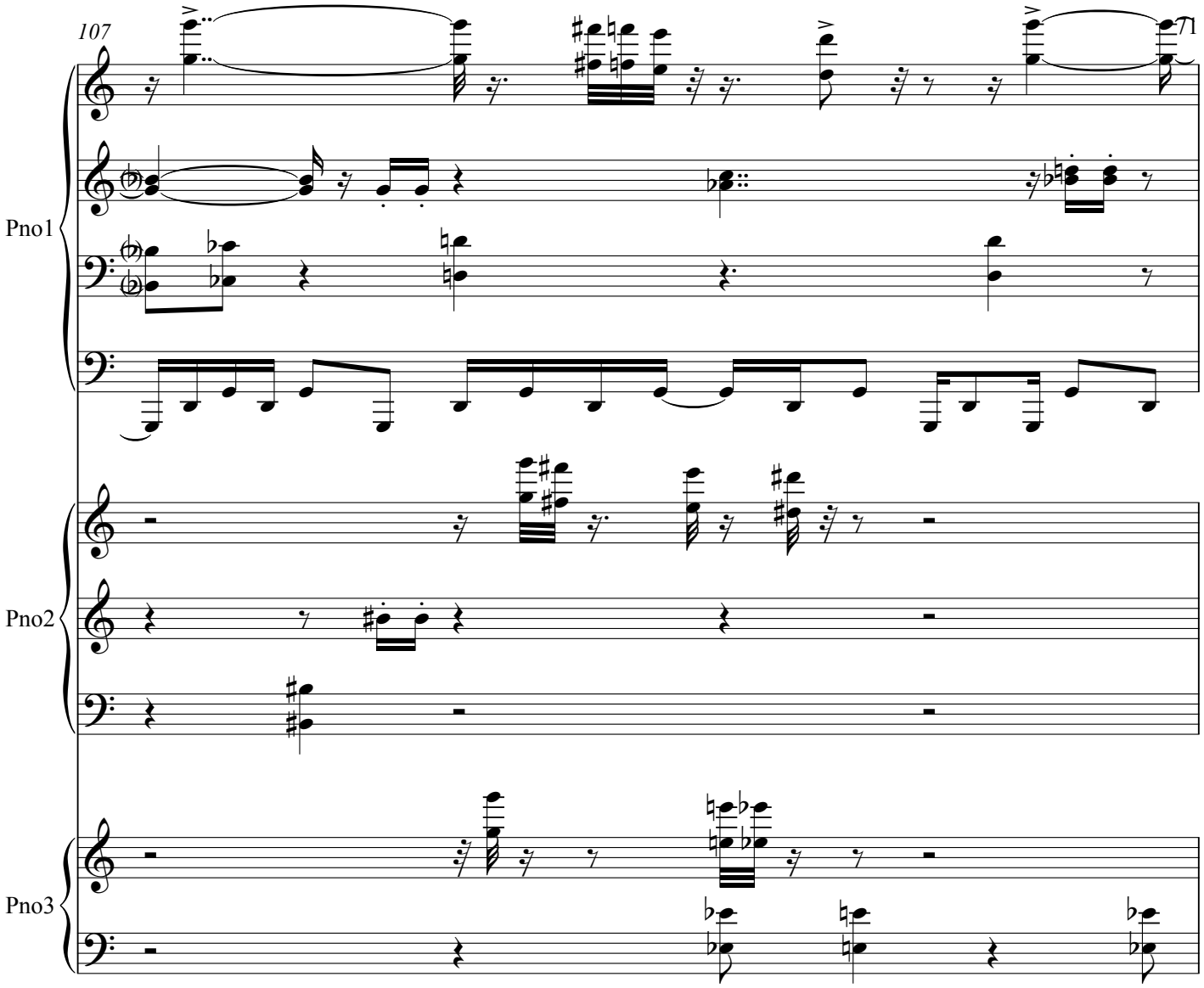

♩ = 132
102
Pno1
mf
11
mf
mf
Pno2
11
mf
mf
mf
♩ = 132
Pno3
mf
11
mf
mf
mf

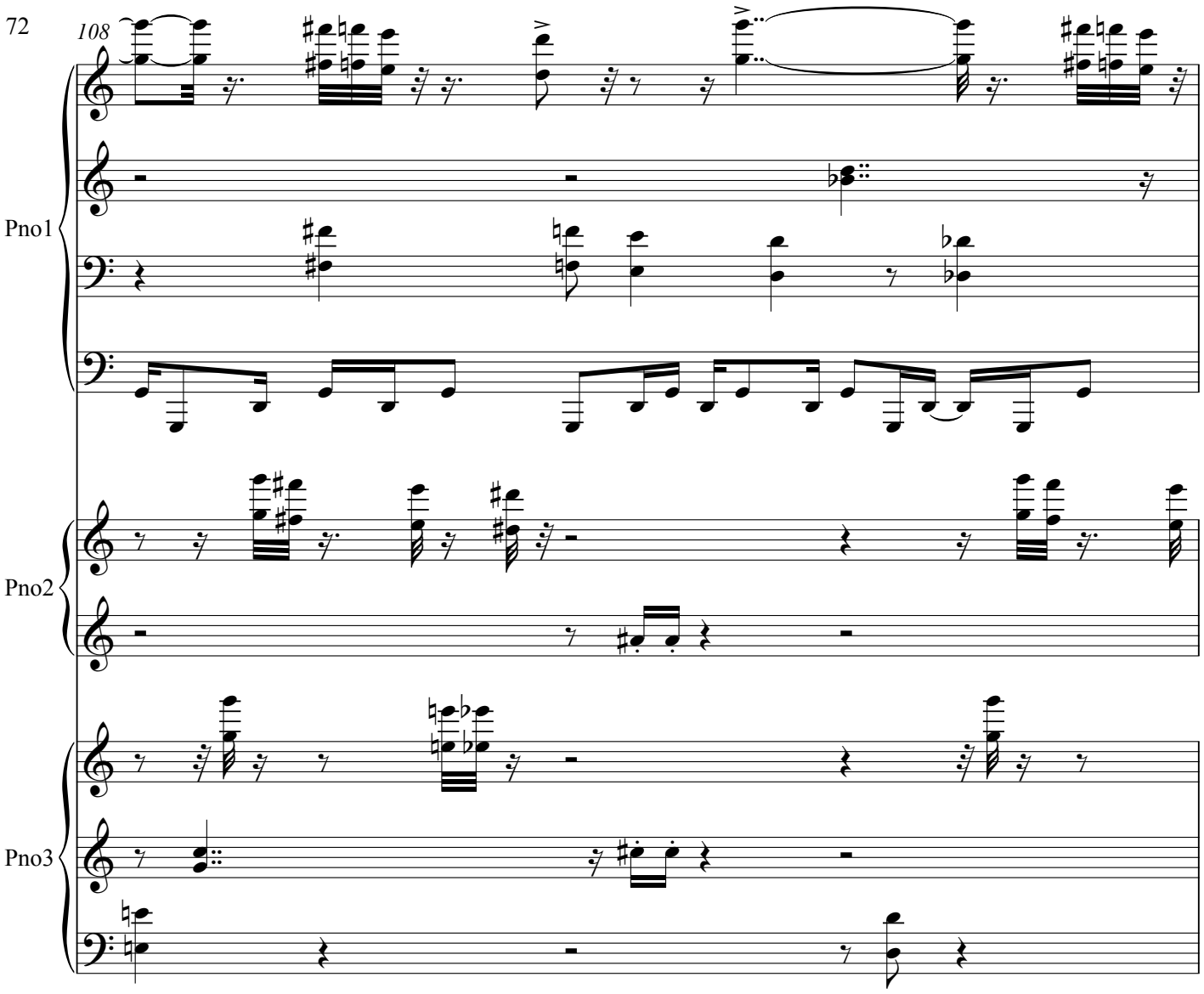

103
♩ = 175
Pno1
Pno2
Pno3
7
28:15
♩ = 175
5
26:15

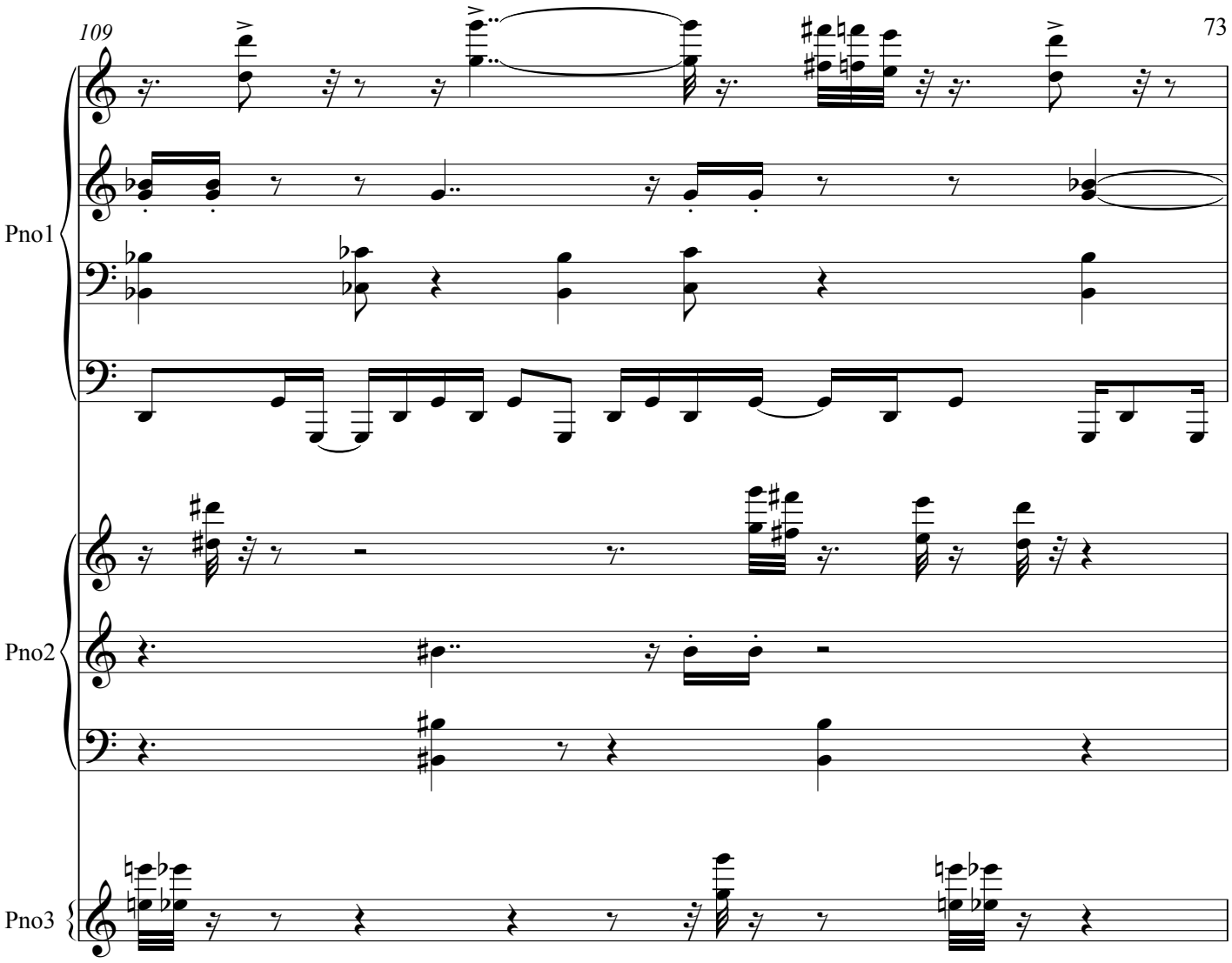

104
