Vox Machina

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ABSTRACT

Vox Machina, for soprano, chamber ensemble, real-time digital signal processing and digital sounds, deals with the historical relationship between humanity and machines. The text uses excerpts drawn from a variety of sources, all in the public domain, as well as material written especially for the piece by the composer. The instrumental ensemble consists of 8 performers: flute, b-flat clarinet, horn, violin, viola, cello, guitar and percussion. A conductor is required, as well as a technician to control a mixing board and the performance of computer-generated sections of music. Digital sounds may be performed directly from computer, or may be played from DAT cassette.

Vox Machina, pour soprano, ensemble de musique de chambre, traitement numérique des signaux en temps réel et sons numérique, traite des relations historiques entre l'humanité et les machines. Le texte utilise des extraits qui proviennent d'une varieté de sources du domaine publique. aussi bien que du matériel écrit par le compositeur. L'ensemble conprend 8 instruments: flûte, clarinette en si bémol, cor, violon, alto, violoncelle, guitare et percussions. Il faut un(e) chef-d'orchestre, aussi bien qu'un(e) technicien(ne) pour contrôler une console de mixage et l'exécution des sections de musique générées par l'ordinateur. Les sons numérique peuvent être joués, soit directement de l'ordinateur, ou à partir d'une cassette DAT.

Acknowledgements

I was very fortunate to receive a great deal of assistance from many sources in the preparation of this thesis. First of all, I wish to thank Professor John Rea for the guidance he provided during the writing of this piece, and throughout my program of study. Professor Bruce Pennycook also gave valuable advice concerning technical considerations Several pieces of custom software were written for this piece by McGill graduate students studying computer applications in music, including Kharim Hogan, Jason Vantomme, and a major program for mixing soundfiles on Macintosh computers by Dale Stammen. Most of the work on *Vox Machina* was done at McGill University, however I would also like to thank Robert Rosen of the Banff Centre for the Arts, and Gordon Rostoker of the Canadian Network for Space Research at the University of Alberta, Edmonton, for allowing me access to their facilities during the summer of 1993.

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INTRODUCTION

Vox Machina deals with the changing relationship between humanity and machinery. The title makes reference to two historical developments. The first is the "*vox humana*" stop on early pipe organs. Intended to imitate the human voice, this stop represents one of the earliest attempts by mankind to replicate itself musically through technology. A direct line may be drawn from this development to the sophisticated sampling and sound-manipulation methods of present-day digital *musique concrête*. The second is the the technique of "*deus ex machina*" used in ancient Greek dramas. Literally translated at "God from the machine," this expression refers to the appearance of Apollo, descending in a chariot from above the stage, to decide the outcome of a play. While such a mechanical resolution of a complex plot may seem almost comical to us today, a parallel exists between this antique theatrical device and the modern belief that the world's problems could easily be solved if only the appropriate technology could be developed.

The following analysis will take a topical, rather than a time-line, approach to *Vox Machina*. Text, duration, pitch content, texture, and synthesis techniques will be discussed in relation to the overall structure of the piece. The principal concern will always be the connection between musical parameters and thematic development.

TEXT

The text for *Vox Machina* is a montage of extracts from various sources, with additional material written by the composer. Primary consideration was given to the development of a concise, thematically-integrated text. As a result, little importance was placed on the original context of the excerpts used, and the passages may have been edited or utilized in a way that distorts their initial meaning. The extracts are thus treated as "found objects," and their manipulation is analogous to that of sound samples taken from the environment for *musique concrête*. In both cases it is the meaning of the samples in the context of the piece *itself* that matters, and it is not always desirable for the audience to identify the original source.[1]

Vox Machina divides thematically into six distinct sections.[2] A main body consisting of four smaller sections is framed on either side by a prologue and an epilogue. As will be discussed later, these are also differentiated in terms of overall formal design and texture. The inner sections have titles that refer to their overall themes: "The Nature of the Machine," "Humanity and Machine," "Sensual Machine," and "Consequences." The textual development of each of these sections, and of the prologue and epilogue, will be discussed in turn.

The prologue evokes a time when machines were reserved almost exclusively for the use of God. In Latin we are told that the human race is not able to understand nor to explain the machinery God uses to accomplish His work. Significantly, this statement assumes both that God performs physical actions upon the world, and that God relies upon machinery to carry out His will. In order to discover the nature of God's work, we turn to the Biblical Book of Job, in which God speaks to Job out of a whirlwind. This extraordinary Old Testament passage is almost a definition of godhood. A distinction is made between humankind's inability to influence the physical world, and God's power to

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[1]For example "it's a train!" or "it's Shakespeare!" This may interrupt the listener's concentration by momentarily taking focus from the continuing piece.

[2]The complete text with original sources identified and English translations is given in the Appendix.

affect all things. This includes the capacity to measure the exact proportions of the earth, to descend into the ocean, to change the weather, and to control lightning. The irony of this excerpt is that today we are able to meet God's challenge to Job. Humanity can do all of these things and more, using *its* machinery. The passage continues by asking who has given us our intelligence and our sense of self-awareness. This is a far more difficult question, and one that is unlikely to be resolved solely with the help of machinery.

The first section of the piece explores "The Nature of the Machine." In other words, what are the distinguishing characteristics of machinery? What is it that *defines* a machine? The views presented are deliberately objective. Machines are first characterized as being repetitive: "the machine that repeats its movements without faltering is as simple as a child repeating a prayer."[3] Thus a machine is periodic, uncomplicated, and even innocent. Like the child at prayer, a machine cannot possibly have malicious intentions. Needless to say, this is an extremely benign view of technology.

The following portion of text says that a machine needs no purpose. Unlike a tool, which is defined by its purpose, a machine is only required to carry out a particular action over and over again. A good illustration of this characteristic is the perpetual motion machine. Great scientists devoted years of their lives to a futile search for a machine that would do nothing useful, but would do it forever The text continues with a comparison of the human heart to a machine. Here the focus is on the inner workings of machinery. In the heart, as in a watch, many smaller parts are interconnected and work in an interlocking manner to produce a single action. This interdependency is fragile; if only one element fails to perform correctly, the entire unit cannot continue to operate. However, the consequences of the failure of the heart are much more serious than merely causing that organ to be unable to function It is not just the complex system of the heart

[3]Franz Hellens, "Simplicité," in *The Poet and the Machine*, Paul Ginestier translated from French by Martin B. Friedman. Chapel Hill: University of North Carolina Press, 1961, 20.

of the body that will die.

The brief excerpt which follows presents machinery in an almost pastoral setting. The dreamer who sits under the station lights and imagines that the plumes of steam rising from a train are lilies could easily be transported to a star-lit hillside, where clouds take the shape of flowers. Again, machines are seen as innocuous, and even pleasant to contemplate.

The next passage addresses technology's ability to inspire fear. In the nineteenth century the Luddites entered factories and destroyed equipment in an attempt to protect their way of life. In the light of this aggressive behavior, the lack of technology is depicted as an aspect of barbarity. Civilized societies rely on machines to lift them out of the depths of savagery.

After this, machines are once more compared to a living organism, this time a snake. The complex inner movements of a machine are likened to the writhing of a serpent This metaphor also alludes to the snake in the Garden of Eden, who tempted humanity with the forbidden fruit of knowledge. As well, there is a suggestion that machines are in some way superior to humanity. When compared with the complexity of a finely made machine, the human frame seems poorly constructed. In this comparison there is an insinuation that it is possible for people to make machines that go beyond human capabilities. While machines have long been able to exceed humanity's physical abilities, we are now able to take advantage of machines that go beyond our mental abilities. In fact, researchers into artificial intelligence have designed neural networks that are able to learn more than just the set of instructions that were originally programmed into them. Will we someday be able to build machines that will be self-aware and able to acquire knowledge of their own volition and at a higher level than us?

Section 1 ends with another machine/animal metaphor. Great steamships in a harbor are depicted as birds floating in a garden. The sound of the boat horns is equated with the

cry of water fowl. Here excerpts from two different sources are juxtaposed to supply the words that come from the lungs of the ships. They tell us that the entire universe is itself nothing more than a machine designed to manufacture gods

The next large section, "Humanity and Machine," begins in almost the same manner as the first. The machinery operating in a metal refinery is described. At the end of the passage, however, the focus shifts from the machines to the people who run them. The man operating the machine spends all of his day in an environment dominated by noise and heat, yet his mind is filled with thoughts that go beyond his surroundings He dreams of mankind's capacity for love, of the love which God holds for humanity, and of the way that this love could transform the world It is implicit that the changes the worker anticipates include escape from the domineering machines of his workplace

Continuing on, the emphasis remains on the factory laborer. Just as the machine was previously described in animal terms, the human animal is now portrayed as a machine. Unlike the equipment that the worker operates, however, the human machine has the capacity to feel pain, fatigue, and despair. The machine, whose objectivity was previously described as almost benevolent, continues to run, forcing the worker to carry on despite the hardship.

The following passage presents the possibility of a human taking on the characteristics of a machine. And in turn, the breaking of the human spirit parallels the machine breaking of the Luddites. Charles Darwin's statement that the circumstances of his life have inhibited his ability to appreciate humanity's artistic creations forms the focal point of the final text of the section Darwin feels that he has become machine-like in his thoughts. Perhaps this is the greatest danger we can imagine that rather than us making machines in *our* image, they will remake us in *their* image.

"The Sensual Machine," returns to centre on machines and the awe that their power can instill in us. The text of this section describes machines in rapturous terms, which border at times on the erotic. The first excerpt gives a description of the workings of an

engine in which the individual parts push and penetrate each other in an orgy of motion; all of the components spit in each other's mouths. Walt Whitman's description of a train could at times be mistaken for a poetic representation of the male sexual organ. From trains to sports cars to ultra-fast computers, powerful machines have the ability to infuse humans with a sense of ecstasy.

The result of our love affair with technology, however, is that we sometimes do not consider the possible complications. It is this potential for extreme danger to us and our world which is raised in "Consequences," the final section of the main body of the piece. The text is fragmented and apocalyptic. The image of a dark world in which every element of nature has been damaged by machinery dominates section four. Machines have destroyed the world and will soon turn on their creators, destroying humanity as well. The text has now come full circle from the innocuous view of machines presented in section one. Whereas machines were seen to have no goals or direction of their own, it is finally recognized that it is people who must choose the purposes to which technology will be put.

The epilogue that follows presents a world that is the inverse of that described in the prologue. It is an environment in which humanity, not God, has worked its will upon the earth with the aid of machinery. The Latin phrase that is spoken by the soprano, and then by the machines, says that not even God tries to effect great changes in a short span of time. Humanity's exploitation of technology has likely altered the world more in the last century than in all the rest of human history. The rate of change has increased exponentially, as is illustrated by the evolution of the computer chip. In 1971 the first chip introduced by Intel Corporation contained 23,000 transistors. This number has doubled approximately every two years until the most recent chip to be introduced contains three million transistors.[4]

The overall thematic development of the text moves from an objective description of

[4]Wayne W. Brideaux "The Pentium Chip - Taking Care of Business" in *The Computer Paper*, Volume 6, No. 8, August 1993. pp 27-8.

the characteristic features of machines to an ominous premonition of a world destroyed by machinery. The prologue and epilogue are concerned with the relationship between God, humanity, and technology. The four sections of the main body of the piece alternately focus on machinery and humanity. The first section defines what a machine is, the second explores the connection between humanity and machinery, the third looks at machines as sensual objects, and the last describes the consequences for humankind of uncontrolled technological advancement.

DURATION

The consideration of duration in music covers a wide spectrum of phenomena, from surface rhythmic organization to the largest overall structural elements. The following discussion will first identify the proportional system of *Vox Machina*, and will then deal with the grouping of temporal units, progressing from the extreme background to foreground rhythmic details.

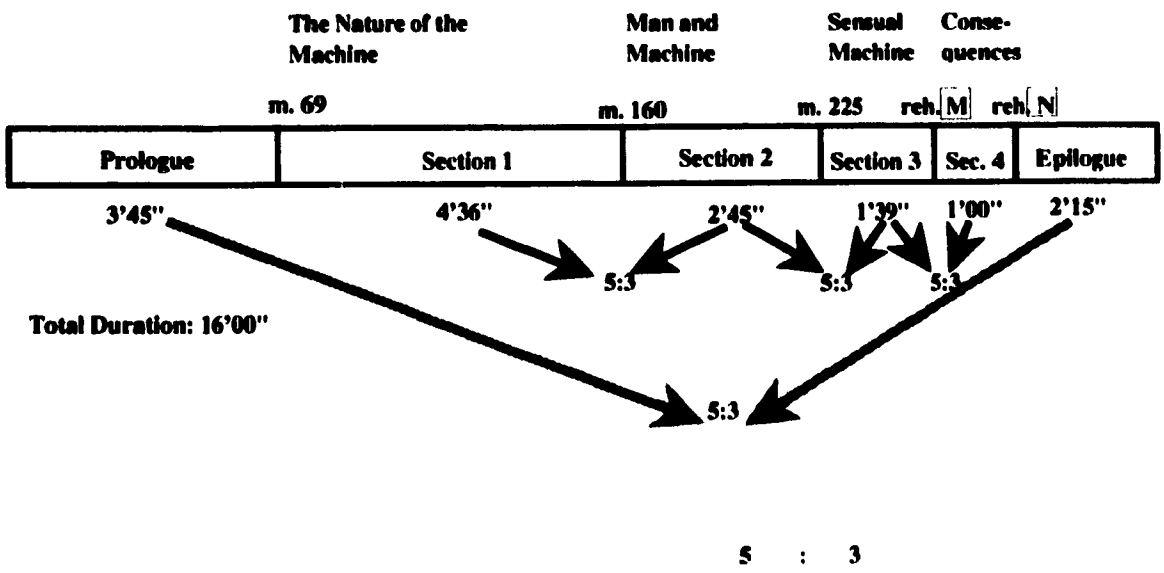
The ratio 5:3 completely saturates all the structural levels of the piece. This ratio was chosen for several reasons. First, it is drawn from the Fibonacci series and therefore approximates the ratio of the golden section,[5] which has a long history of creative applications in both visual and musical arts. Second, it is a ratio of two integers, which simplifies the calculation of durations. To find the 5:3 division of a given span of time, the total duration is divided by 8 and the result is multiplied by 5. As well, the length of the second section may be derived from the length of the first by multiplying by .6. Third, it is a ratio that translates to relatively simple foreground rhythms and cross-rhythms, as opposed to, for instance, the ratio 8:13, which is the next pair that occurs in the Fibonacci series.

Before continuing, it will be necessary to consider the degree of accuracy used in determining durations. It is not always possible to make a completely precise temporal division. For example, the point dividing a section consisting of 115 quarter note beats into two parts having the ratio 5:3 occurs at beat 71.875. This point does not correspond to a division of the beat by any integer less than 12, which might be considered the smallest desirable division, depending on the tempo of the section. A reasonable approximation must be found. This figure could be rounded off to 71.75 (71 quarter notes plus a dotted eighth note) or to 71.83333 (71 plus 10 thirty-second notes, grouped 12 to the beat), or simply to 72. In *Vox Machina*, the degree of precision depends on the

[5]The proportion between two units in which the ratio of the whole to the larger part is the same as the ratio of the larger part to the smaller.

length of the overall section: the larger the span of time being divided, the greater the amount of imprecision allowed. This mirrors our ability to perceive duration. We are less able to distinguish between varying units of time as their length increases. As well, the probability of fluctuations in a performer's tempo increases over time. Thus the rounding off which occurs at the background formal level may be to the nearest quarter note, while that which occurs at the foreground may be to the nearest sixteenth note. This must be borne in mind in the following discussion of the formal plan of *Vox Machina*.

At the highest level, the piece divides into two sections: a main body and a prologue/epilogue. These coincide with those mentioned in relation to the organization of text. As EXAMPLE 1 illustrates, the ratio of the duration of the main body of the

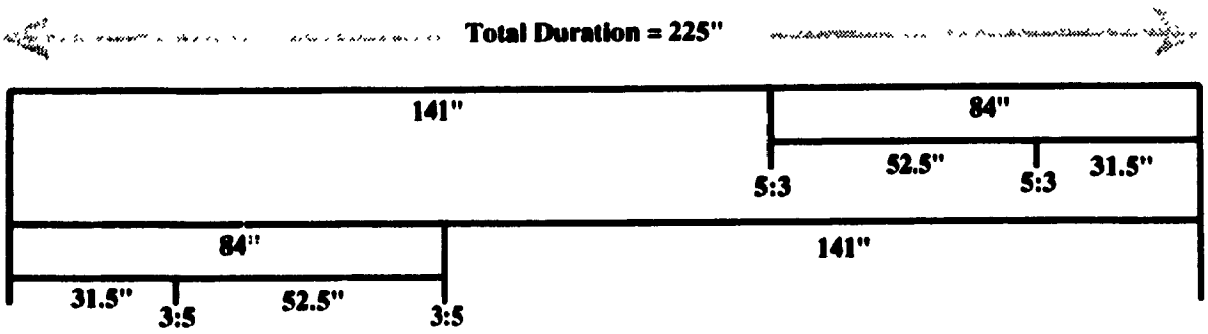


EXAMPLE 1: *Vox Machina* Formal Plan

piece to the combined durations of the prologue and epilogue is 5:3. This ratio also applies to the durations of the prologue and epilogue. The main body of the piece divides further in 4 sections, each of which is in a 5:3 relationship with its neighbor. In other words, the duration of section 2 is equal to 60 per cent of section 1, and in turn, section 3

is equal to 60 per cent of section 2. The same holds true between sections 3 and 4. The continually decreasing lengths of the sections mirrors the increasing rate of development of new technologies throughout history. Of course, the latter has increased exponentially, while the formal divisions of the piece decrease in length by a constant ratio.

These large sections further divide into smaller formal units,[6] again using the 5:3 ratio. The prologue, concluding at 68-3,[7] has a total duration of 225 seconds and contains two main parts. An abrupt change in character at 50-0 marks this division. The beginning of the second part occurs at 141 seconds, which divides the prologue into



EXAMPLE 2: Prologue

two units having the relationship 5:3.[8] A significant division also takes place at the

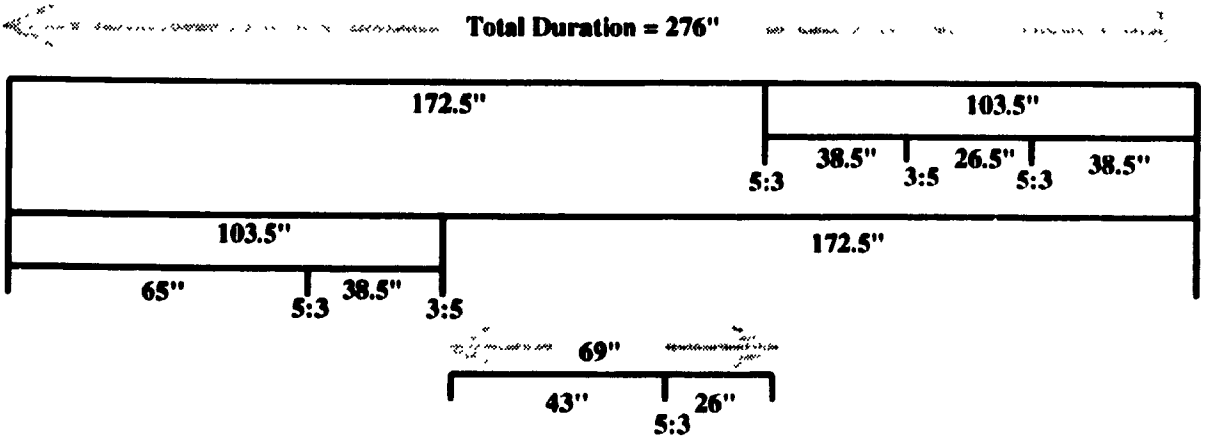
[6]In this discussion of duration, the use of the word "section" will be reserved only for the four sections making up the main body of the piece. Subdivisions of the sections will be designated in other ways (ie. part, unit, etc.).

[7]Throughout this paper the form "measure number-beat number" is commonly used when designating temporal location. Note that the beat number always includes the entire beat from beginning to end, unless otherwise specified. The downbeat of a bar is indicated as 0, while portions of beats are shown as fractions.

[8]Duration in seconds of a given section of music may be determined in the following manner: 60 is divided by the metronome marking and the total number of beats is multiplied by the result, giving the exact duration. For example, the first 19 measures are in 12/8 time at a tempo of 54 to the dotted quarter note, giving a total of 76 beats. The ratio between the duration of one beat at 54 to one second is obtained by dividing 60 by 54, giving 1.1111. Thus by multiplying the number of total beats (76) by this ratio we arrive at the total duration of the first 19 measure: 84.44444, which is rounded off to 84 seconds. Using the same process it may be determined that the next 30 measures have a duration of 57 seconds, giving a total duration to the end of measure 49 of 141 seconds. If the total duration of the prologue is 225 seconds then the point corresponding to the ratio 5:3 equals (220/8)*5, or 140.625, which is rounded off to 141 seconds.

point which divides the prologue at the inverse of this ratio, or 3:5. This occurs in the first part of the prologue at the downbeat of measure 20, and is marked by a change of tempo and the introduction of the flute. The preceding 19 measures, lasting 84 seconds, divide at their 3:5 point at 7-4, corresponding to the entry of the voice. The second part of the prologue is divided at the 5:3 point of its duration at 59-4, distinguished by the culmination of a long crescendo. As EXAMPLE 2 illustrates, the overall organization of the prologue is symmetrical; the consecutive durations are the same reading from beginning to end and from end to beginning.

Section 1, beginning at 69-0 and ending at 159-4, has a total duration of 4'36", making it the largest formal element of the piece. Together with the prologue it makes up just over half of the total duration of *Vox Machina*. Section 1 contains 6 smaller units.

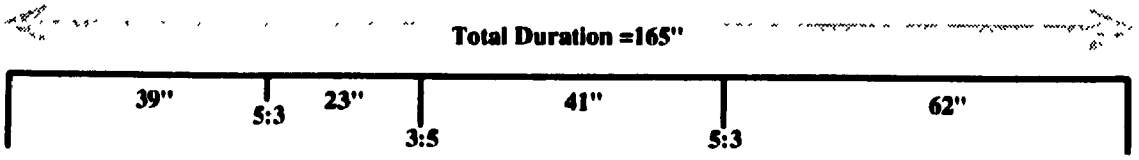


EXAMPLE 3: Section 1

The first of these is characterized by a collection of 5 simultaneous ostinati and ends at 99-4, which is the 3:5 point of the entire section 1. This first unit divides at its 5:3 point at 88-1.5, where the voice changes its style of singing from detached to legato. The next two units occupy the space between the 3:5 and 5:3 points of section 1, from 100-0 to

124-4. They separate this region into parts related by the ratio 5:3 at 117-2. At this time there is a sudden change from a complex to a simple texture. Unit 4 begins at 125-0, or the 5:3 juncture of section 1, with a sudden sforzando attack in the horn, guitar, and percussion. The final 3/8ths of this section is partitioned at 139-3 (3:5) and 148-0 (5:3) corresponding to the beginning of units 5 and 6. The former is marked by the entry of the strings, and the latter by a change of tempo and the use of a lower register.

The sound of machine noises beginning on the downbeat of measure 160 ushers in the next large-scale formal element. Section 2 has a total duration of 2'45". The 3:5 point



EXAMPLE 4: Section 2

occurs at 184-2.5, where the strings enter with the tremolo chord, while the 5:3 division takes place at 201-.5, coinciding with the start of the second segment of digital sounds. The change from narration to singing that occurs at 175-2.25 corresponds to the 5:3 partition of the region from 160-0 to 184-2.5.

The final two sections of the main body are too short to include any major divisions. Each represents a single unified formal element, where the 5:3 ratio is most apparent between the sections themselves. The only exception occurs at the 5:3 point of section 3, when the instrumentalists stop following the conductor and begin their individual crescendos and accelerandos.

The epilogue, which consists entirely of digital sounds, has two significant divisions. The total duration of 135 seconds is divided at the 3:5 point (50.625 seconds precisely) by the sudden forte entrance of the speaking machines all combined and stretched out

past the point of legibility. There is a brief break from these sounds and then they reenter at the 5:3 point (84.375 seconds), this time staggered and more intelligible.

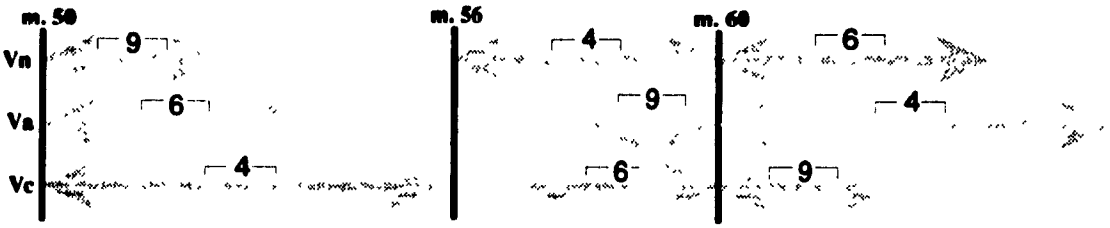
Having dealt with duration at the background and middleground structural levels, we now turn to the foreground rhythmic features of the work. These are again based to a large degree on the 5:3 ratio. To begin with, a numerical series was constructed from which many rhythmic groupings could be developed. The series is <25,15,9,5,3>. It maintains the ratio 5:3 between each adjacent value, except the pair 9 and 5. Multiplication of 9 by .6 yields the number 5.4, which is rounded off to 5 to allow for integral durations (ie. 5 sixteenth notes, rather than 5.4), and also to permit the series to continue on to 3.

Durations are derived from this series in several ways. The clearest manifestations are rhythmic lines which take their values directly from it, either forwards or backwards. The horn part beginning in measure 52 is constructed of groupings of sixteenth note quintuplets according to the plan 15-9-5-3-5-9-15-25. Each pair of durations moves linearly within the original series. From 164-3 to 171-1 the horn again takes its rhythmic values from it. The vocal line starting at 74-4 consists of single staccato notes separated by silences whose lengths are chosen as values of sixteenth rests in the succession 25-15-9-5-3, and then, beginning at 79-2, the series is reversed as 3-5-9.

The original series may also be overlapped with its inverse. For example, the string parts beginning at 50-0 are all built using the overlapping progression 25-3-15-5-9-9-5-15-3-25, where the odd-numbered elements are the normal order and the even-numbered elements are reversed. These two layers are differentiated in the following way: the decreasing series consists of separately articulated notes, while the increasing series consists of held notes. Thus, the overall character of these lines is of diminishing activity. By assigning a different rhythmic subdivision to each of the string instruments using this overlapping series, a very complex texture is created out of reiterations of the same basic proportional relationships. The violin plays the series based on groupings of 9

thirty-second notes per beat, the viola uses sixteenth note sextuplets, and the cello uses straight sixteenth notes. At the same time, the tom-toms use the series 15-3-9-5-5-9-3-15 in a similar way, subdividing the beat into sixteenth-note quintuplets.

This process occurs twice more in the prologue. At 56-5 the process is reversed, with the diminishing pattern occurring in the held notes and the ascending occurring in the articulated notes. Here the overall character is an increase in rhythmic activity. At 60-0 the original series is repeated again as at measure 50. In each of these three sections, however, the organization of rhythmic subdivisions is varied so that each member of the string trio plays all three groupings: regular sixteenth notes, sextuplet sixteenths, and nine thirty-seconds per beat. This disposition is shown in EXAMPLE 5.



EXAMPLE 5: Rhythmic Organization of Strings in Prologue

The combination of the original series with its inverse occurs frequently throughout the piece, with the two versions distinguished in a similar manner: one articulating all of the rhythmic units, and one holding a single note for the given duration. The percussion part at 160-0 uses the series 25-3-15-5-9-9-5-15-3-25, and this time the two processes are also highlighted by a change of timbre. Articulated notes are played on the tom-toms, while held notes are executed on the bass drum and cymbal. The strings use the same durational scheme from 208-2 to 225-1, first the cello, then the viola, and finally the violin.

This same section demonstrates another usage of the series: cross-rhythms. The cello enters at 208-2 with durations derived from triplet eighth notes. At 216-2 the viola enters

with the same rhythmic proportions as the cello, but based on quintuplet sixteenth notes. Finally, a subdivision of nine thirty-second notes is used as the basis for the rhythmic proportions of the violin at 220-0. The values of these subdivisions are taken from the last three numbers of the series, 9-5-3, and thus maintain the approximate ratio of 5:3 between their speeds and their durations. The entrance of the instruments is also staggered such that each begins at the 5:3 point of the total duration of the previous line.

Another example of cross-rhythms based on the 5:3 ratio occurs between 125-0 and 139-3. Here the guitar plays a chord every 7 quintuplet sixteenths, while the percussionist plays a cymbal stroke two quarter notes apart. These parts coincide each measure and a half: that is, every 5 guitar chords and every 3 cymbal notes. As well, the horn in this section articulates every 6th triplet eighth, creating an overall 5:3 cross-rhythm with the pulse, which is clearly heard in the flute and clarinet.

Durations of individual notes may also be taken out of the context of the series. In other words, the ordering of the series is not maintained. The flute and clarinet parts beginning at 50-0 are grouped in values of 10 thirty-second notes to the beat in the following way: 5-3-5-5(rest)-9-9(rest)-5-3-3(rest)-9 etc. Most of the durations used in the vocal line from measure 8 to 19 are also taken from the series: for example, the values used in measures 15 and 16, counted in eighth notes, are 3-5-3-5-3.

An interesting application of the series occurs in the first unit of section 1, from 69-0 to 99-4. In this section five ostinati are overlaid, each having a different length measured in quarter notes. The percussion ostinato repeats every 25 beats, the strings every 15, the woodwinds every 9, the guitar every 5, and the horn every 3. These ostinati begin in an incomplete form and are filled in at approximately measure 85. A similar process takes place in section 3, which is entirely made up of repeating patterns of 3, 5, 9, 15, and 25 sixteenth notes. The complete form of these ostinati is given later in this paper as part of the discussion of pitch organization.

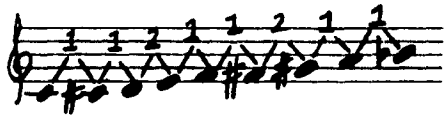
Another rhythmic aspect of *Vox Machina* is the use of speech rhythms in the vocal

part. Much of the rhythm of the soprano part results from a translation of the cadence of the excerpts as they are spoken into musical notation. This applies to the passages in which only rhythm is notated, as at measure 52, as well as to some sections notated with pitch, such as 218-25. Of course, those excerpts without rhythmic notation will also be performed using the performer's own speech rhythms.

Finally, *Vox Machina* contains a prominent rhythmic motive. This appears for the first time in the guitar in measures 5 and 6. It consists simply of three repeated notes: two short and one long. Especially in those passages which describe the interconnected workings of a machine, this motive is often at the forefront of the musical texture. The horn ostinato as seen in measure 85 consists of a repeated pattern of two sixteenths and an eighth, while the flute and clarinet at the same point use fragments based on groups of three notes. From measures 126 to 139 the flute and clarinet use interlocking gestures entirely made up of two sixteenths and one eighth. Finally, every instrumental part in section 3 is exclusively composed of patterns of three repeated notes.

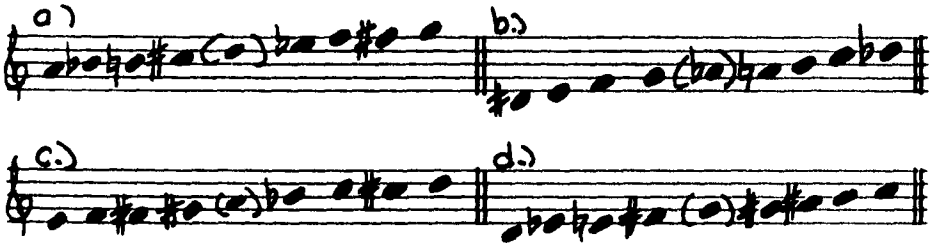
PITCH

Pitch organization in *Vox Machina* is based on the 9-note collection given in EXAMPLE 6. This set is inversionally symmetrical. In other words, its intervallic pattern is the same ascending as it is descending. As a result, only 4 distinct versions of the set are possible; it replicates itself exactly at transposition by multiples of 4 semitones.



EXAMPLE 6: Basic Pitch Set of *Vox Machina*

Two transpositions of this set dominate the piece. These are given as EXAMPLE 7a and b. Notice that they are spaced symmetrically around either *d* or *a-flat*. These central pitches are sometimes omitted from a passage, leaving only 8 notes. Transpositions c and d also occur at various times, but always in conjunction with the two principal versions.



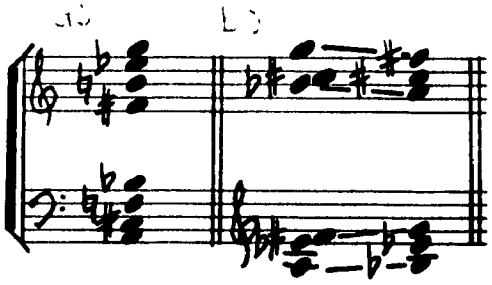
EXAMPLE 7: Four Possible Transpositions of Source Set

Harmonic organization on the surface of the music is often symmetrical, again with *d* and *a-flat* as the centers of symmetry. These two pitches act as poles to which the harmony is anchored, further limiting the pitch structures of the piece and thereby increasing the coherence of the musical materials. The voicing of chords is based upon

the tension inherent in the interval of a minor 9th. This interval is extremely dissonant, and has a strong resolution tendency. Aurally, a minor 9th tends to create the expectation that it will resolve to an octave. Either the lower note can move up a semitone, or the upper note can descend. In *Vox Machina*, it is common for both of these tendencies to be realized at the same time, yielding a major 7th. Again, the upper note of a major 7th tends towards a resolution up a semitone to create an octave, while the bottom note tends to downward movement. If both resolve, the interval returns to a minor 9th. In this way a dynamic tension is achieved in which there is a constant oscillation between the two intervals. This tension is increased when two minor 9ths are combined, resolving to two major 7ths, as in EXAMPLE 8. This is the characteristic harmonic sonority of the piece. It may be seen in exactly this form in the guitar part of measures 2 and 3. Here, the last beat of measure 2 resolves to the broken chord of the first two beats of measure 3.

EXAMPLE 8: Minor 9ths Resolving to Major 7ths

Often the dissonance of this combination of intervals is mitigated by the addition of other notes which create a more consonant adjacent interval content. Typical voicings are given in EXAMPLE 9.



EXAMPLE 9: Characteristic Voicings

EXAMPLE 9a contains only major 3rds, perfect 4ths, and a minor 6th. In this version the chord is symmetrical around *d*, but it may also be transposed so that *a-flat* is its center of symmetry. This chord does not actually appear in this form in the music. Instead, its upper and lower tetrachords occur alternately in the guitar part at, for example, measures 20 and 21.

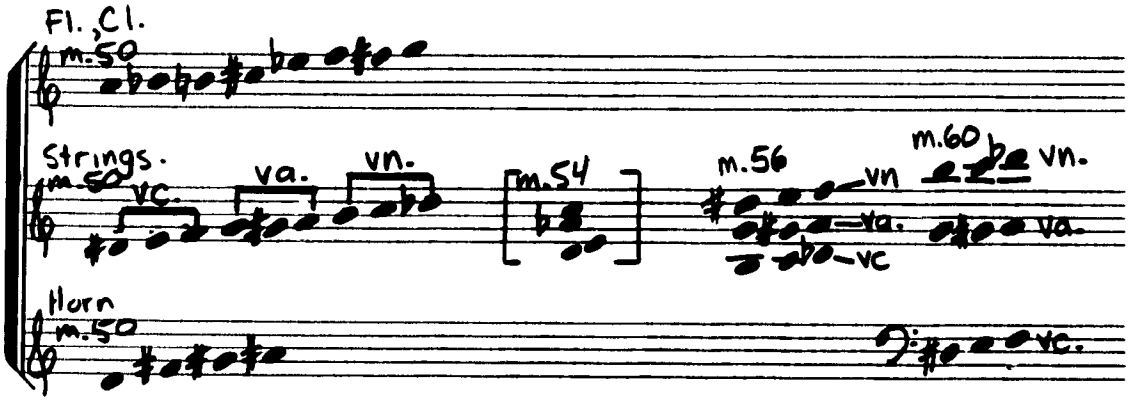
EXAMPLE 9b occurs more frequently throughout the piece, by virtue of the fact that it is easily performed by string trio. It appears for the first time from measures 45 to 49. The chord with its resolution is presented in measures 184-190. This pairing also takes place in measures 100-103 first in open voicing, then transposed, and finally in its principal form. The two-chord progression is expanded to four in the following measures. As EXAMPLE 10 demonstrates, this larger progression is also symmetrical and is based upon semitonal 4-part voice leading (the two added pitches remain constant). Measures 100-117 repeat this progression, first as solid chords, and then - at 112-4 in the string parts - as broken chords. The same progression is repeated at a lower pitch level in four voices from 148 to 156. Here the upper and lower dyads are staggered and the rhythm is augmented.

EXAMPLE 10: Four-Chord Progression

It should be noted that whereas the above passages omit the note forming the center of symmetry, this pitch is sometimes provided by another part. In the section beginning in measure 125, for example, the basic 4-note chord is repeated in the guitar while the horn provides the central *a-flat*.[9]

[9]Remembering that the guitar sounds an octave lower than written.

Other arrangements of the basic set are also used. At 50-0 the strings partition the three semitonal trichords which occur in set **b**. Throughout the following section, up to 66-1, three gradually expanding voicings of this type occur. All are symmetrical around *a-flat*. The horn supplies the three notes which form the chromatic compliment to this transposition: *d*, *f-sharp*, and *b-flat*, as well as the central *a-flat*. The woodwinds throughout this same section use set **a**, voiced to also have *a-flat* as the center of symmetry. The complete pitch structure is given in EXAMPLE 11.



EXAMPLE 11: Pitch Organization of mm. 50-66

The basic set is also used less rigorously as a type of mode for scalar melodic passages. This use may be seen in the strings from 139-4 to 147-4. Here a short delay is constructed whereby each line follows the previous by the value of one triplet eighth note. Use of the collection as a mode also occurs from 208 to 225 in the strings. The original cello line is transposed up a perfect 5th for the viola, and then another perfect 5th for the violin. Other examples of scalar motion occur in the flute and clarinet in measure 50, at beats 5 and 6 of measure 51, and from 58-4 to 60-3.

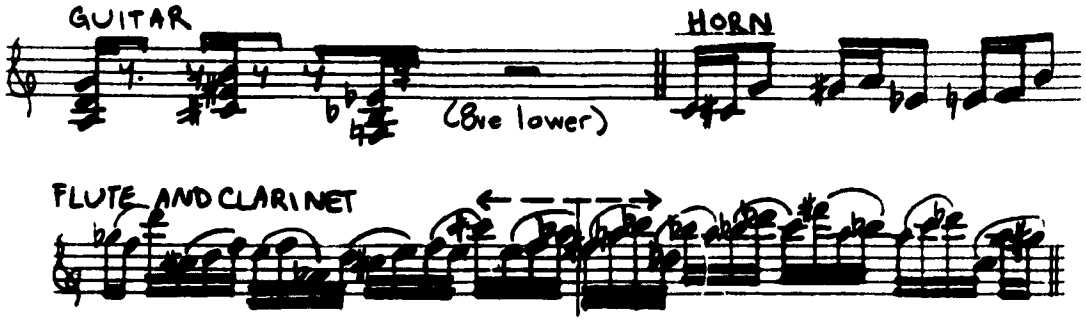
A prominent feature of the motivic construction of the piece is the combination of simple, repetitive, interlocking cells to create a complex overall texture. This is the case

in the section from measure 69 to measure 99. As discussed previously in this paper, five overlapping ostinati of varying lengths are combined, resulting in a constantly changing pattern. These ostinati are themselves made up of smaller motives which are varied in different ways. In order to differentiate the various layers, intervals are partitioned between each ostinato according to the following plan:

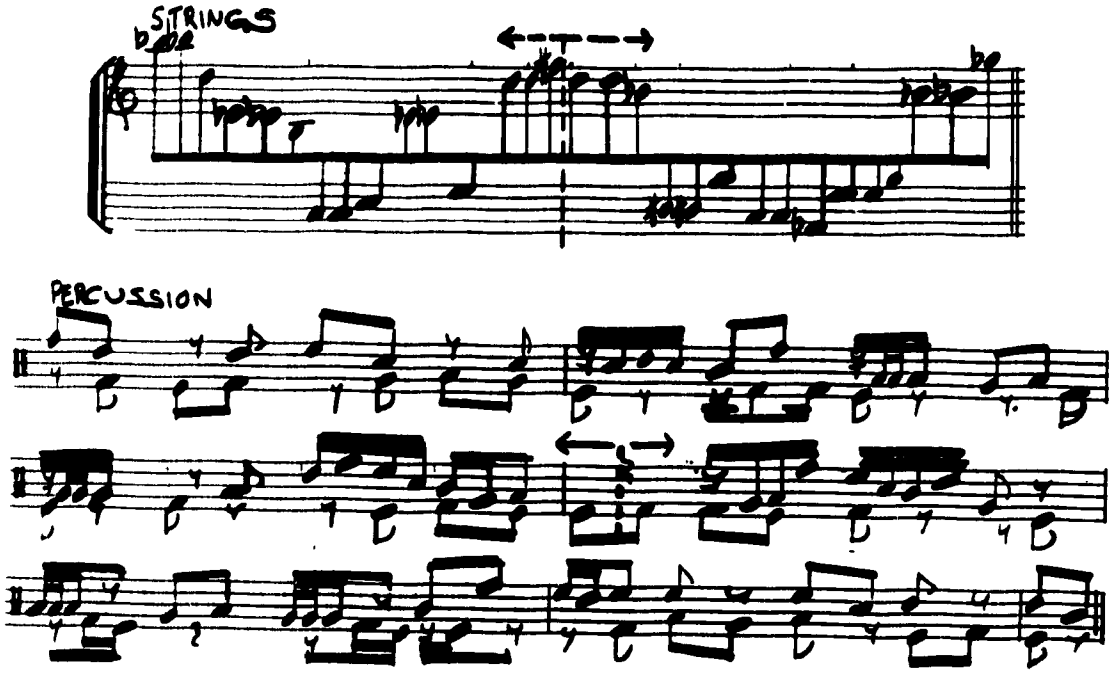
Ostinato 1 - Horn	Length: 3 beats	Intervals: dim. 5 and aug 4
Ostinato 2 - Guitar	Length: 5 beats	Interval: perfect 4
Ostinato 3 - Fl. and Cl.	Length: 9 beats	Intervals: min. 3 and maj. 6
Ostinato 4 - Strings	Length: 15 beats	Intervals: maj. 3 and min. 6
Ostinato 5 - Percussion	Length: 25 beats	Intervals: N/A

Seconds and sevenths have not been partitioned and are used freely throughout the instruments.