♩ = 54
Pno1
Pno2
♩ = 54
Pno3

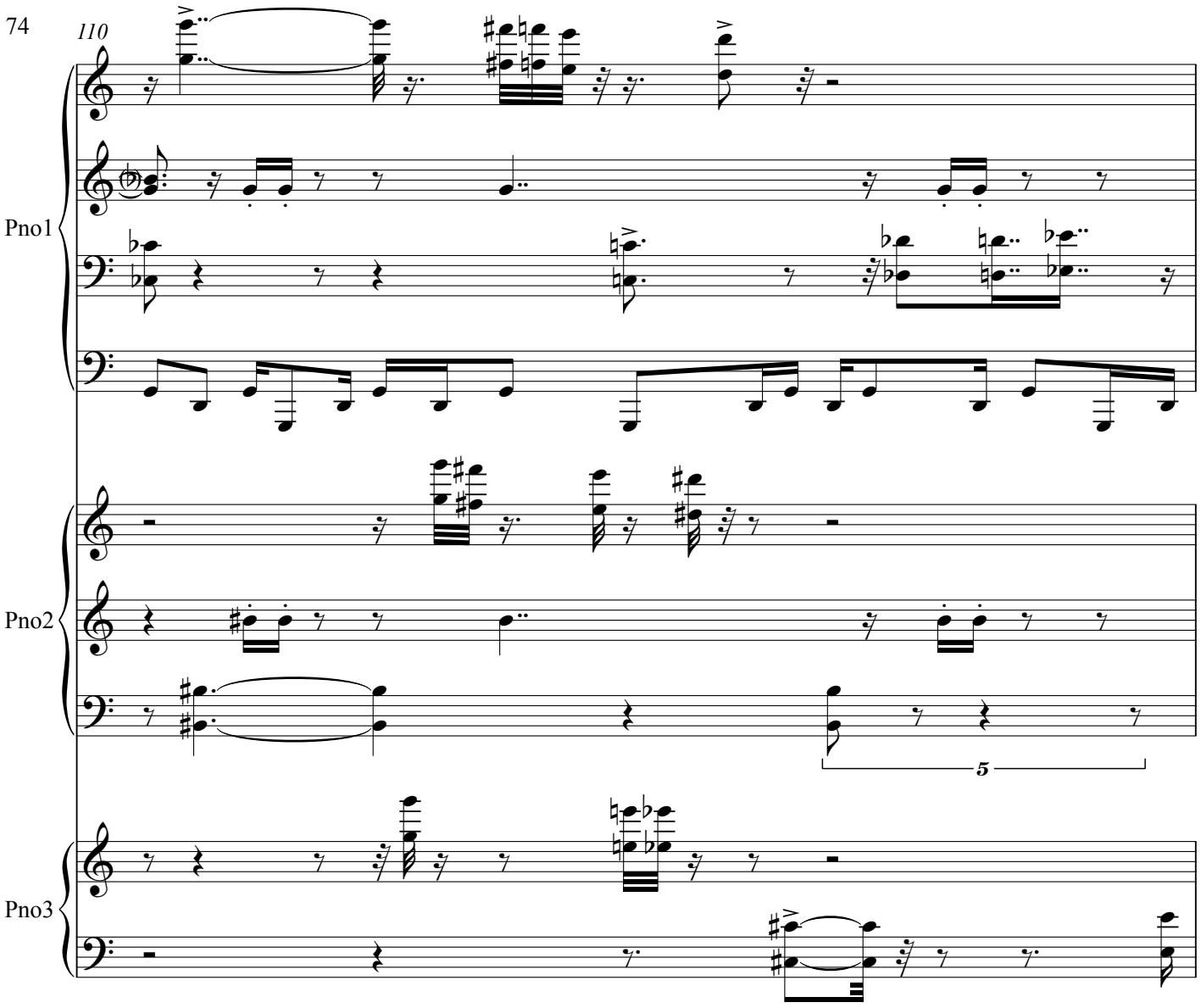

105
Pno1
Pno2
Pno3

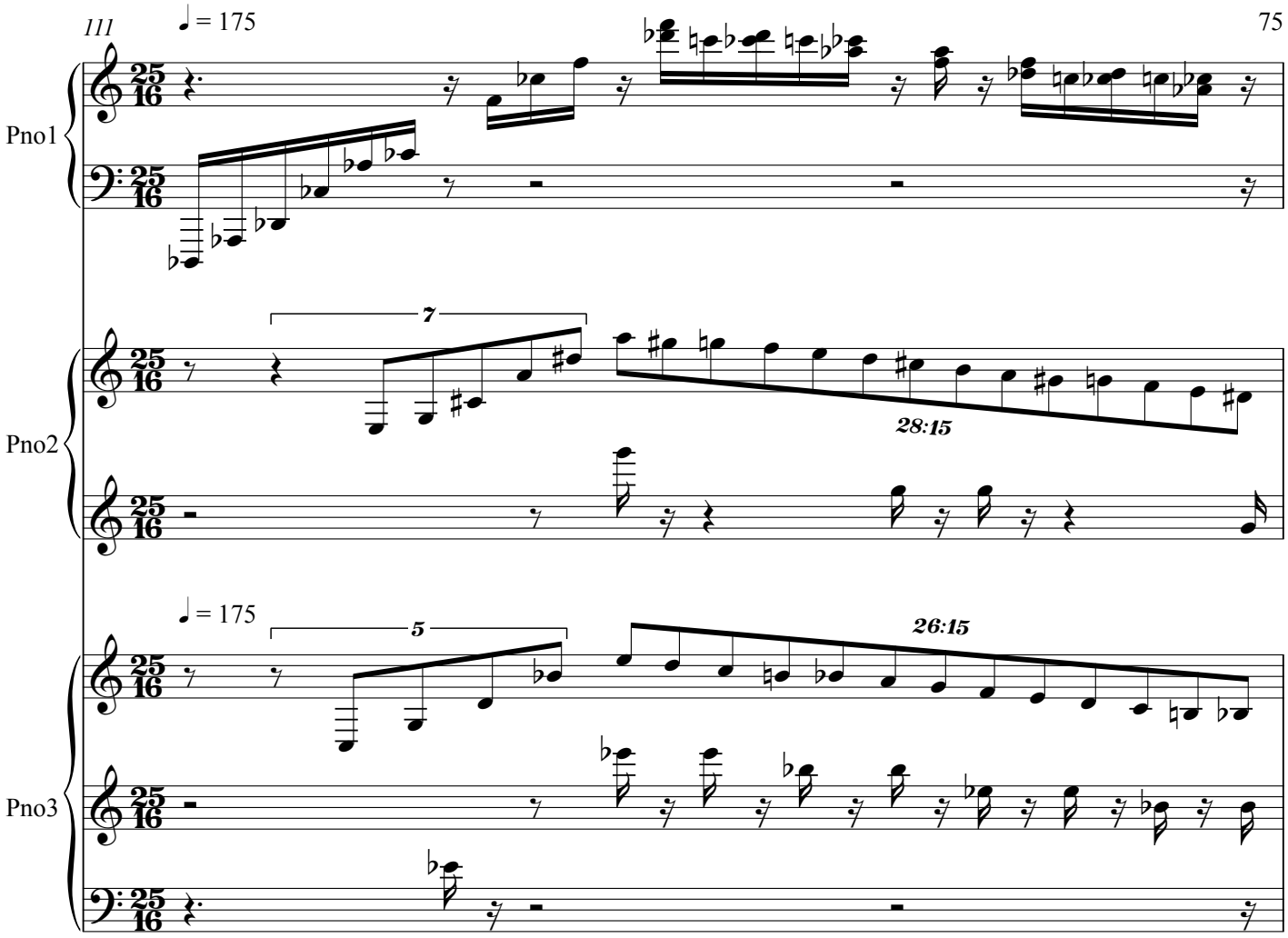

106
Pno1
Pno2
Pno3

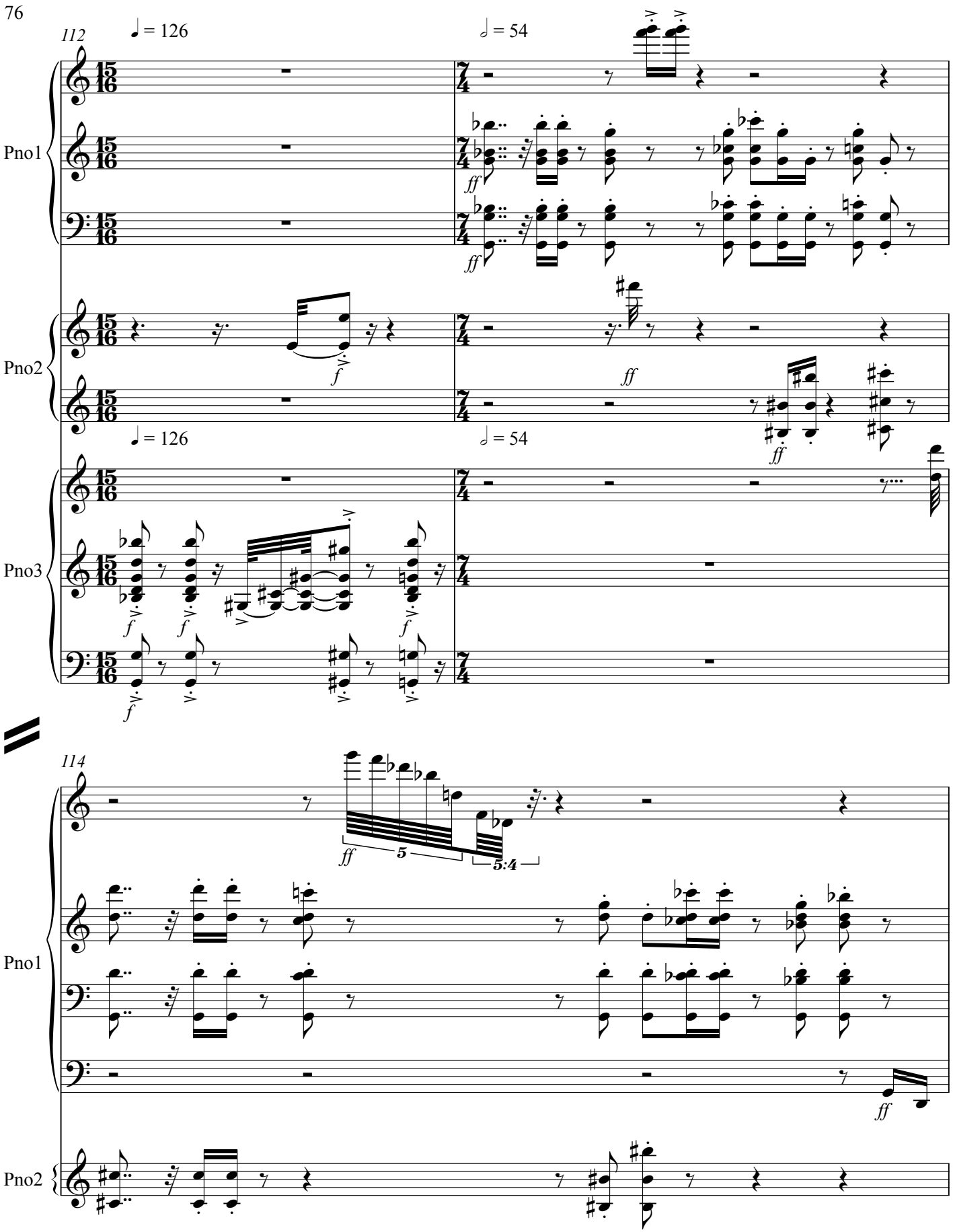

107
71
Pno1
Pno2
Pno3

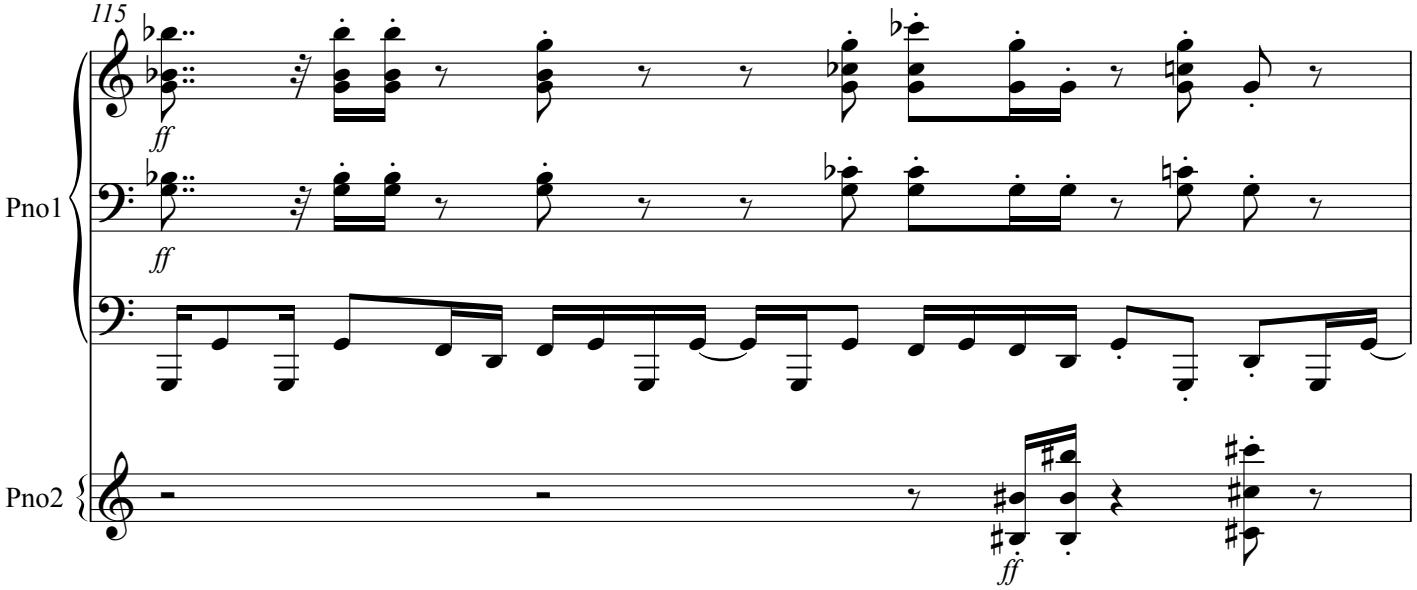