EXAMPLE 12 gives the complete form of each ostinato. Ostinato 1 uses the pitch collection given as EXAMPLE 7b, ostinato 2 uses **a**, ostinato 3 uses **c**, and ostinato 4 uses **d**. The three longest ostinati are constructed symmetrically such that the second half of each is the retrograde of the first. In ostinato 3 the retrograde is inverted and transposed down 2 semitones,[10] and in ostinato 4 the retrograde is transposed down 4 semitones. The percussion ostinato is inverted within each group of instruments, independently of the others. In other words, the temple blocks, the wood blocks, and the bongos are all inverted separately. Ostinati 1 and 2 are too short to be divided in this manner.

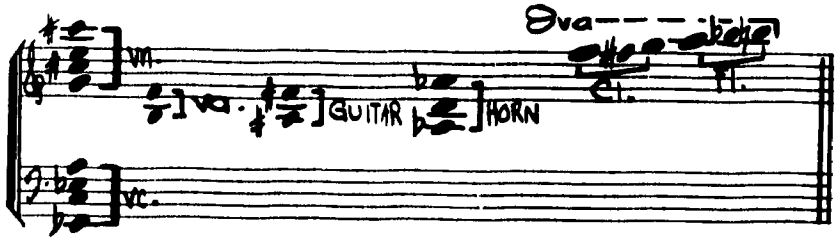


[10]That is, if we consider that the retrograde should begin with the last pitch of the original: a-flat.



EXAMPLE 12: Ostinati from m. 69 to m. 99

A similar process to that described above occurs in the third section, "The Sensual Machine." Here the durations are measured in sixteenth notes and are organized as follows: strings[25], woodwinds[15], horn[9], guitar[5], and percussion[3]. Harmonically, the strings, horn, and guitar are voiced symmetrically around *d*, while the woodwinds take the *a-flat* and octave and a half higher as a central pitch. This arrangement is given in EXAMPLE 13, while the ostinati in their complete forms appear in boxes in measures 243 to 245.



EXAMPLE 13: Harmonic Organization of Section 3

A completely different approach to pitch organization occurs in the final section of the main body. The instrumentalists are to choose their pitch materials freely. As well, the stringed instruments gradually become detuned, so that the harmonic structure begins to include microtonal elements in an unpredictable way. The improvised character of this section reflects the chaos described by the text.

TEXTURE

The following discussion treats texture generally, as the aural characteristics of the musical surface, including both timbral and structural[11] textures. Above all, texture will be dealt with as it relates to and reinforces the thematic development of the vocal text.

The overall textural process of *Vox Machina* consists of a gradual progression from the entirely acoustic prologue to the entirely synthesized final moments. This movement contains several intermediate steps which help to highlight the formal divisions of the piece. After the prologue, section 1 of the main body retains the original timbre of the instruments, but moves the *location* of their sound from the natural environment to the loudspeakers. Section 2 begins with the appearance, in the speakers, of noises other than those generated by the instruments, specifically unaltered samples of machine sounds. Thus, while the machines are not actually physically present, all the sounds coming from the loudspeakers *appear* to be natural.

This changes in the third section, where a metallic-sounding plate reverb is applied to the amplified instruments in order to change their characteristic timbres. In addition to the overall effect of the plate reverb, the guitar is further altered by the addition of a distortion box.[12] Section 4 maintains this setup, but the instruments' normal tone is now modified through the use of less standard methods of playing. These include fluttertongue in the woodwinds, "grind" sonority in the strings, striking the body of the instrument in the guitar and percussion, and stopped tones in the horn. As well, the digital machine sounds are now modified so that they are less recognizable. Finally, the epilogue contains only the voice with synthesized sounds which have been greatly changed (with the exception of the *vox humana* chorale).

The thematic significance of this process lies in its musical representation of the growing importance of technology in our lives. The acoustic prologue represents an

[11] For example, homophonic, polyphonic, etc

[12] This creates the type of distortion commonly found in rock music.

idealized environment in which humanity is free of machines, while the synthetic epilogue depicts a possible future in which machines have completely subsumed the natural world. Between these two extremes the natural voices of the instrumental ensemble are gradually stolen. The human voice is also taken, but in two different senses. First, the soprano's *narrative* voice is lost. Up to section 3 the singer appears as a character, posing questions in the prologue, and subsequently providing commentary. However, by section 4 this aspect of the vocal part is lost, and the text consists solely of quotations of other people without comment. Finally, in the epilogue, the *literal* voice of the soprano is stolen by the machines, who end the piece by repeating portions of the text previously performed by the singer, while she remains silent.

The structural design also reflects the text. For example, the homophonic texture of the first 49 measures evokes the simplicity of an earlier time. The following polyphonic passage, from measures 50 to 66, is a complex representation of the whirlwind from which God speaks. The overlapping crescendos and decrescendos symbolize the circling of material within the whirlwind. As well, the contrapuntal sections of the piece in which many small motives are combined to generate a complex surface are metaphorical representations of the internal workings of a machine. This type of texture occurs from 60 to 99, from 103 to 117, from 125 to 139, and for all of section 3 (m. 225 to rehearsal letter M). Finally, the very close canon in the strings from measure 139 to 147 describes the interconnected writhing of the cylinders and rods, and the frequent unisons which occur here parallel the touching mentioned in the text.

Choice of instruments and playing style was also determined to a large degree by the thematic structure of the piece. Guitar was chosen for the "antique" opening because of its similarity to the lute. The high string tremolos from 120 to 124 are meant to suggest both the clouds of steam and the dreamers thoughts. In the second section, "Humanity and Machine," (160 to 202) the percussionist takes on the character of the worker in the factory: the "striker." The frenetic increase in complexity and difficulty of performance

that takes place at the end of this section represents the chaining of the human to a machine whose pace exceeds the workers ability to keep up. As well, the extended playing techniques in the fourth section, in which instruments are used in an "unnatural" manner, parallel the debasing of human nature which accompanies excessive technological developments.

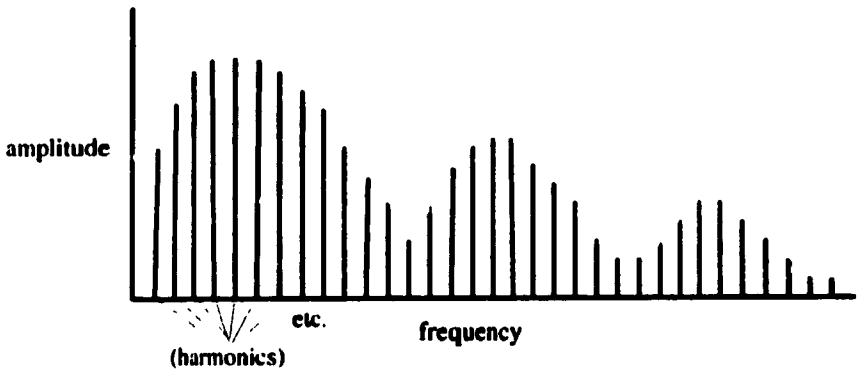
SYNTHESIS

The principal means of synthesis in *Vox Machina* is computer-based *musique concrête*. That is, recordings of sounds taken from the real world have been sampled into the computer, edited, and mixed together to make new combinations. The process is identical in most respects to tape-based electroacoustic music. In this piece sampling and editing were performed on a NeXT computer, while the final mix was done on a Macintosh. The two main techniques of sound manipulation used were vocal cross-synthesis using linear prediction and extreme time expansion using the phase vocoder program.

Both of these methods are classified as analysis/synthesis techniques. This type of synthesis is useful for generating audio signals in which a sound source is analysed to extract its characteristic properties, generating analytical data that contains a parametric representation of the input. The data may then be resynthesized to recreate the original signal. One of the powerful applications of these techniques is that the stored analytical information may be edited. A differentiation must be made between the transformations available here and those possible with a sampled signal. The situation in conventional sampling is directly analogous to that of tape-based *musique concrete*. In both there is an unbreakable link between the time and frequency domains: lowering pitch *must* increase duration while raising pitch *must* decrease duration. The exciting prospect raised by analysis/synthesis is that of independent control of pitch and duration. As well, linear prediction also provides the potential for cross-synthesis.

For this type of cross-synthesis, the signal to be analysed is modeled as an excitation source and a time-varying spectral envelope that resonates and attenuates the harmonic spectrum of this source. This model originated in speech synthesis, where the excitation source is provided by the vocal folds and the spectral envelope is determined by the position of the articulators of the vocal tract - the lips, tongue, jaw, etc.

In EXAMPLE 14 the curved line connecting the top of each harmonic component is the spectral envelope. The three peaks of this envelope represent formant regions, or areas of the spectrum which contain more energy than others. In speech the location of these formants determines the vowel being heard, each vowel having an arbitrary number



EXAMPLE 14: Spectral envelope.

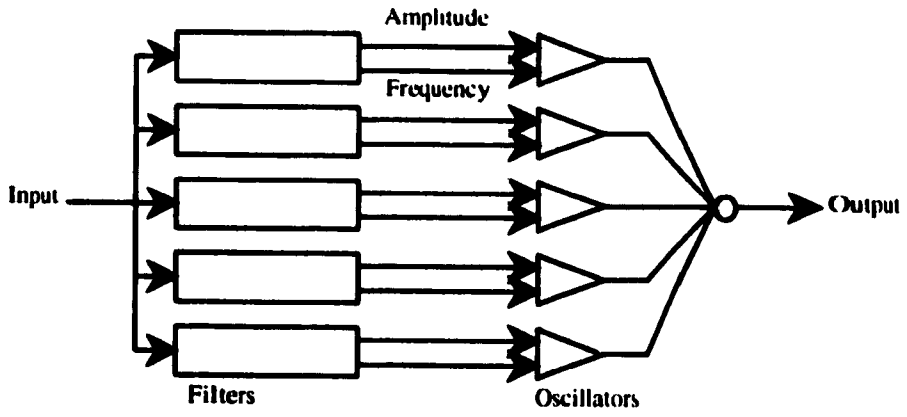
of formants. The spectral envelope operates independently of the excitation source. In other words, a given vowel being spoken at different fundamental pitches will have formant regions at the same frequencies regardless. This feature of formants can be understood with the aid of the vocal model; in speech the vocal folds change independently of the articulators. The purpose of linear prediction is to extract the time-varying spectral envelope from a source sound. In the case of *Vox Machina* the source is speech. This complex filter may then be applied to another sound. An analogy is the replacement of the human vocal chords with, for example, the sound of a jet airplane. As the articulators moved, the jet would speak.

It is this type of cross-synthesis which is used in the piece. Near the end of the epilogue the soprano becomes silent and we hear the sound of machines repeating a number of characteristic phrases of text. These talking machines were created by analyzing speech samples using linear prediction and resynthesizing them using the sounds of machinery as substitute excitation sources, exactly as described above. It is also possible to change the time-scaling of the resynthesis to stretch out the speech to much longer than the original. In the epilogue the machine voices progress from large-

scale time-expansion to normal time, so that the sounds are gradually recognized as speech.

The other synthesis technique used is phase vocoding. The input signal to the phase vocoder is modeled as the sum of sine waves, each of which has its individual time-varying amplitude and frequency. The frequencies of these sine waves need not be harmonically related. Obviously this model applies to the vast majority of musical sounds, including those generated by most percussion instruments. The phase vocoder is thus a powerful tool for representing and reproducing a given input signal from its derived analytical data, yielding in most cases an output which is for all practical purposes identical to the original. As well, the information may also be edited to give completely independent control of pitch and duration.

One way of understanding the phase vocoder is to imagine that the analytical side of the phase vocoder consists of a number of bandpass filters which detect the time-varying



EXAMPLE 15: The Phase Vocoder

frequency and amplitude of those harmonic components of the input signal that fall in the vicinity of their cut-off frequencies.[13] This analytical data may then be used as the control input to a corresponding set of sine-wave oscillators in order to recreate the original signal using additive synthesis (EXAMPLE 15).

The phase vocoder allows the user to stretch out a sample to many times its original length while still maintaining a high level of sound quality. In *Vox Machina* this technique was applied to samples of machinery. Section 3, "The Sensual Machine,"

[13]This description is known as the "filterbank view." See Dolson, M., "The Phase Vocoder: A Tutorial," *Computer Music Journal* 10, Winter 1986, 14-27.

contains a constantly pulsating sound which was created by stretching a sample of an air hammer to approximately 12 times its original length. The background texture that accompanies the organ at the beginning of the epilogue is made by stretching the noise of wood being filed by over 5 times its original length. This sound was then mixed with itself many times, with amplitude envelopes and panning added to create a complex texture. Time-scaling of this magnitude is similar to looking at a very small object using an electron microscope. The character of the item as we perceive it normally is often distorted to the point where it is impossible to recognize the original.

CONCLUSION

As previously stated, the primary objective of this analysis has been to discuss the musical structure of *Vox Machina* as it relates to the thematic development of its text. Duration, pitch, and texture have all been used to reinforce the meaning of the excerpts. This includes the alignment between large-scale textual, durational, and timbral organization, a background progression which moves from a completely natural to completely synthesized sound, and passages in which many small motivic units performed on different instruments interconnect to create an overall musical structure. The synthesis techniques used also support the theme of the text, particularly the use of linear prediction to create *literal* "machine voices." In addition to the compositional techniques employed in *Vox Machina*, the irony inherent in using state-of-the-art computers to call into question man's ongoing fascination with technology should be noted.

Appendix

Vox Machina: Text[14]

Prologue

> *Neque enim fas est homini cunctas divini operis machinas, vel ingenio comprehendere, vel explicare sermone.* [Man is not permitted either to understand fully or to explain all the machinery by which God accomplishes his work.][15]

What do these words tell us? That we can never understand the *work* of God. That we will *never know* the machinery God uses to accomplish this work. What they *do not* tell us is the nature of the work God does... or what machines God uses.

God speaks from the whirlwind...

> Where wast thou when I laid the foundations of the earth?
> Who hath laid the measures thereof, who hath stretched the line upon it?...
> Hast thou entered into the springs of the sea? or hast thou walked in the search of the depth?
> Canst thou lift up thy voice to the clouds, that abundance of waters may cover thee?
> Canst thou send lightnings, that they may go, and say unto thee, Here we are?
> Who hath put wisdom in the inward parts? or who hath given understanding to the heart?[16]

Section I: Nature of the Machine

> *La machine qui répète*
> *Le mouvement sans broncher*
> *Est aussi simple que l'enfant*
> *Qui répète sa prière.*
> [The machine that repeats
> Its movement without faltering
> Is as simple as the child
> Who repeats his prayer.][17]

Let us define what a machine *is*. A machine *is* what it *does*. A machine does not need to be *useful*. It does not need a *purpose*. A machine only needs to perform. It only exists to *do*... the *heart* is a machine. The pieces of your heart are like the interlocking gears of a watch.

[14]Note All excerpts used are in the public domain

[15]Boëthius, De Consolatione Philosophiae, IV, Prosa 6. in *Dictionary of Quotations (Classical)*, 154.

[16]Taken from Chapter 38 of the Book of Job.

[17]Franz Hellens, "Simplicité," in *The Poet and the Machine*, Paul Ginestier. translated from French by Martin B. Friedman Chapel Hill. University of North Carolina Press. 1961, 20.

Like any machine, if one small part breaks, everything stops. The machine can no longer function.

> *...Heureux qui peut rêver à la lueur des gares*
> *Aux lys de la vapeur couchés sur l'horizon.*
> [Happy is he who can dream under station lights
> Of the steam-lilies lying on the horizon.][18]

People *fear* machines. The Luddites destroyed knitting frames and power looms because they were afraid of what these machines would *do* to them. Today's machine-breakers are frightened of what the *computer* will do to their lives. But we must remember that "Machines are the product of the *mind* of man; and, their existence distinguishes the civilized man from the savage. The savage has no machines, or, at least, nothing that we call machines."[19]

> cylinders and rods touch each other as a serpent writhes; infinitely
> complex anatomy of steel, compared with which the skeleton of a living creature seems
> clumsy and vile.[20]

> *Comme les grands oiseaux prisonniers au jardin,*
> *Dans le port sans amour les steamers se balancent,*
> *Leurs mâts font sur la mer flamber des fers de lances*
> *Et leurs poumons ouverts marquent l'azur marin...*
> [Like great birds imprisoned in a garden
> The steamers ride in the loveless harbor,
> Their masts make spearheads blaze on the sea,
> And their open lungs mark the marine blue...][21]

> *...l'univers...est une machine à faire des dieux.*
> [The universe is a machine for making Gods.][22]

---

[18]Roger Allard, "Un Dimanche Limousin," in *The Poet and the Machine*, Paul Ginestier Translated from French by Martin B. Friedman Chapel Hill: University of North Carolina Press, 1961, 85

[19]William Cobbet, "A Letter to the Luddites," in *Pandæmonium 1660-1886 The Coming of the Machine as Seen by Contemporary Observers*, Humphrey Jennings New York The Free Press, 1985, 142

[20]John Ruskin, "The Cestus of Aglaia," in *Literature and Science An Anthology from English and American Literature, 1600-1900*, McColley, Grant, ed Chicago Packard and Company, 1940, 111

[21]André Salmon, "Anvers," in *The Poet and the Machine*, Paul Ginestier Translated from French by Martin B. Friedman Chapel Hill University of North Carolina Press, 1961, 108

[22]Henri Bergson, "Les Deux sources de la morale et de la religion, ch 4," in *Machine, Metaphor, and the Writer*, Bettina L. Knapp University Park, Pennsylvania State University Press, 1989, 145

Section 2: Humanity and Machine

The flame of the Bessemer cupola roars, with showers of sparks, and rattling of cranes...
I see the reversing of the cupola, and the outpour of molten steel...
...The planing and cutting of armor-plates, the huge resistless steam-driven machinery, the gouges and drills,
And he at the forge streaming with sweat, the striker, with bared breast, turning the claw-hammer heads by the score,
Keeps dreaming and dreaming all day between the strokes, of love which is to come and change our earth into heaven;[23]

> The animal machine - breakable in the best case, subject to a thousand sources of suffering - is chained fast to the iron machine, which knows no suffering and no weariness...[24]

We can *break* machines, but machines can also break *us*. We sometimes treat machines like they were *human*, and human beings like *they* were machines. We can't give a machine feelings. We cannot give a machine a heart. Yet... *we* can be transformed into machines. Even a great humanist can change. As a young man, Charles Darwin cherished the creative works of his *fellow* human creatures. As he grew older, he felt himself changing:

> ...I cannot endure to read a line of poetry. I have lost my taste for pictures and music. My mind seems to have become a kind of machine...[25]

Section 3: Sensual Machine

We fall in love with our machines...

...thy measur'd dual throbbing and thy beat convulsive,
The black cylindric body, golden brass and silvery steel,
Thy ponderous side-bars, parallel and connecting rods, gyrating, shuttling at thy sides,
Thy metrical, now swelling pant and roar, now tapering in the distance,
Thy great protruding head-light fix'd in front,
Thy long, pale, floating vapor-pennants, tinged with delicate purple,[26]

---

[23]Edward Carpenter, "A Voice over the Earth," in *The Industrial Muse: The Industrial Revolution in English Poetry*, Jeremy Warburg, ed. London: Oxford University Press, 1958, 83.

[24]James Phillips Kay, "The Moral and Physical Conditions of the Working Classes," in *Pandæmonium 1660-1886 The Coming of the Machine as Seen by Contemporary Observers*, Humphrey Jennings. New York The Free Press, 1985, 185

[25]Charles Darwin, "Autobiographical Note," in *Pandæmonium 1660-1886. The Coming of the Machine as Seen by Contemporary Observers*, Humphrey Jennings. New York: The Free Press, 1985, 134.

[26]Walt Whitman, "To a Locomotive in Winter," in *Of Men and Machines*, Arthur O. Lewis Jr., ed. New York: E. P. Dutton, 1963, 175.

Des tôles, des barres, des ronds, des angles.
Ça se pousse, ça se débrouille, ça se pénètre.
Toutes les choses se crachent dans la bouche.
[Sheet metal, rods, rounds and angles.
Pushing, shifting, penetrating.
All things spit in each others' mouths.][27]

Section 4: Consequences

...all is seared with trade; bleared, smeared with toil;
And wears man's smudge and shares man's smell.[28]

C'est un noir pays foré de puit, qui fume
Par ses lourds hauts-fourneaux, par ses larges corons,
Ses trains dont les sifflets vrillent de trous la brume
Et cassent le ciel bas que l'air houilleux corrompt.
[It's a black country drilled with coal pits, smoking
From its ponderous blast furnaces, from its big coal towns,
Its trains whose whistles puncture the fog
And crack the low sky tainted by coal smoke.][29]

*ce monde ne **mérite** pas d'être connu.*
[This world doesn't deserve to be known.][30]

The world is dying of machinery; that is the great disease, that is the plague that will sweep away and destroy civilization.[31]

---

[27]Luc Durtain, "Un port," in *The Poet and the Machine*, Paul Ginestier. Translated from French by Martin B. Friedman. Chapel Hill: University of North Carolina Press, 1961, 112

[28]Gerard Manley Hopkins, "The Grandeur of God," in *The Industrial Muse The Industrial Revolution in English Poetry*, Jeremy Warburg, ed London: Oxford University Press, 1958, 68.

[29]Charles Dornier, "Aube sanglante," in *The Poet and the Machine*, Paul Ginestier Translated from French by Martin B Friedman. Chapel Hill: University of North Carolina Press, 1961, 24.

[30]E M. Cioran, "Syllogismes de l'amertune," in *Le Grand Dictionnaire des Citations Françaises*, under 'science '

[31]George Moore, "Confessions of a Young Man," in *Dictionary of Quotations on Historical Principles from Ancient and Modern Sources*, 732.

Epilogue

What hath God wrought![32]

Nihil enim rerum ipsa natura voluit magnum effici cito.
[Nature herself has never attempted to effect great changes rapidly][33]

{*The following are said by the machines*}
[The heart is a piece of machinery]
[The savage has no machines]
[The world is dying of machinery]
[My mind has become a machine]
[What hath God wrought]
[Nihil enim rerum ipsa natura voluit magnum effici cito]

[32]Quoted by Samuel Morse in the first electric telegraph message, Washington, May 24, 1844.

[33]Quintillian, *De Institutione Oratoria, X., 3, 4,* in *Dictionary of Quotations (Classical)*, 154.

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VOX MACHINA

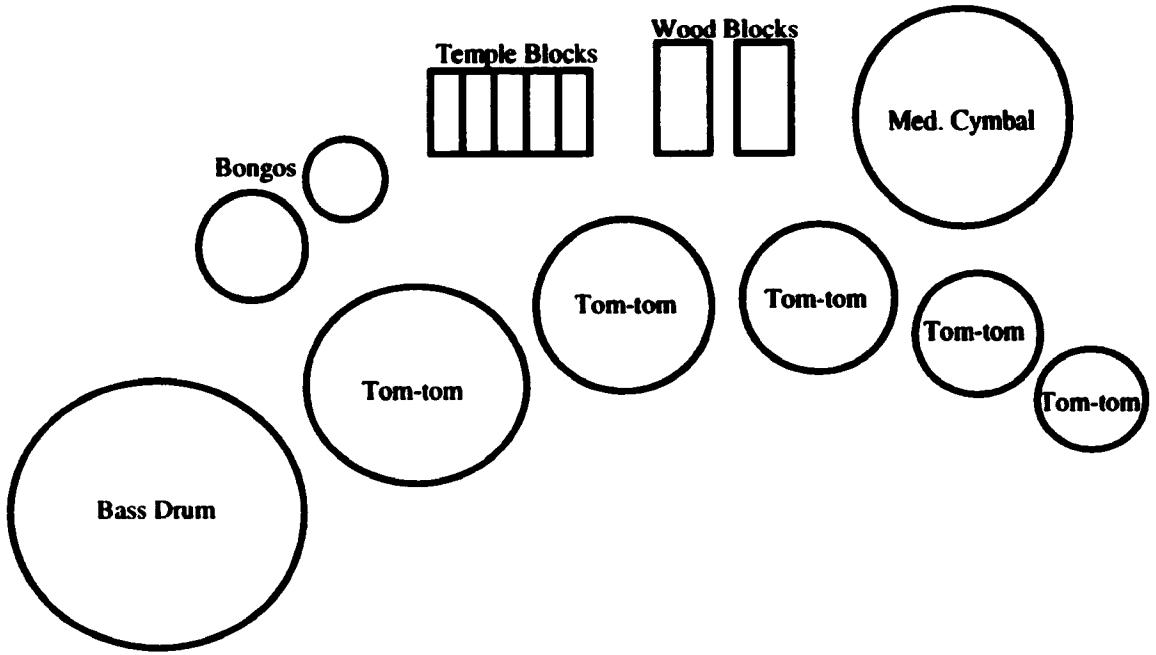
FOR SOPRANO, CHAMBER ENSEMBLE AND DIGITAL SOUNDS

SEAN FERGUSON

Instrumentation

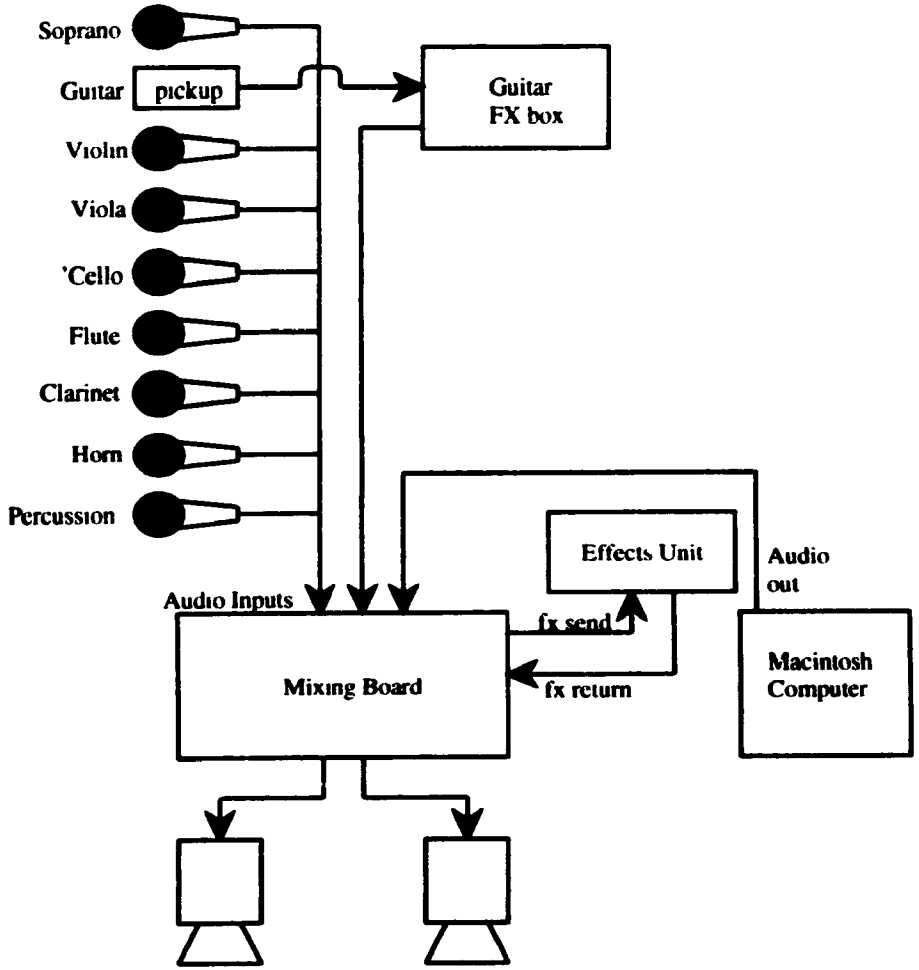
Soprano
Flute
B-flat Clarinet
Horn in F
Violin
Viola
'Cello
Guitar
    (nylon strings, with pickup and distortion pedal)
Percussion (One Player)
    5 Temple Blocks, 2 Wood Blocks, 2 Bongos, Medium Cymbal, 5 Tom-Toms, Bass Drum
Conductor
Technician
    Operating Effects Unit, Mixing Board, Computer (or DAT Player)

Suggested Percussion Setup



Percussion should be amplified so that all instruments are present in the mix. A minimum of four microphones is required.

Technical Setup



Macintosh Computer requires Audiomedia II board, Sound Tools, and MAX. Note: while only three audio inputs are shown into the board, each instrument must have its own input channel - at least 12 input channels (percussion requires multiple microphones). Mixing board, effects unit, and Macintosh are all operated by a single technician who reads the score.

Performance Notes:

This is a transposed score! The clarinet is written a major second higher than it sounds, the horn is written a perfect 5th higher than it sounds (even in the bass clef), and the guitar is written an octave higher than it sounds.

Since the instruments are amplified for most of the piece, any reasonable setup of the ensemble will be acceptable. A suggested arrangement of the percussion instruments is given below, but it may be changed if desired.

Vox Machina is as much a piece of theatre as a piece of music. A great deal of attention should be given to sections of spoken text, whether notated with or without rhythm. The singer should feel free to interpret the text with appropriate physical gestures and movement. For this reason a head-set microphone is preferable to a fixed microphone. All excerpts used are in the public domain.

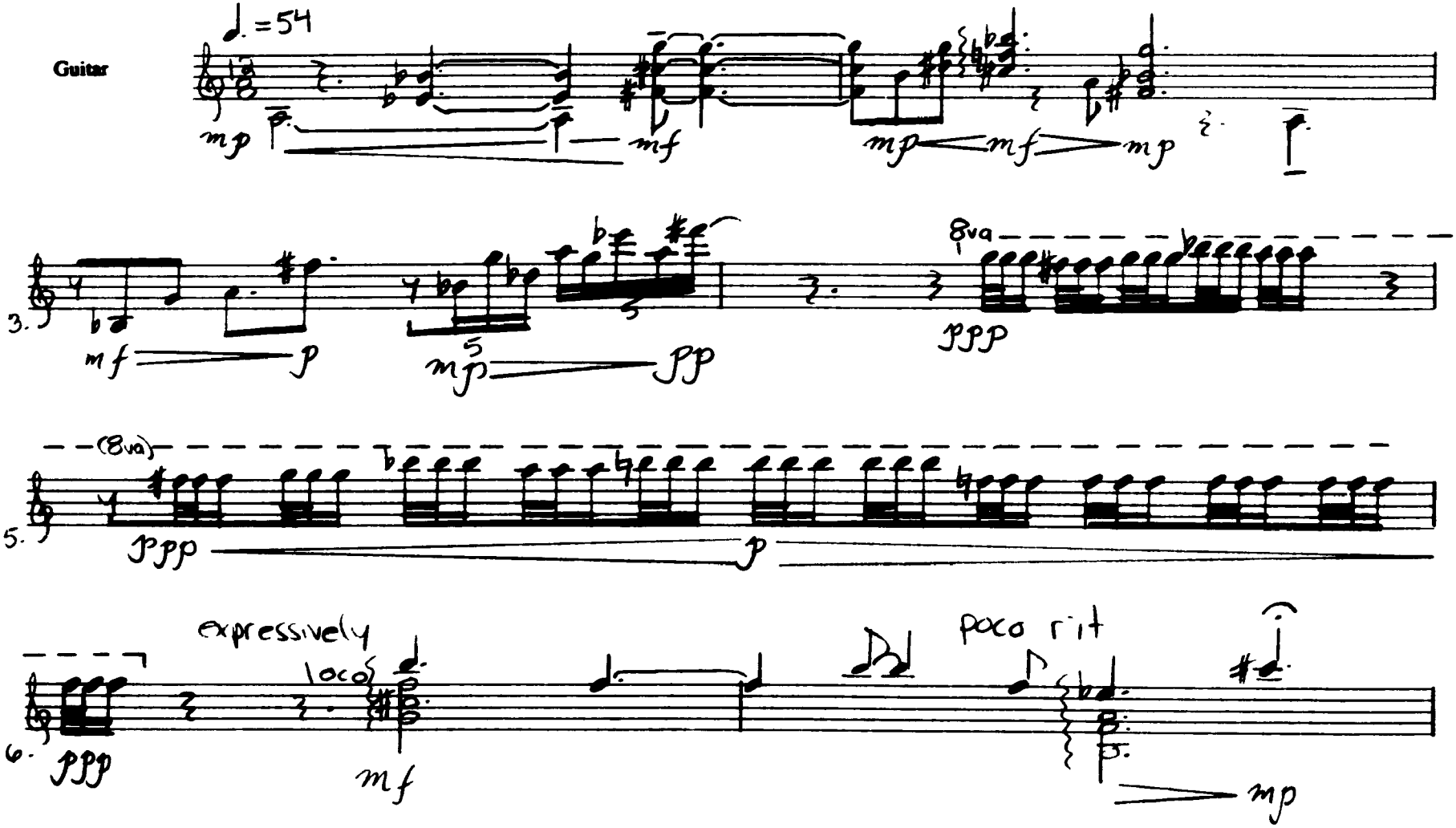
The guitar must be a nylon-stringed classical guitar which is equipped with a pickup, either permanently installed or temporarily placed in the sound hole. The guitarist requires a "fuzz-box" distortion pedal commonly used for rock guitar effects.

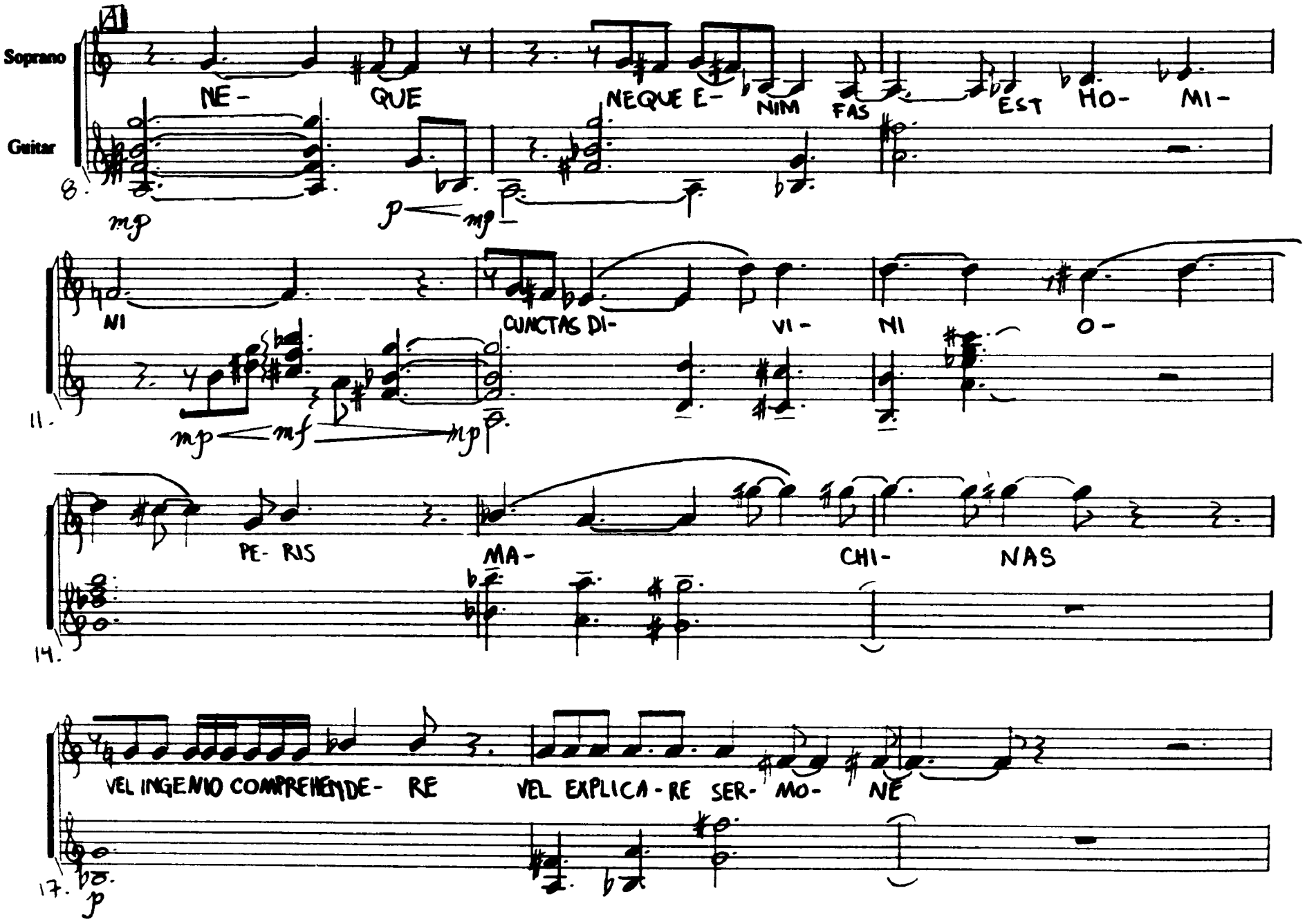
The technician requires a score to follow, and should be able to perform his part with a minimum of direction from the conductor. The digital sounds were created to be played by Dale Stammen's "Sound" Max Object, but they may also be performed equally well from DAT cassette tape.