108
Pno1
Pno2
Pno3

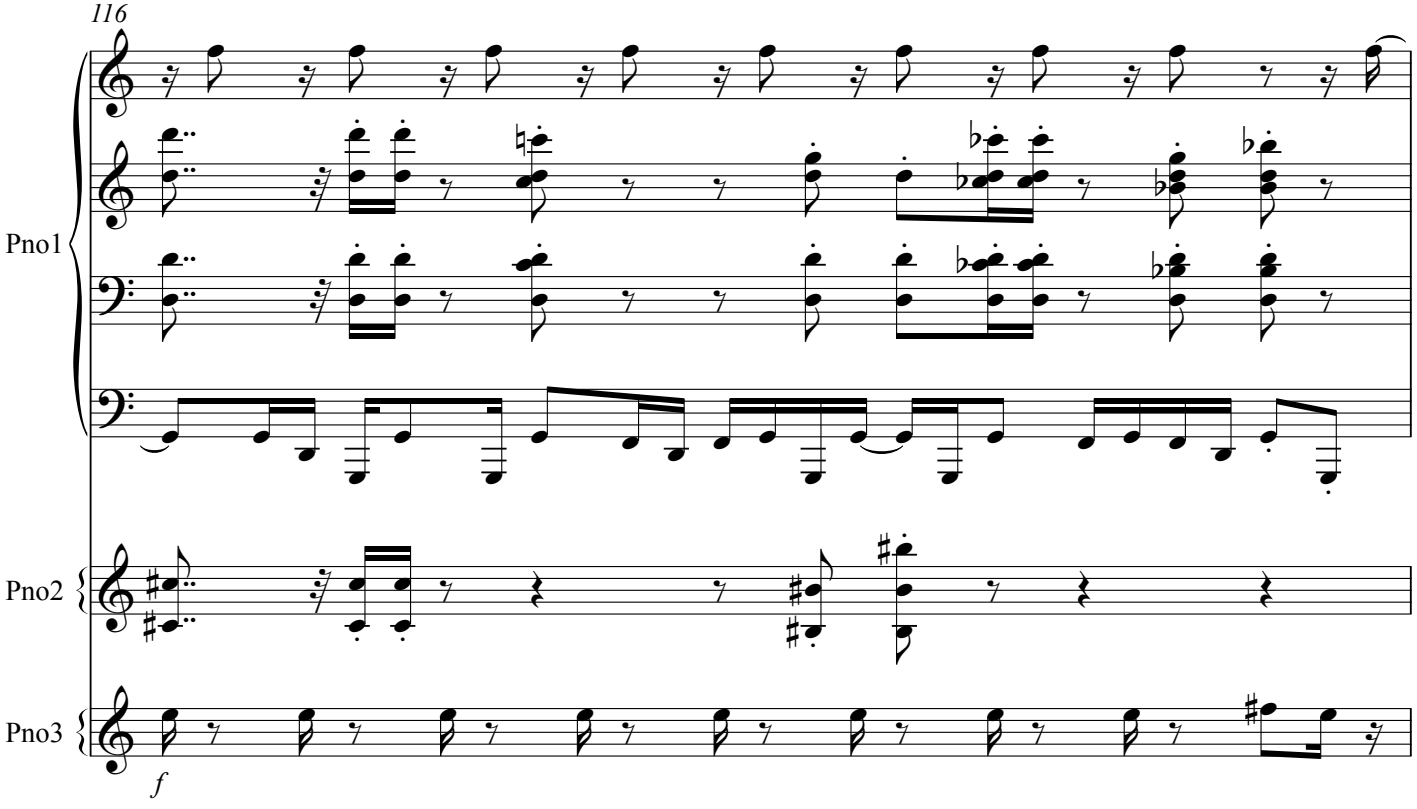

109
Pno1
Pno2
Pno3

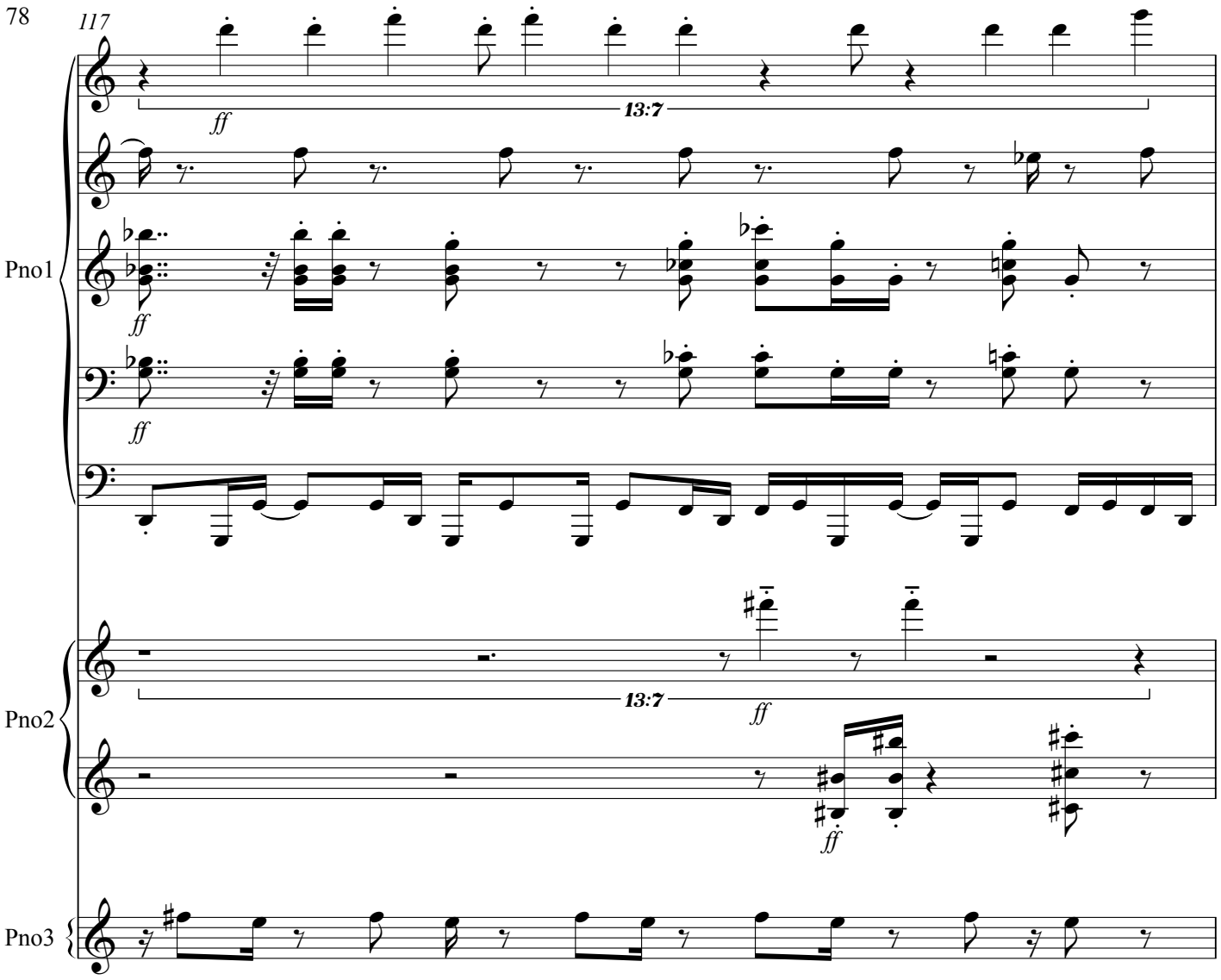

110
Pno1
Pno2
Pno3
5

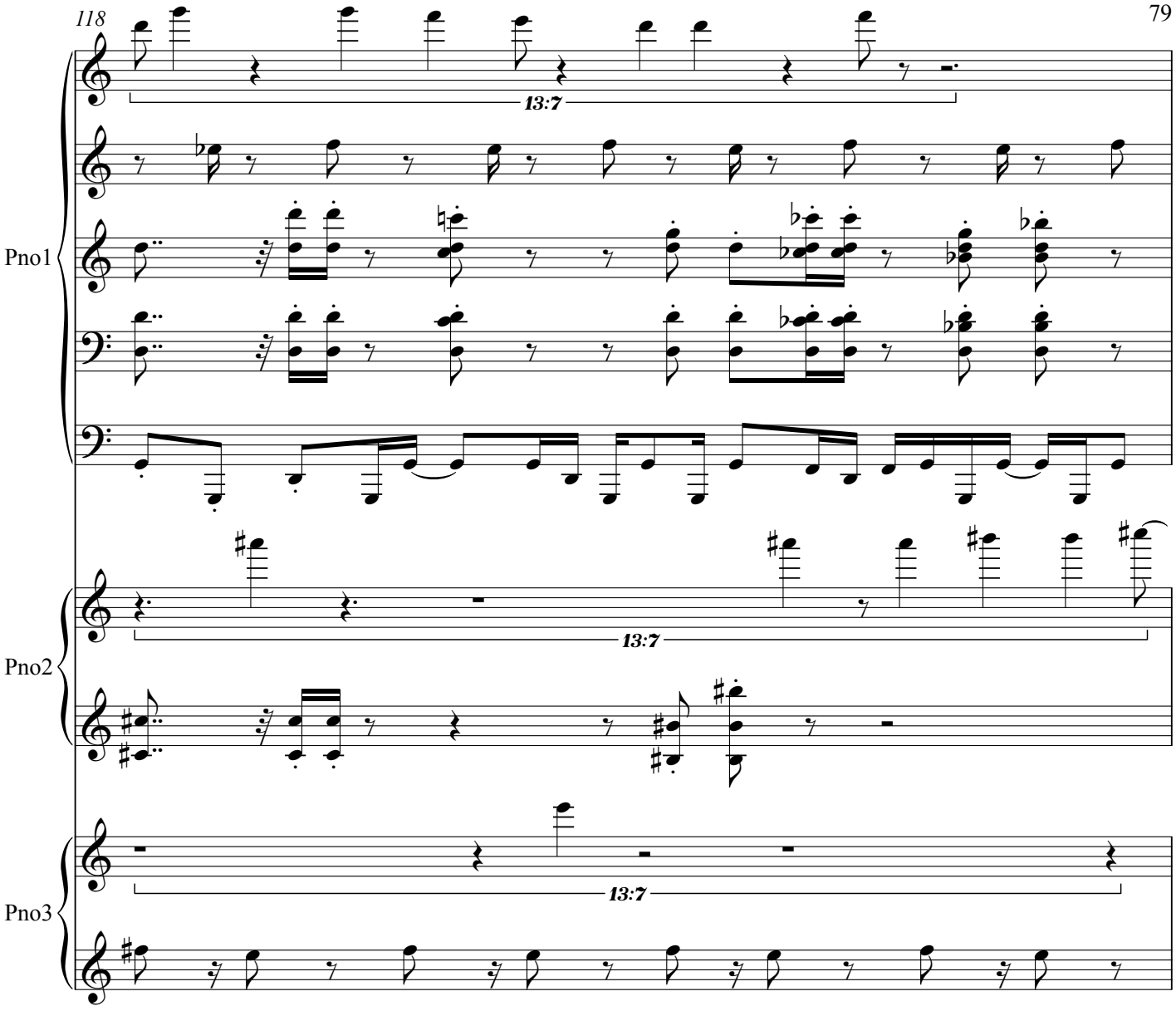

♩ = 175
Pno1
Pno2
7
28:15
♩ = 175
5
26:15
Pno3