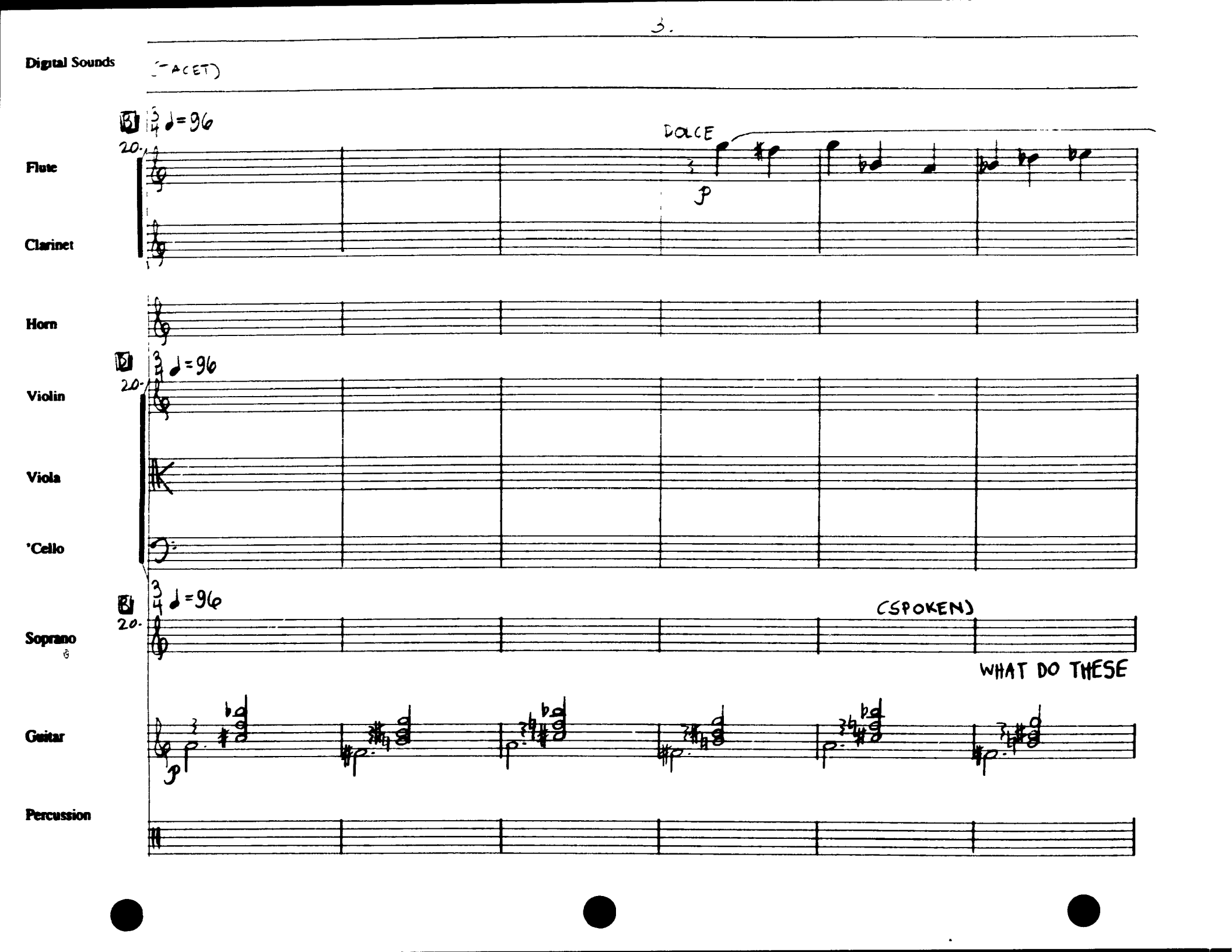
Total Duration = 16'00"

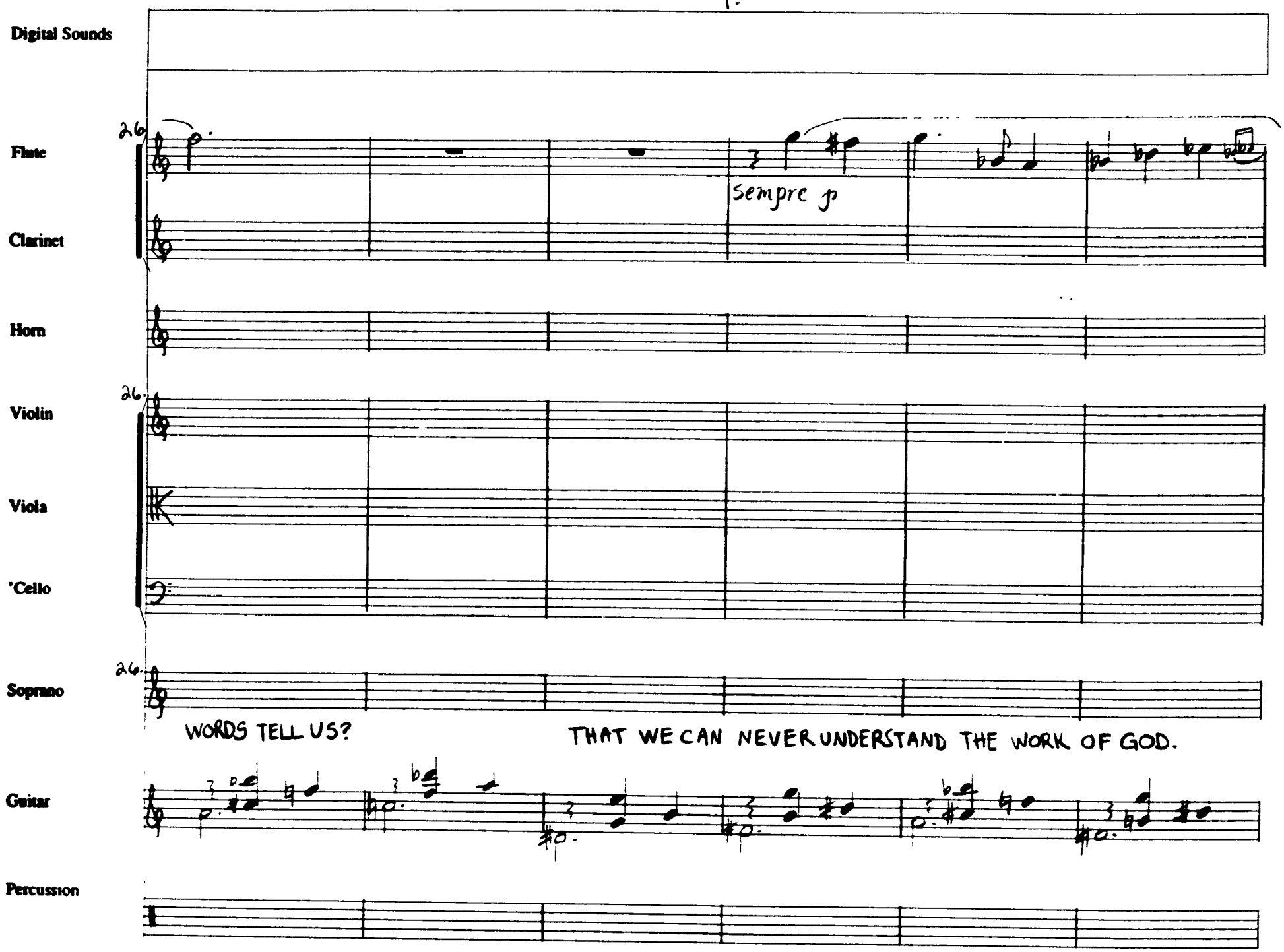
VOX MACHINA

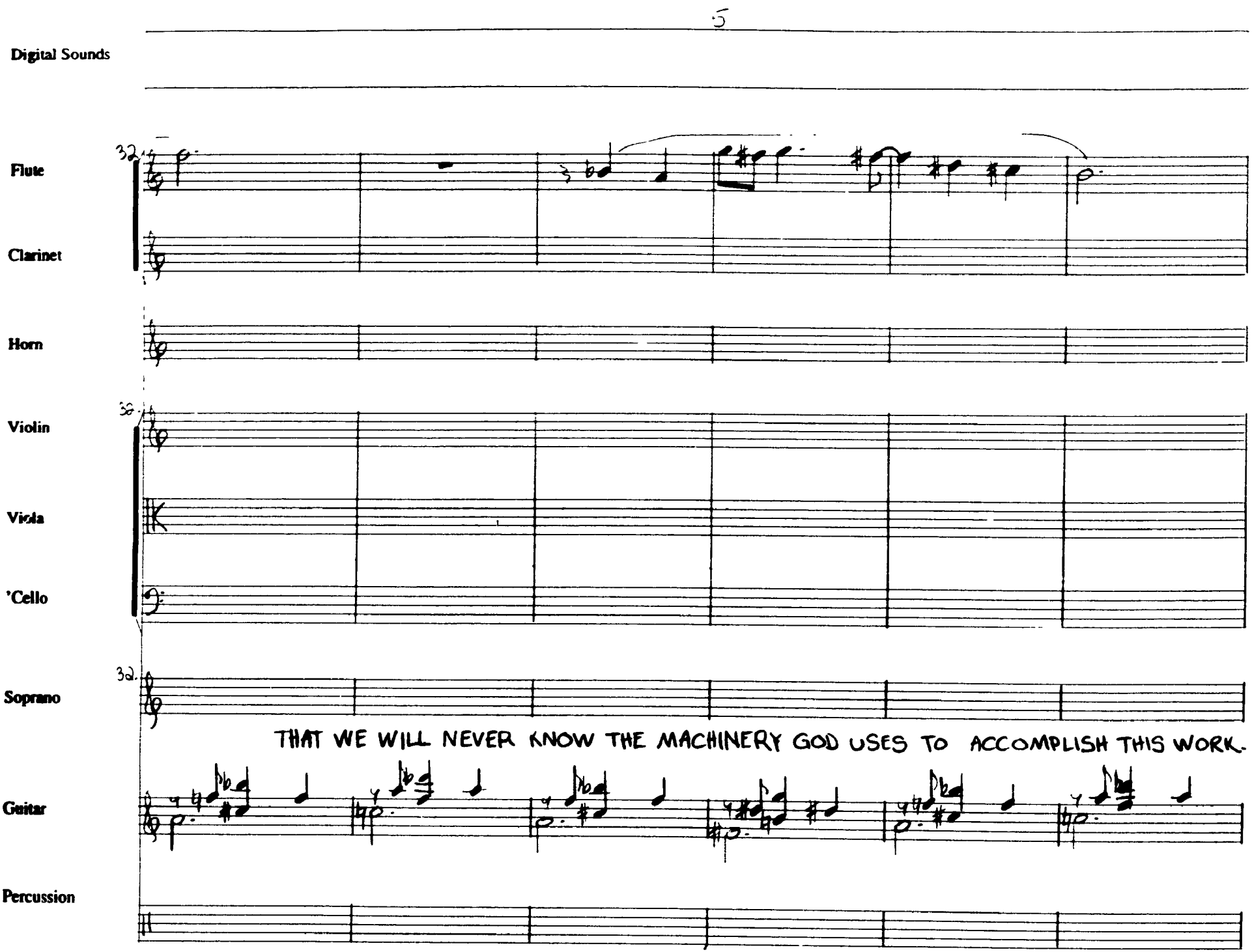
Sean Ferguson

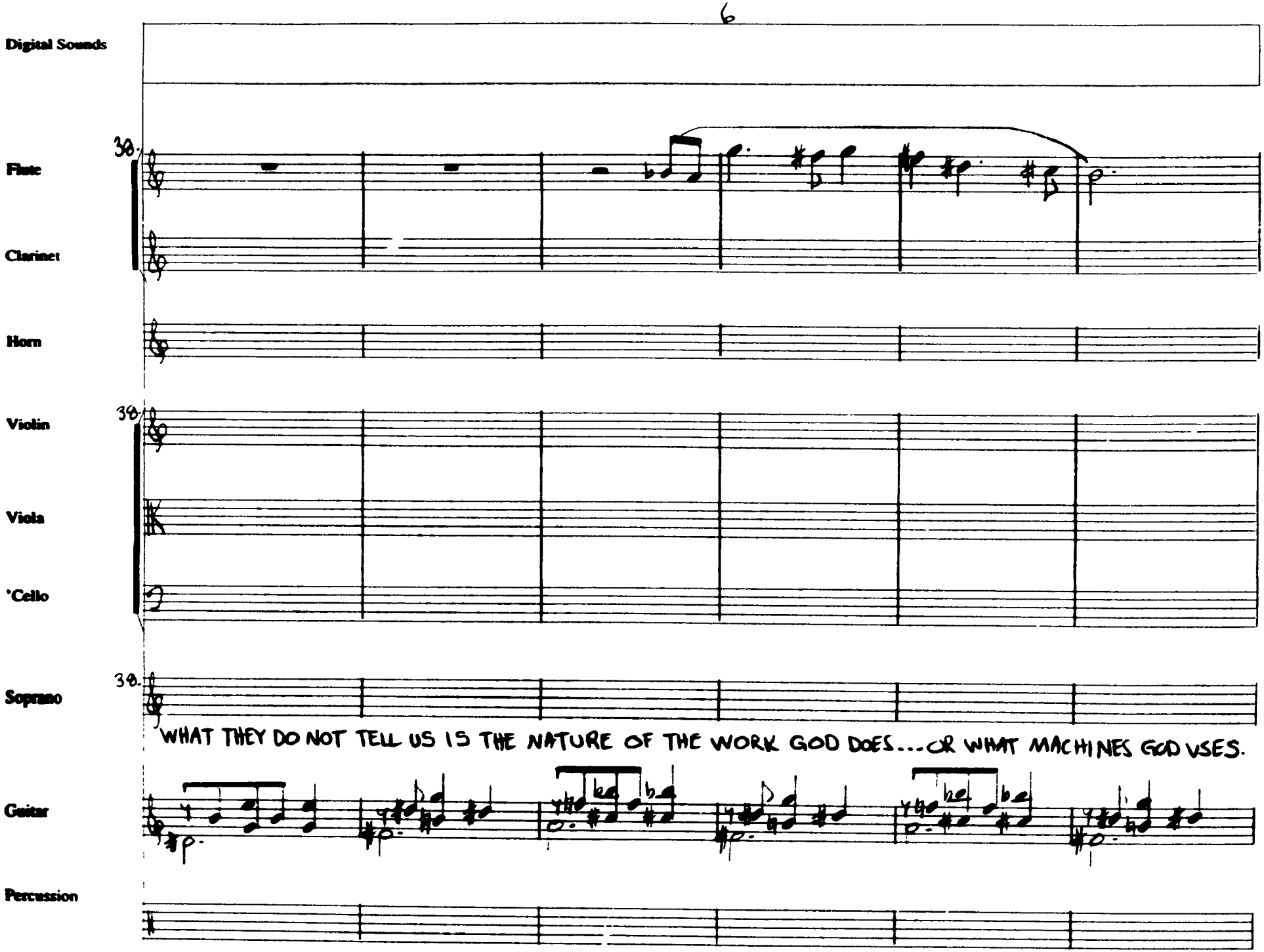


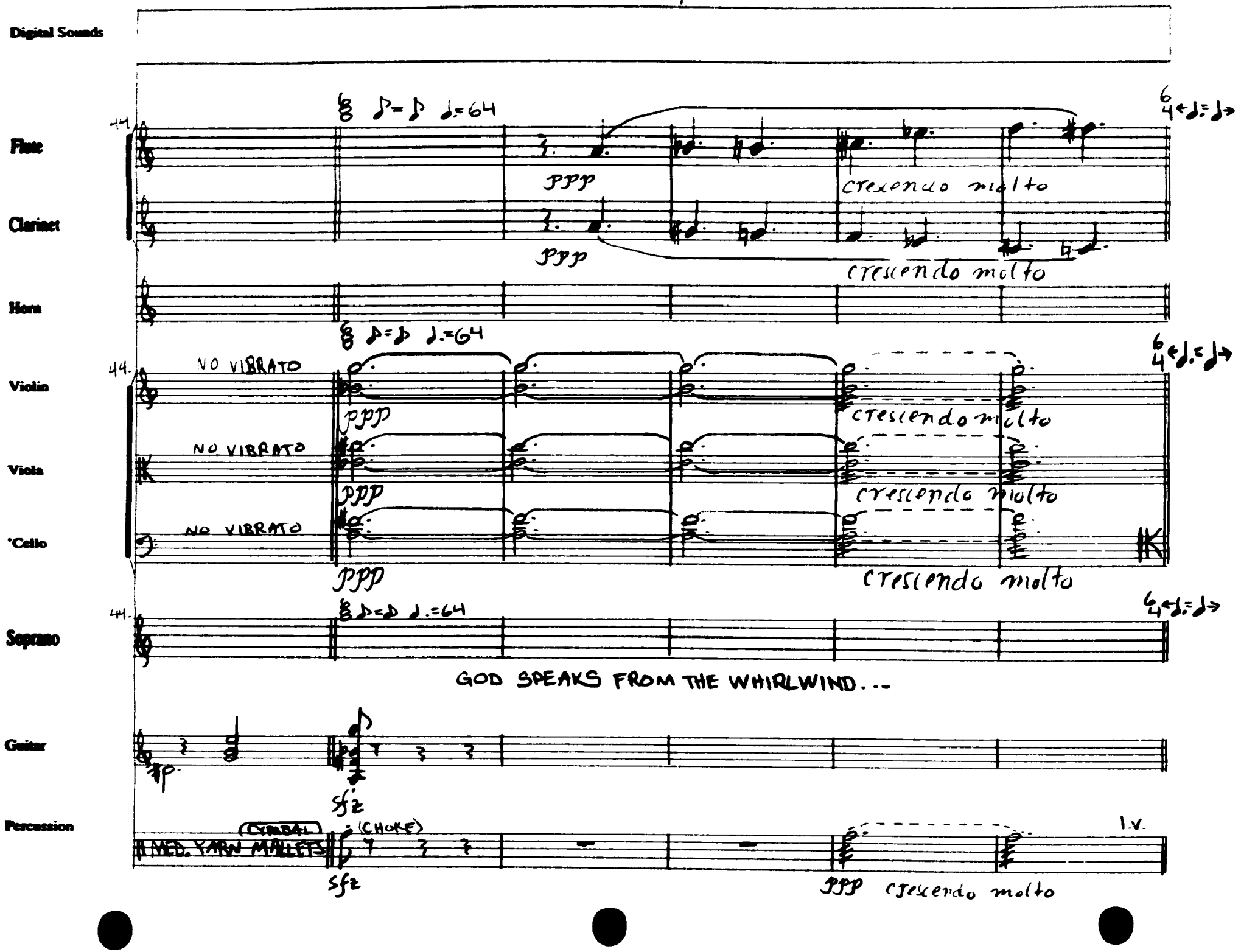

A
Soprano
Guitar
8.
NE- QUE NEQUE E- NIM FAS EST HO- MI-
mp
p mp
NI CUNCTAS DI- VI- NI O-
11.
mp mf mp
PE- RIS MA- CHI- NAS
14.
VEL INGENIO COMPREHENDE- RE VEL EXPLICA-RE SER- MO- NE
17.
p

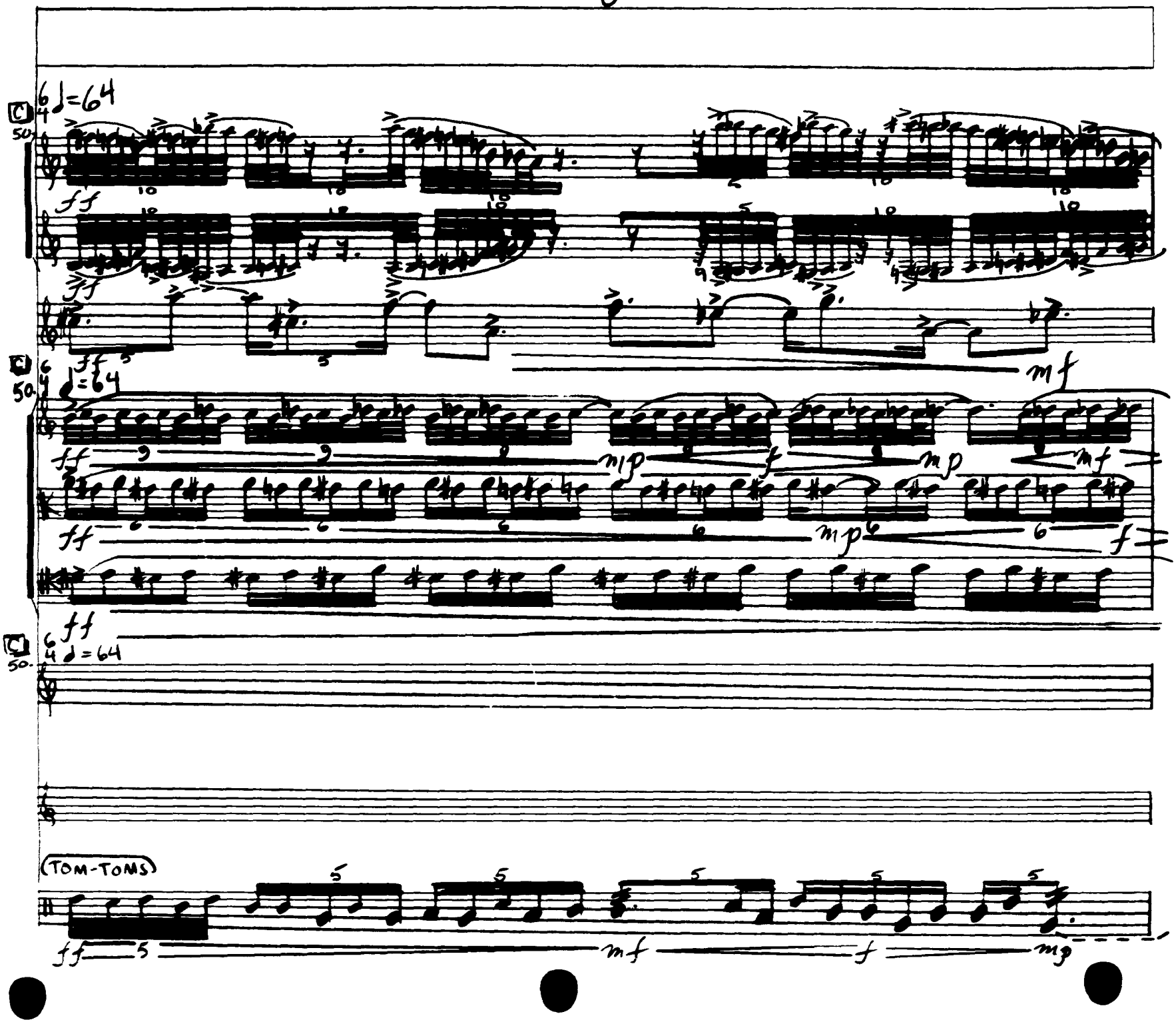

Digital Sounds
(FACET)
B
3/4 ♩=96
20.
Flute
DOLCE
p
Clarinet
Horn
B
3/4 ♩=96
20.
Violin
Viola
'Cello
B
3/4 ♩=96
20.
Soprano
(SPOKEN)
WHAT DO THESE
Guitar
p
Percussion

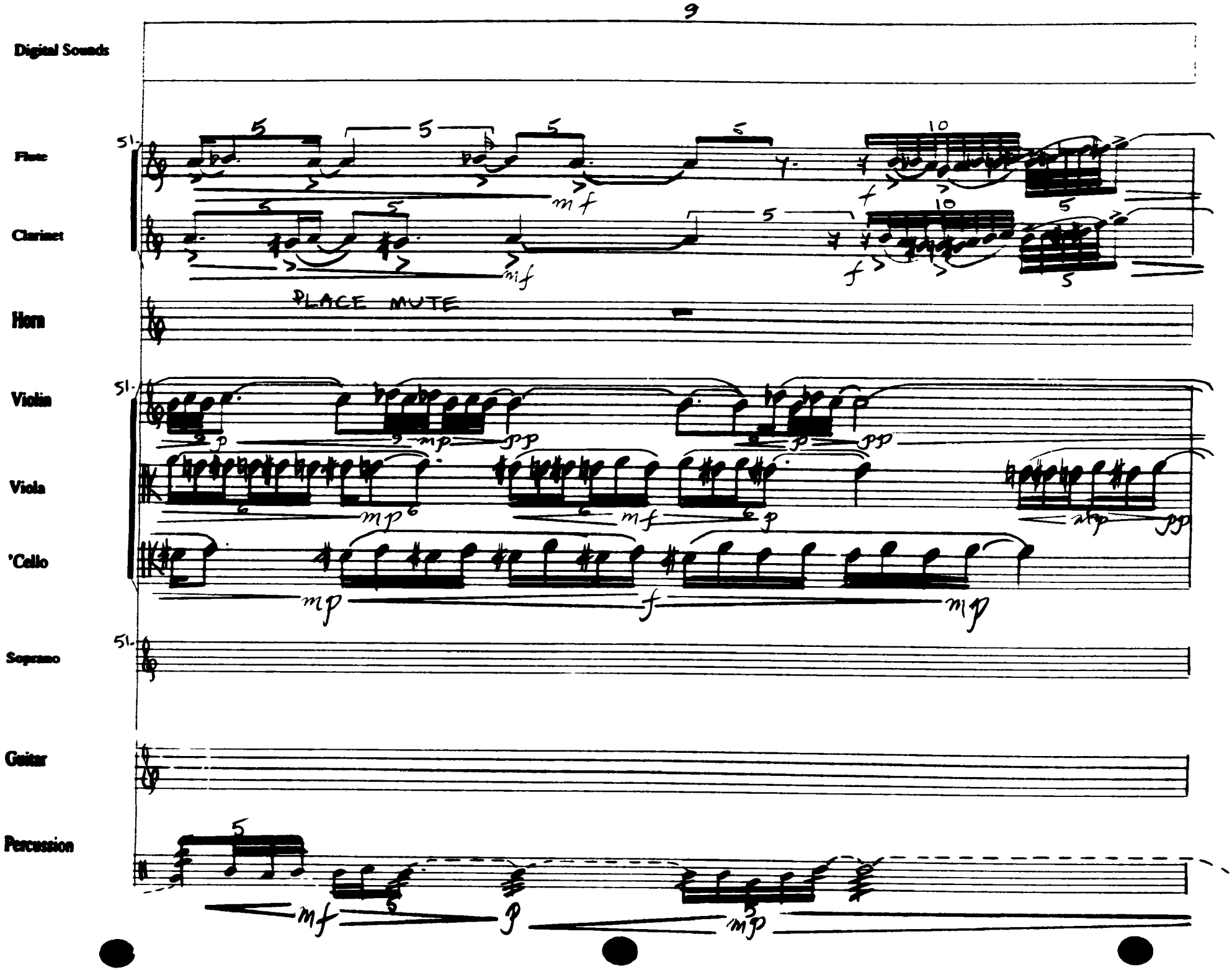

Digital Sounds
26
Flute
Clarinet
sempre p
Horn
26.
Violin
Viola
'Cello
26.
Soprano
WORDS TELL US?
THAT WE CAN NEVER UNDERSTAND THE WORK OF GOD.
Guitar
Percussion

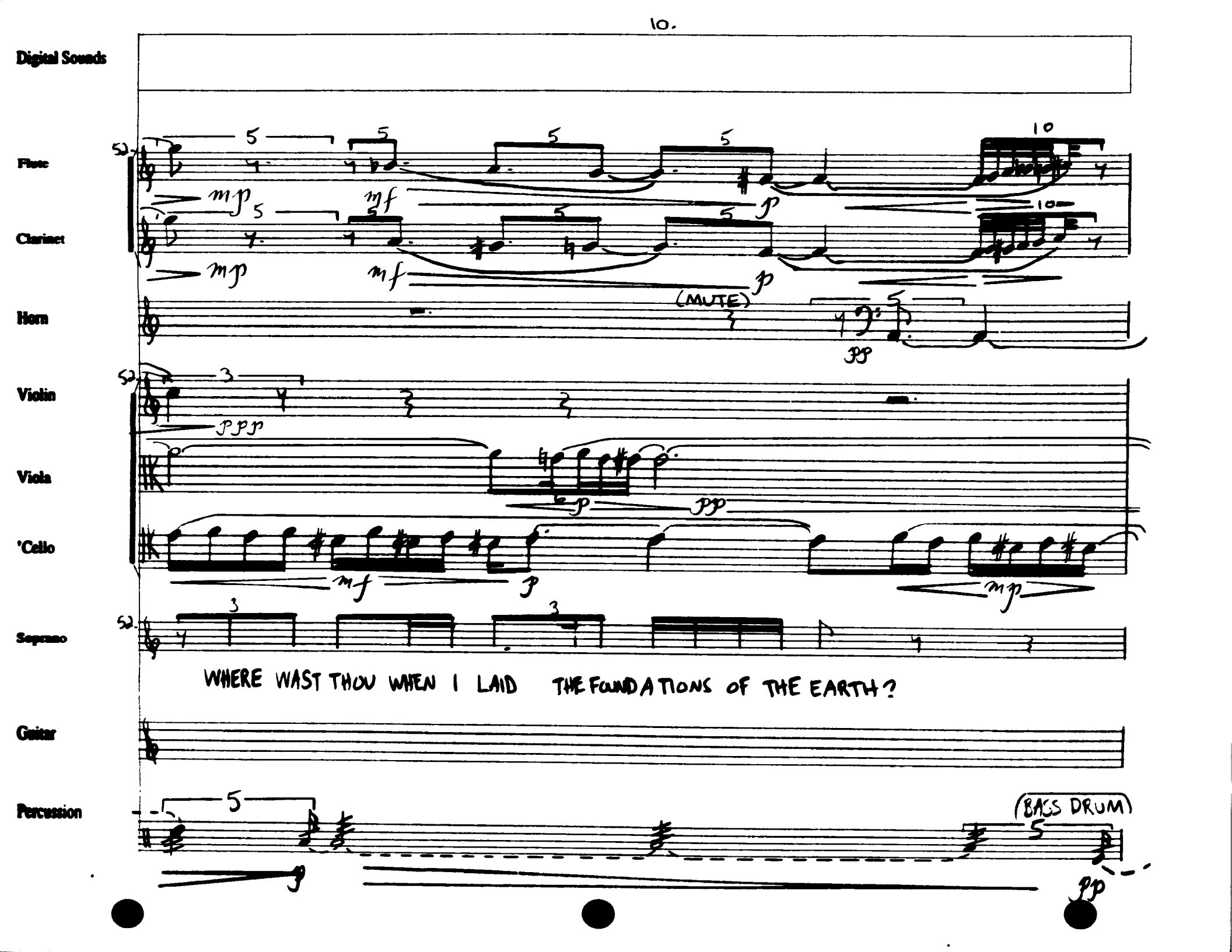

Digital Sounds
32
Flute
Clarinet
Horn
38
Violin
Viola
'Cello
32
Soprano
THAT WE WILL NEVER KNOW THE MACHINERY GOD USES TO ACCOMPLISH THIS WORK.
Guitar
Percussion

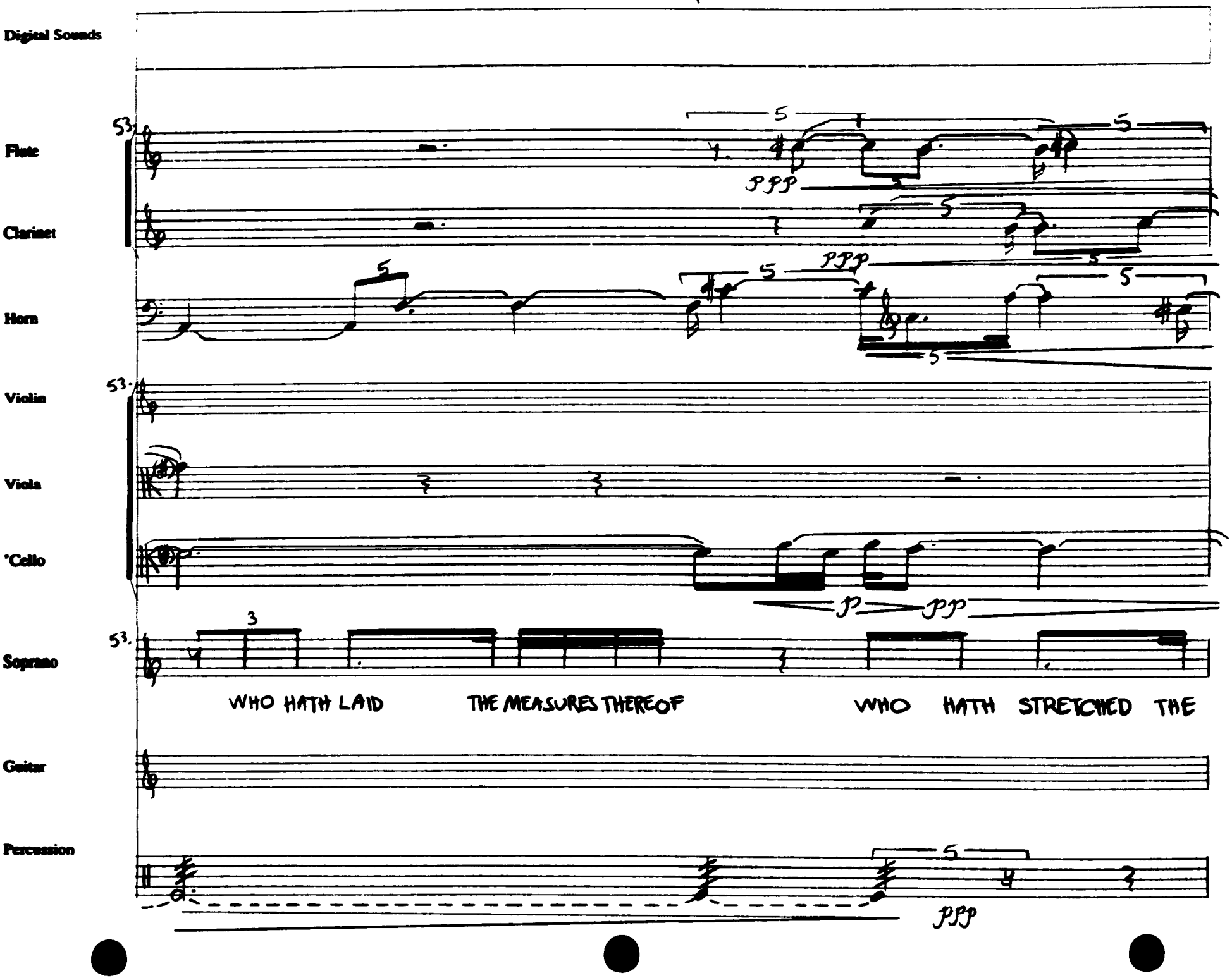

Digital Sounds
30
Flute
Clarinet
Horn
30
Violin
Viola
'Cello
30
Soprano
WHAT THEY DO NOT TELL US IS THE NATURE OF THE WORK GOD DOES...OR WHAT MACHINES GOD USES.
Guitar
Percussion

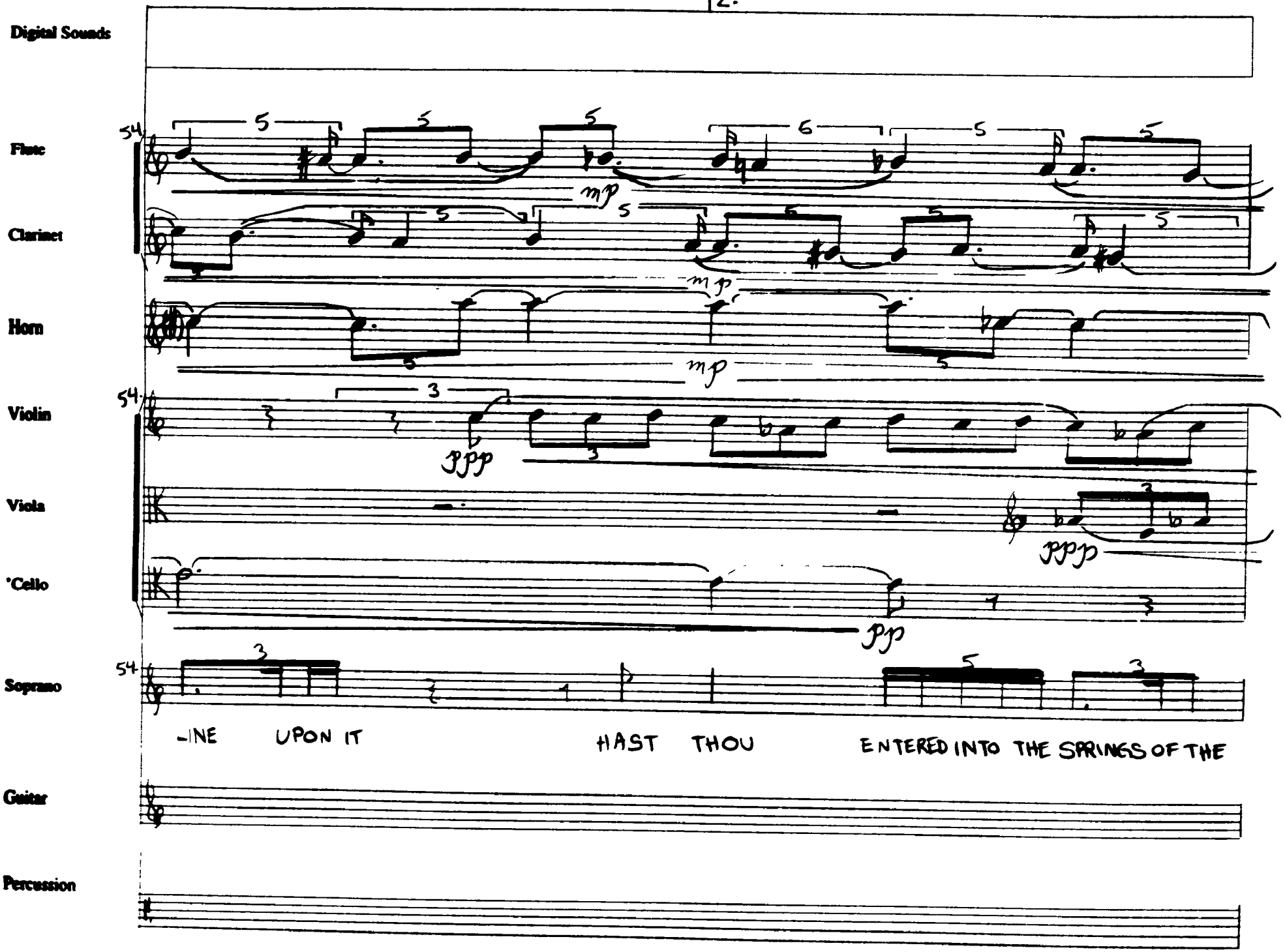

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
44
♪=♪ ♩.=64
6/4 ♩.=♩
ppp
crescendo molto
NO VIBRATO
GOD SPEAKS FROM THE WHIRLWIND...
sfz
(CYMBAL)
MED. YARN MALLETS
(CHOKE)
l.v.

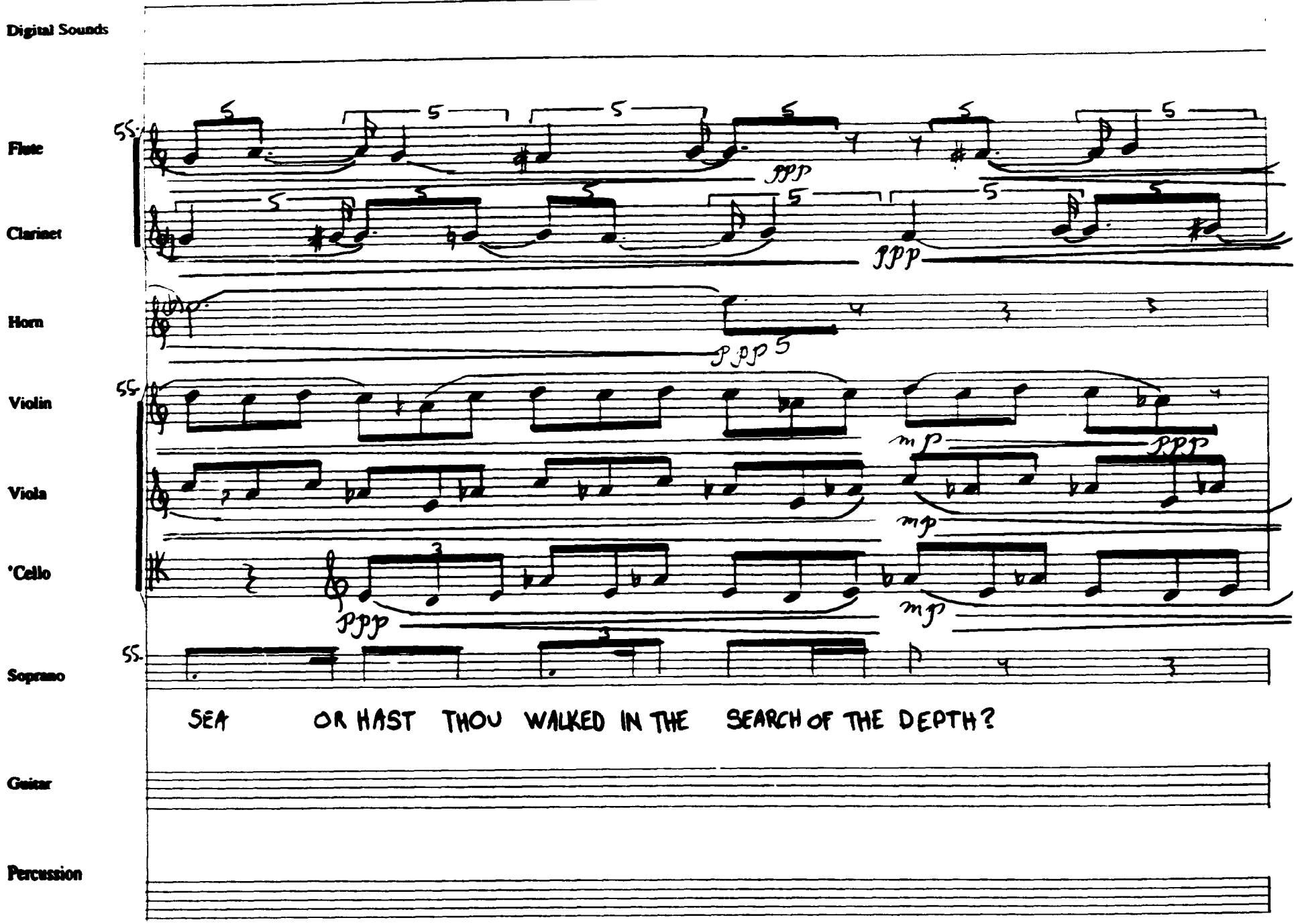

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
(TOM-TOMS)

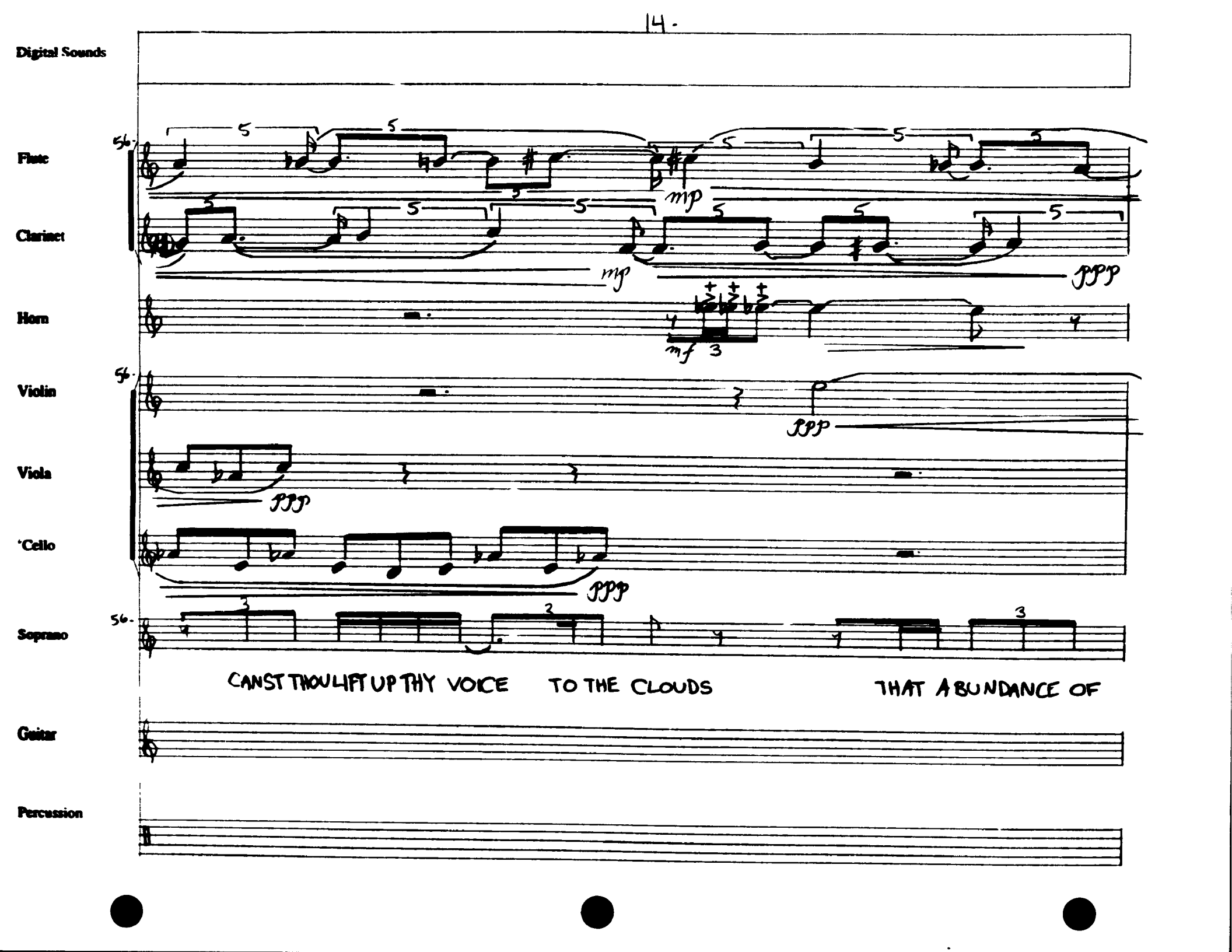

Digital Sounds
Flute
Clarinet
Horn
PLACE MUTE
Violin
Viola
'Cello
Soprano
Guitar
Percussion

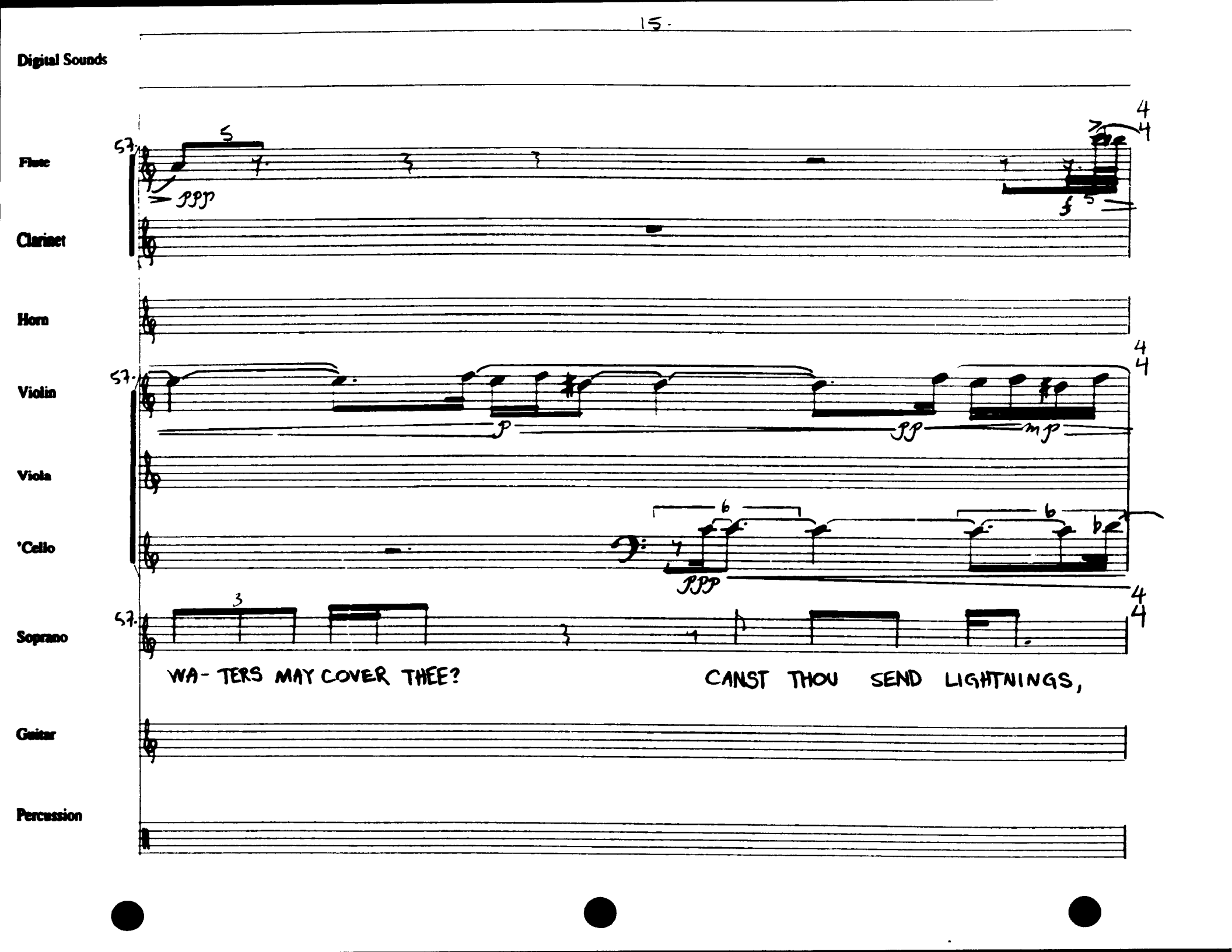

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
(MUTE)
(BASS DRUM)
WHERE WAST THOU WHEN I LAID THE FOUNDATIONS OF THE EARTH?