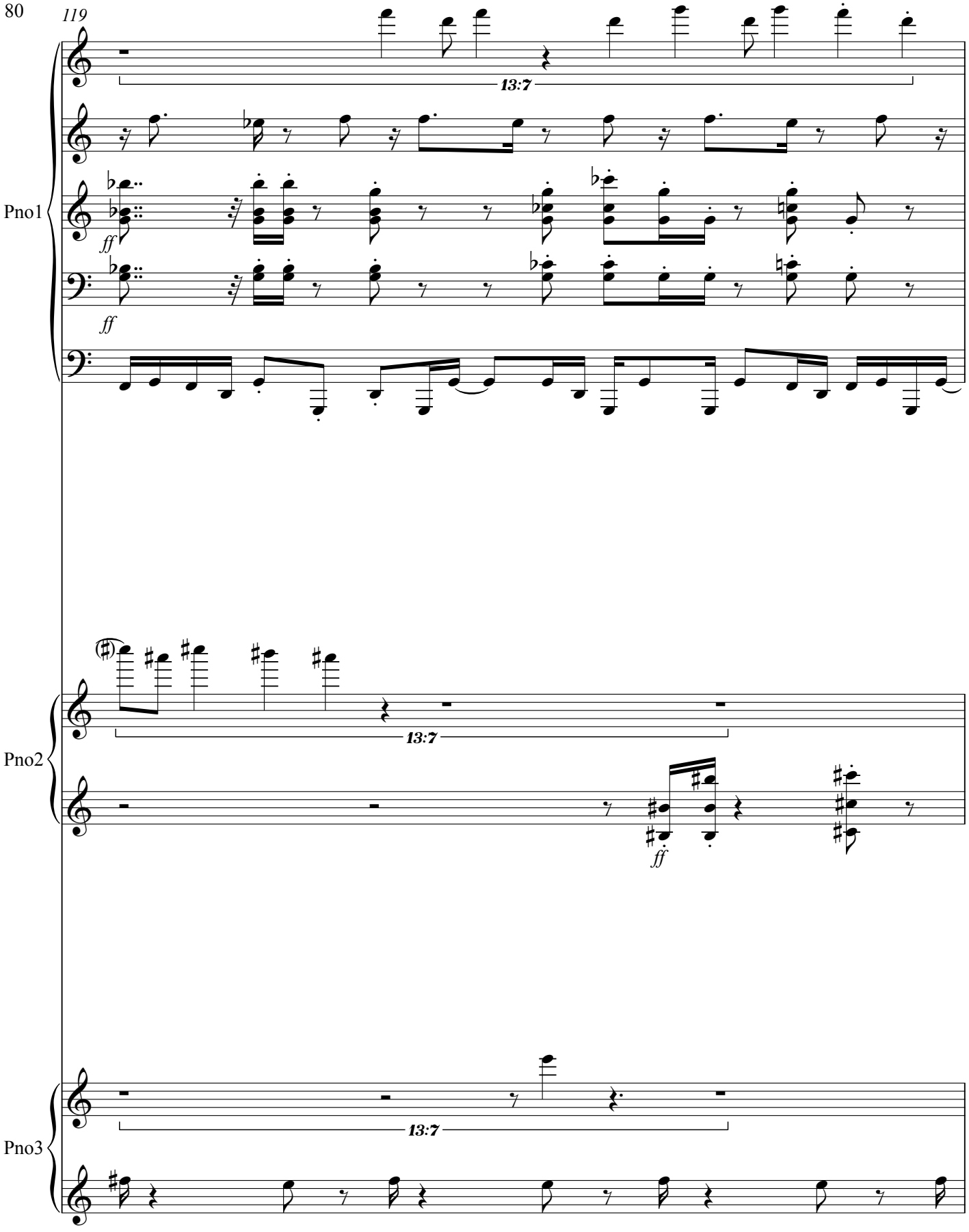

112
♩ = 126
𝅗𝅥 = 54
Pno1
Pno2
Pno3
114
5
5:4

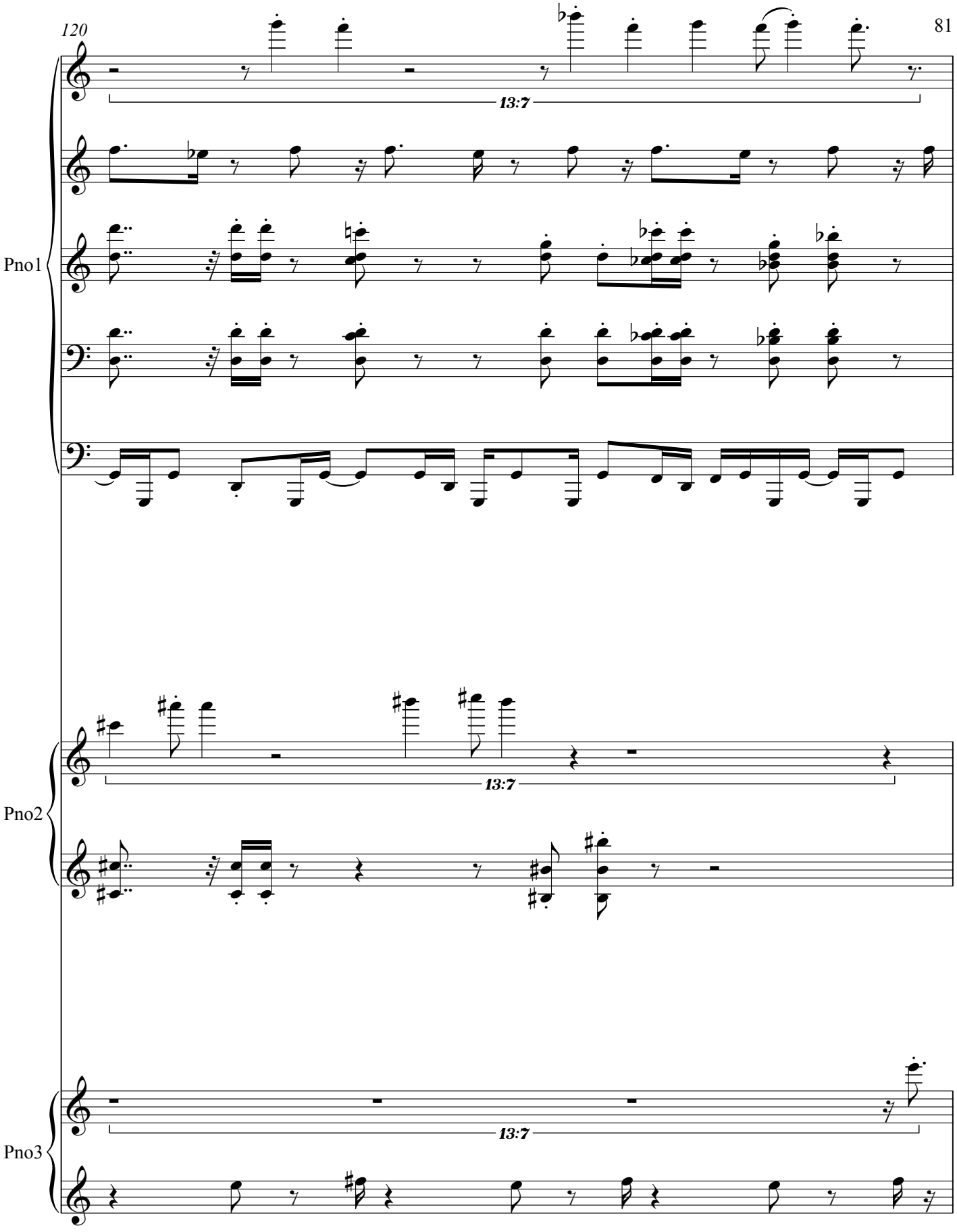

115
Pno1
Pno2
ff
ff
ff

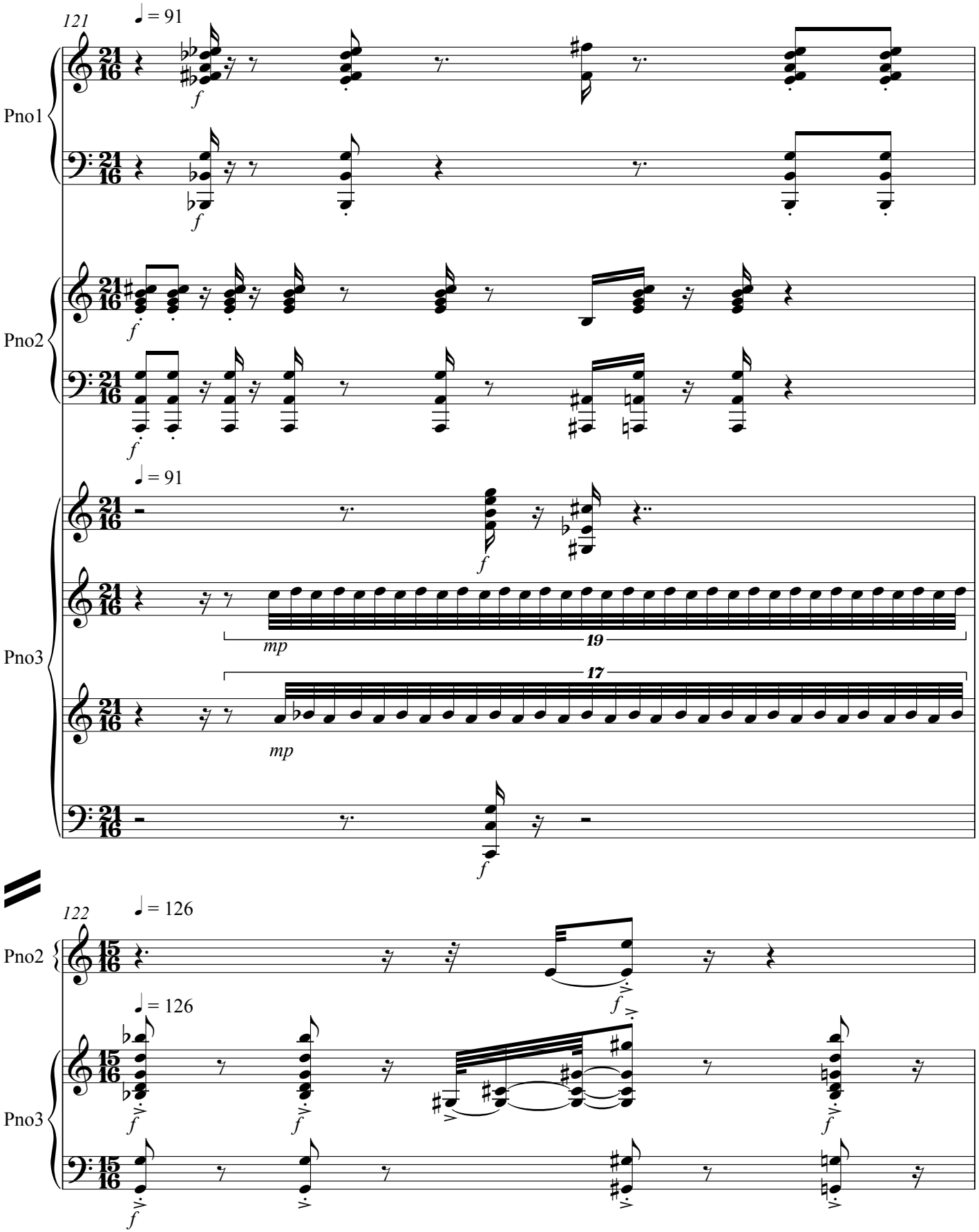

116
Pno1
Pno2
Pno3
f

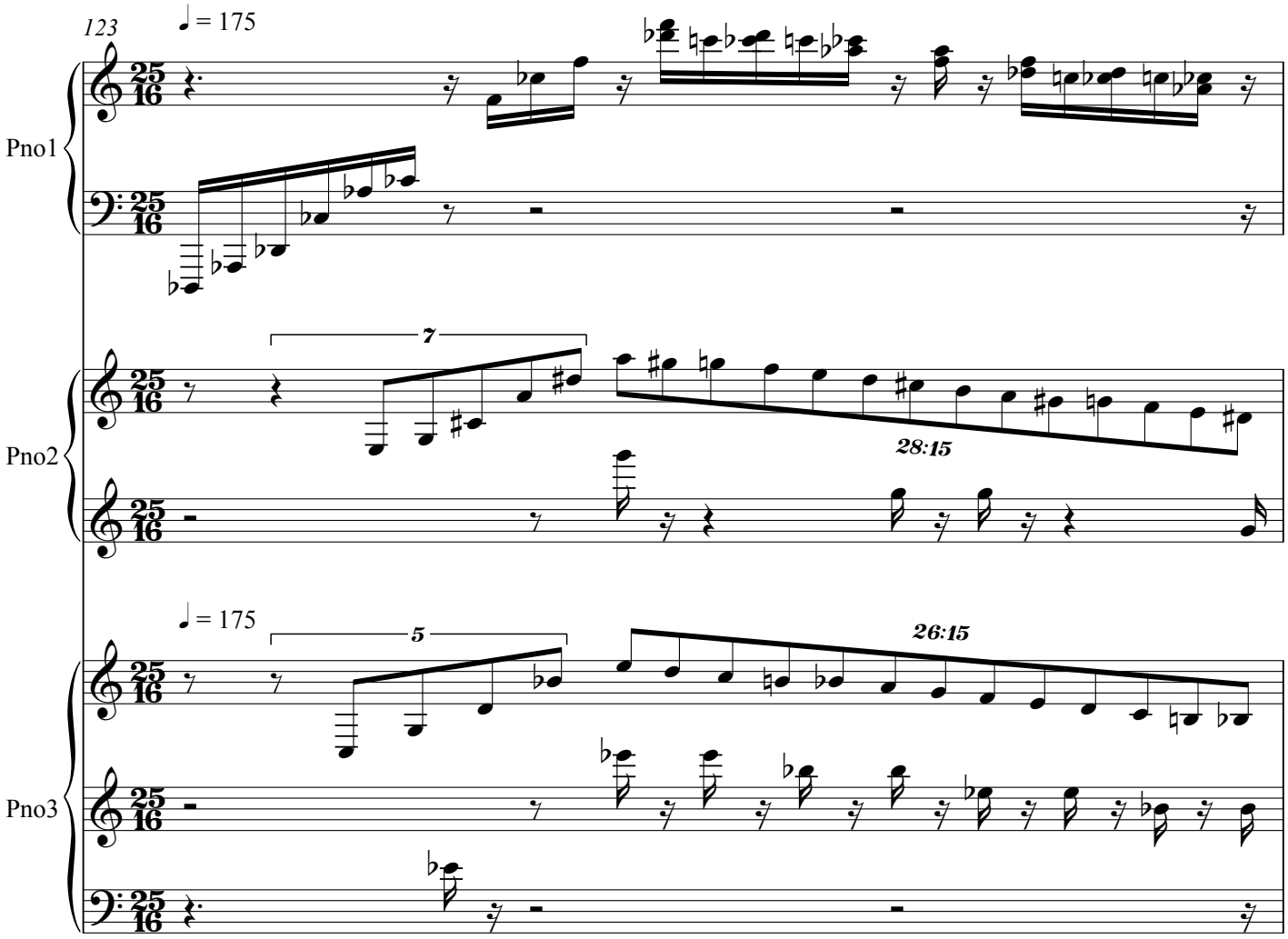

117
ff
13:7
Pno1