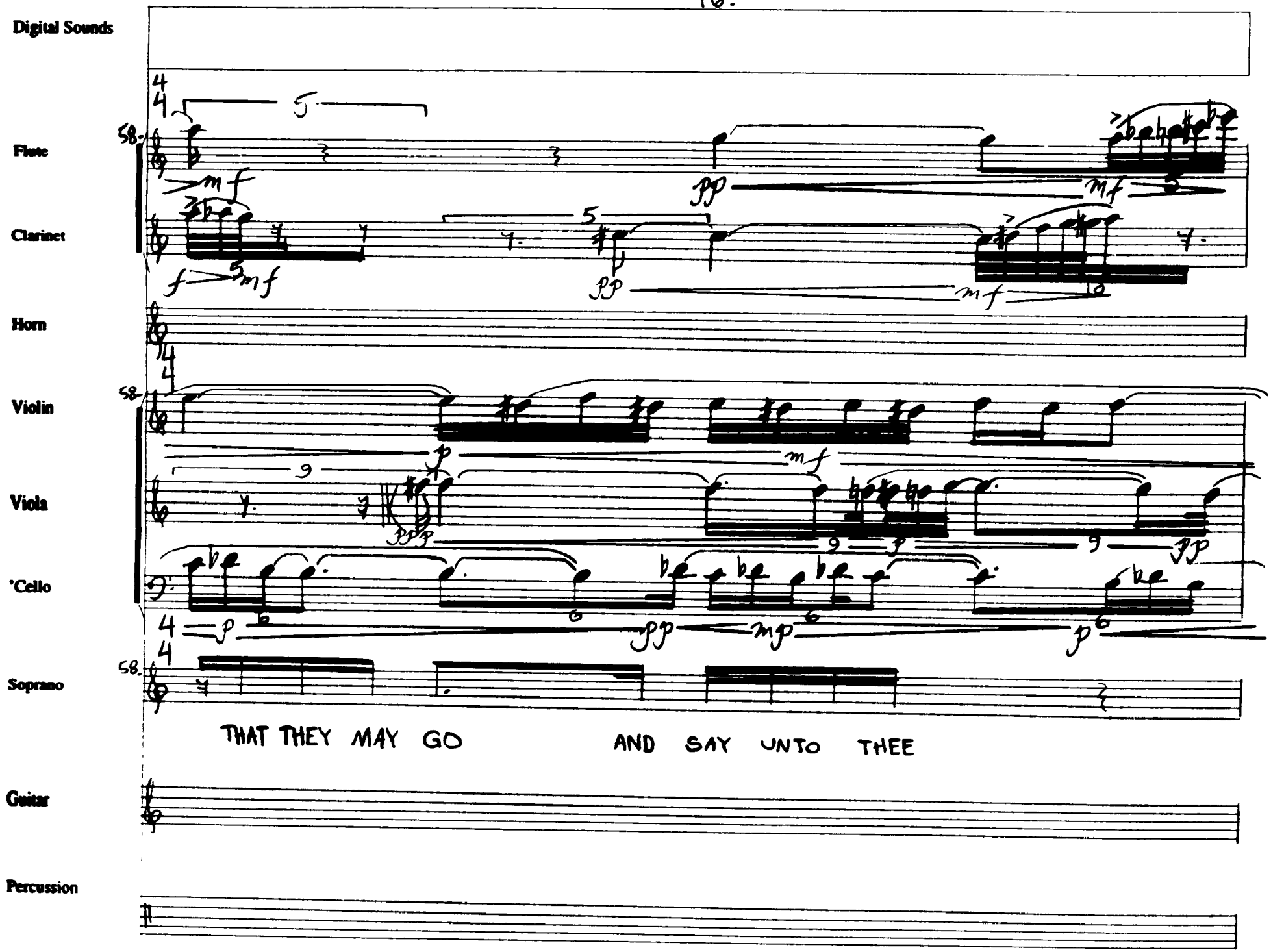

Digital Sounds
53.
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
WHO HATH LAID
THE MEASURES THEREOF
WHO HATH STRETCHED THE
Guitar
Percussion
ppp
p
pp

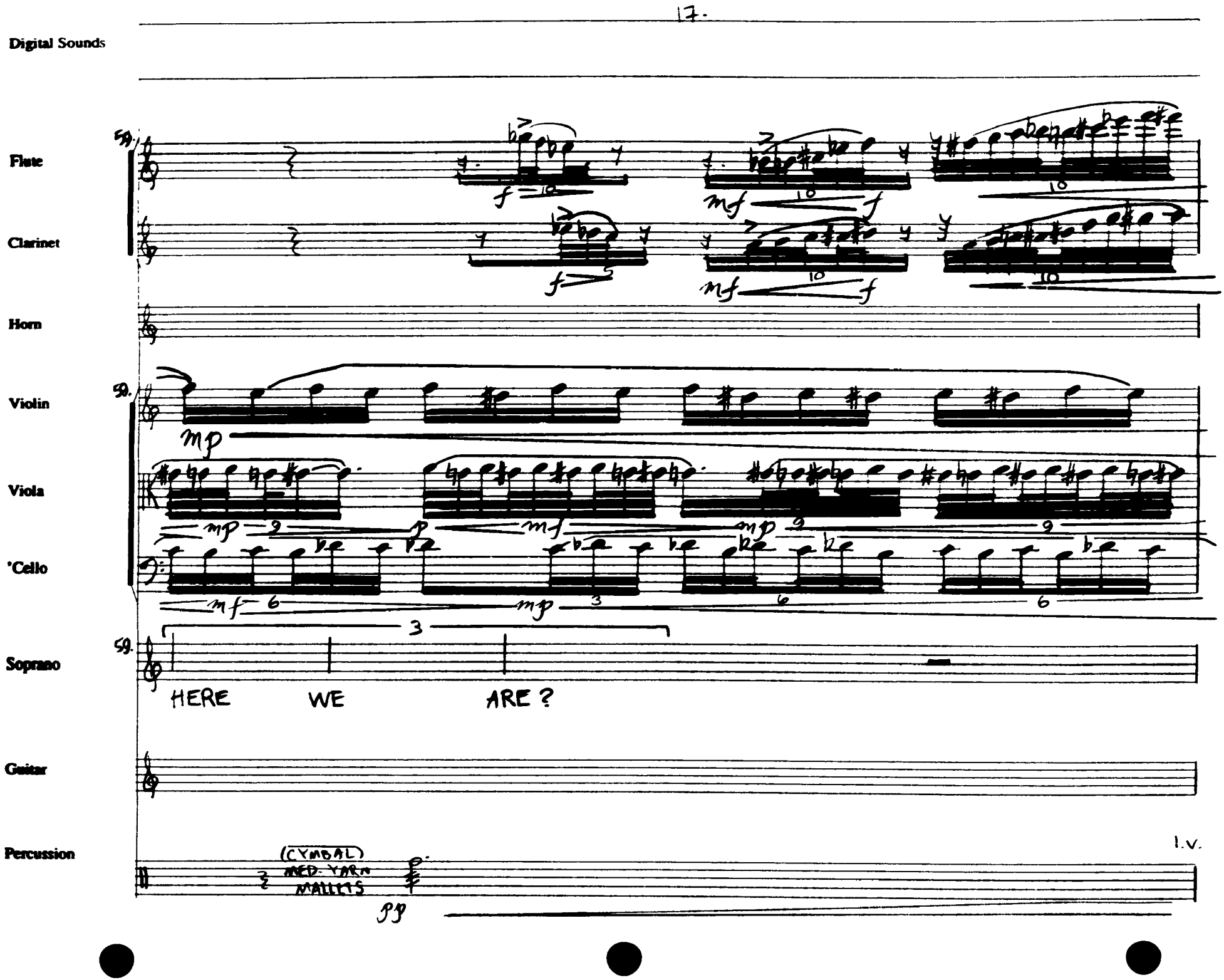

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
54
mp
mp
mp
ppp
ppp
pp
-INE UPON IT HAST THOU ENTERED INTO THE SPRINGS OF THE

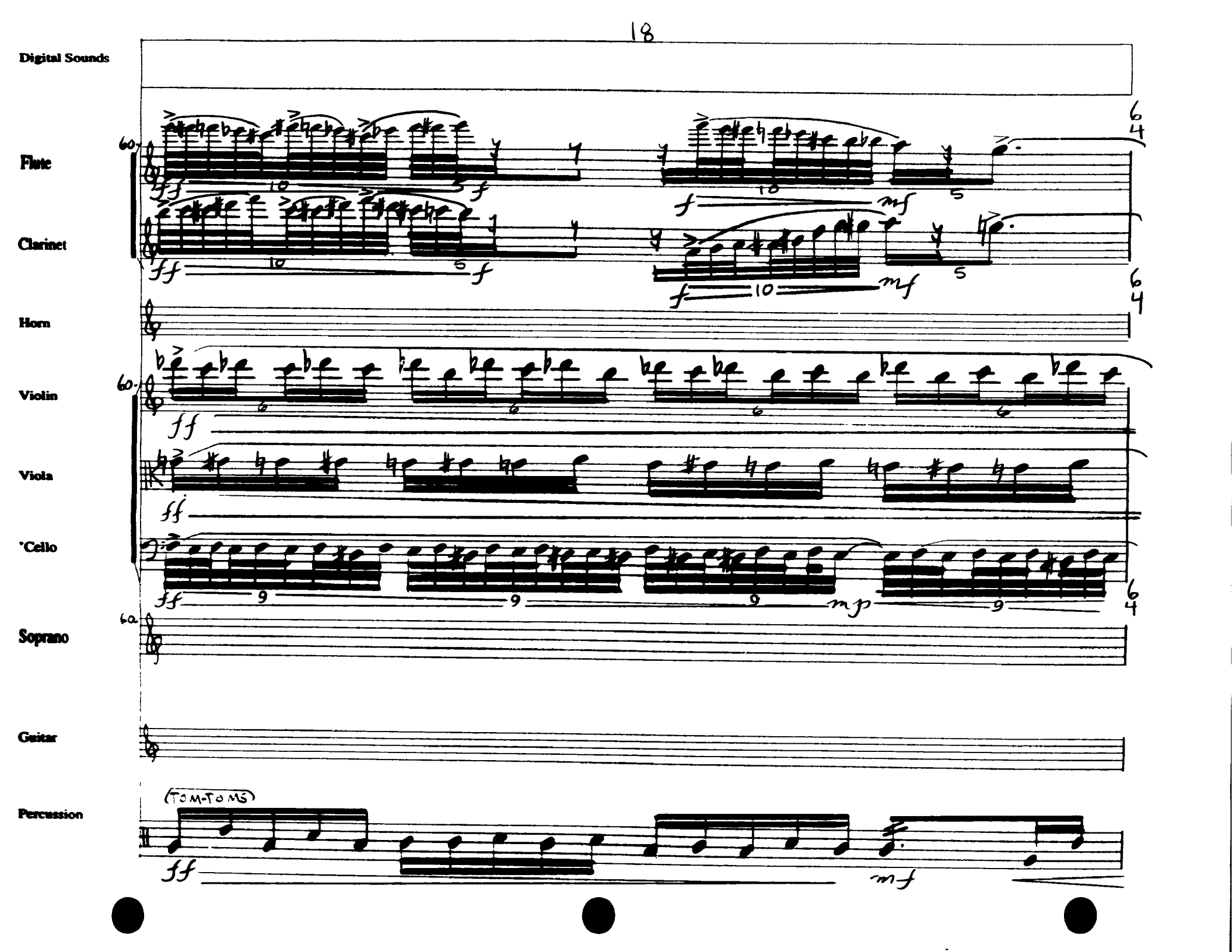

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
55.
ppp
mp
SEA OR HAST THOU WALKED IN THE SEARCH OF THE DEPTH?

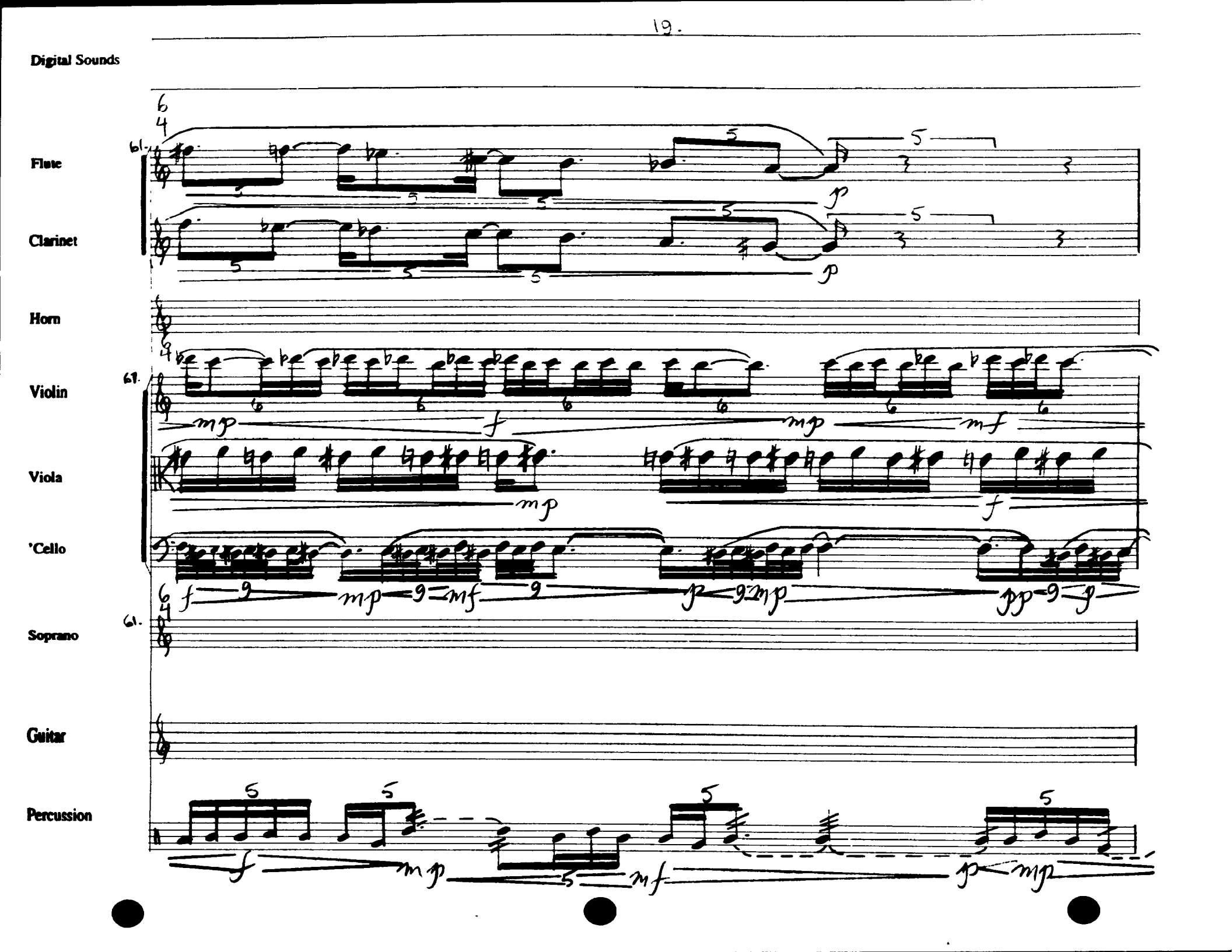

Digital Sounds
56.
Flute
Clarinet
Horn
Violin
Viola
'Cello
56.
Soprano
CANST THOU LIFT UP THY VOICE TO THE CLOUDS THAT ABUNDANCE OF
Guitar
Percussion
mp
mp
ppp
mf
ppp
ppp
ppp

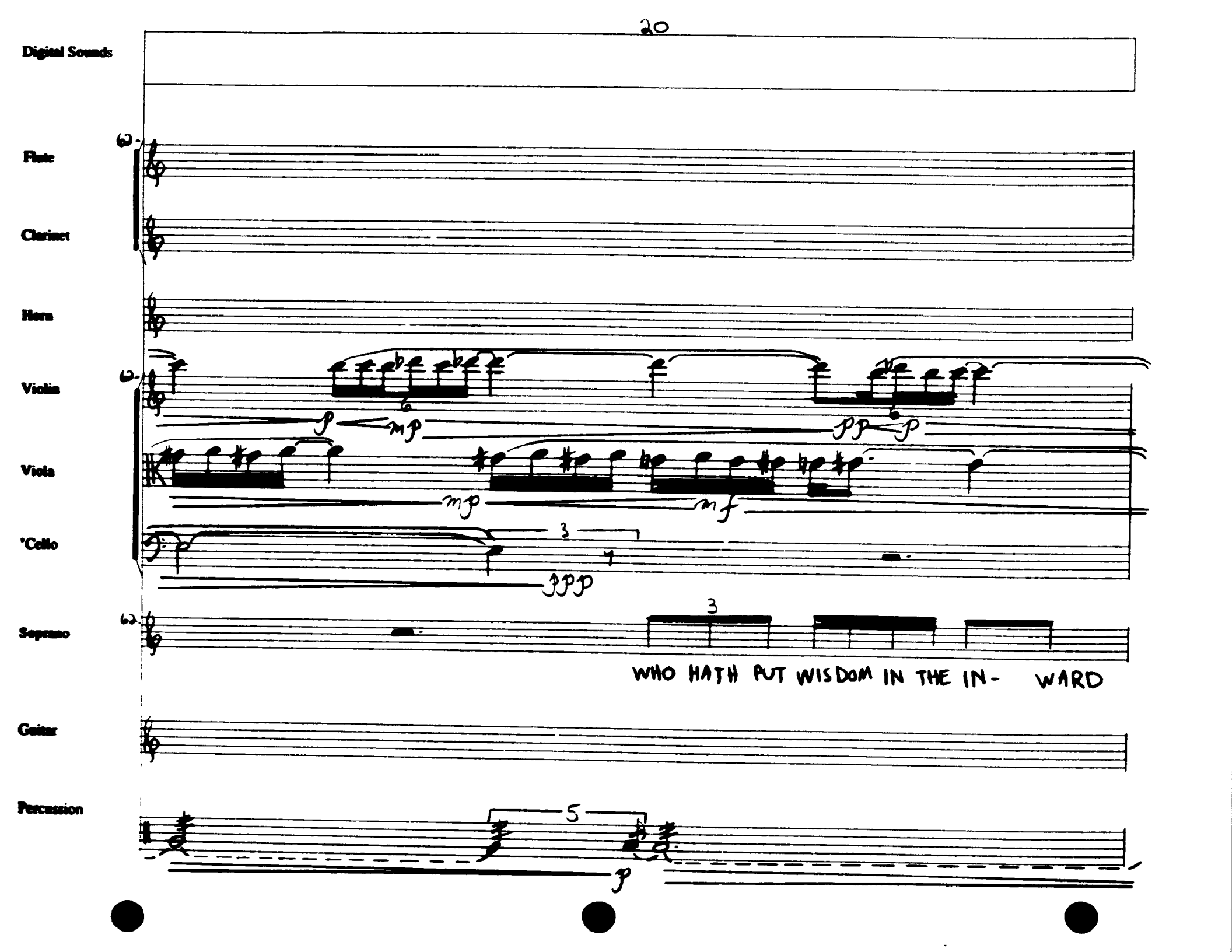

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
57.
PPP
P
PP
mp
WA- TERS MAY COVER THEE?
CANST THOU SEND LIGHTNINGS,

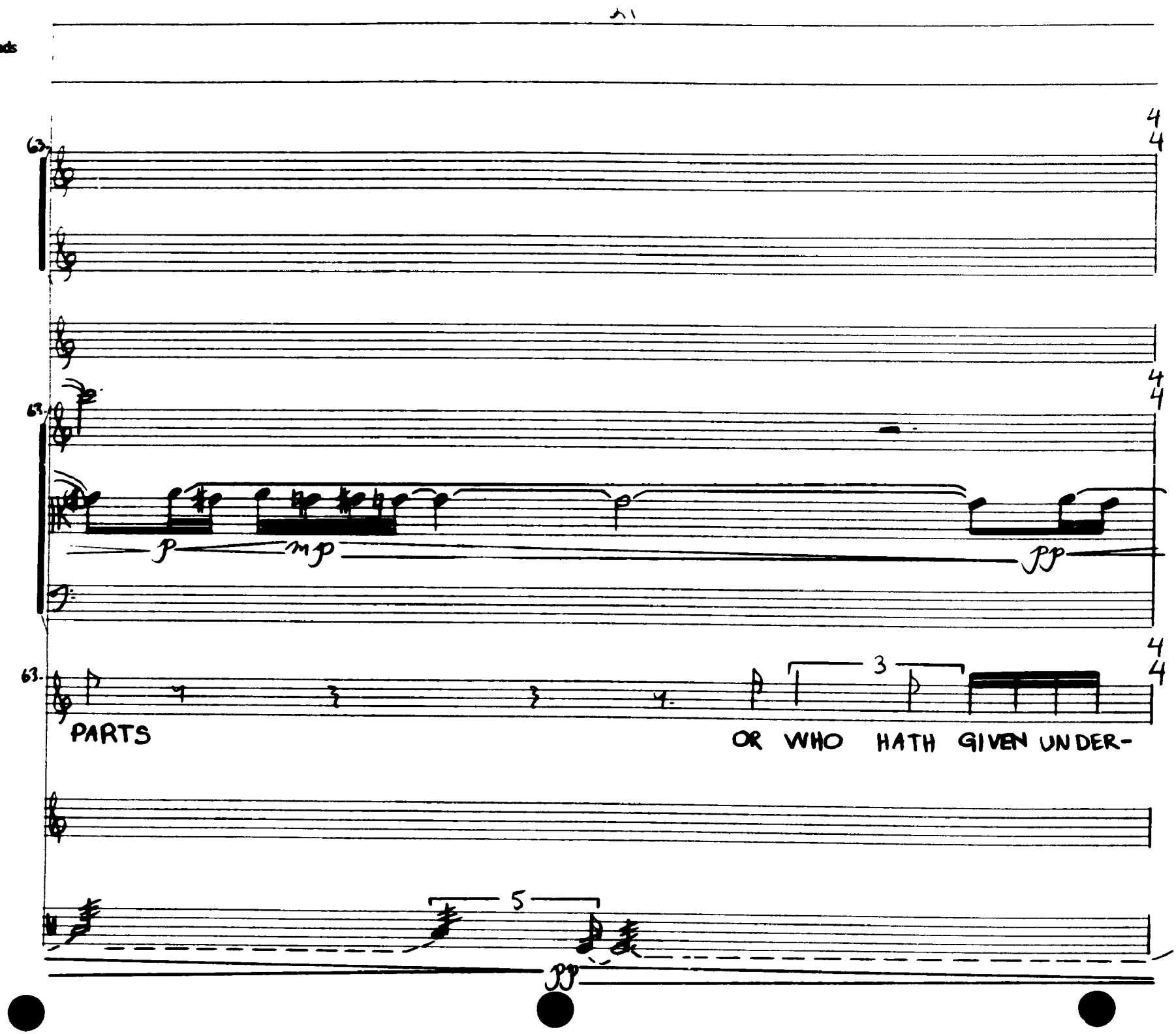

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
58.
THAT THEY MAY GO
AND SAY UNTO THEE

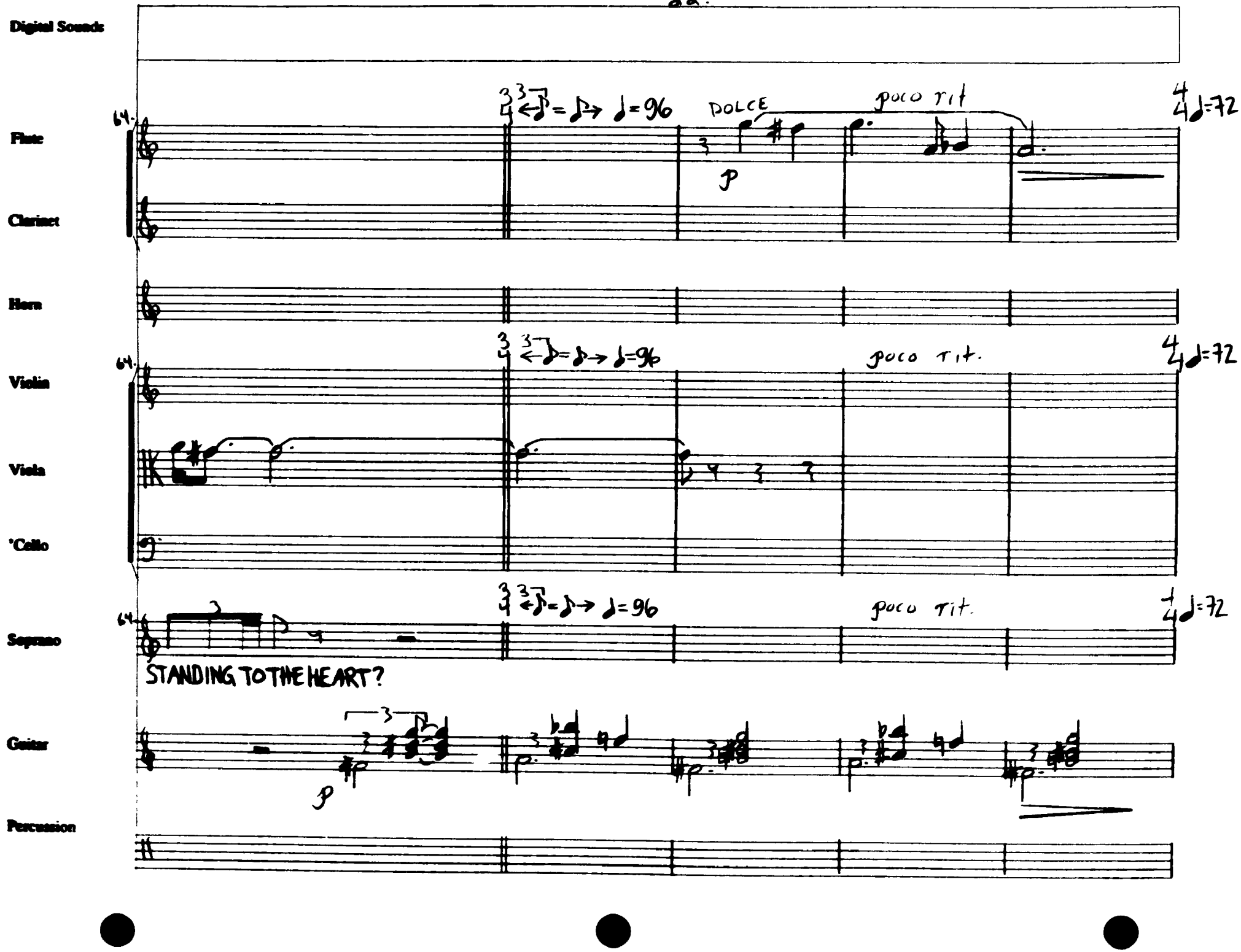

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
HERE WE ARE ?
Guitar
Percussion
(CYMBAL)
MED. YARN MALLETS
l.v.

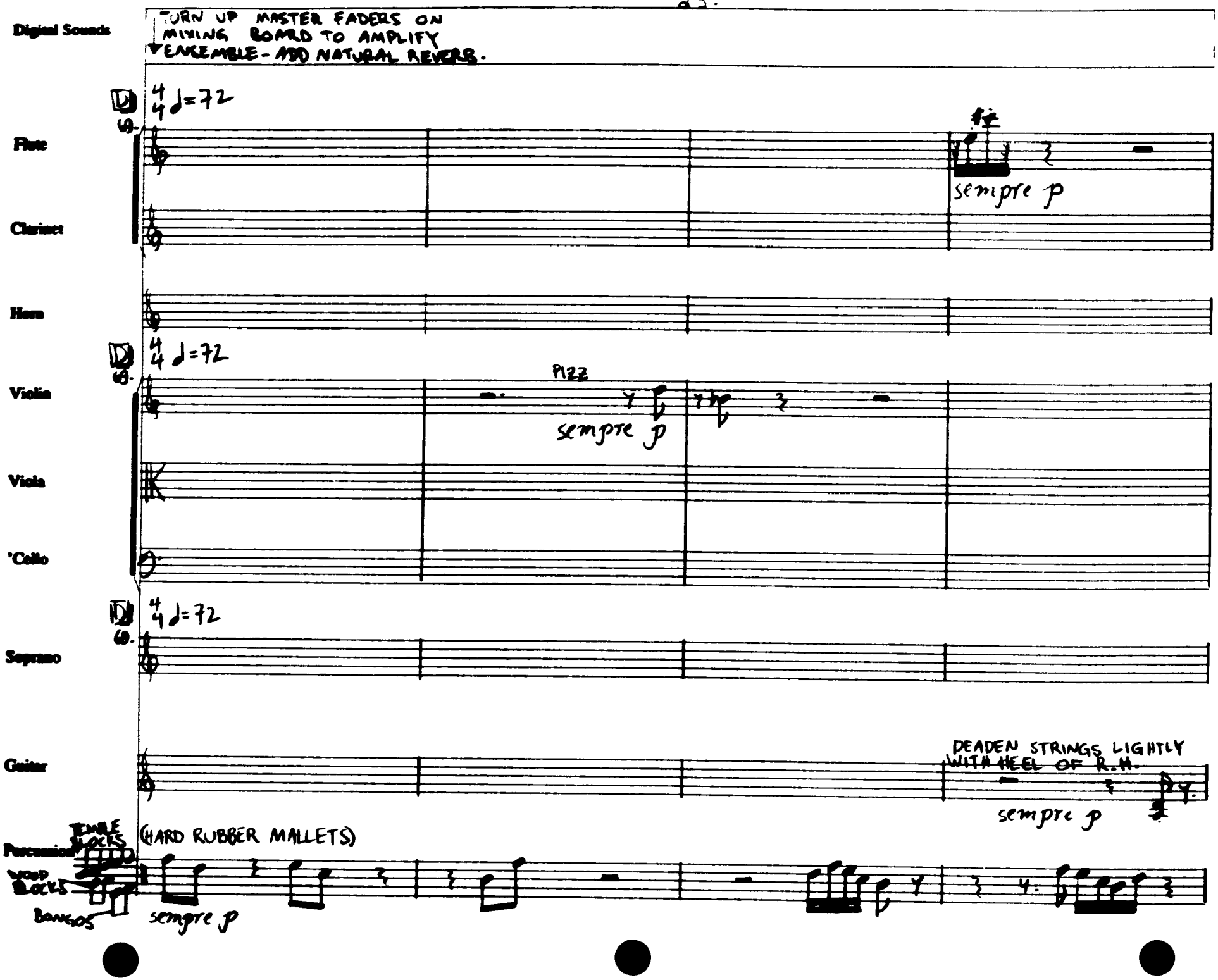

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
(TOM-TOMS)

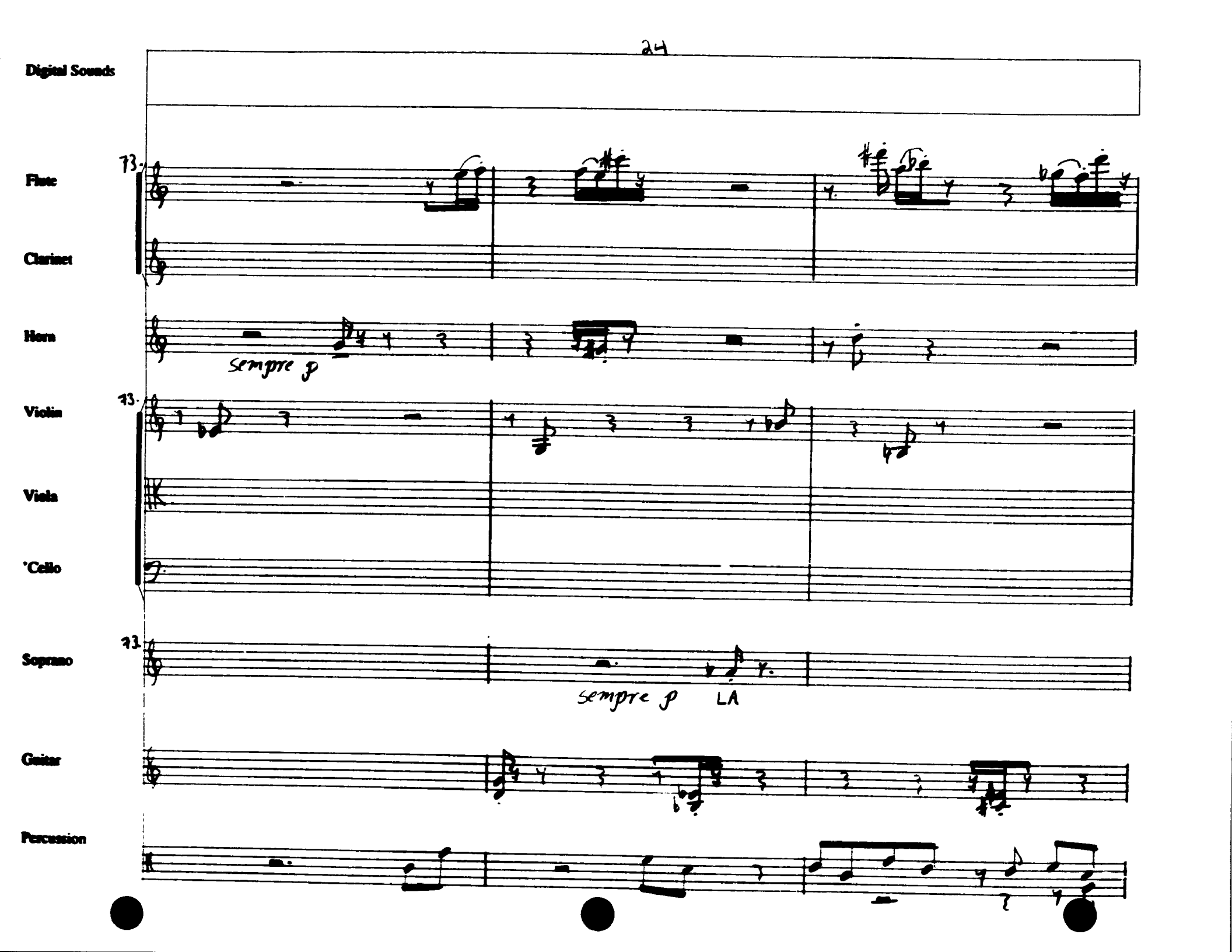

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
61.
mp
f
mf
p
pp

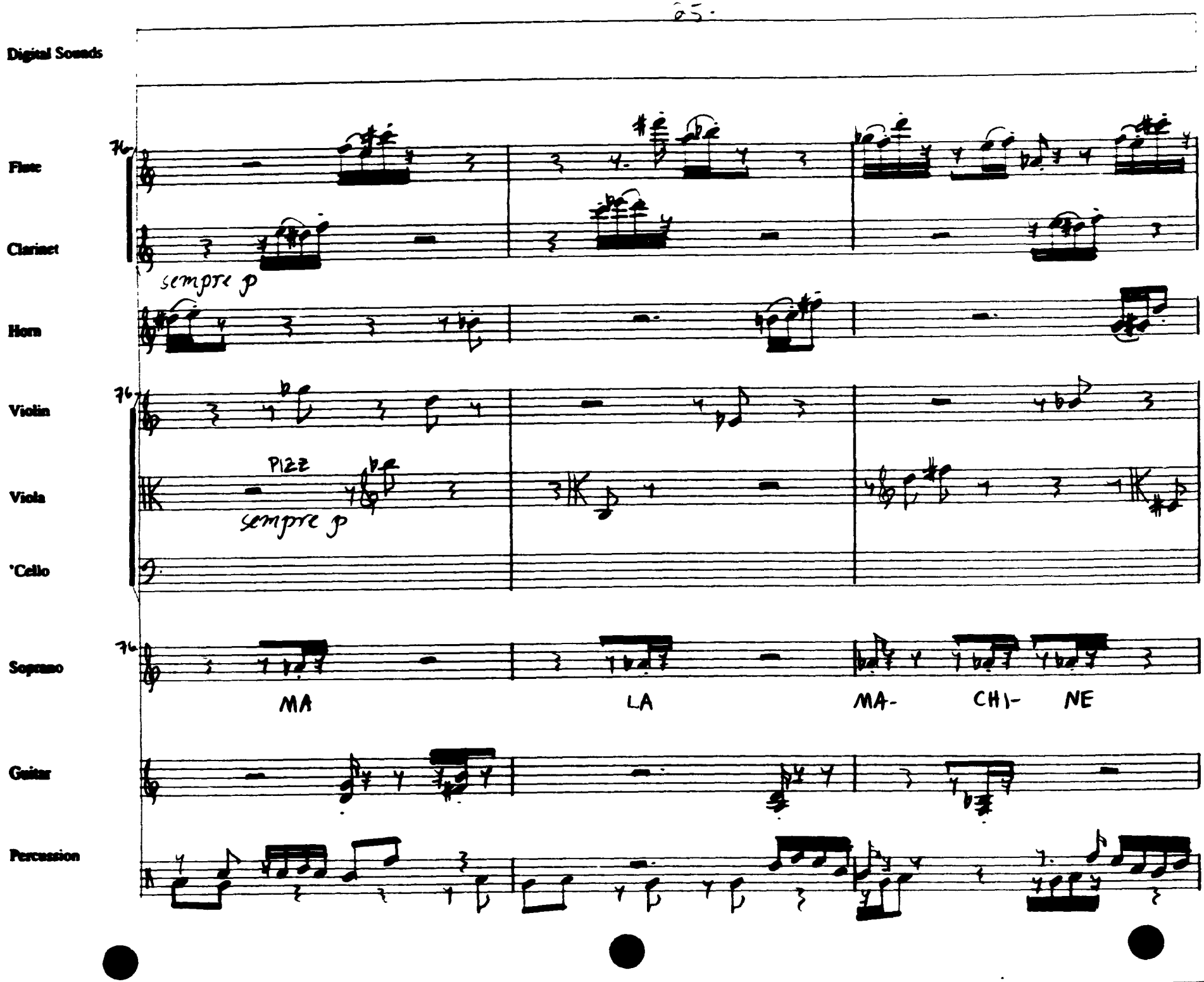

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
WHO HATH PUT WISDOM IN THE IN- WARD
Guitar
Percussion

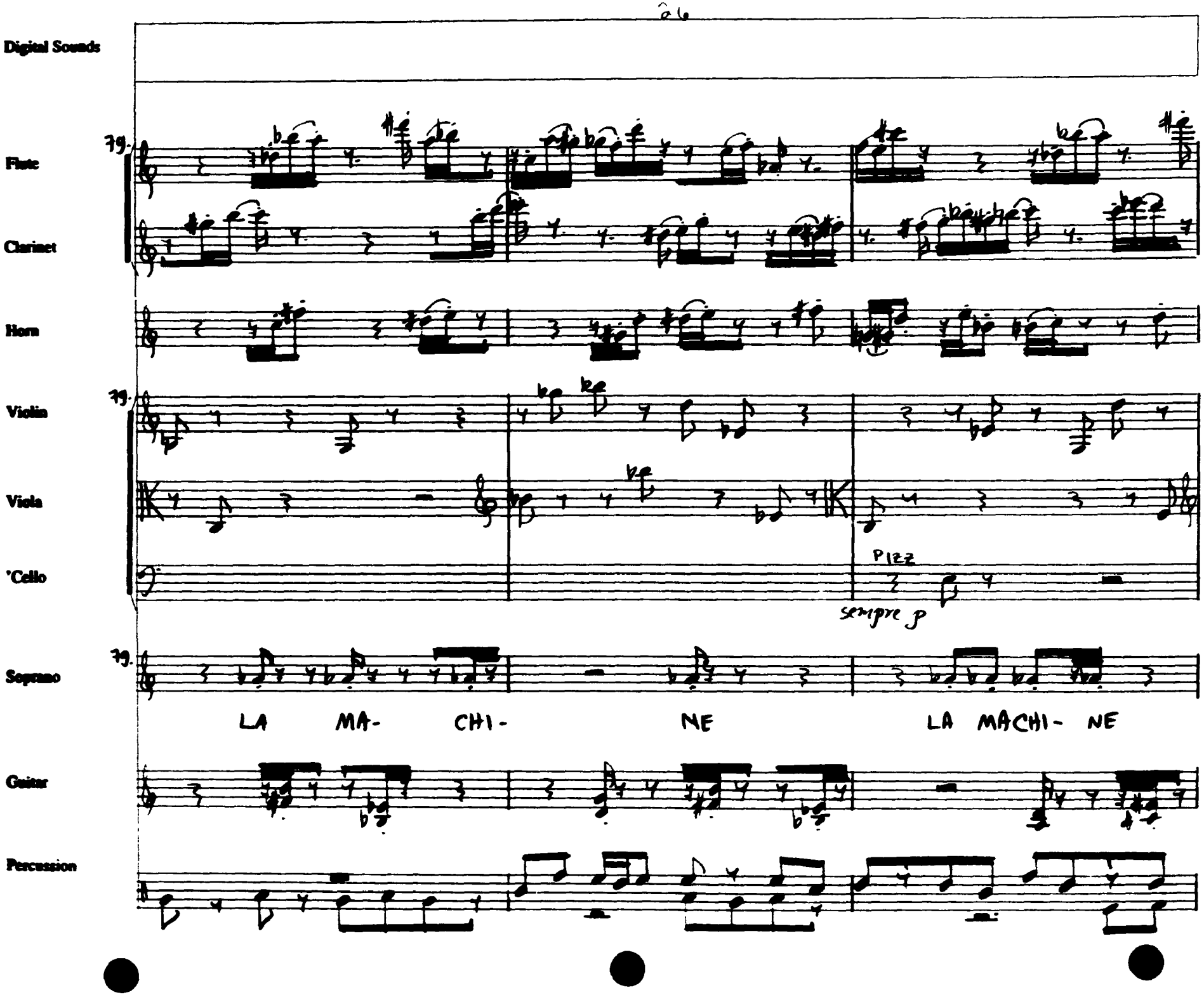

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
63.
4
4
p
mp
pp
3
5
PARTS
OR WHO HATH GIVEN UNDER-


Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
64.
DOLCE
poco rit
poco rit.
STANDING TO THE HEART?

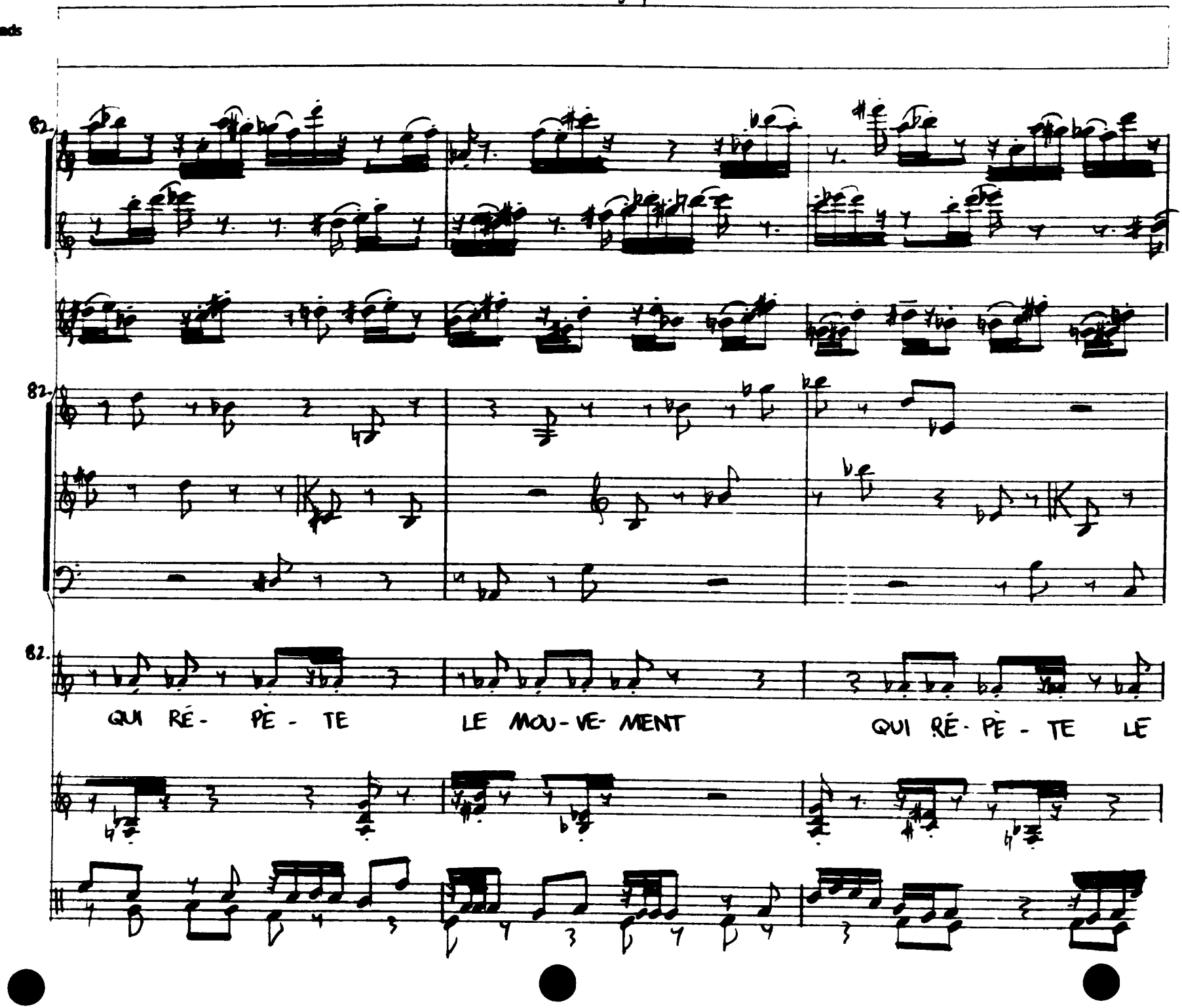

Digital Sounds
TURN UP MASTER FADERS ON MIXING BOARD TO AMPLIFY ENSEMBLE - ADD NATURAL REVERB.
49.
4/4 ♩=72
Flute
Clarinet
sempre p
Horn
65.
4/4 ♩=72
Violin
Viola
'Cello
PIZZ
sempre p
60.
4/4 ♩=72
Soprano
Guitar
DEADEN STRINGS LIGHTLY WITH HEEL OF R.H.
sempre p
Percussion
TEMPLE BLOCKS
WOOD BLOCKS
BONGOS
(HARD RUBBER MALLETS)
sempre p

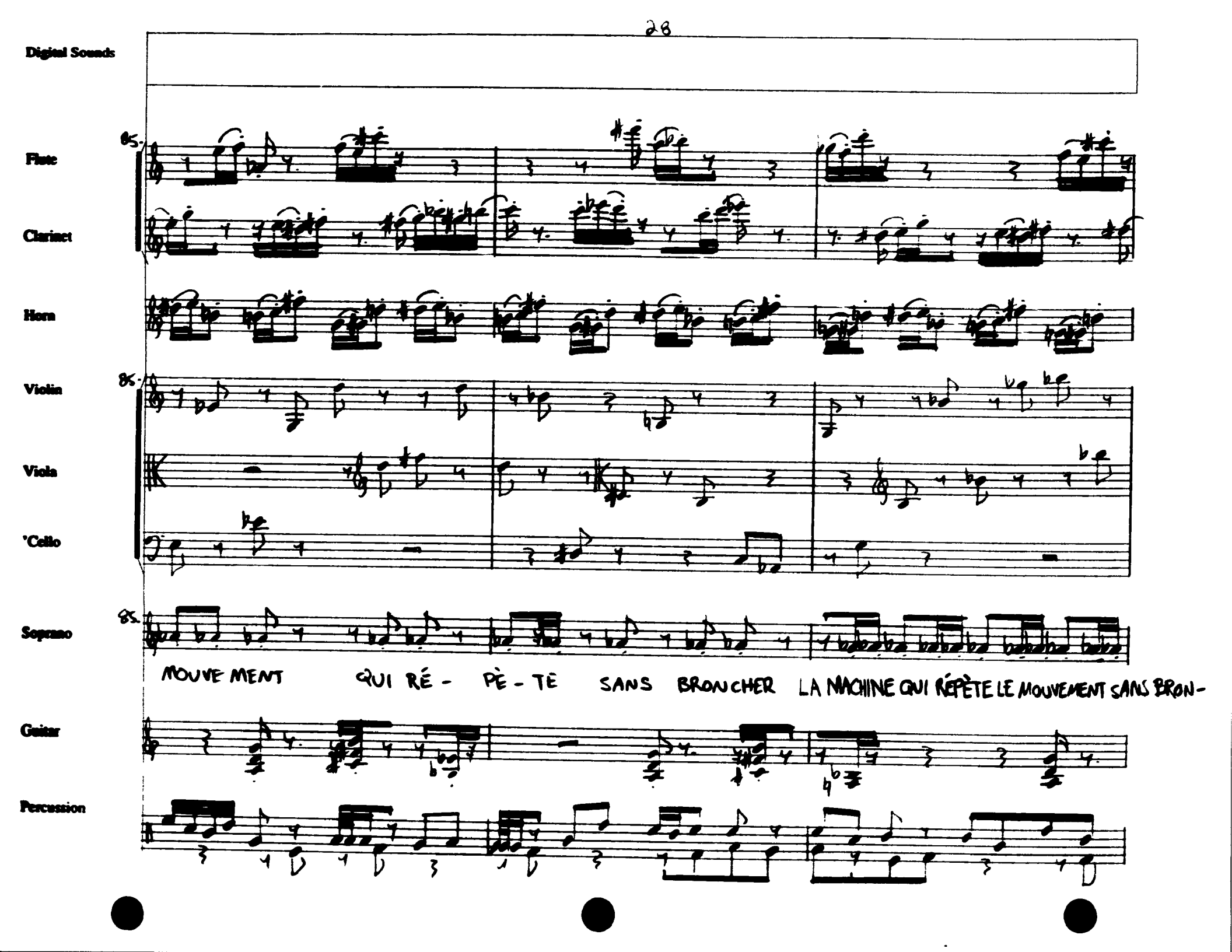

Digital Sounds
73.
Flute
Clarinet
Horn
sempre p
73.
Violin
Viola
'Cello
73.
Soprano
sempre p LA
Guitar
Percussion

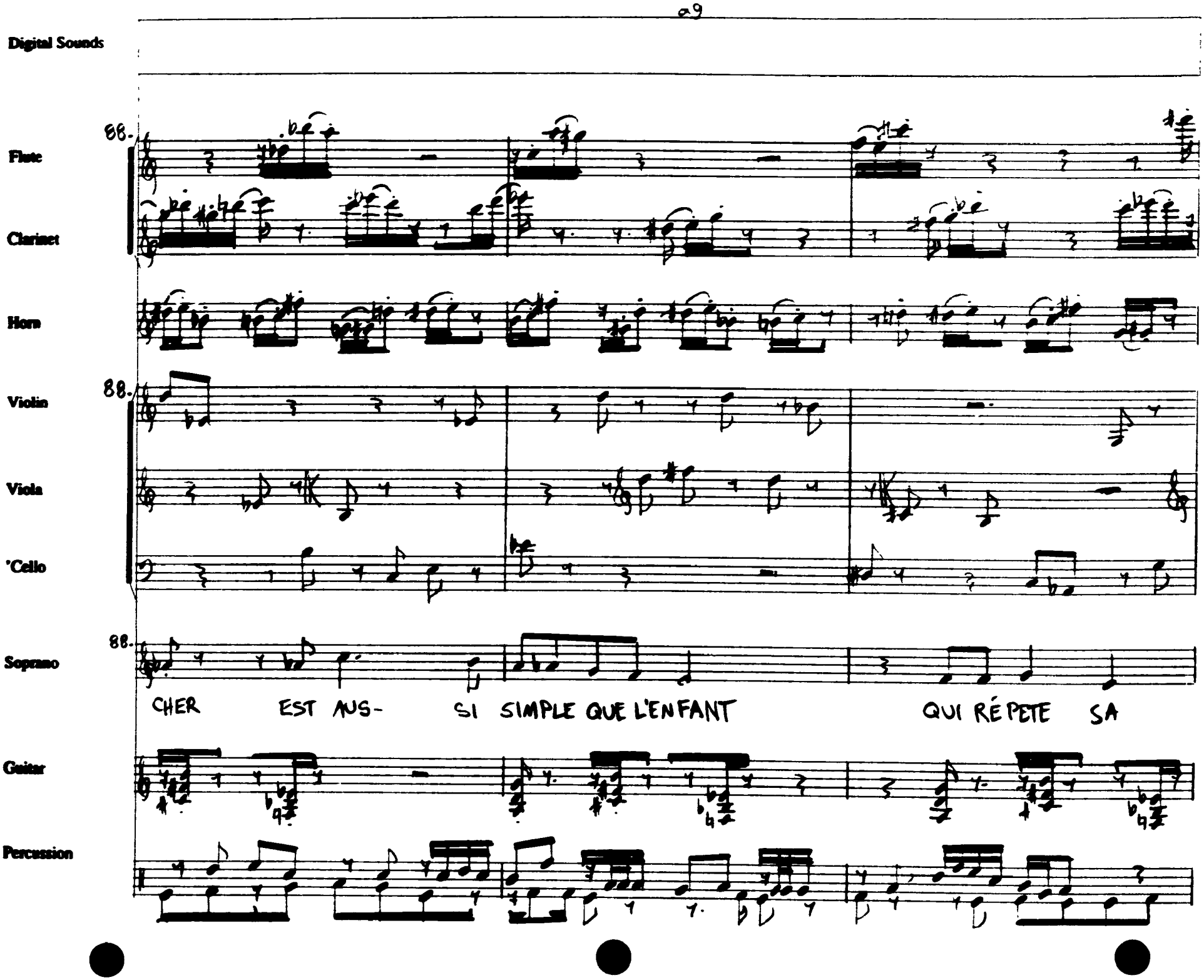

Digital Sounds
76
Flute
Clarinet
sempre p
Horn
76
Violin
Viola
PIZZ
sempre p
'Cello
76
Soprano
MA
LA
MA-
CHI-
NE
Guitar
Percussion

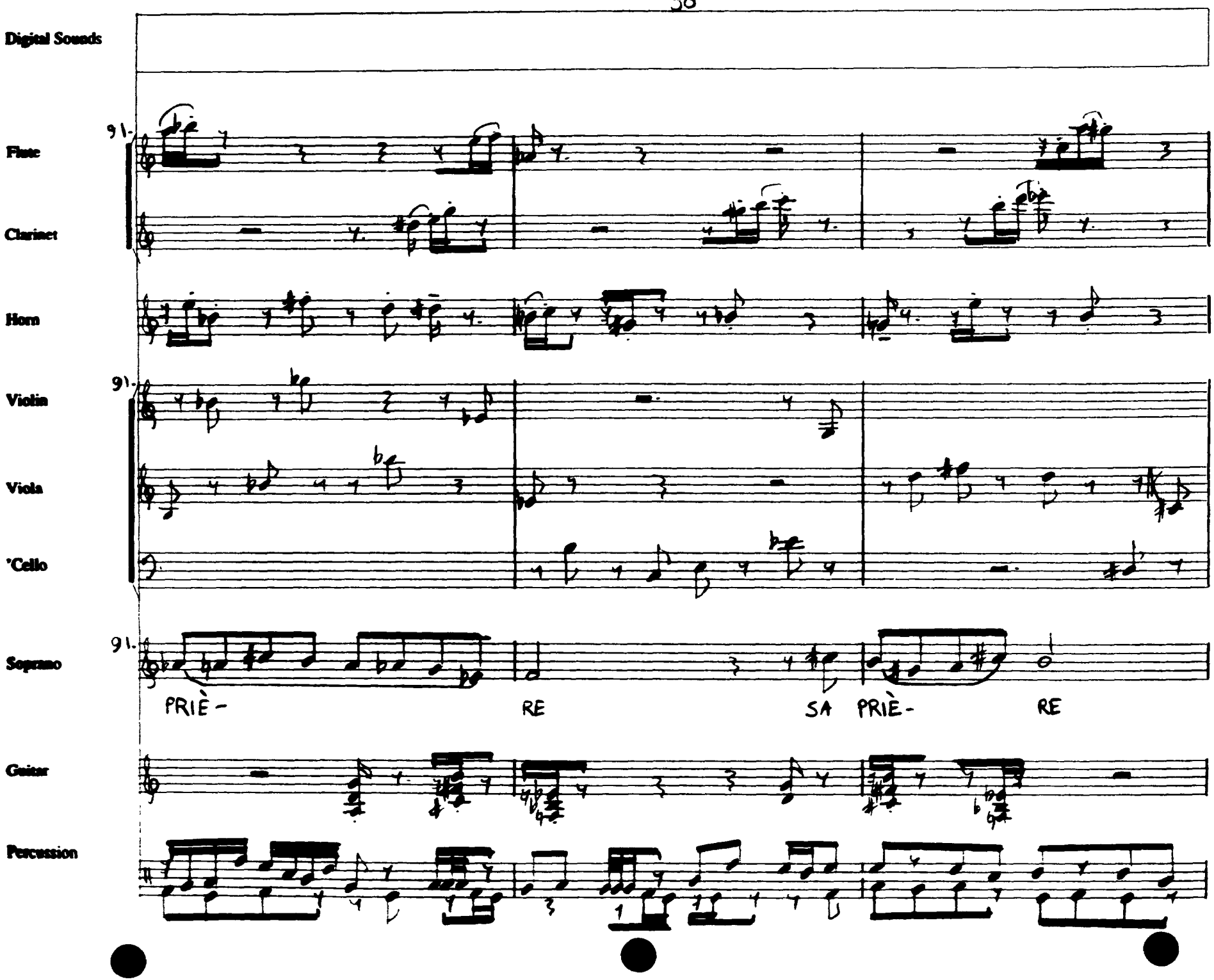

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
79.
Pizz
sempre p
LA MA- CHI- NE LA MACHI- NE

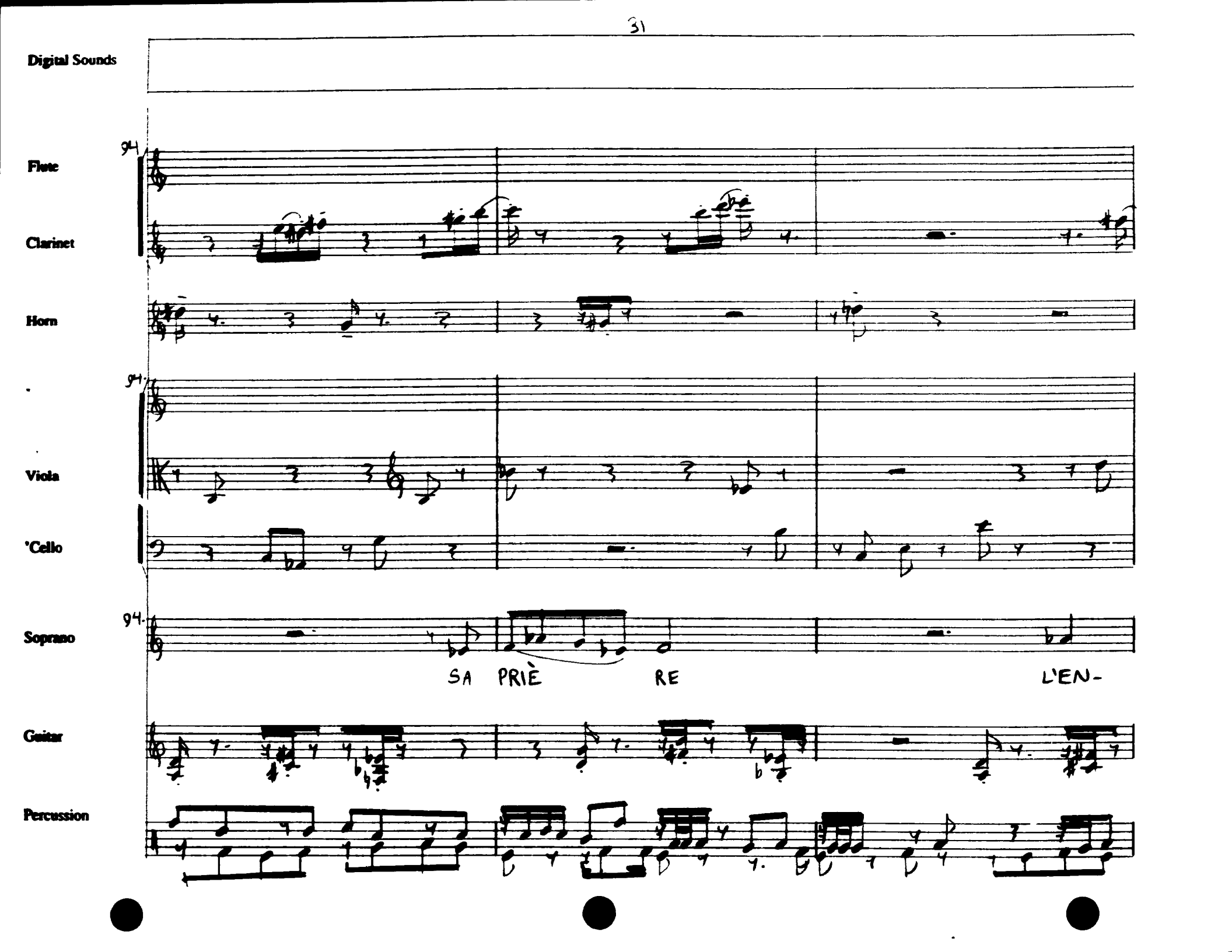
Digital Sounds

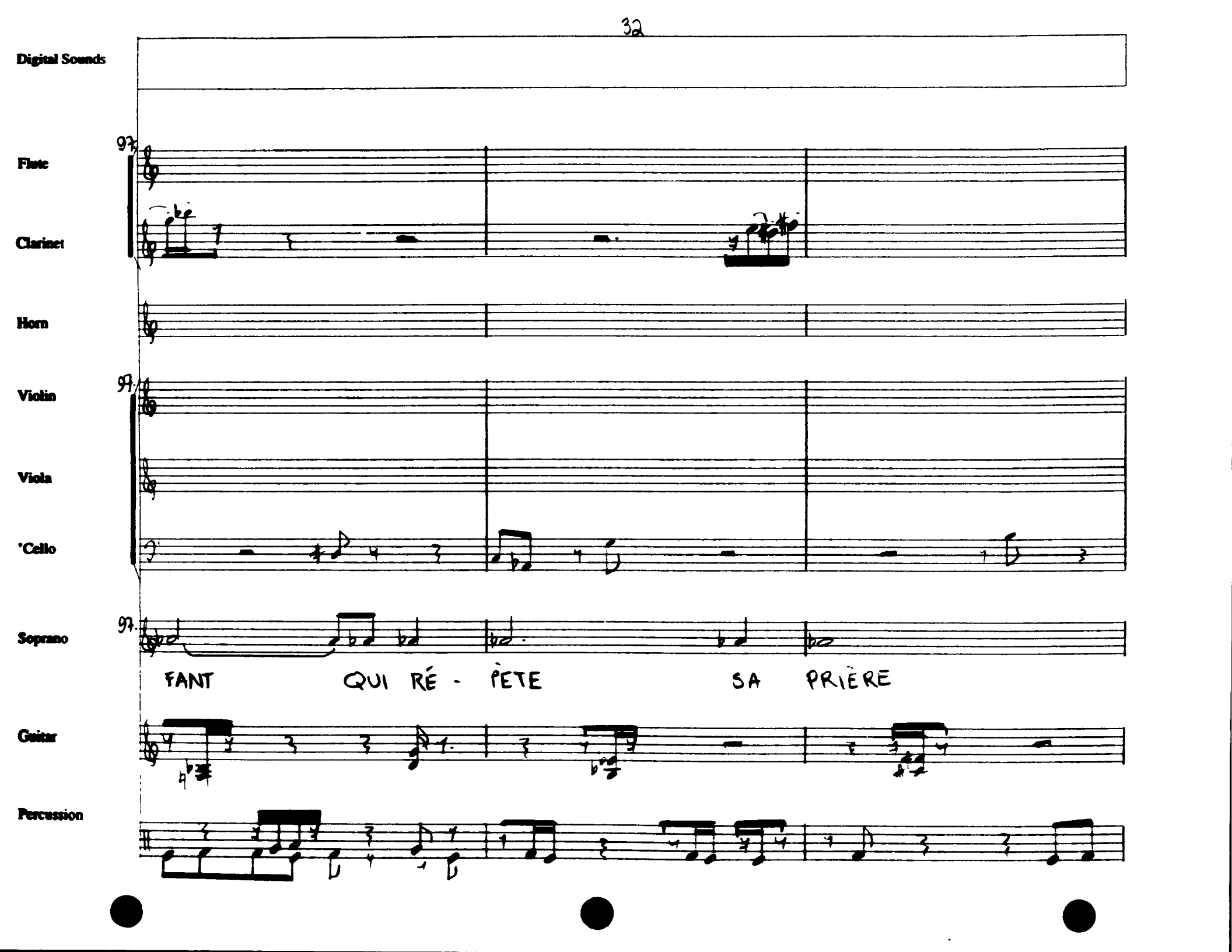



Digital Sounds
85
Flute
Clarinet
Horn
86
Violin
Viola
'Cello
85
Soprano
MOUVE MENT QUI RÉ - PÈ - TE SANS BRONCHER LA MACHINE QUI RÉPÈTE LE MOUVEMENT SANS BRON-
Guitar
Percussion

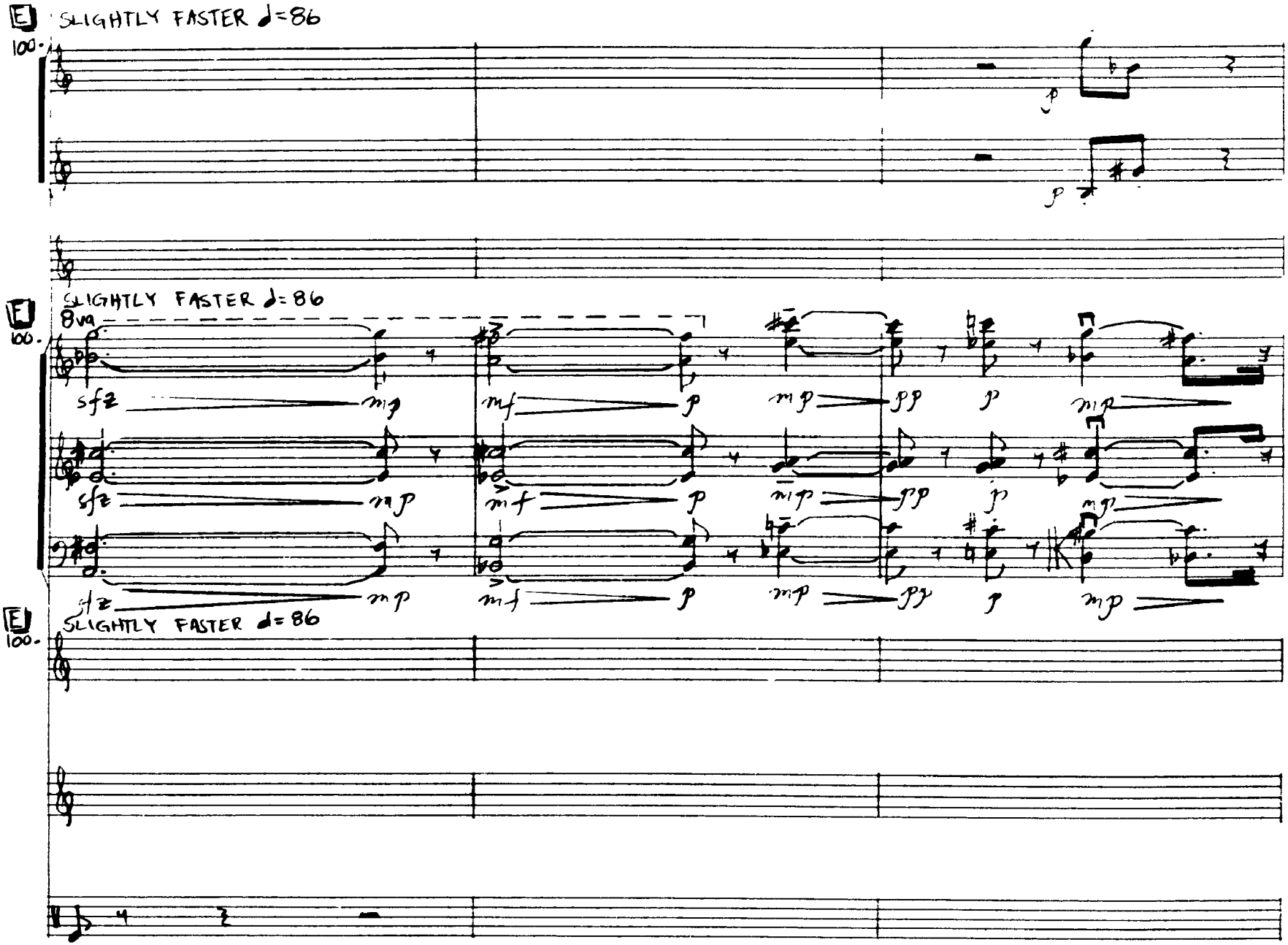

Digital Sounds
88.
Flute
Clarinet
Horn
88.
Violin
Viola
'Cello
88.
Soprano
CHER EST AUS- SI SIMPLE QUE L'ENFANT QUI RÉPETE SA
Guitar
Percussion

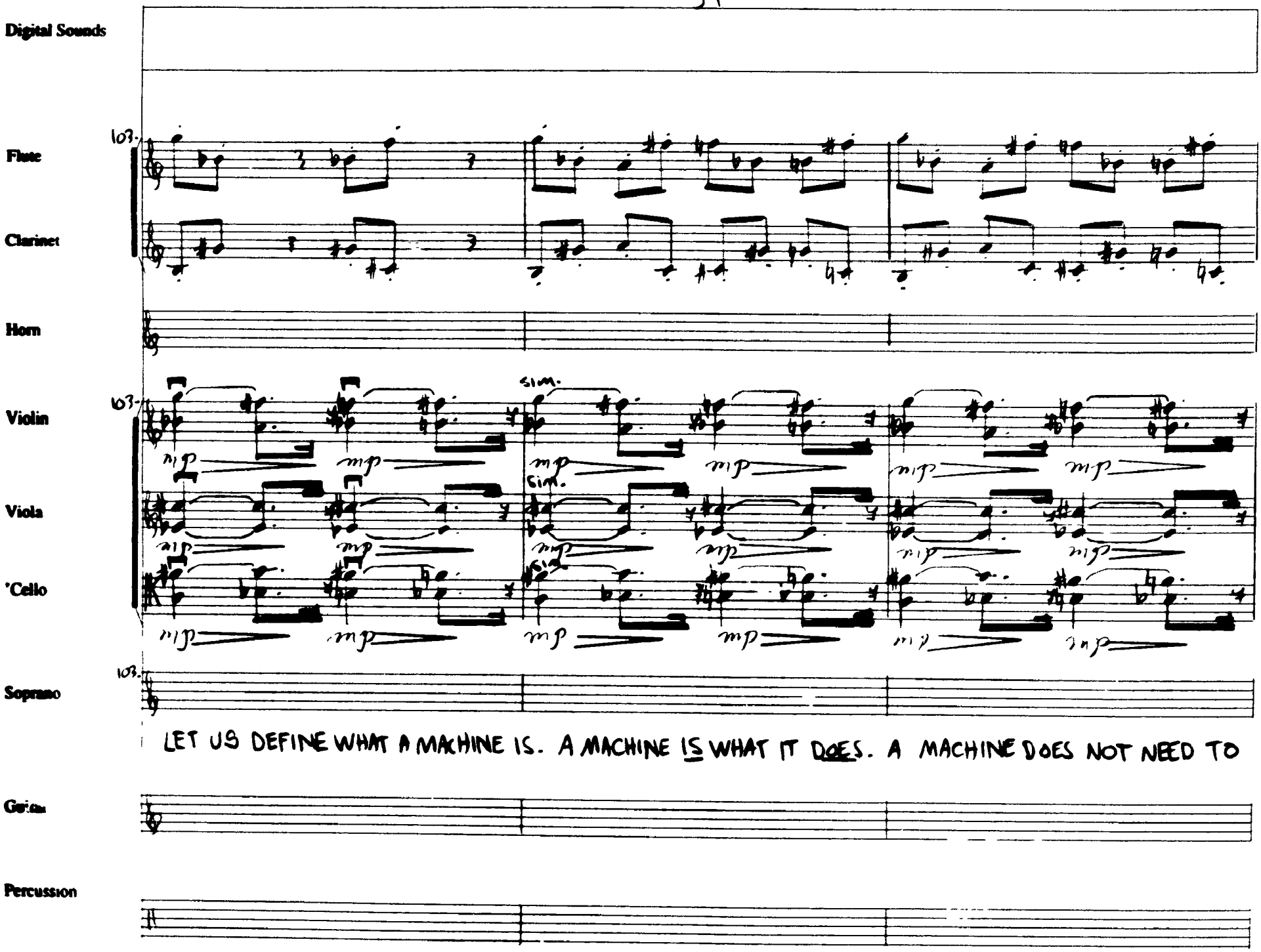

Digital Sounds
91.
Flute
Clarinet
Horn
91.
Violin
Viola
'Cello
91.
Soprano
PRIÈ-
RE
SA
PRIÈ-
RE
Guitar
Percussion

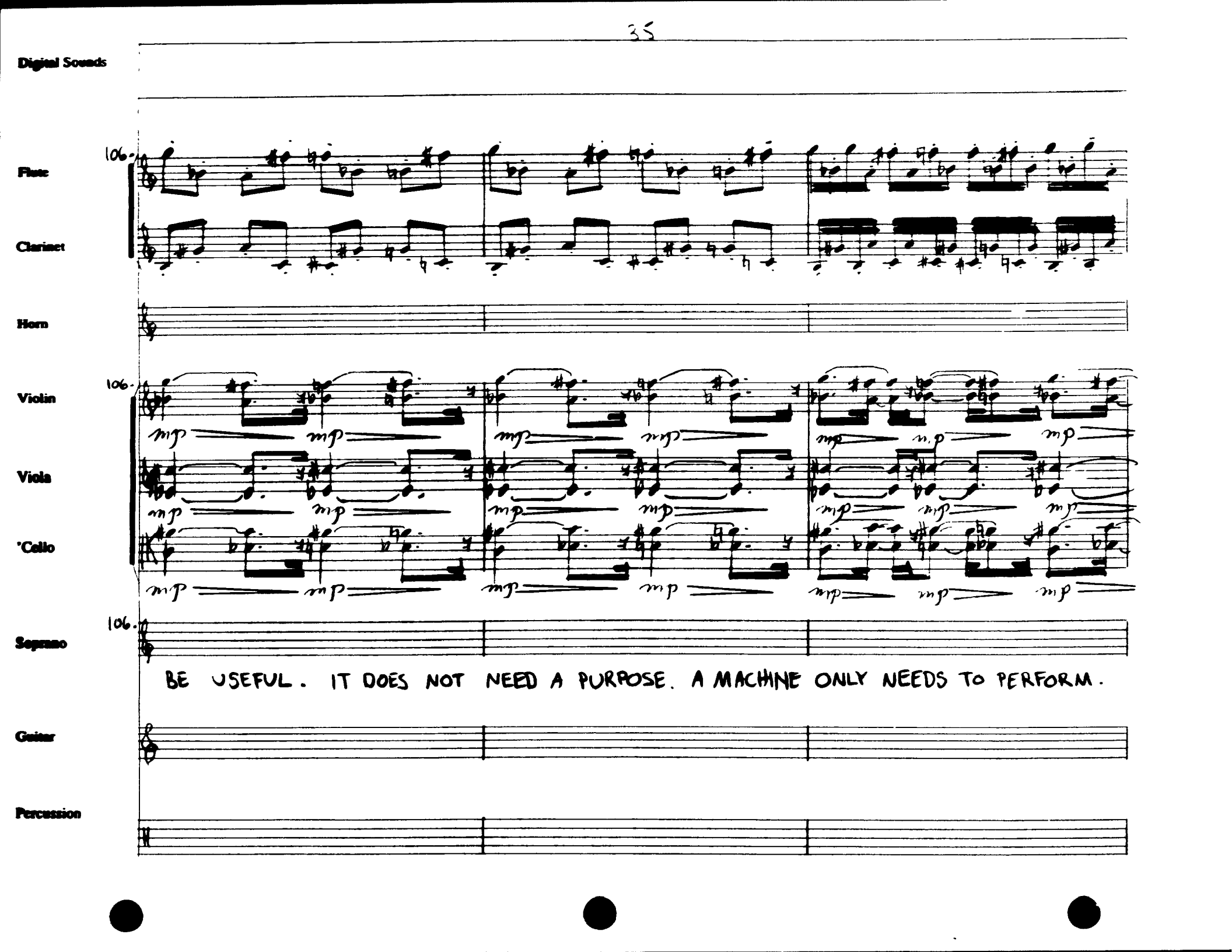

Digital Sounds
94
Flute
Clarinet
Horn
94
Viola
'Cello
94
Soprano
SA PRIÈ RE L'EN-
Guitar
Percussion