ff
ff
Pno2
13:7
ff
ff
Pno3

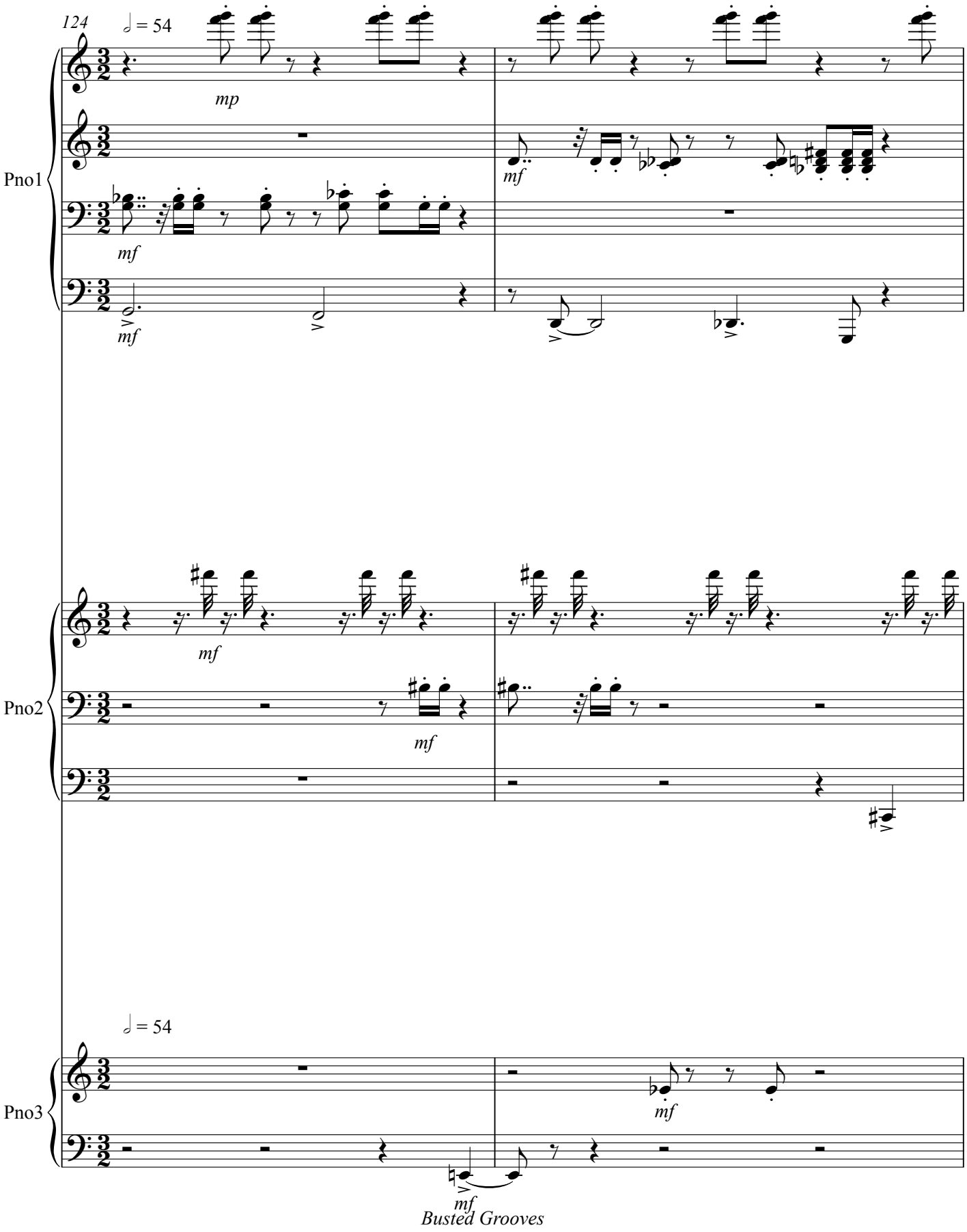

118
13:7
Pno1
13:7
Pno2
13:7
Pno3

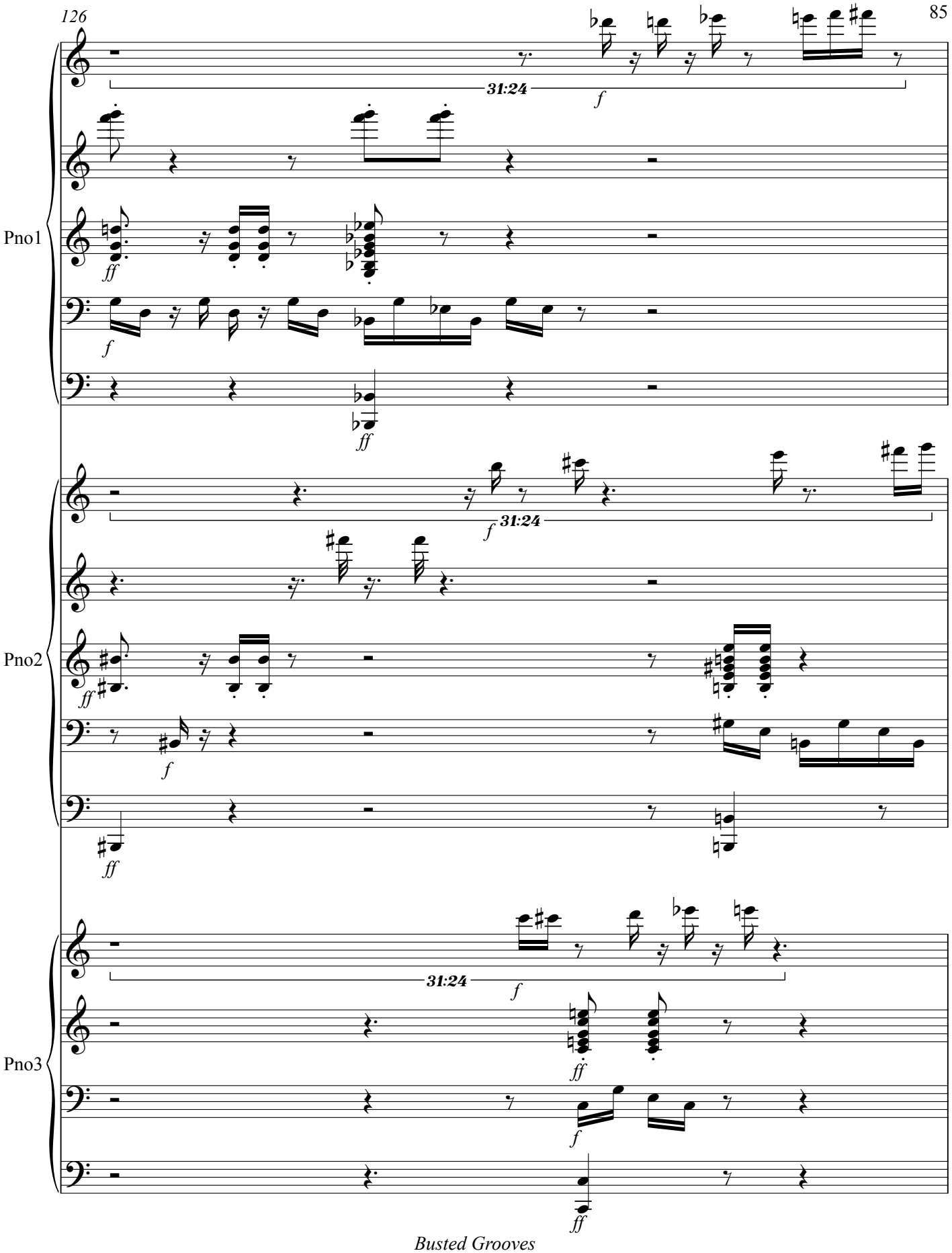

119
13:7
Pno1
ff
ff
13:7
Pno2
ff
13:7
Pno3

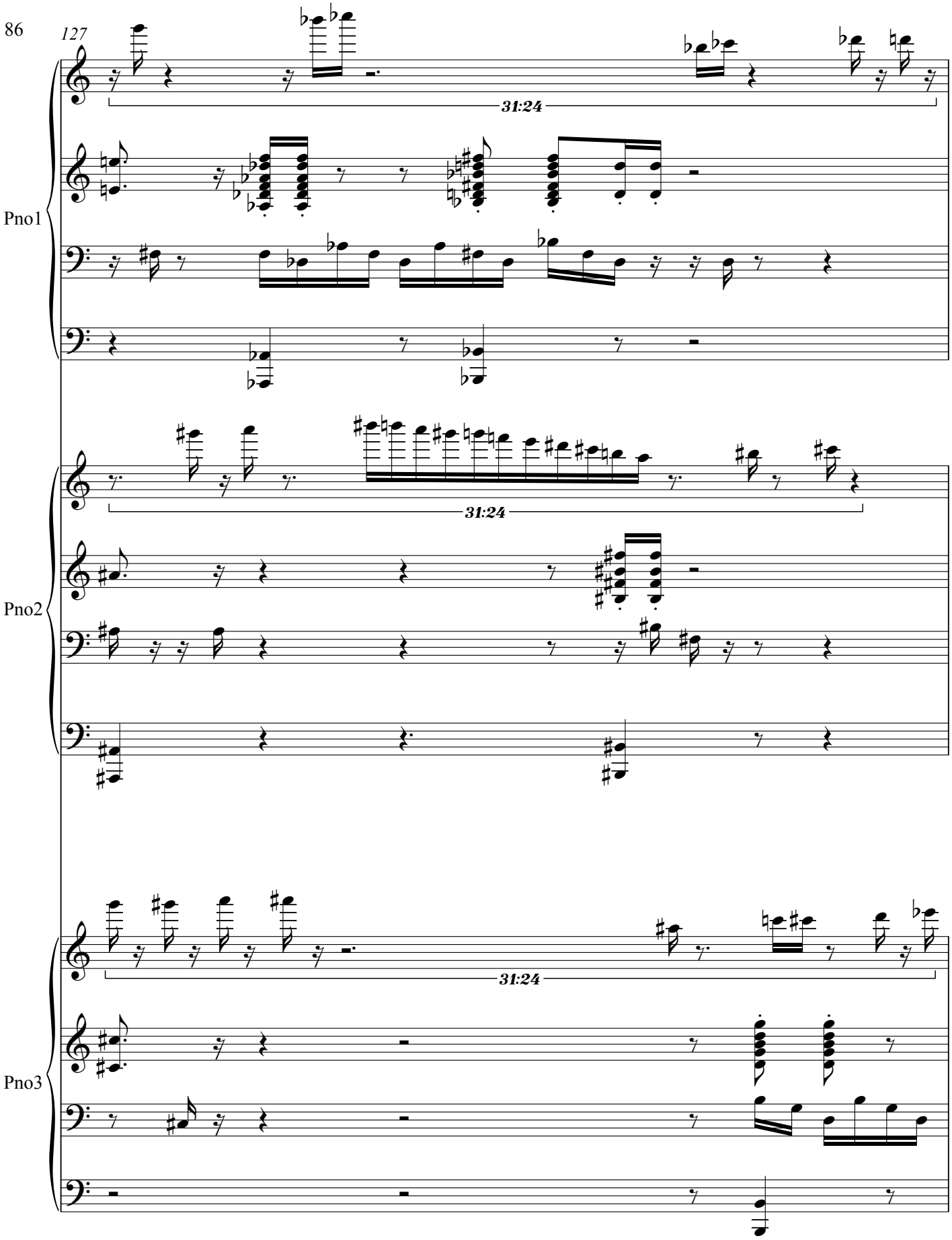

120
13:7
Pno1
13:7
Pno2
13:7