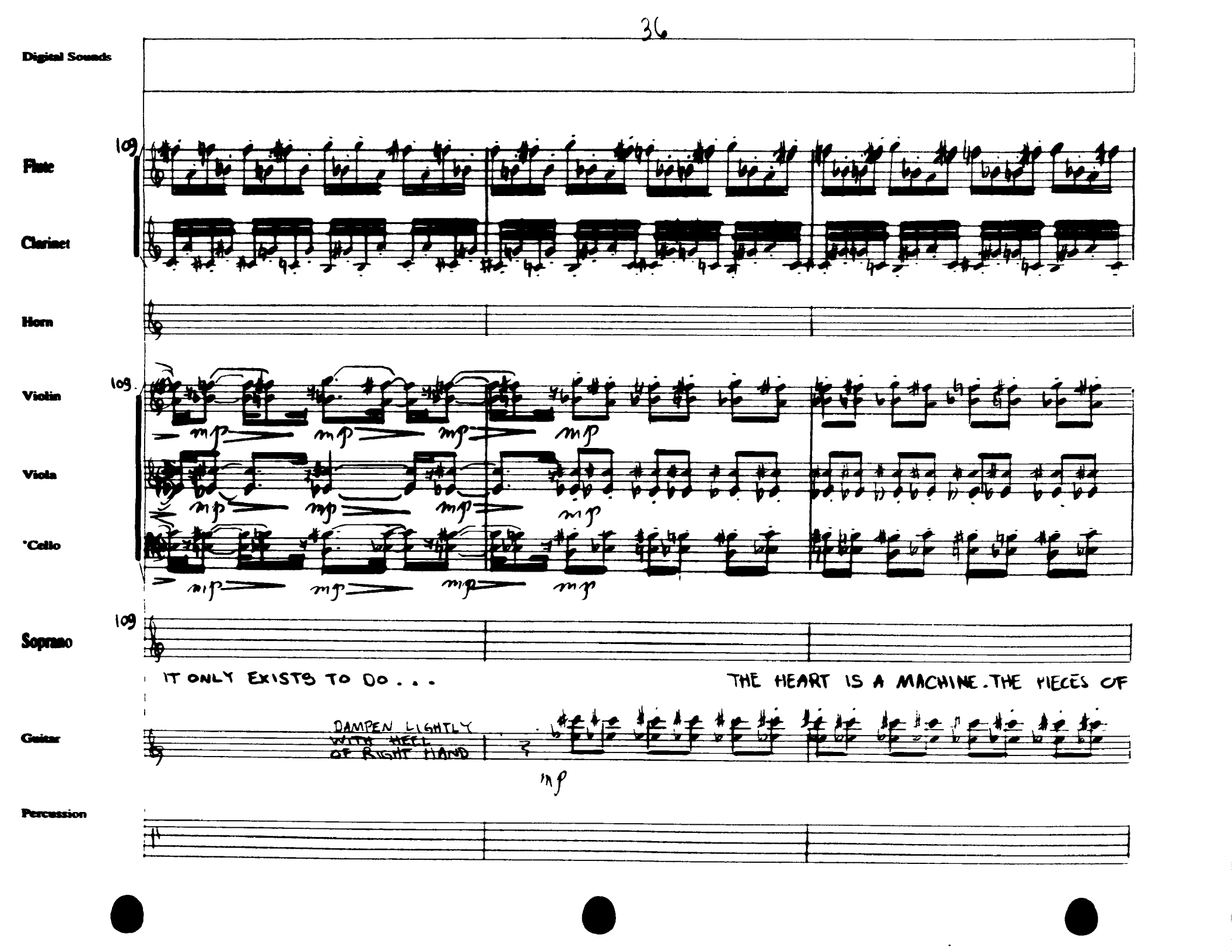

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
FANT QUI RÉ - PÈTE SA PRIÈRE
Guitar
Percussion

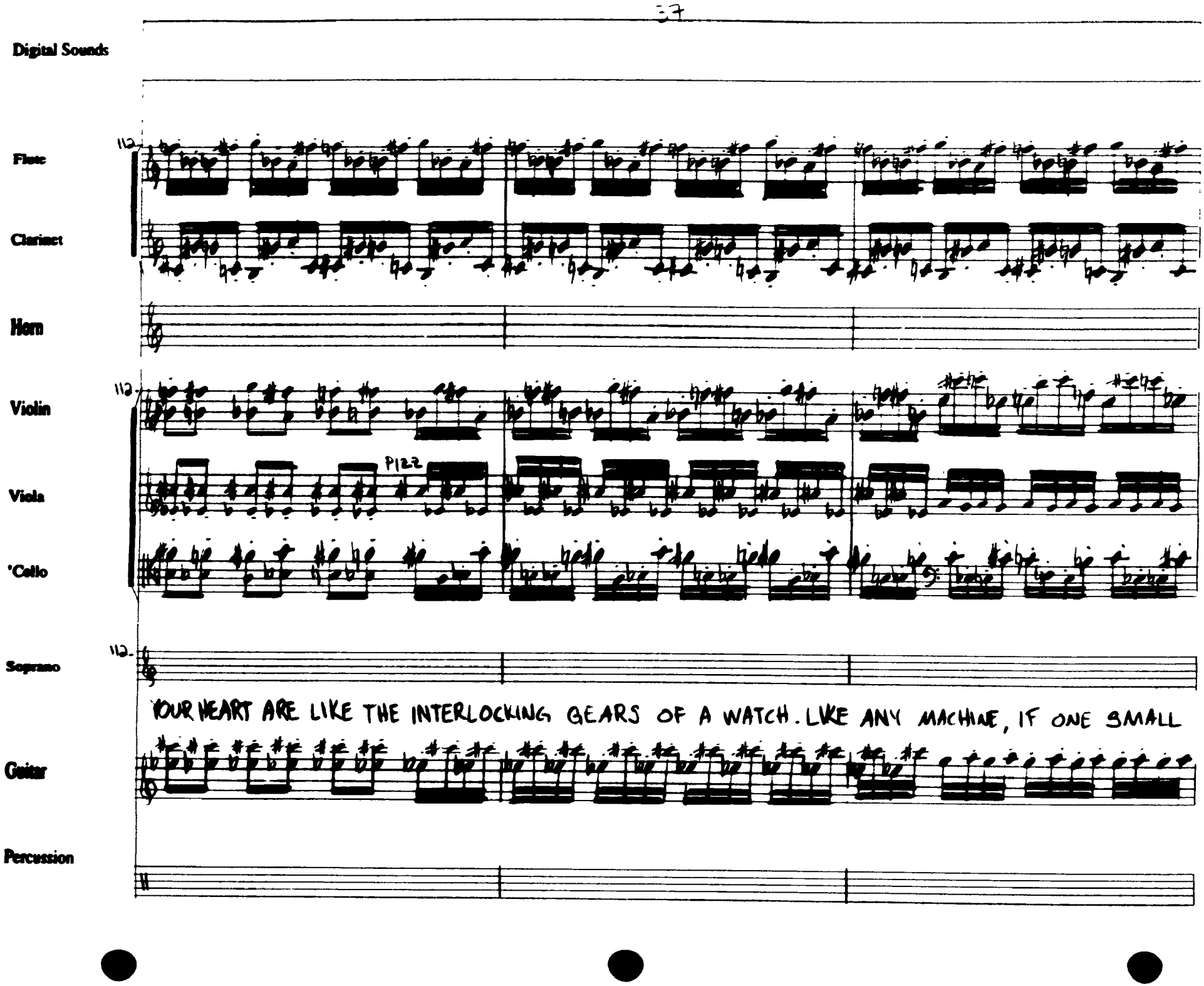
Digital Sounds

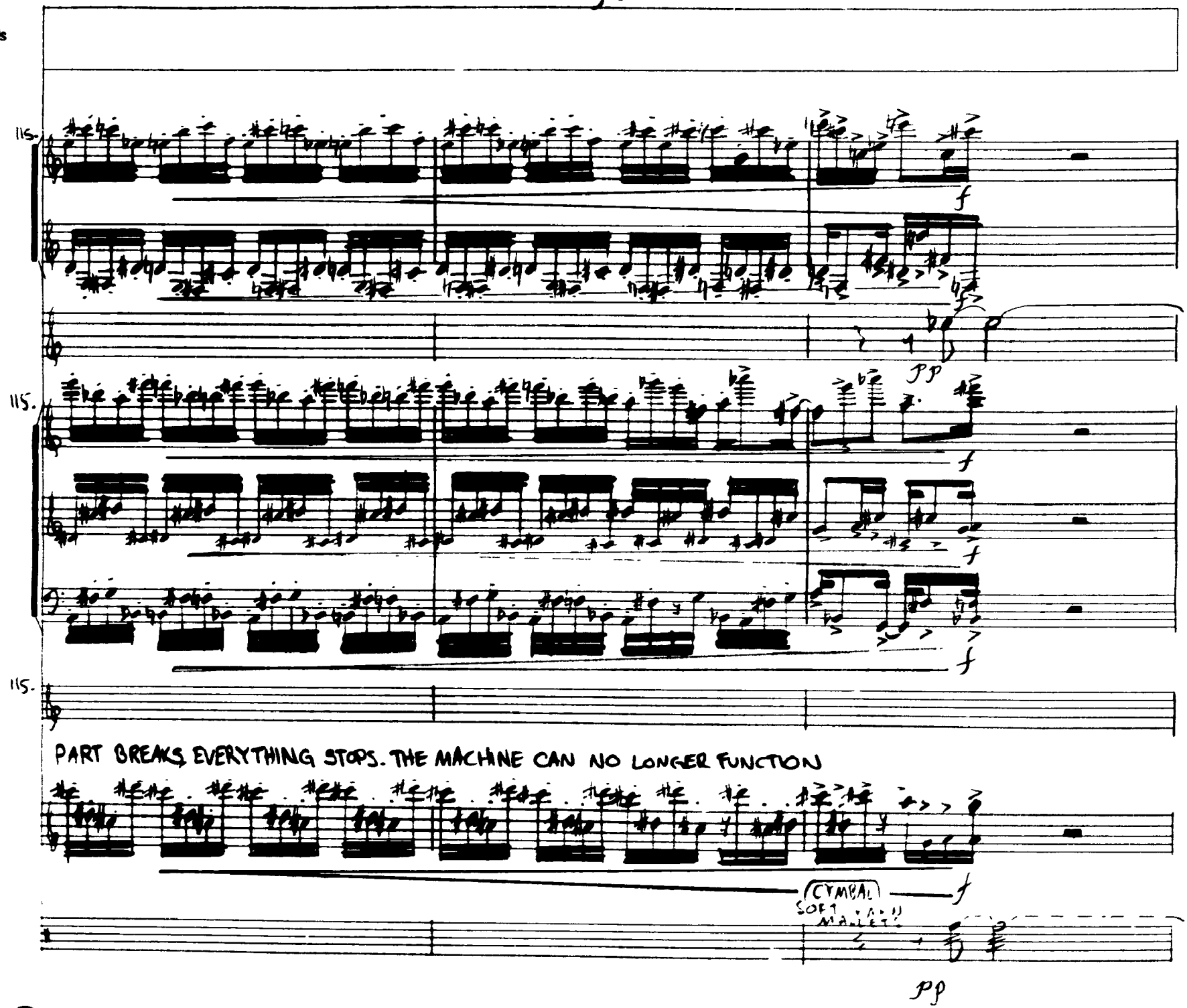



Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
103.
sim.
LET US DEFINE WHAT A MACHINE IS. A MACHINE IS WHAT IT DOES. A MACHINE DOES NOT NEED TO

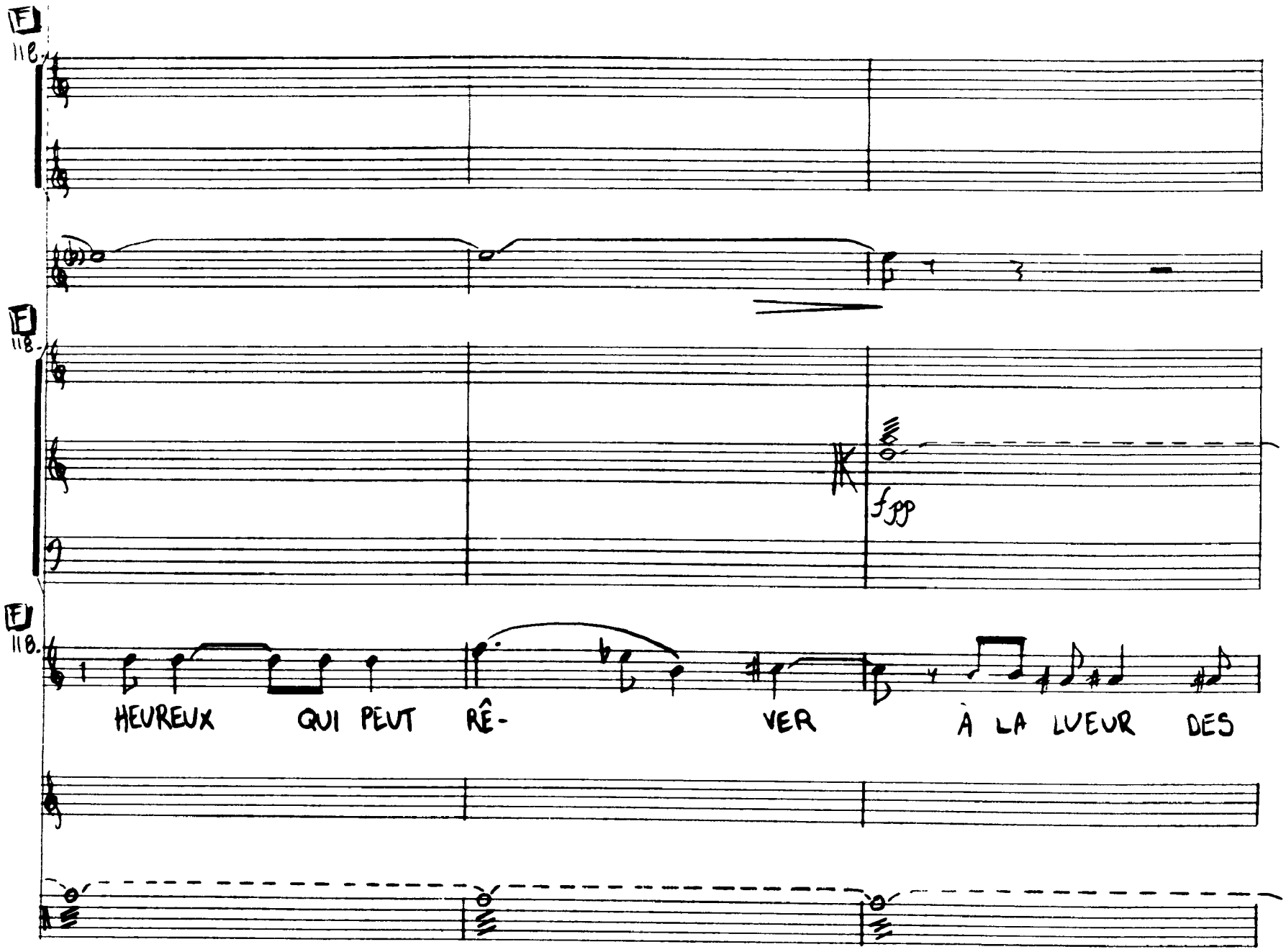

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
106.
106.
106.
BE USEFUL. IT DOES NOT NEED A PURPOSE. A MACHINE ONLY NEEDS TO PERFORM.

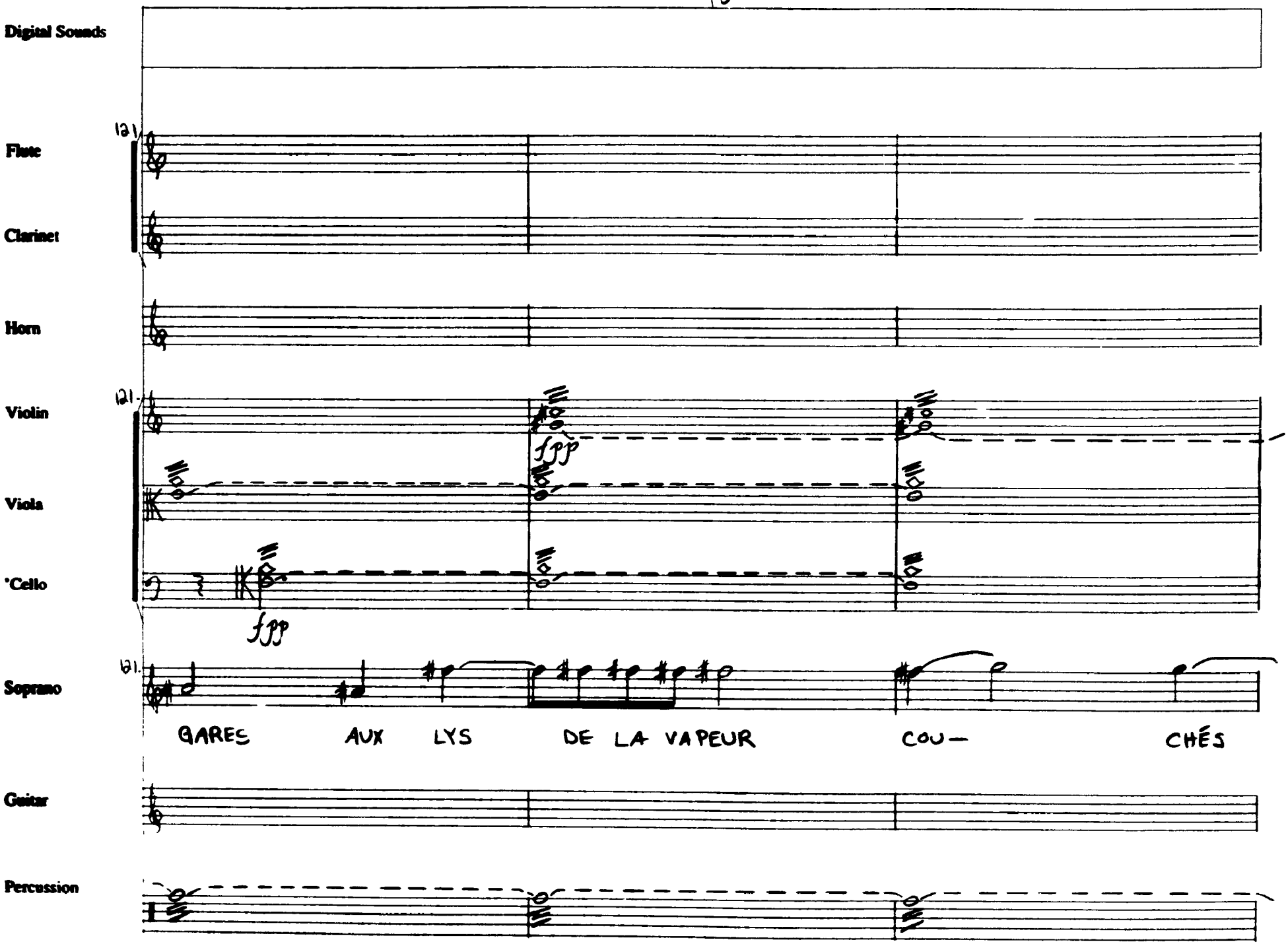

Digital Sounds
109
Flute
Clarinet
Horn
109
Violin
Viola
'Cello
109
Soprano
IT ONLY EXISTS TO DO . . .
THE HEART IS A MACHINE. THE PIECES OF
Guitar
DAMPEN LIGHTLY
WITH HEEL
OF RIGHT HAND
mp
Percussion

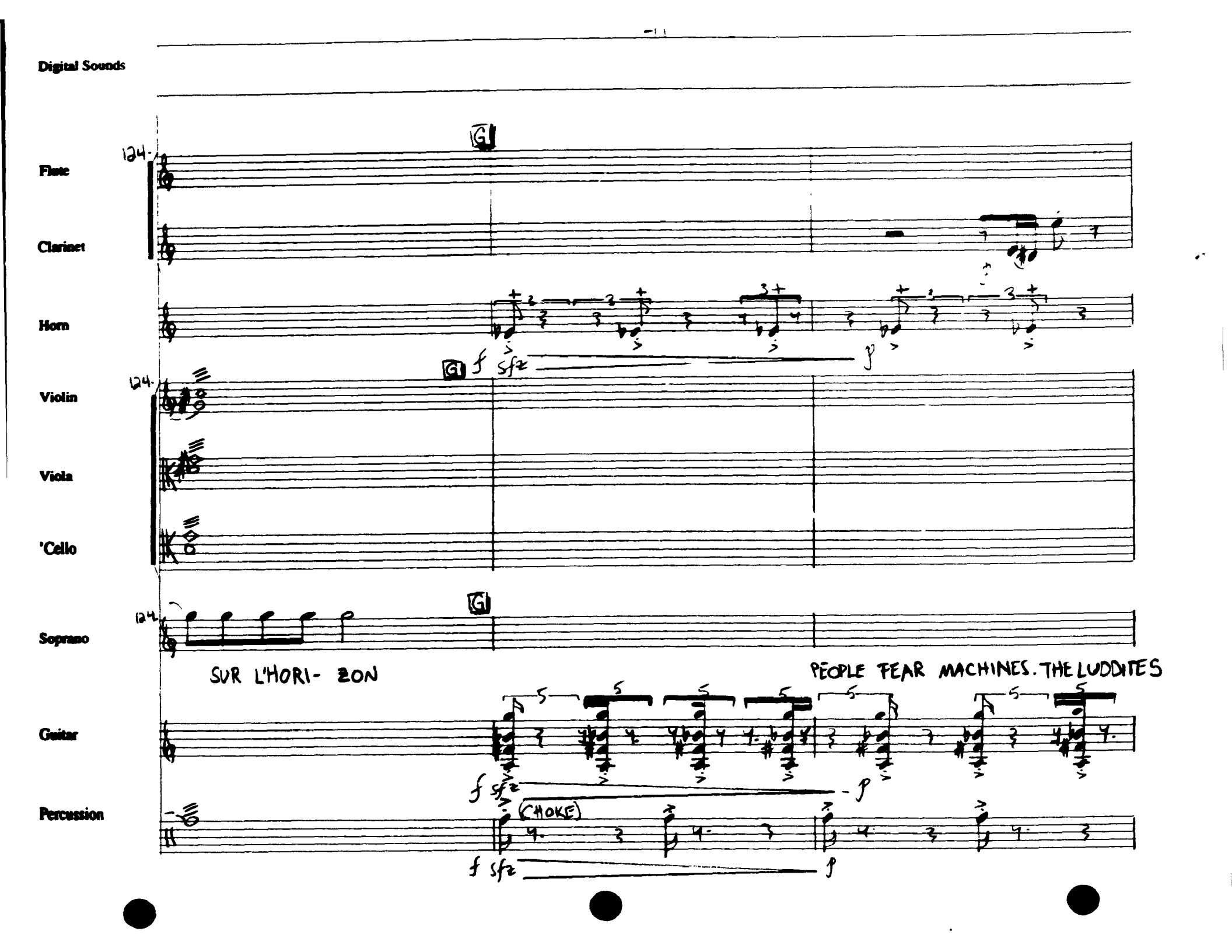

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
112
112
112
P122
YOUR HEART ARE LIKE THE INTERLOCKING GEARS OF A WATCH. LIKE ANY MACHINE, IF ONE SMALL

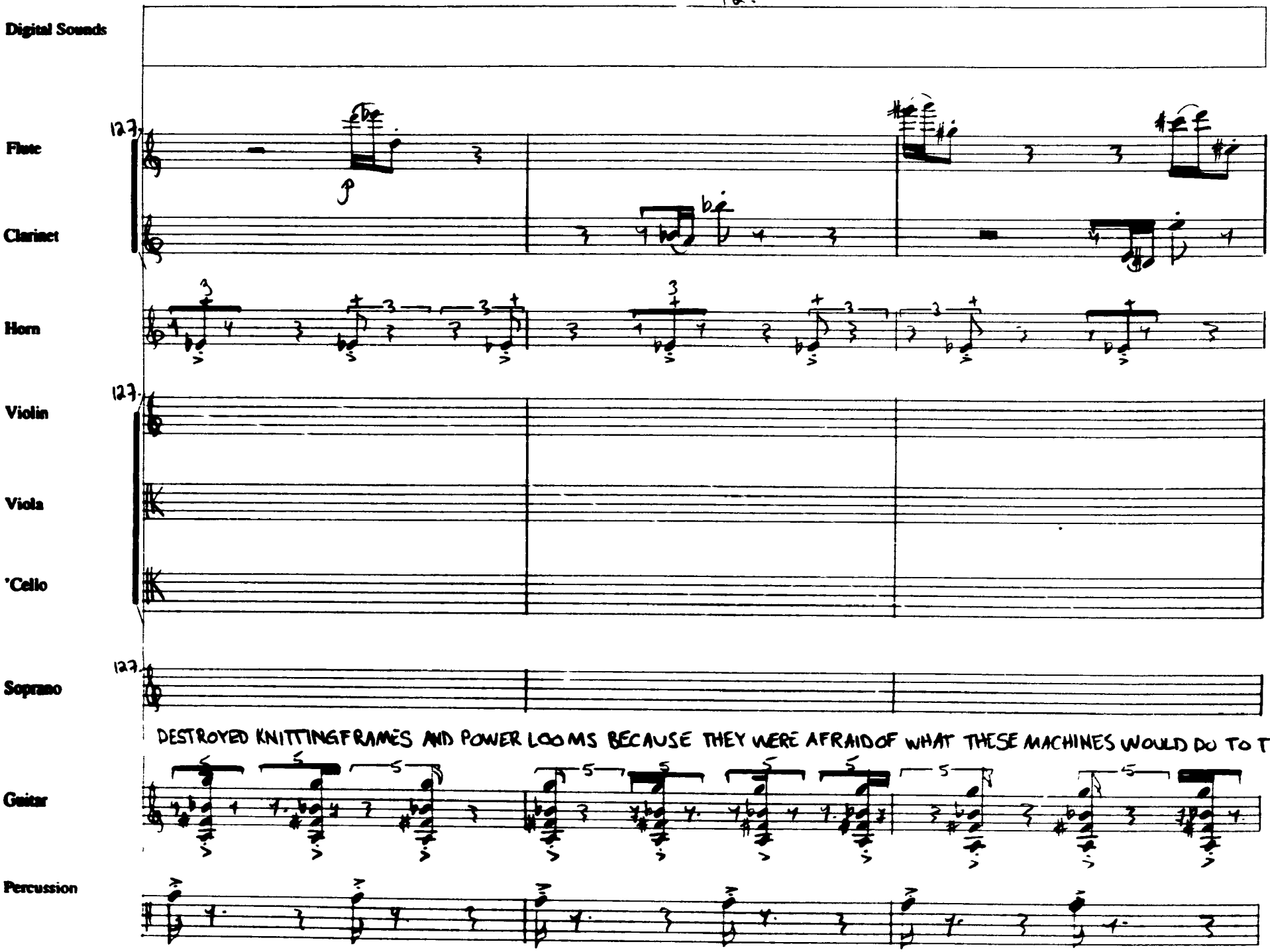

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
115.
115.
115.
PART BREAKS, EVERYTHING STOPS. THE MACHINE CAN NO LONGER FUNCTION
CYMBAL
SOFT MALLET
f
pp

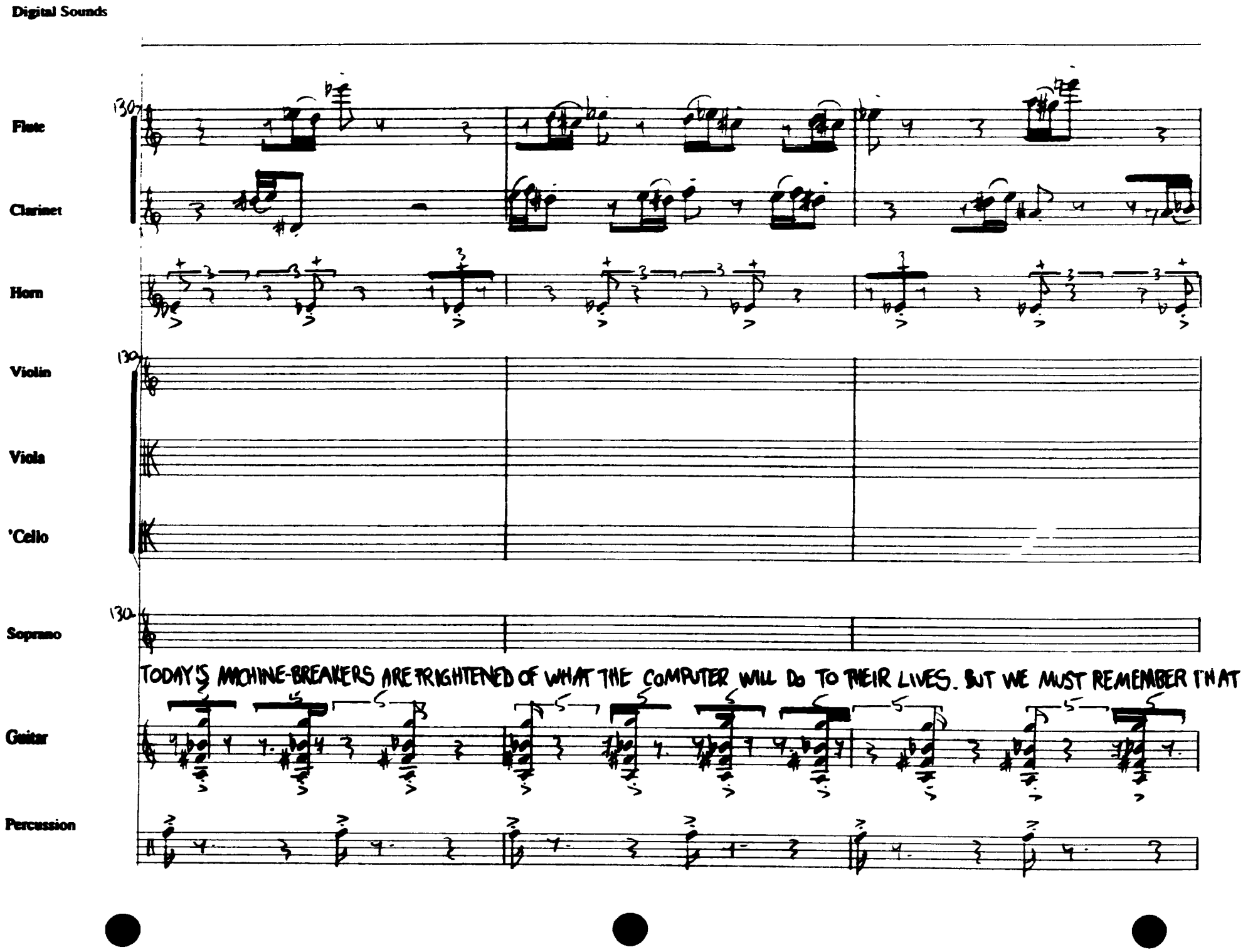
Digital Sounds

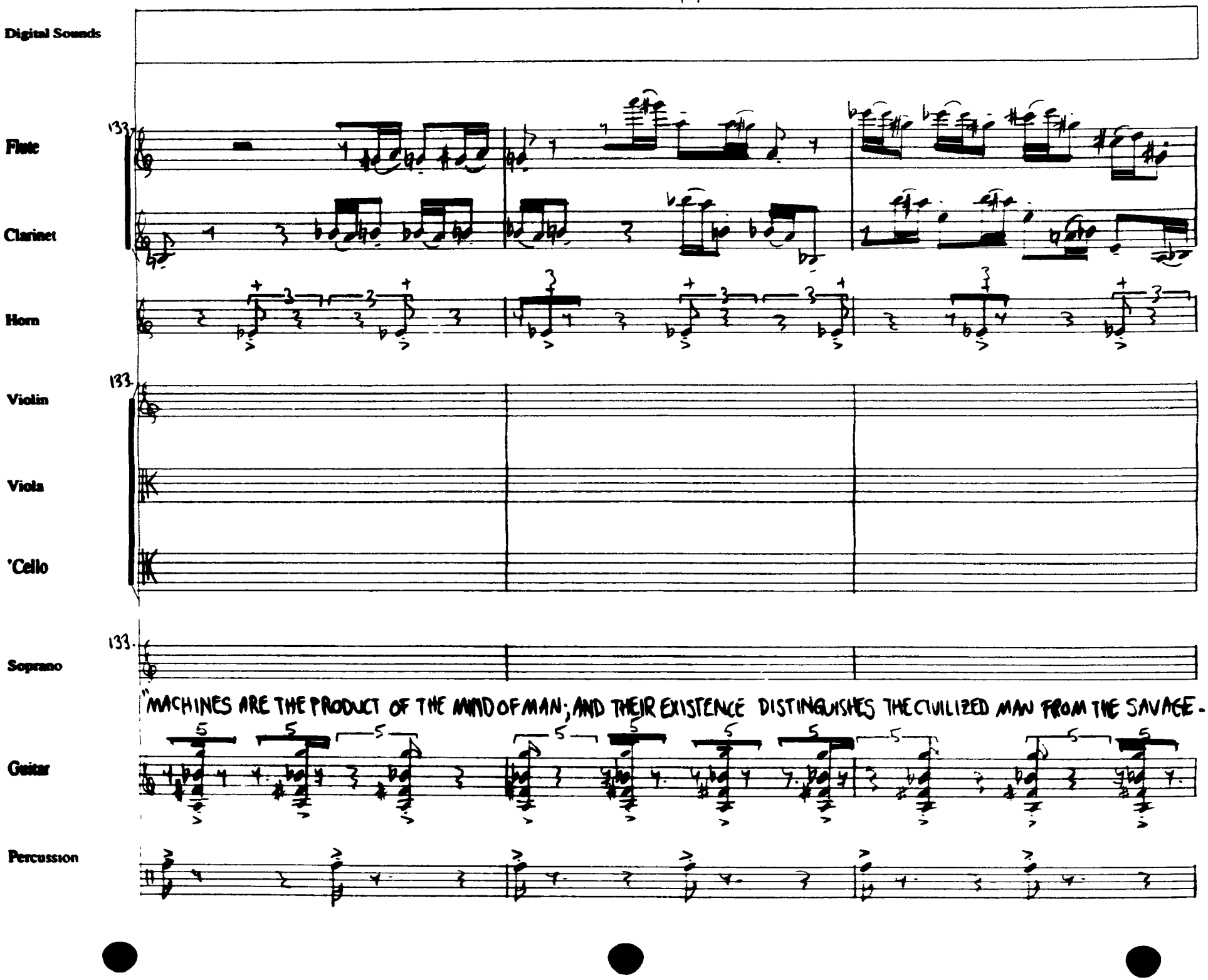



Digital Sounds
121
Flute
Clarinet
Horn
121
Violin
Viola
'Cello
fpp
fpp
121
Soprano
GARES AUX LYS DE LA VAPEUR COU— CHÉS
Guitar
Percussion

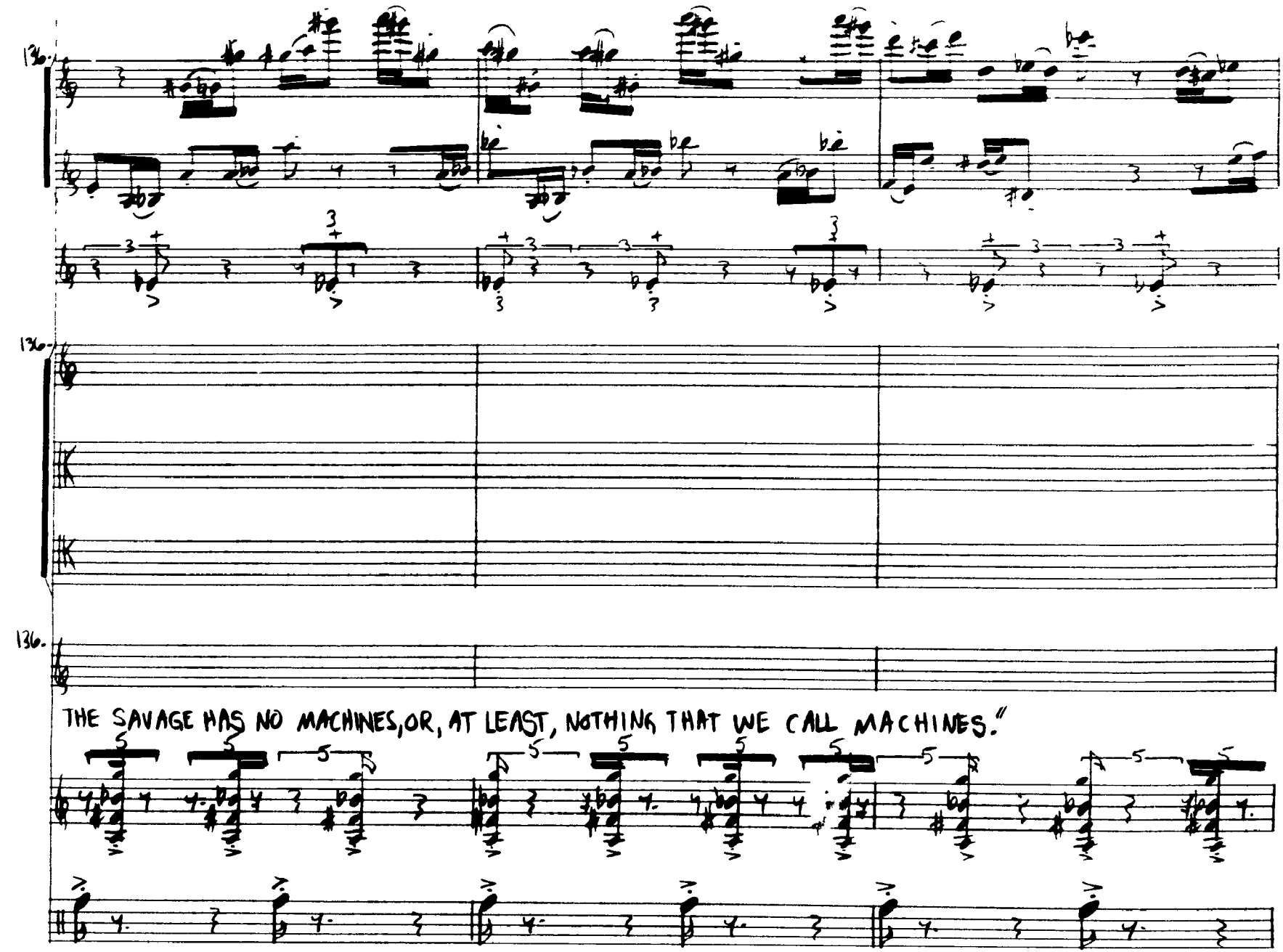

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
124.
G
f sfz
p
SUR L'HORI- ZON
PEOPLE FEAR MACHINES. THE LUDDITES
(CHOKE)

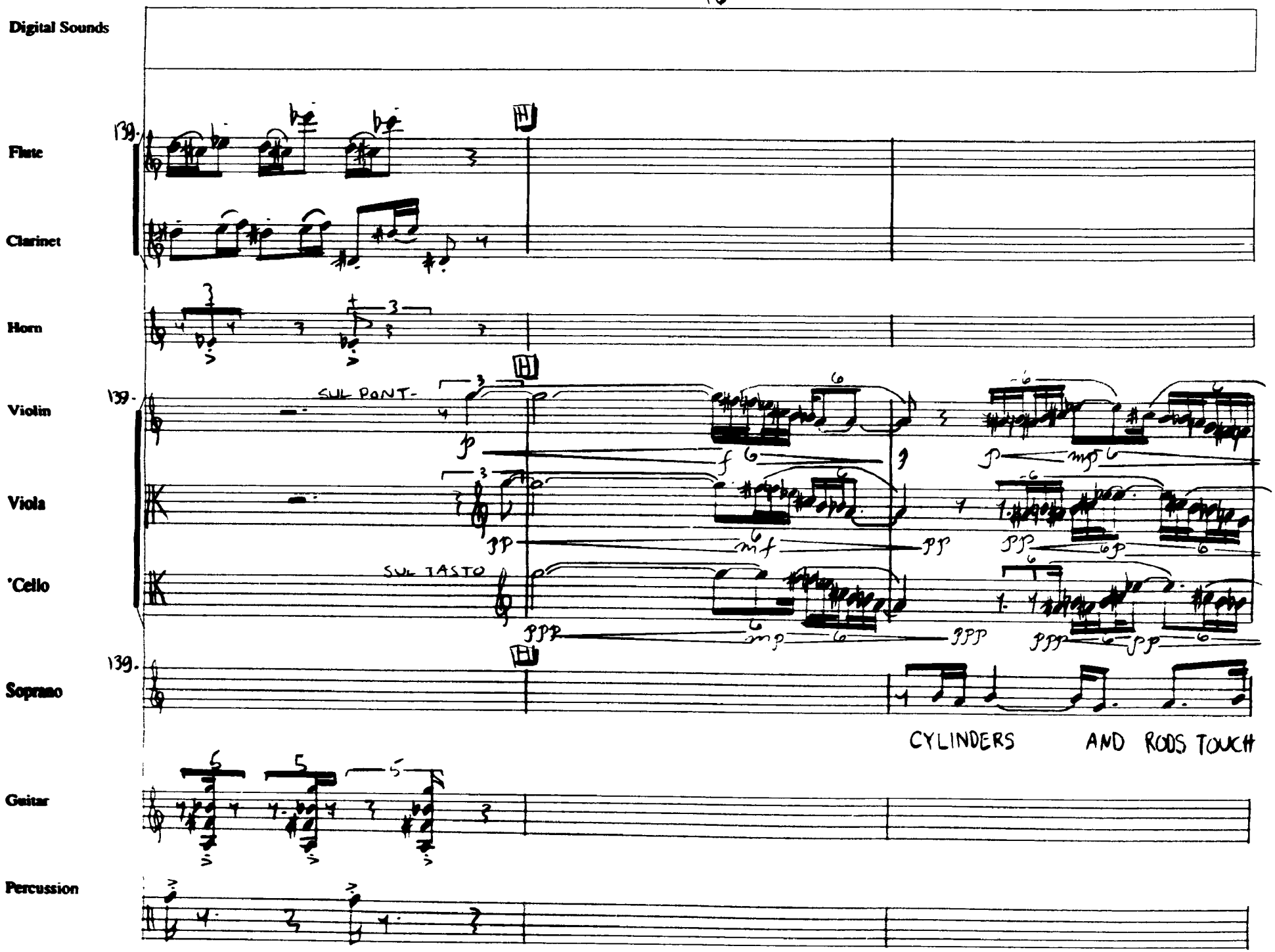

Digital Sounds
127
Flute
Clarinet
Horn
127
Violin
Viola
'Cello
127
Soprano
DESTROYED KNITTING FRAMES AND POWER LOOMS BECAUSE THEY WERE AFRAID OF WHAT THESE MACHINES WOULD DO TO THEM.
Guitar
Percussion

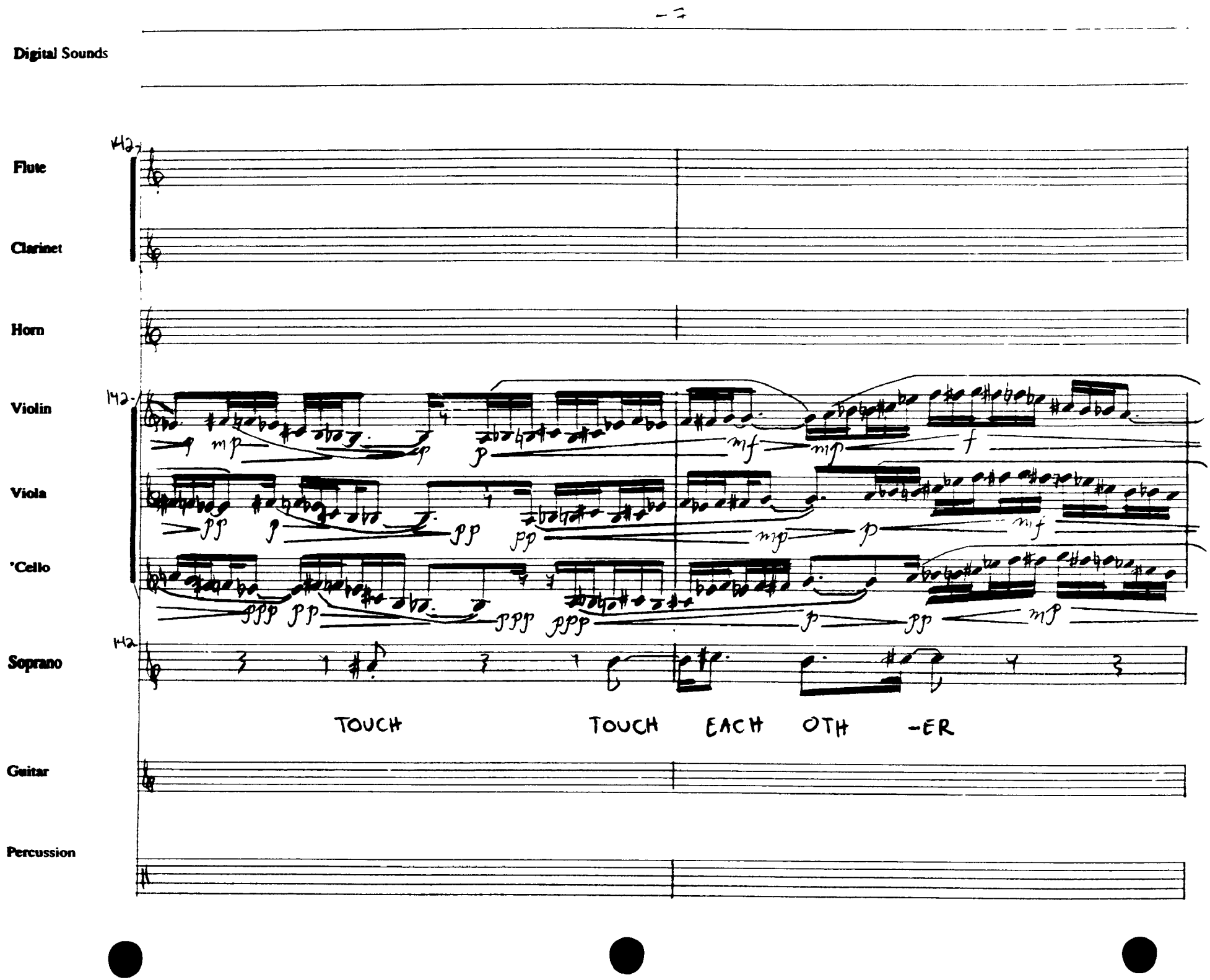

Digital Sounds
130
Flute
Clarinet
Horn
130
Violin
Viola
'Cello
130
Soprano
TODAY'S MACHINE-BREAKERS ARE FRIGHTENED OF WHAT THE COMPUTER WILL DO TO THEIR LIVES. BUT WE MUST REMEMBER THAT
Guitar
Percussion

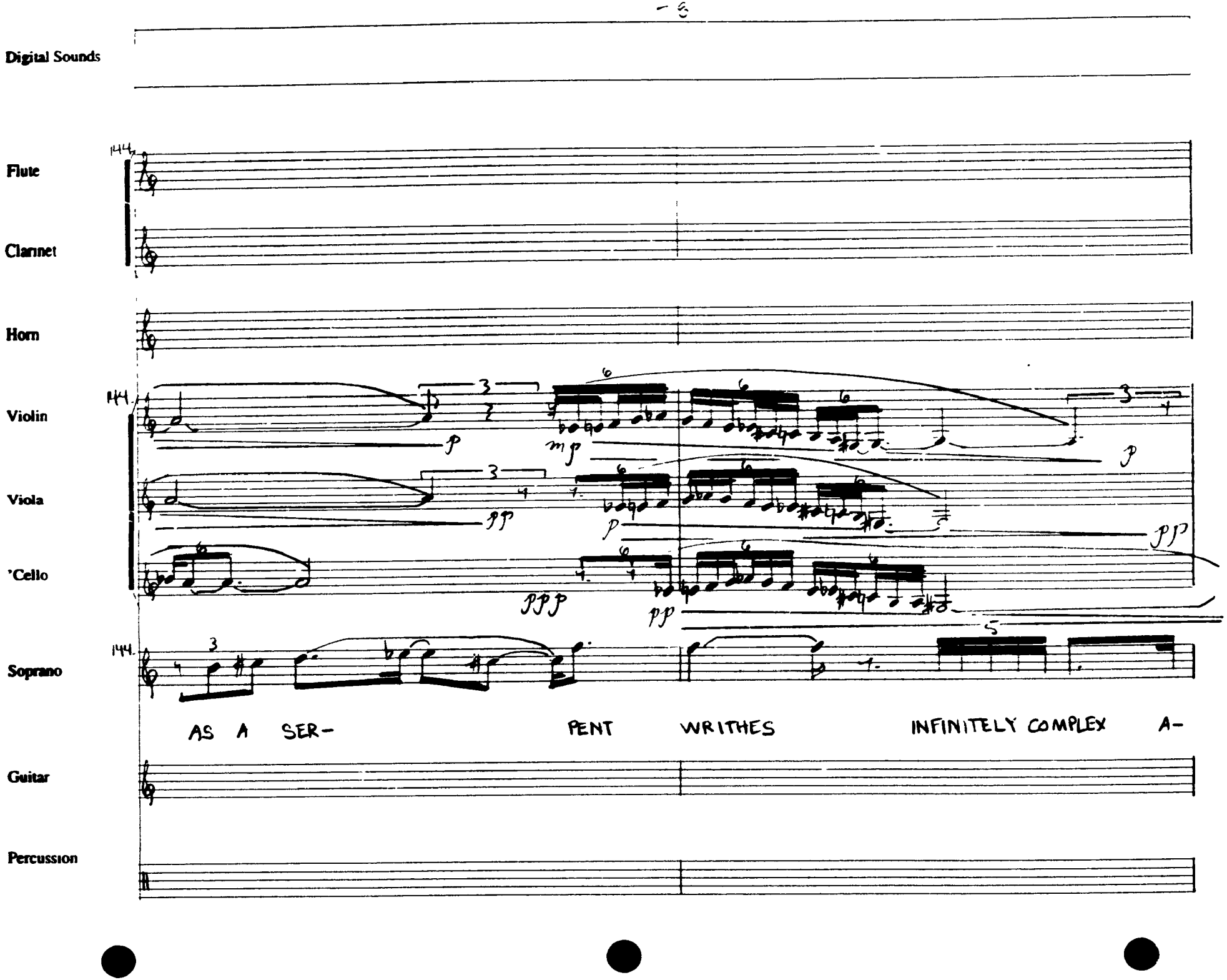

Digital Sounds
133.
Flute
Clarinet
Horn
133.
Violin
Viola
'Cello
133.
Soprano
"MACHINES ARE THE PRODUCT OF THE MIND OF MAN; AND THEIR EXISTENCE DISTINGUISHES THE CIVILIZED MAN FROM THE SAVAGE.
Guitar
Percussion

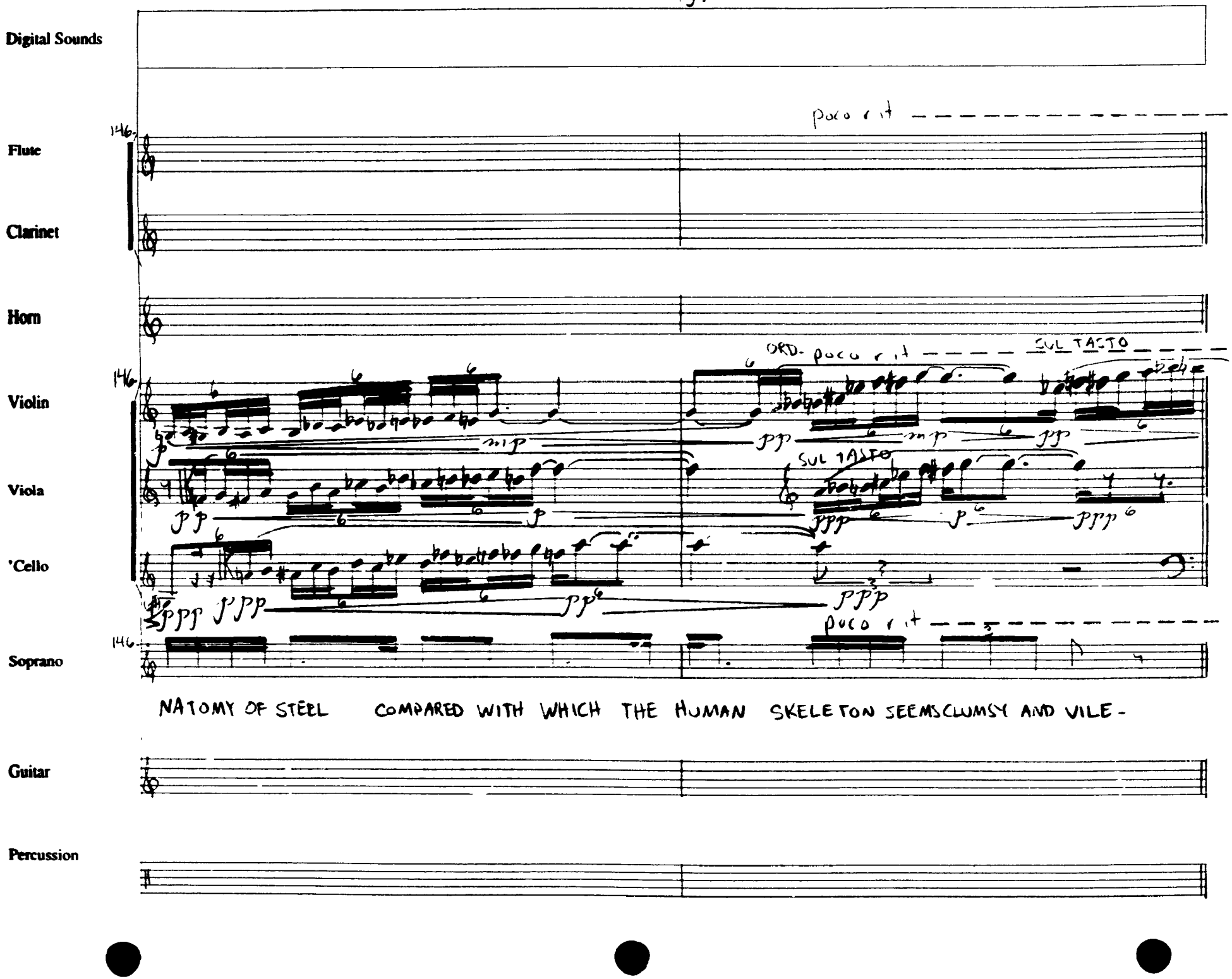
Digital Sounds

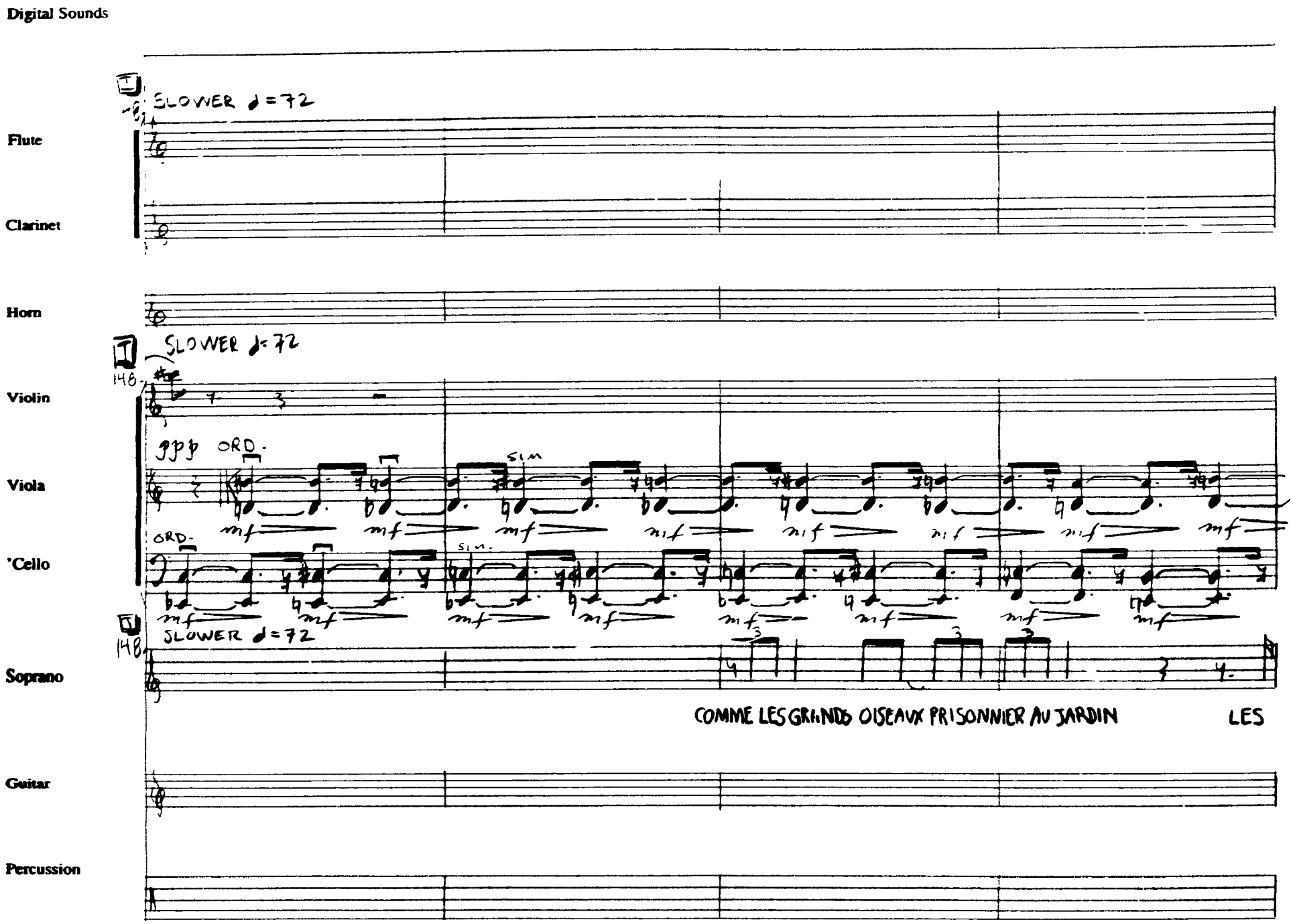


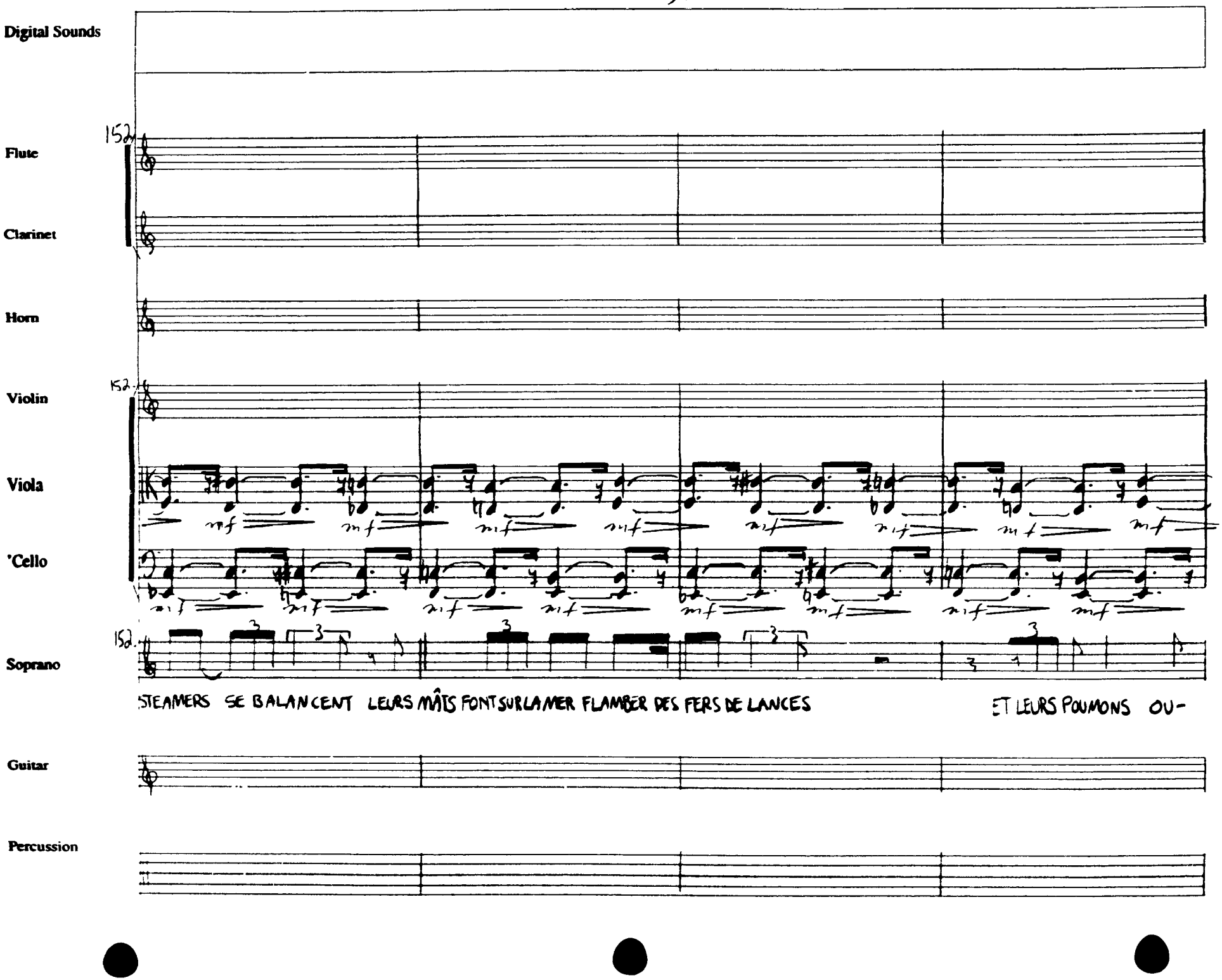

Digital Sounds
139.
Flute
Clarinet
Horn
139.
Violin
SUL PONT-
Viola
'Cello
SUL TASTO
139.
Soprano
CYLINDERS AND RODS TOUCH
Guitar
Percussion

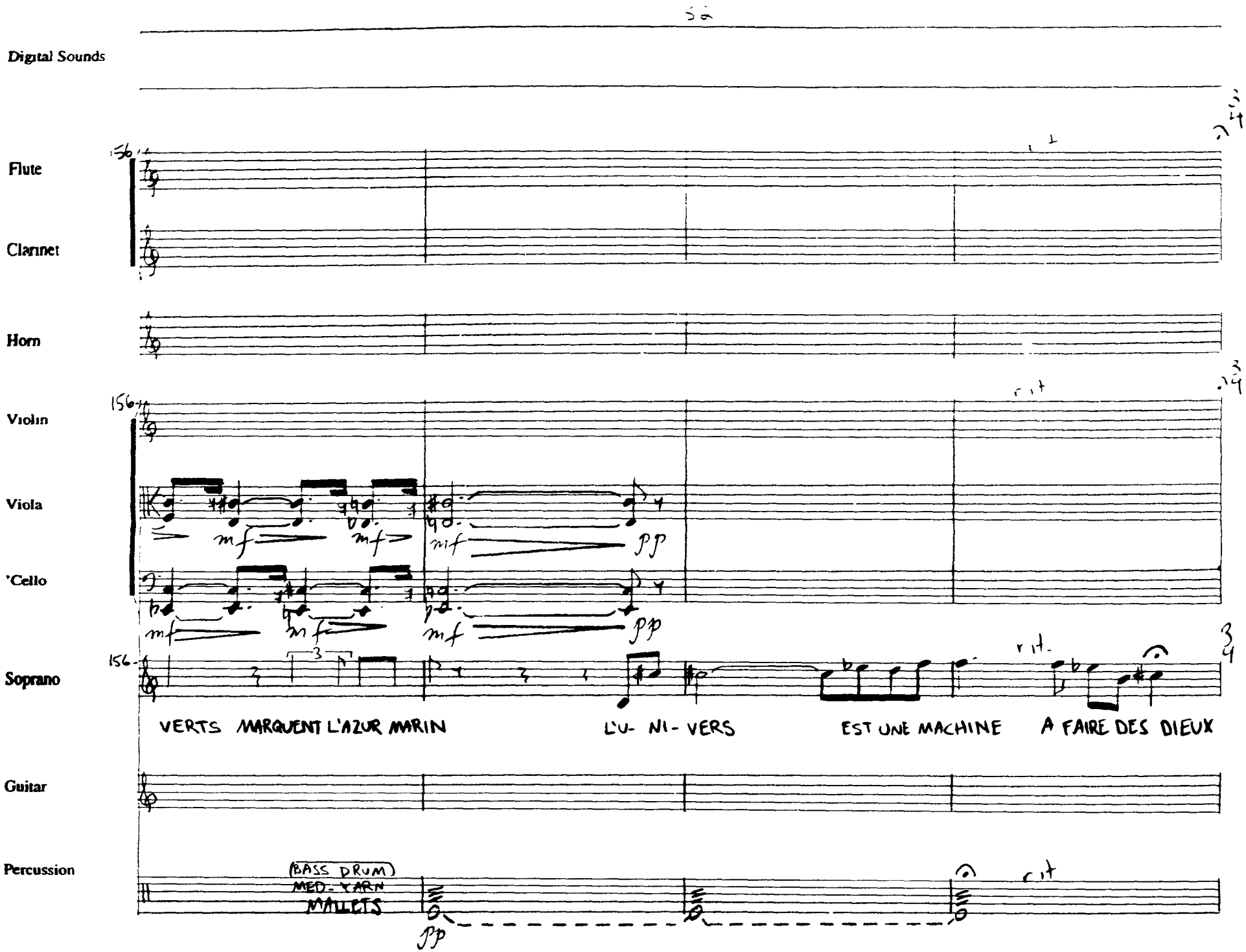

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
142
142
142
TOUCH
TOUCH
EACH
OTH
-ER


Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
AS A SER- PENT WRITHES INFINITELY COMPLEX A-


Digital Sounds
146
Flute
Clarinet
Horn
poco r.it
146
Violin
Viola
'Cello
ORD. poco r.it
SUL TASTO
SUL TASTO
146
Soprano
poco r.it
NATOMY OF STEEL COMPARED WITH WHICH THE HUMAN SKELETON SEEMSCLUMSY AND VILE-
Guitar
Percussion


Digital Sounds
SLOWER ♩=72
Flute
Clarinet
Horn
SLOWER ♩=72
148
Violin
ppp ORD.
sim
Viola
ORD.
sim.
'Cello
SLOWER ♩=72
148
Soprano
COMME LES GRANDS OISEAUX PRISONNIER AU JARDIN
LES
Guitar
Percussion


Digital Sounds
152
Flute
Clarinet
Horn
152
Violin
Viola
'Cello
152
Soprano
STEAMERS SE BALANCENT LEURS MÂTS FONT SUR LA MER FLAMBER DES FERS DE LANCES
ET LEURS POUMONS OU-
Guitar
Percussion


Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
156
rit
mf
pp
VERTS MARQUENT L'AZUR MARIN
L'U- NI- VERS
EST UNE MACHINE
A FAIRE DES DIEUX
(BASS DRUM)
MED. YARN
MALLETS

[J]
160.

Digital Sounds

BEGIN CUE #1: FACTORY SOUNDS.

a tempo ♩= 72

Horn

Soprano

Percussion

CYMBAL

MED YARN MALLETS

TOM-TOMS

BASS DRUM

fp ffff p fff pp ff pp f

164

Digital Sounds

(CUE #1 CONTINUED)

Horn

ppp ff pp

Soprano

THE FLAME OF THE BESSEMER CUPOLA ROARS, WITH SHOWERS

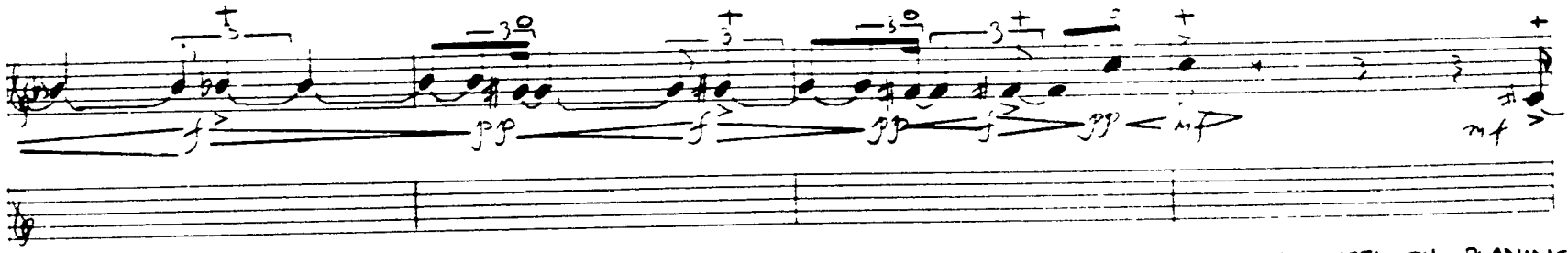
Percussion

(dampen)

ppp < mf

168.

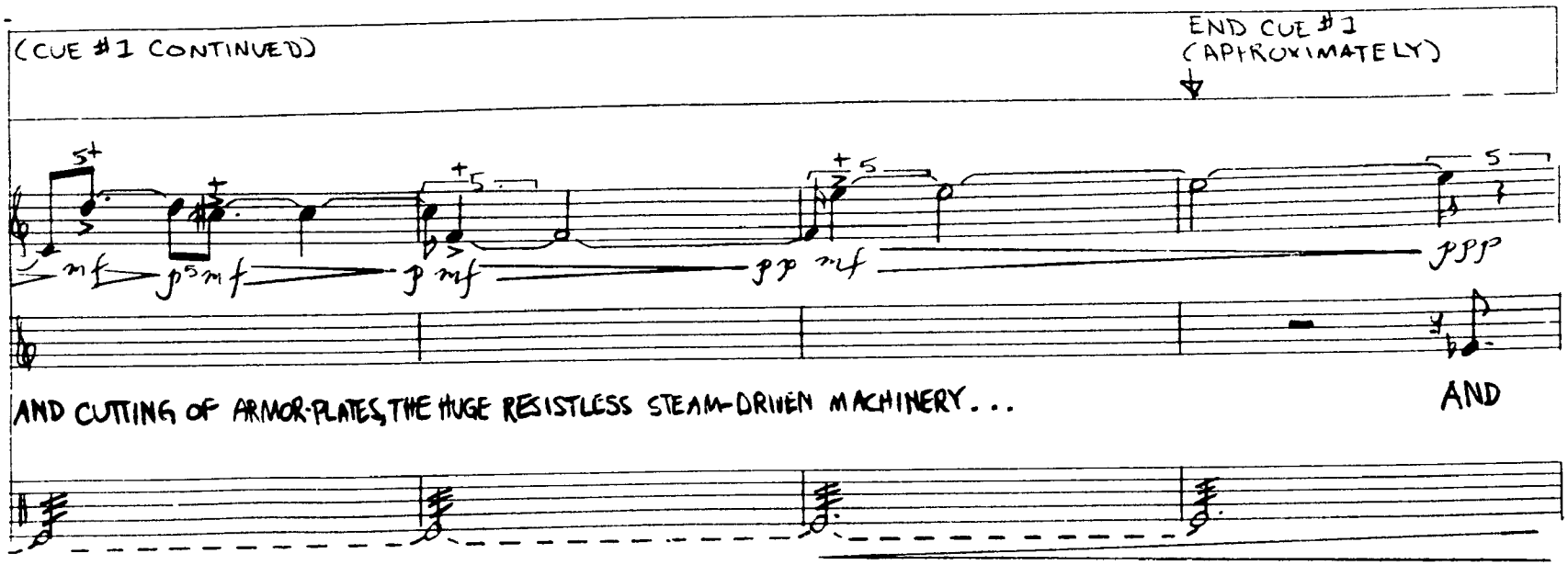
Digital Sounds (CUE #1 CONTINUED)



172.

Digital Sounds (CUE #1 CONTINUED)

END CUE #1 (APPROXIMATELY)



176.

Digital Sounds

Horn

Soprano

HE AT THE FORGE, STREAM- ING WITH SWEAT,

Percussion

180

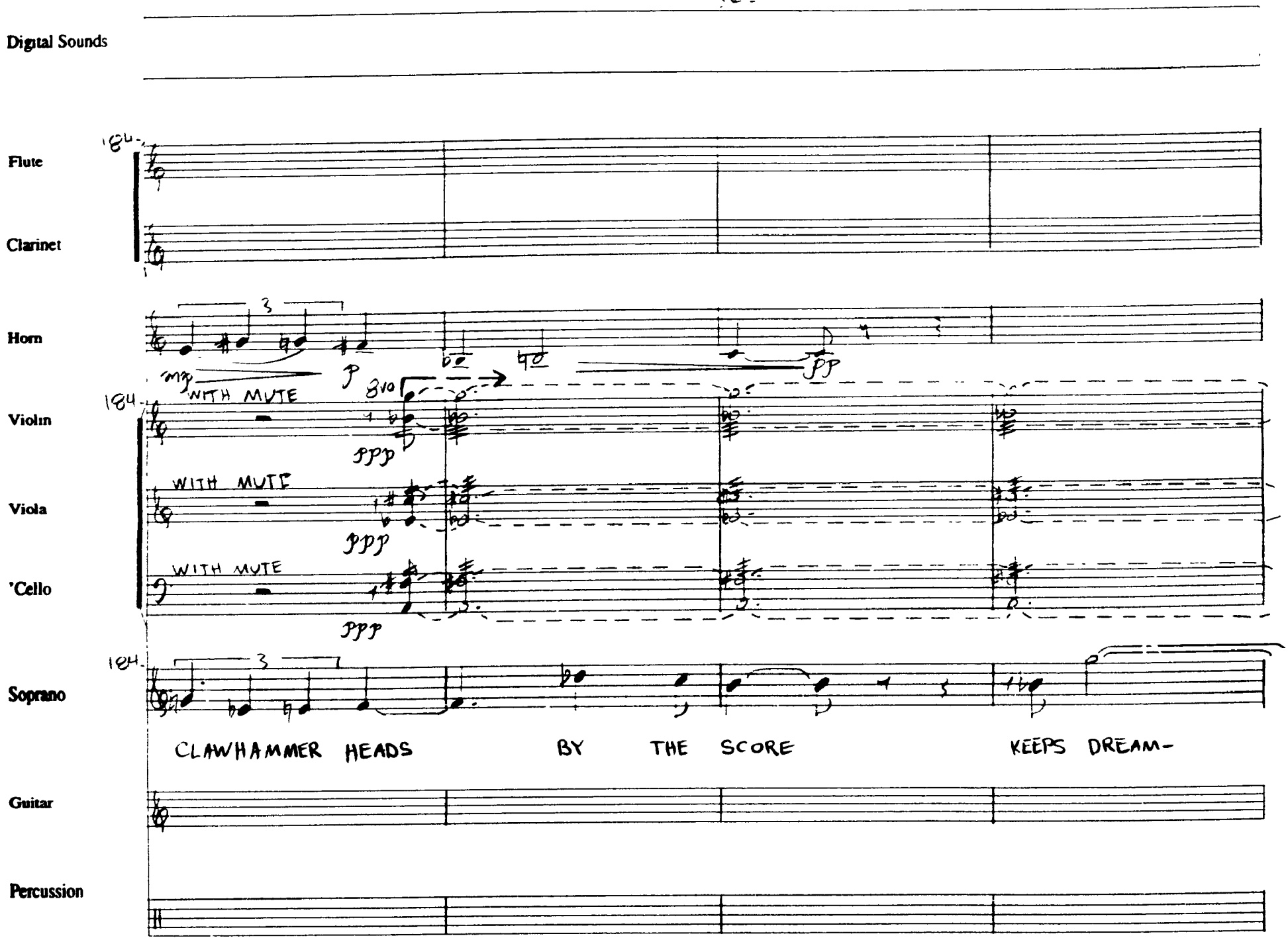
Digital Sounds

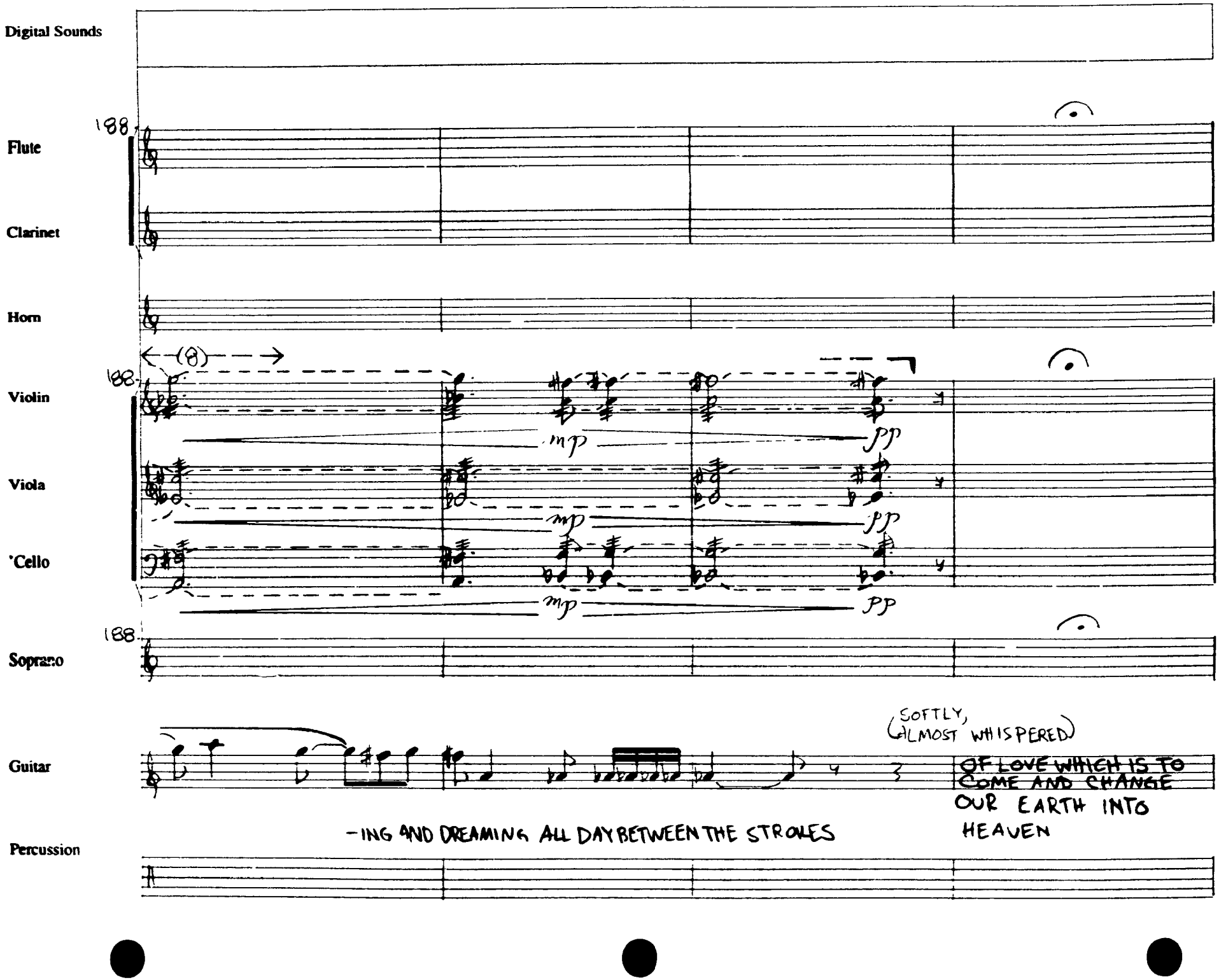
Horn

Soprano

THE STRIKER WITH BARED BREAST TURNING THE

Percussion


Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
184
WITH MUTE
WITH MUTE
WITH MUTE
CLAWHAMMER HEADS BY THE SCORE KEEPS DREAM-


Digital Sounds
188
Flute
Clarinet
Horn
(8)
188
Violin
Viola
'Cello
mp
pp
mp
pp
mp
pp
188
Soprano
(SOFTLY, ALMOST WHISPERED)
Guitar
OF LOVE WHICH IS TO COME AND CHANGE OUR EARTH INTO HEAVEN
-ING AND DREAMING ALL DAY BETWEEN THE STROKES
Percussion

K

192

Soprano

"HE ANIMAL MACHINE - BREAKABLE IN THE BEST CASE, SUBJECT

Percussion

TOM-TOMS

mf p mp pp

195

Soprano

TO A THOUSAND SOURCES OF SUFFERING - IS CHAINED FAST TO THE IRON MACHINE, WHICH KNOWS NO

Percussion

mf mp pp mf mp p

198

Soprano

SUFFERING AND NO WEARINESS.

Percussion

11. 5 rr. 11 rr. 5 sim.

f

201.

Digital Sounds: BEGIN CUE #2: BREAKING SOUNDS

Soprano: WE CAN BREAK MACHINES, BUT

Percussion: 5 3 3 5 — 5 3 — fffff

204.