Pno3

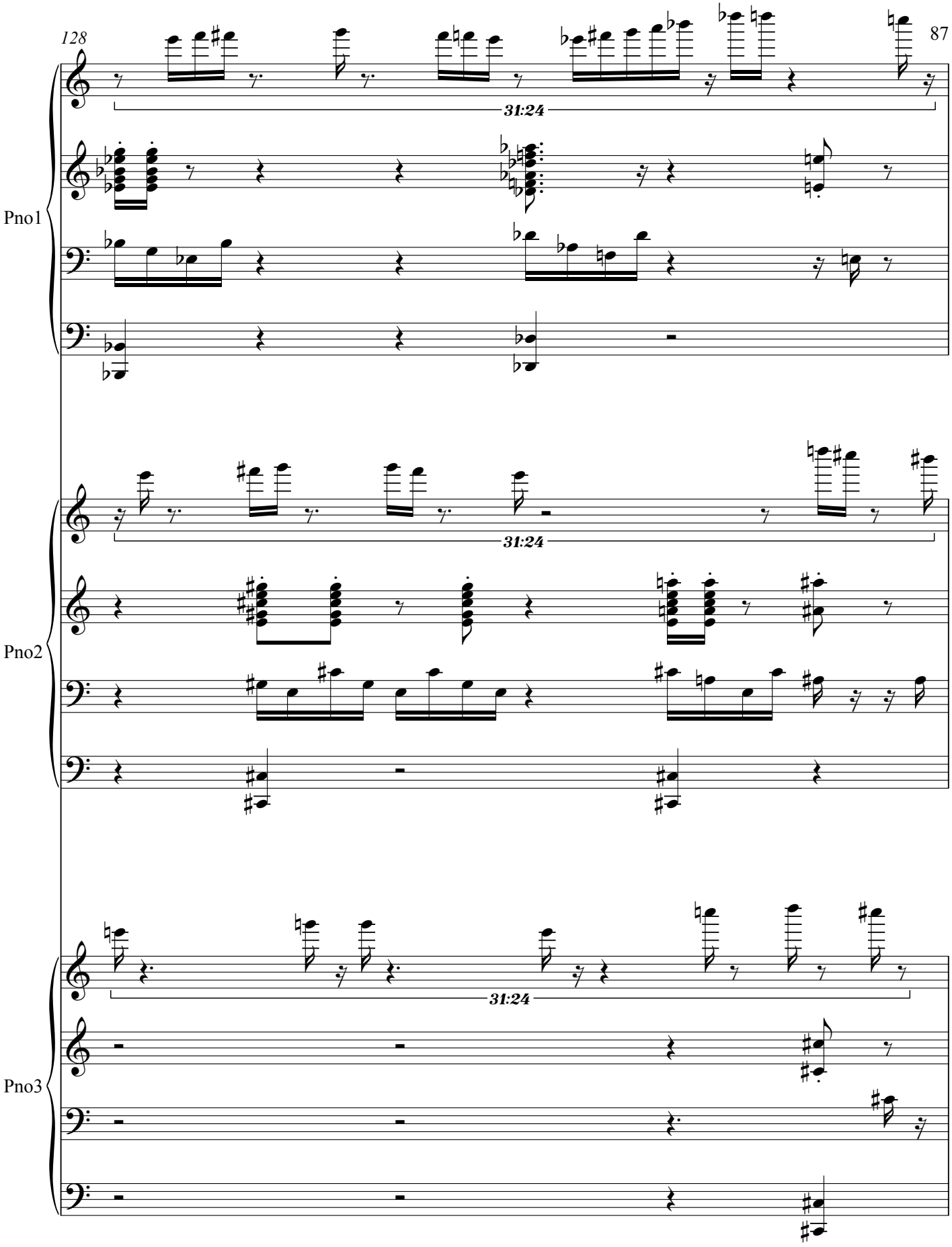

121
♩ = 91
Pno1
Pno2
Pno3
mp
19
17
122
♩ = 126

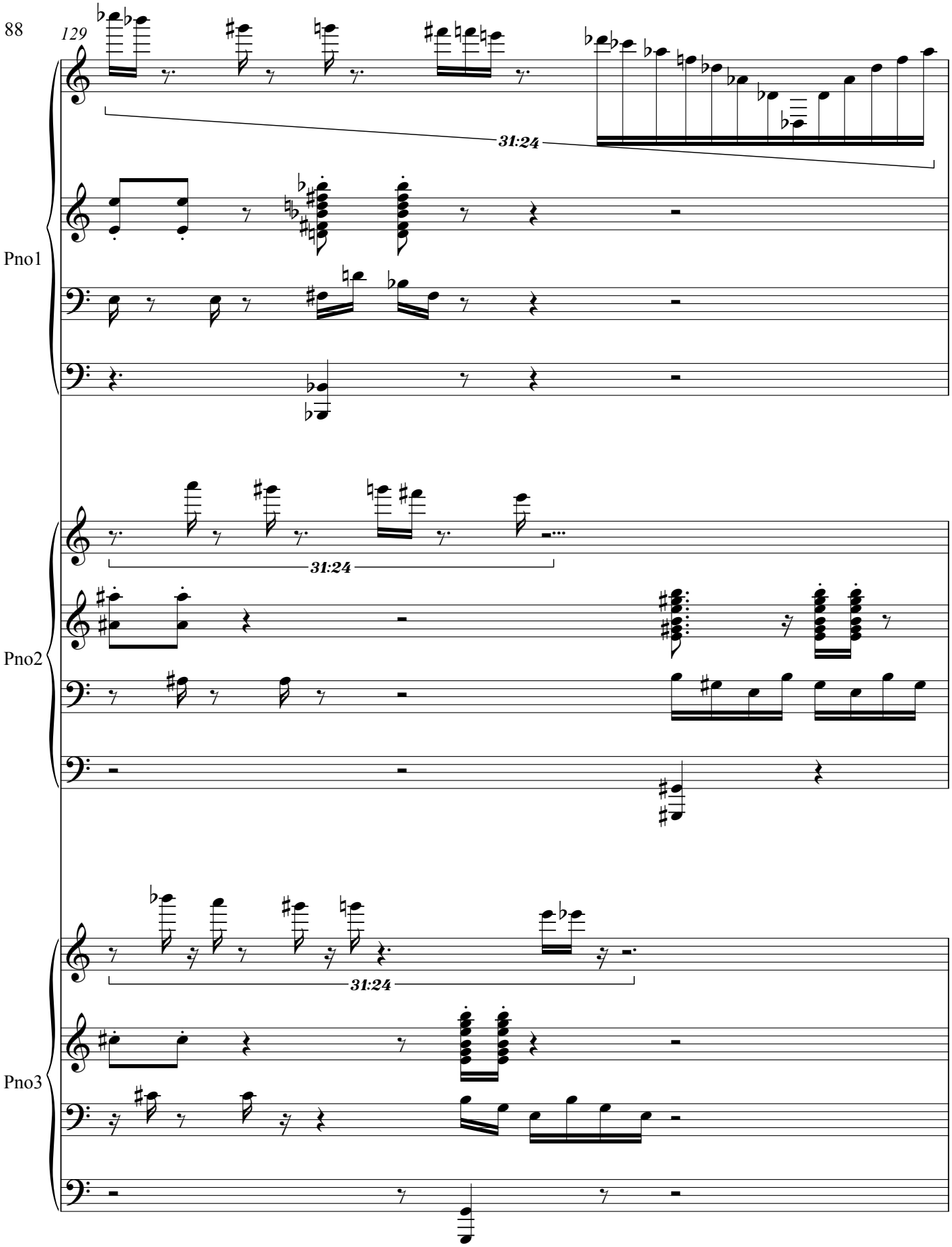

123
♩ = 175
Pno1
Pno2
Pno3
7
28:15
♩ = 175
5
26:15


124
♩ = 54
mp
mf
Pno1
mf
mf
mf
Pno2
mf
♩ = 54
Pno3
mf
mf


31:24
f
Pno1
ff
f
ff
31:24
f
Pno2
ff
f
ff
31:24
f
Pno3
ff
f
ff


127
31:24
Pno1
31:24
Pno2
31:24
Pno3


31:24
Pno1
31:24
Pno2
31:24
Pno3


129
31:24
Pno1
31:24
Pno2
31:24
Pno3

130

Pno1

31:24

13:11

Pno2

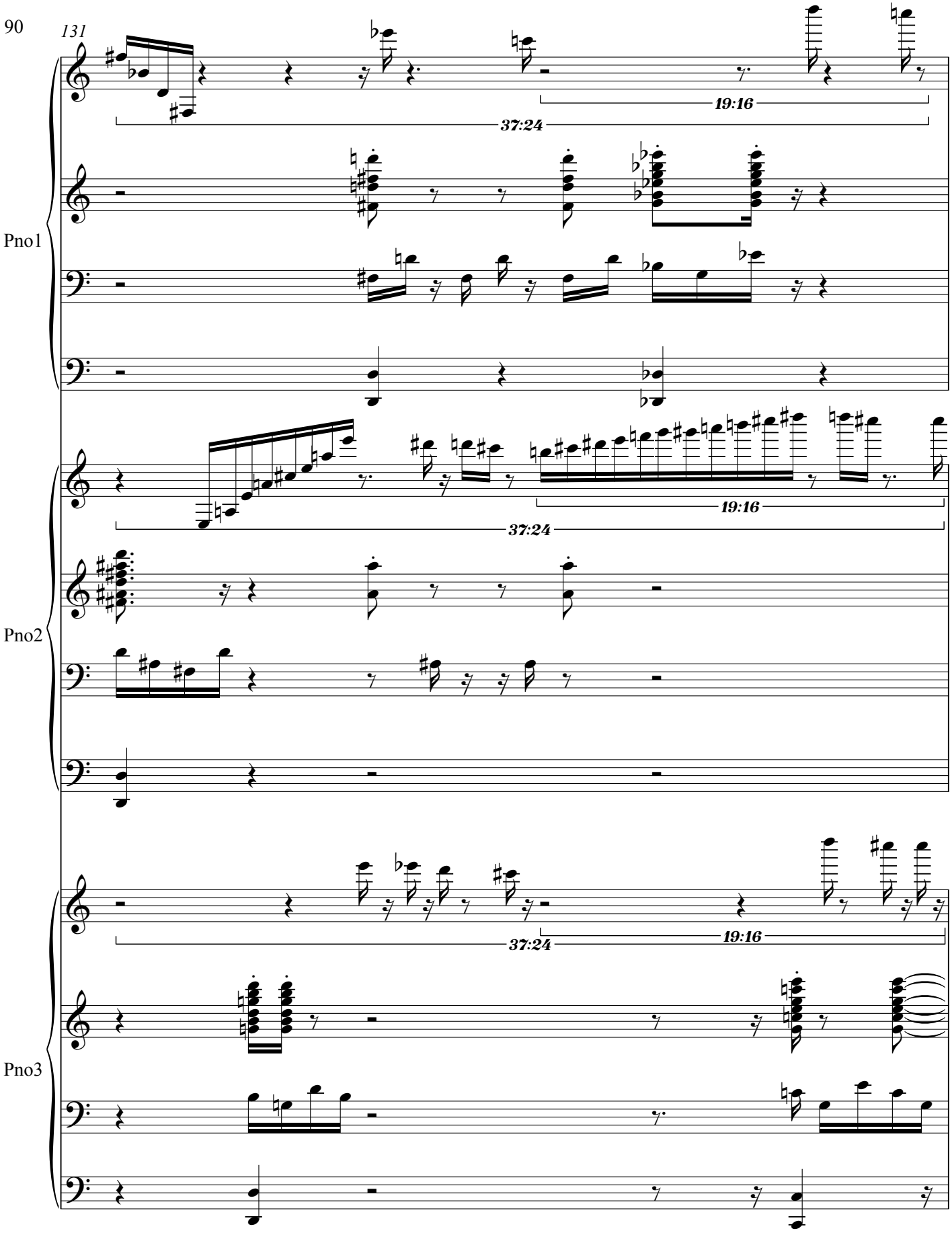
31:24

13:11

Pno3

31:24

13:11

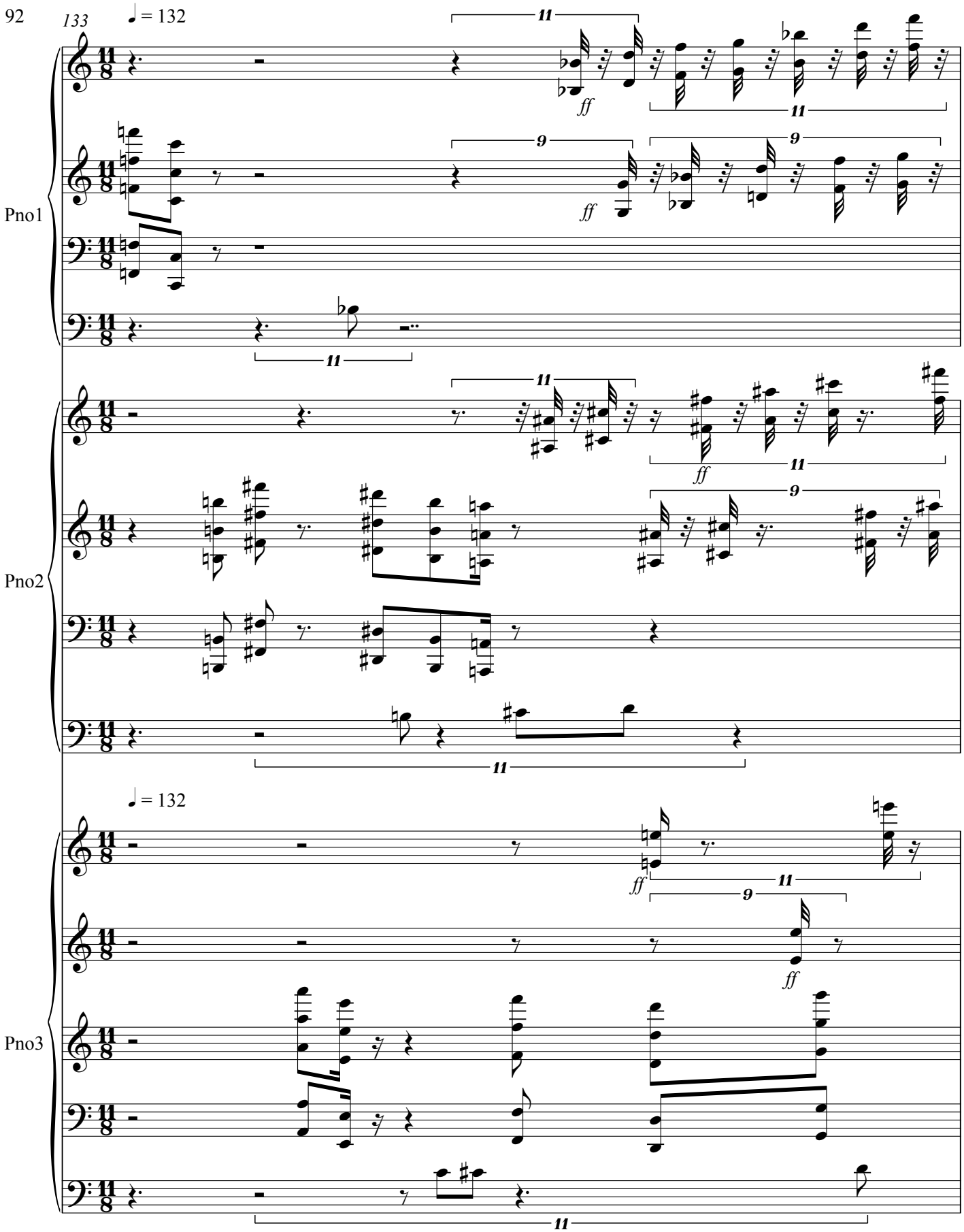

131
Pno1
37:24
19:16
Pno2
37:24
19:16
Pno3
37:24
19:16

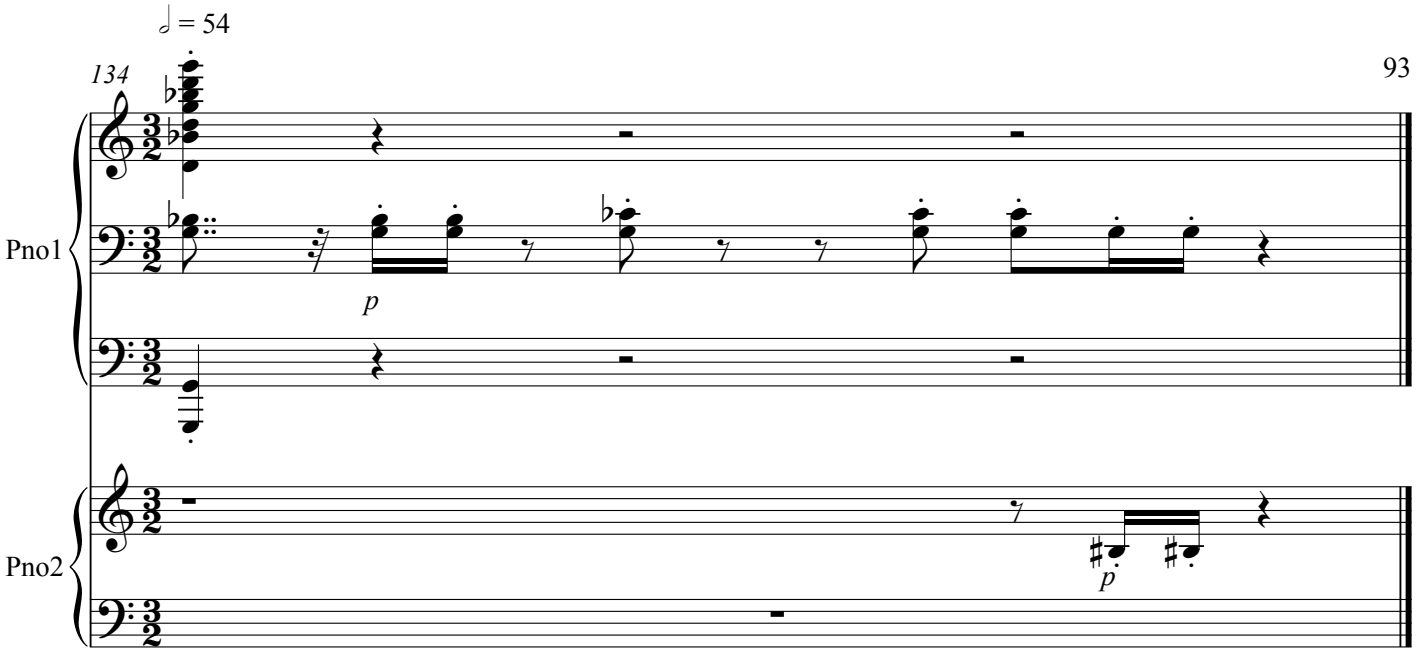
132

Pno1

Pno2

Pno3


133
♩ = 132
Pno1
Pno2
Pno3
ff
11
9



April 24 - May 25, 2017
Germantown, NY