Digital Sounds: (CUE #2 CONTINUED)

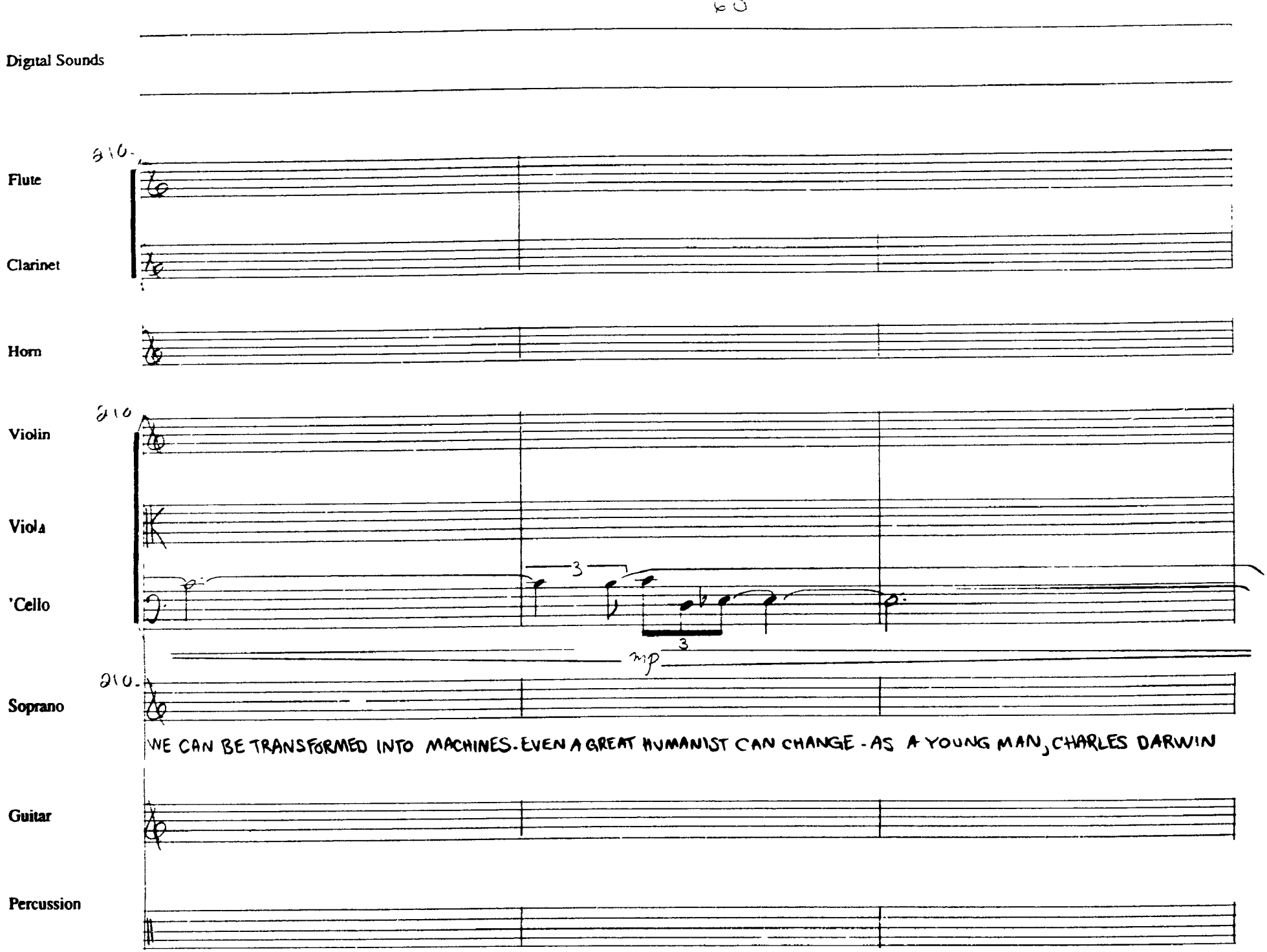
Soprano: MACHINES CAN ALSO BREAK US. WE SOMETIMES TREAT MACHINES LIKE THEY WERE HUMAN, AND HUMAN

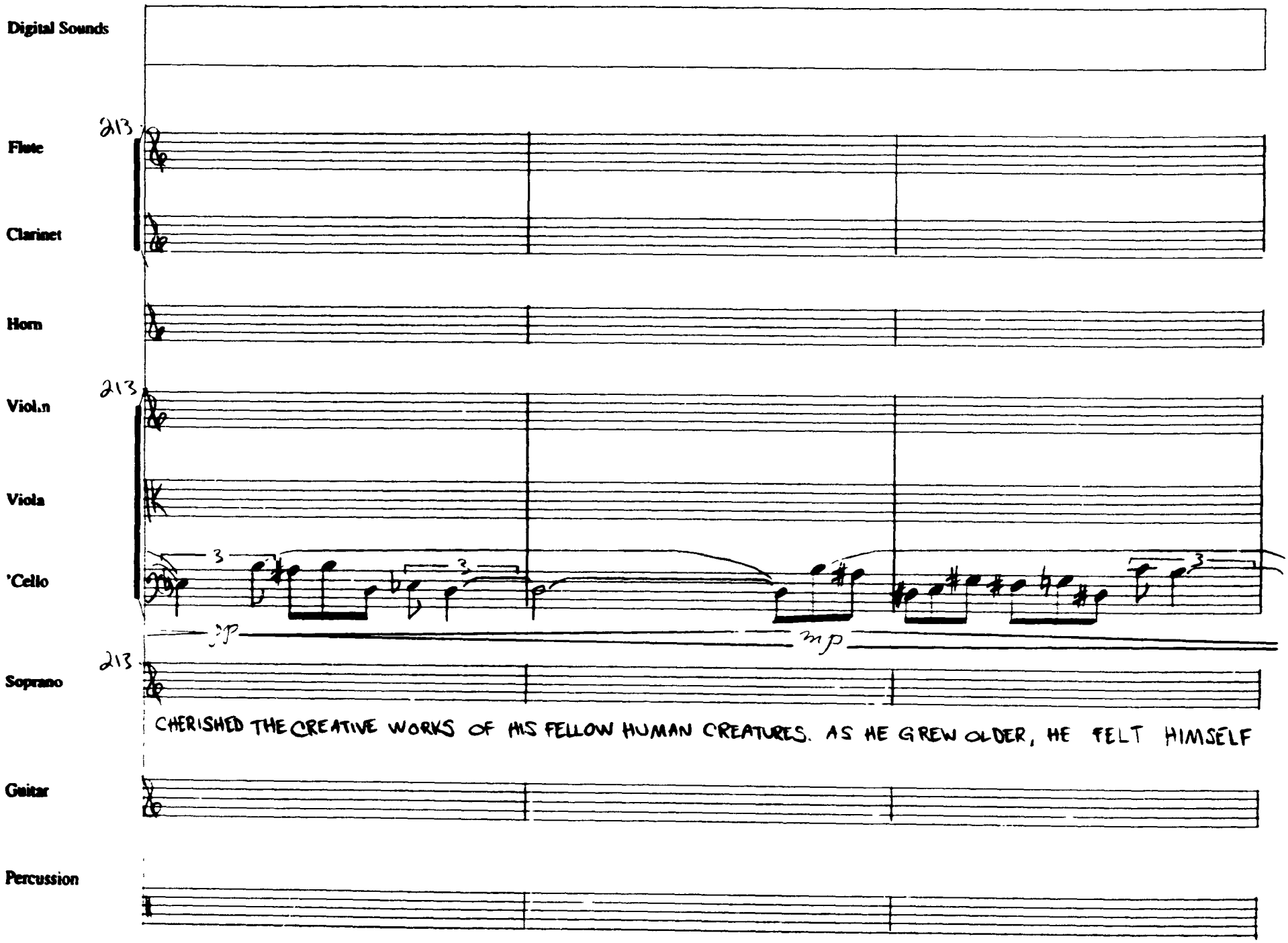
207.

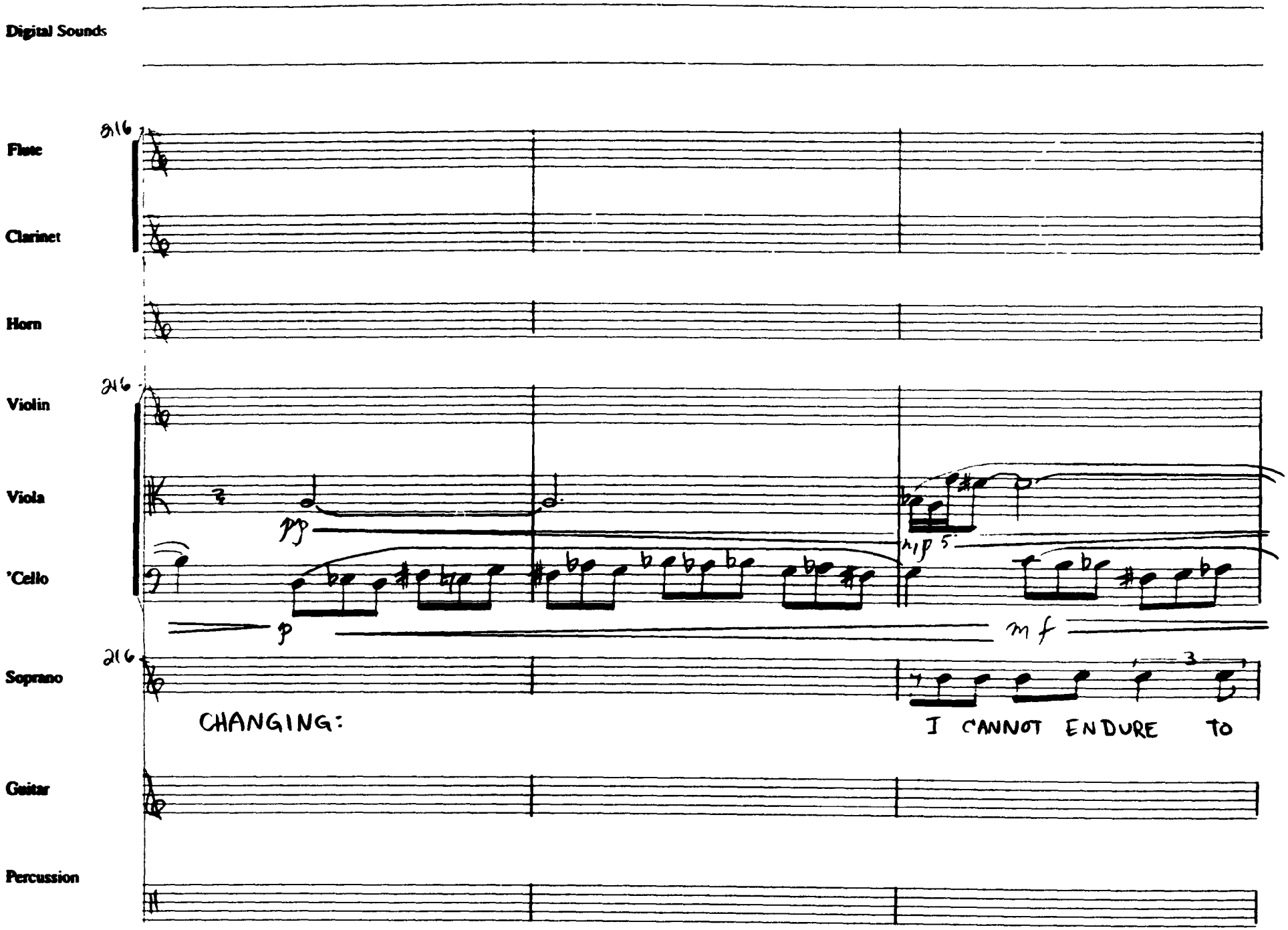
Digital Sounds: (CUE #2 CONTINUED) — END CUE #2 (APPROXIMATELY)

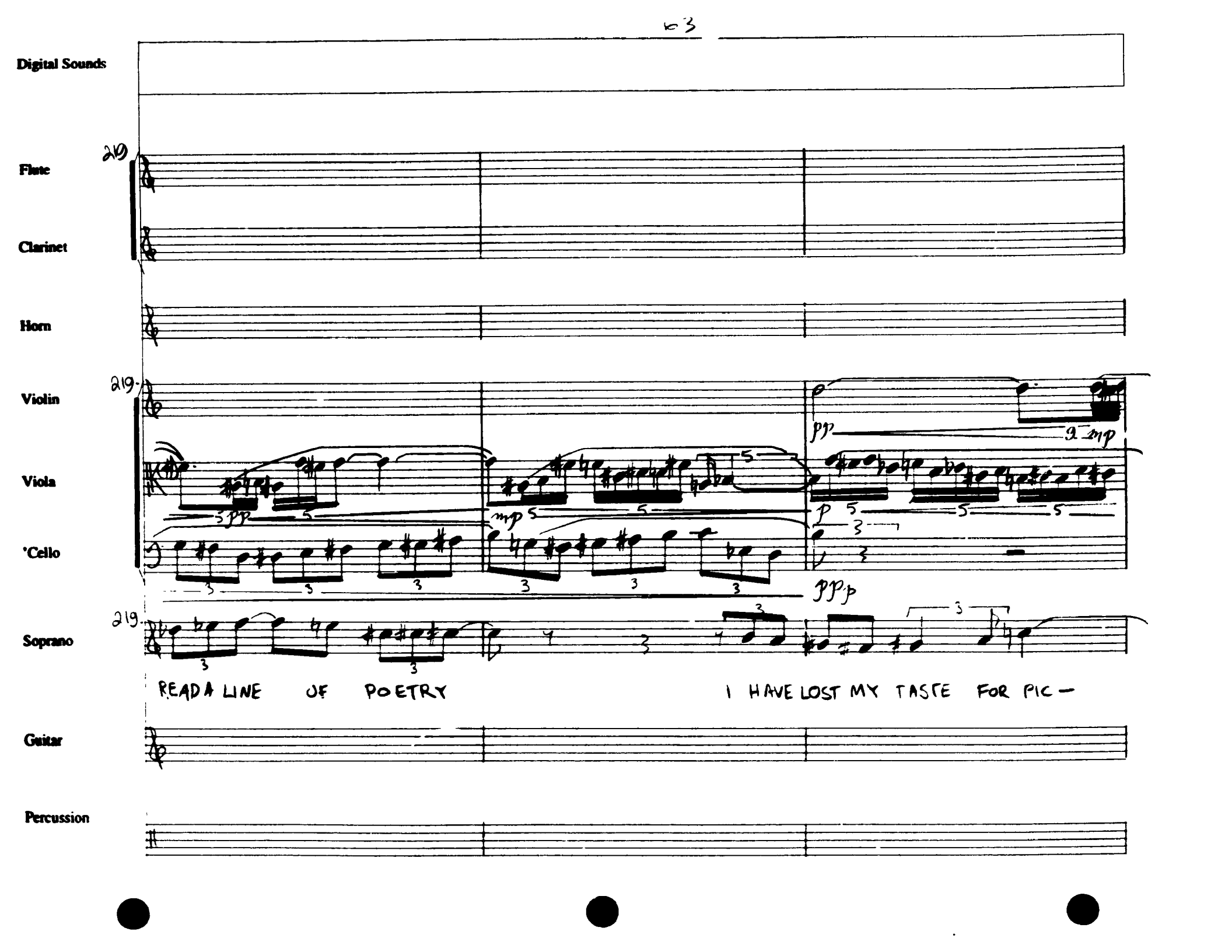
'Cello: 3 — pp

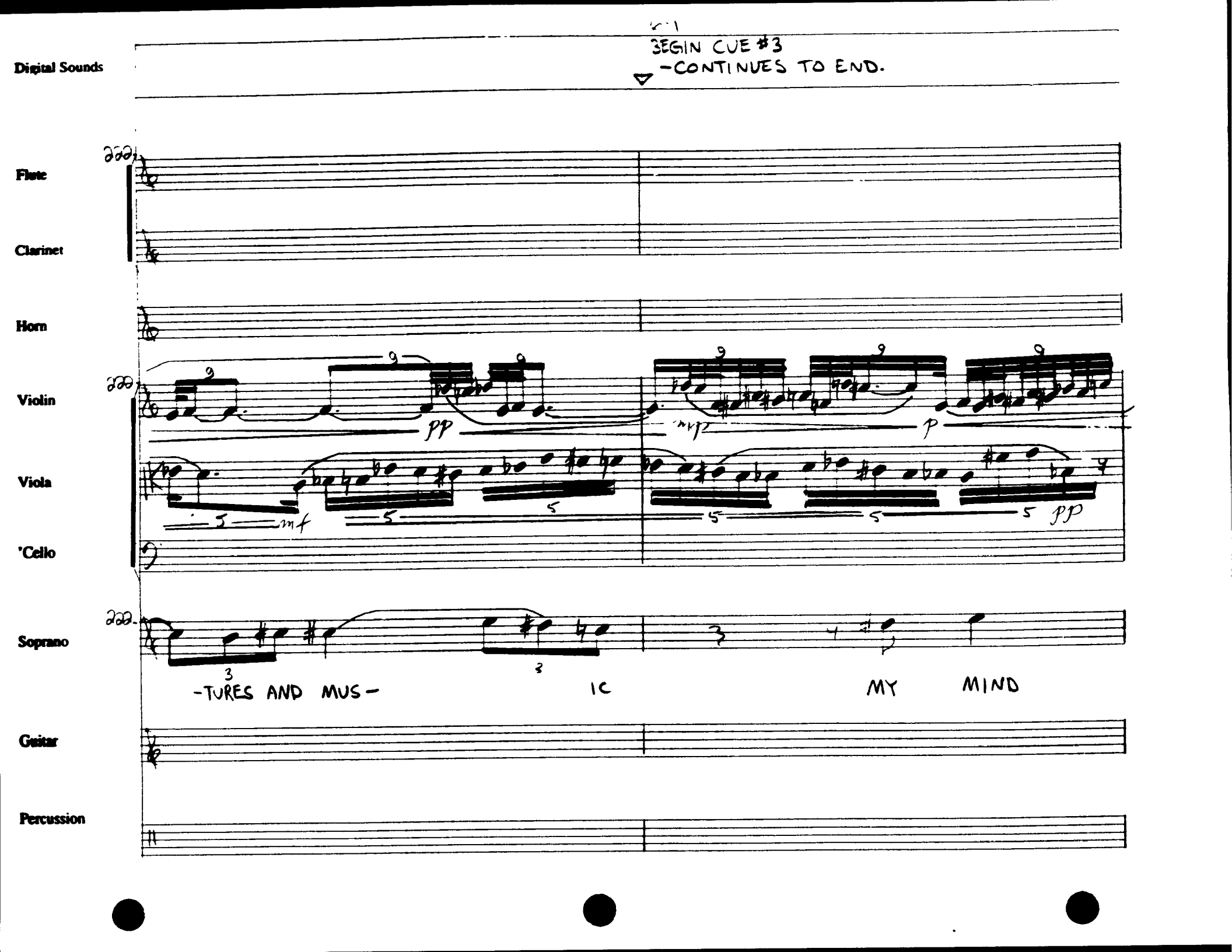
Soprano: BEINGS LIKE THEY WERE MACHINES. WE CAN'T GIVE A MACHINE FEELINGS. WE CANNOT GIVE A MACHINE A HEART. YET

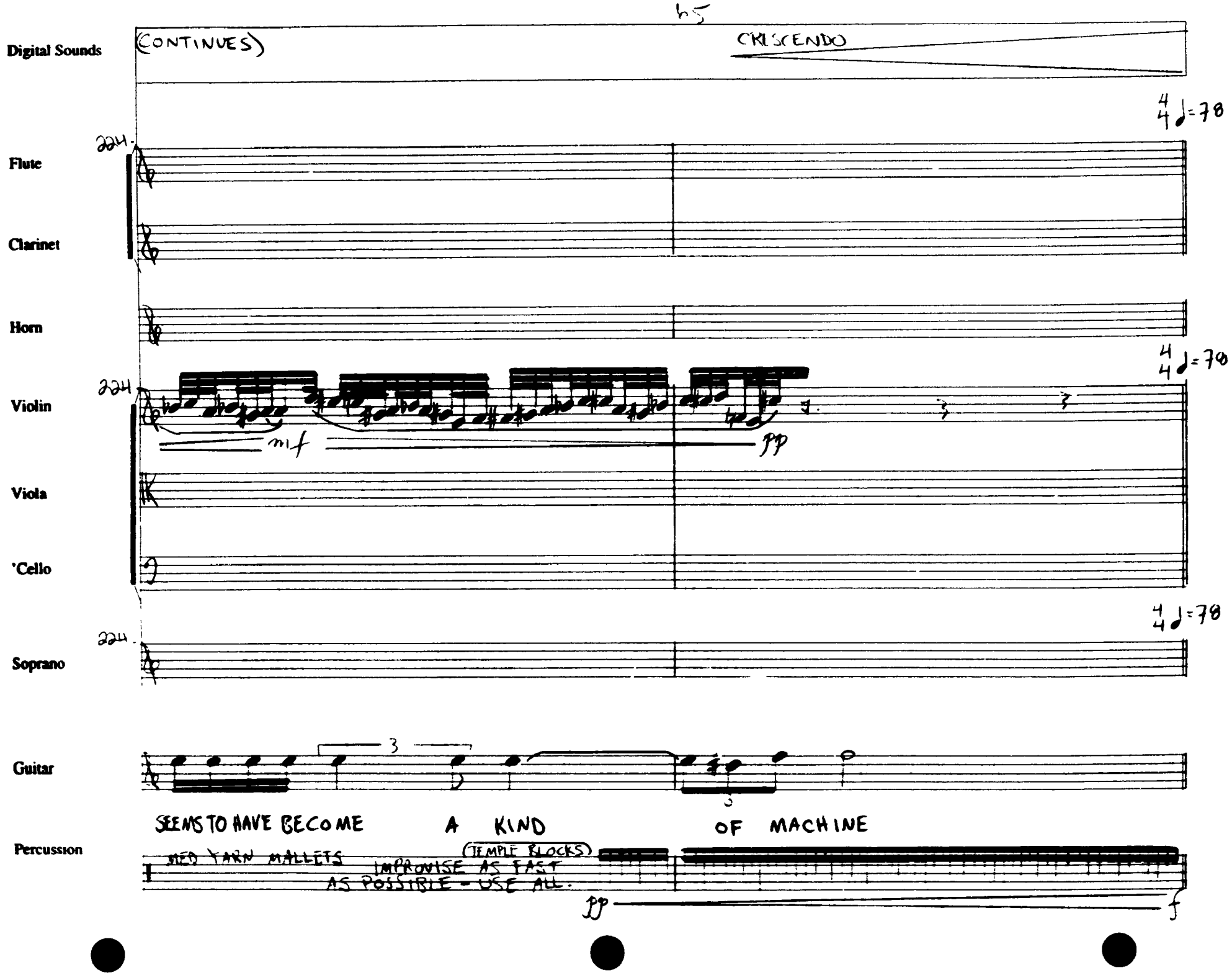

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
mp
WE CAN BE TRANSFORMED INTO MACHINES. EVEN A GREAT HUMANIST CAN CHANGE - AS A YOUNG MAN, CHARLES DARWIN

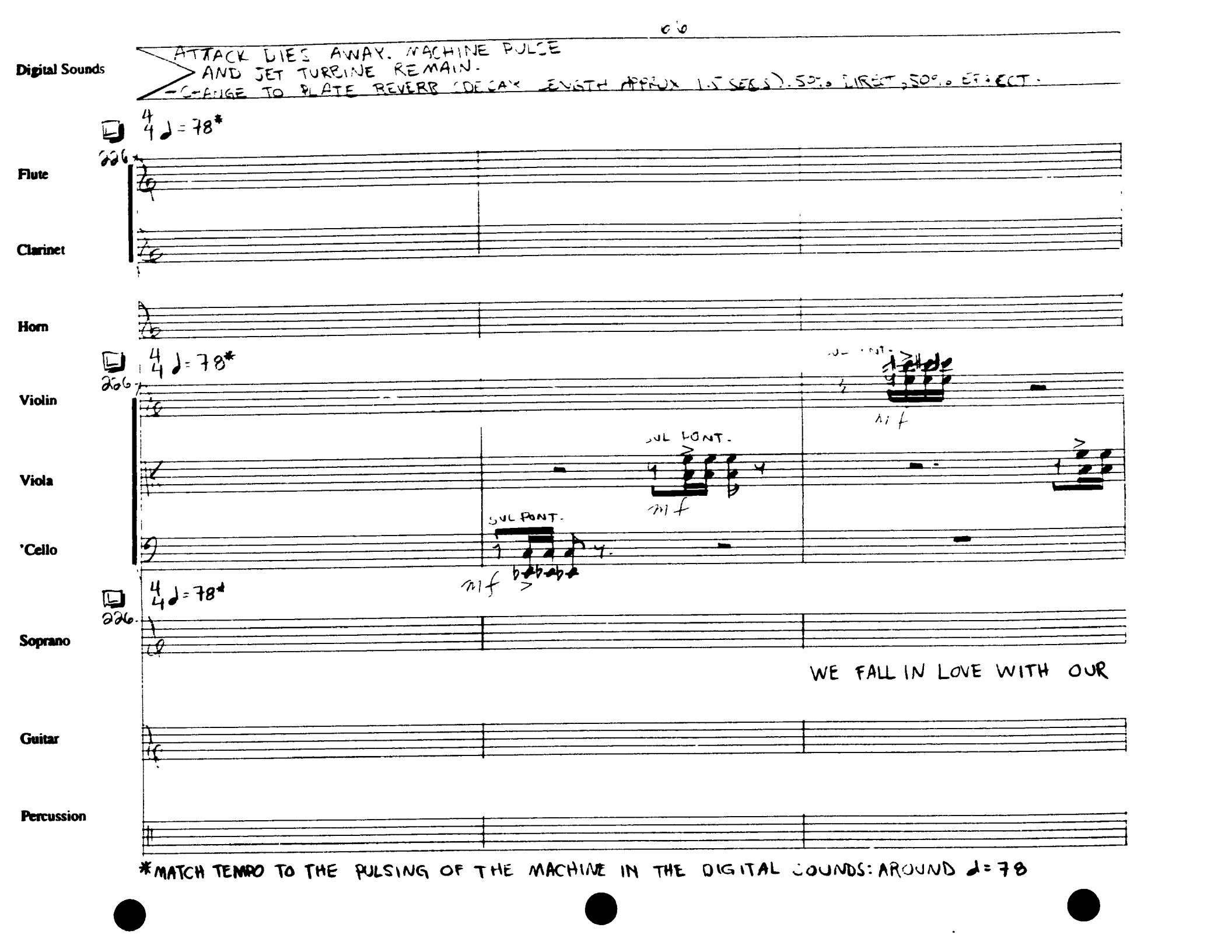

Digital Sounds
213
Flute
Clarinet
Horn
213
Violin
Viola
'Cello
3
3
3
pp
mp
213
Soprano
CHERISHED THE CREATIVE WORKS OF HIS FELLOW HUMAN CREATURES. AS HE GREW OLDER, HE FELT HIMSELF
Guitar
Percussion

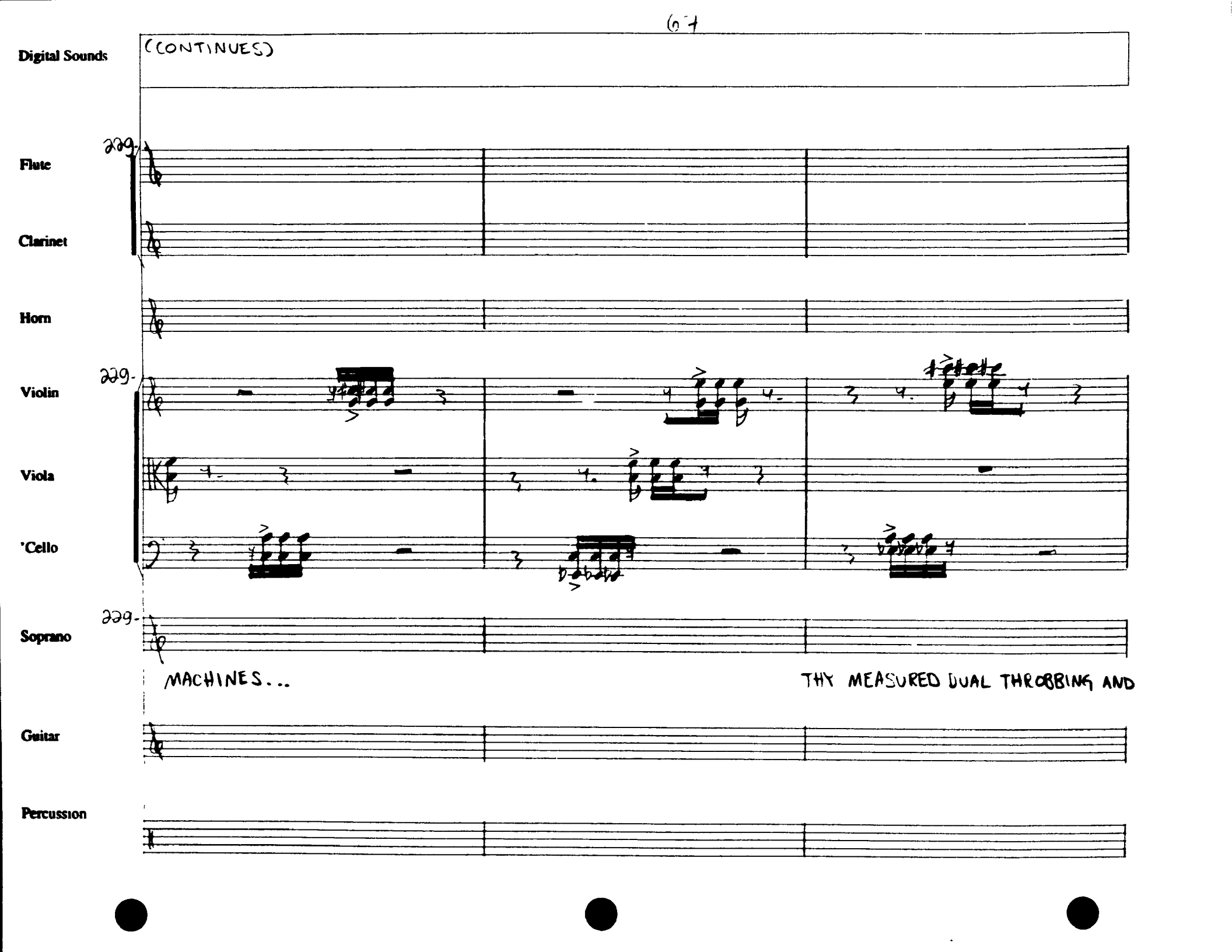

Digital Sounds
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
216
pp
mp
p
mf
CHANGING:
I CANNOT ENDURE TO


Digital Sounds
219
Flute
Clarinet
Horn
219
Violin
Viola
'Cello
219
Soprano
READ A LINE OF POETRY
I HAVE LOST MY TASTE FOR PIC—
Guitar
Percussion

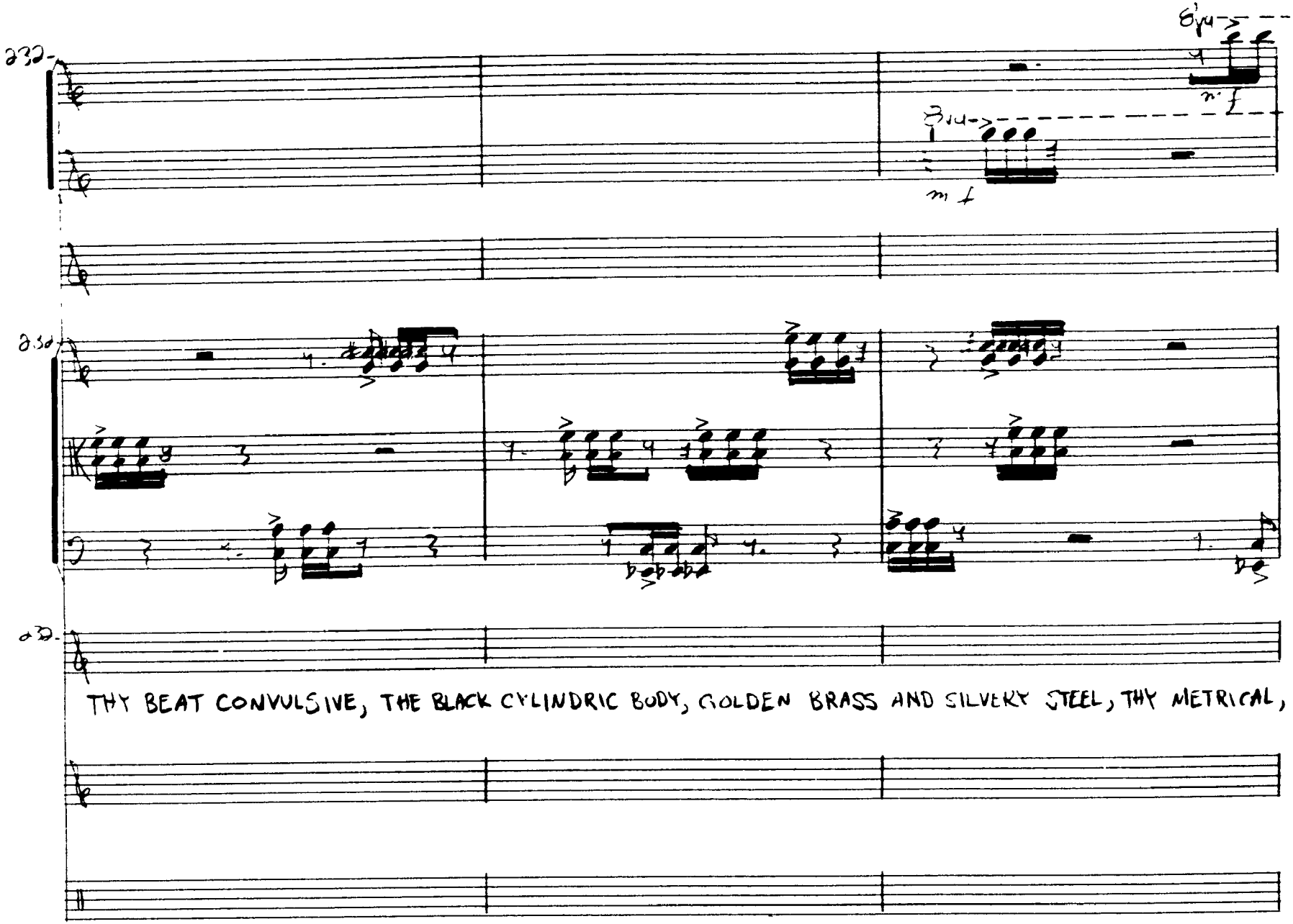

Digital Sounds
BEGIN CUE #3
-CONTINUES TO END.
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
-TURES AND MUS-
IC
MY
MIND
Guitar
Percussion

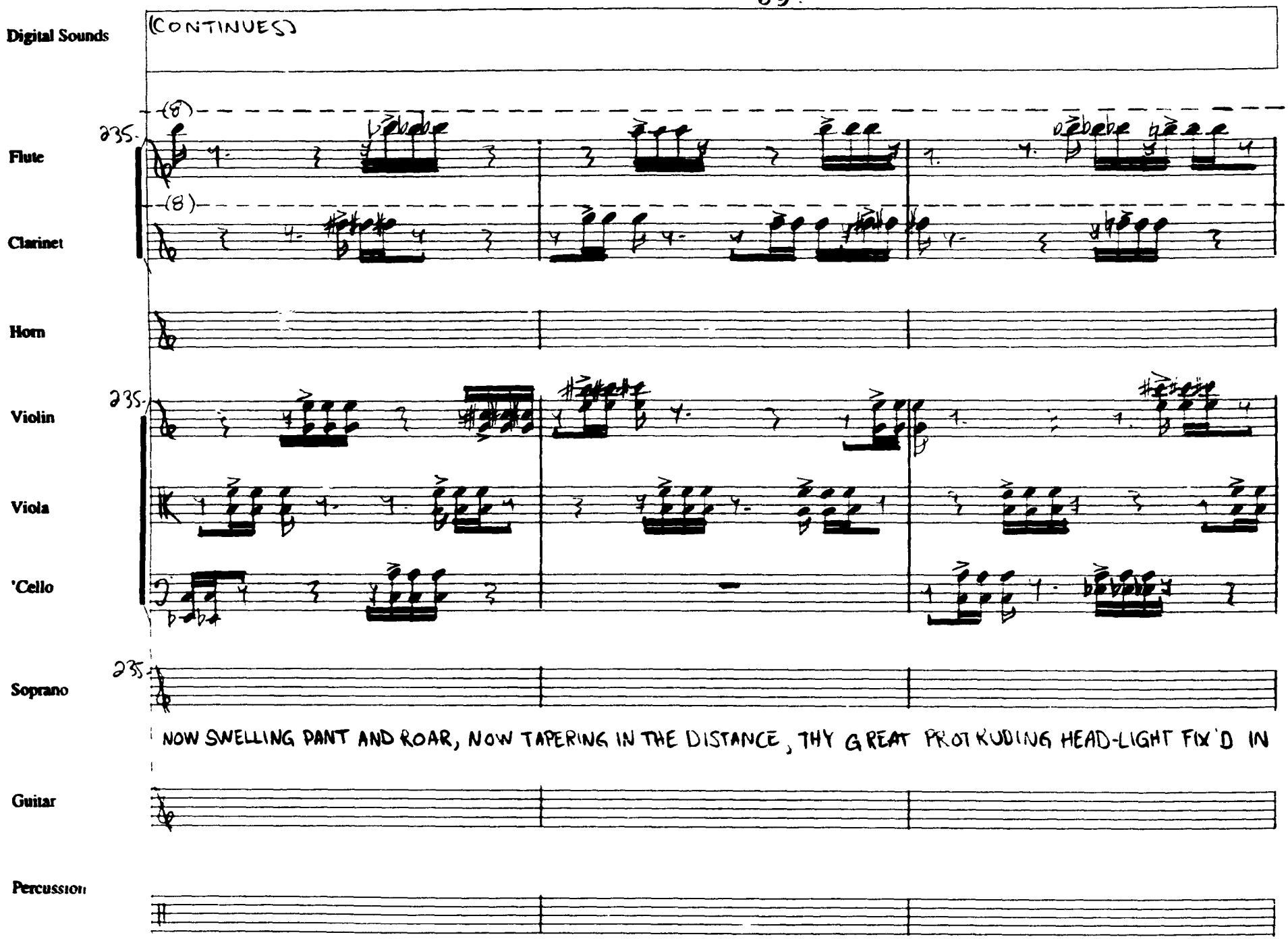

Digital Sounds
(CONTINUES)
CRESCENDO
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
224
4/4 ♩=78
mf
pp
3
SEEMS TO HAVE BECOME A KIND OF MACHINE
MED YARN MALLETS
(TEMPLE BLOCKS)
IMPROVISE AS FAST AS POSSIBLE - USE ALL.
pp
f


Digital Sounds
ATTACK DIES AWAY. MACHINE PULSE AND JET TURBINE REMAIN.
-CHANGE TO PLATE REVERB (DECAY LENGTH APPROX 1.5 SECS). 50% DIRECT, 50% EFFECT.
Flute
Clarinet
Horn
Violin
Viola
'Cello
Soprano
Guitar
Percussion
226
4/4 ♩= 78*
SUL PONT.
mf
WE FALL IN LOVE WITH OUR
*MATCH TEMPO TO THE PULSING OF THE MACHINE IN THE DIGITAL SOUNDS: AROUND ♩= 78

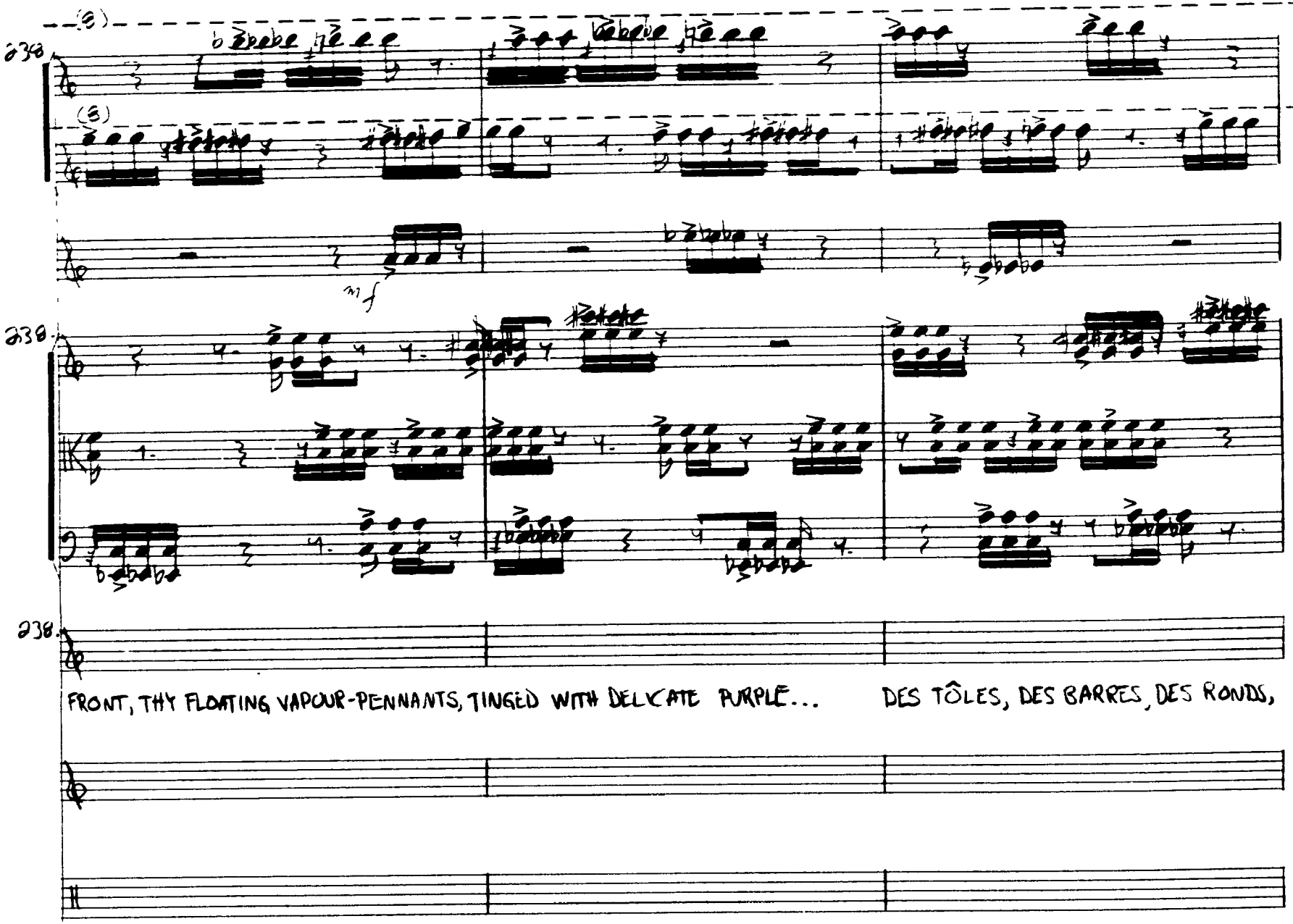

Digital Sounds
(CONTINUES)
229
Flute
Clarinet
Horn
229
Violin
Viola
'Cello
229
Soprano
MACHINES...
THY MEASURED DUAL THROBBING AND
Guitar
Percussion

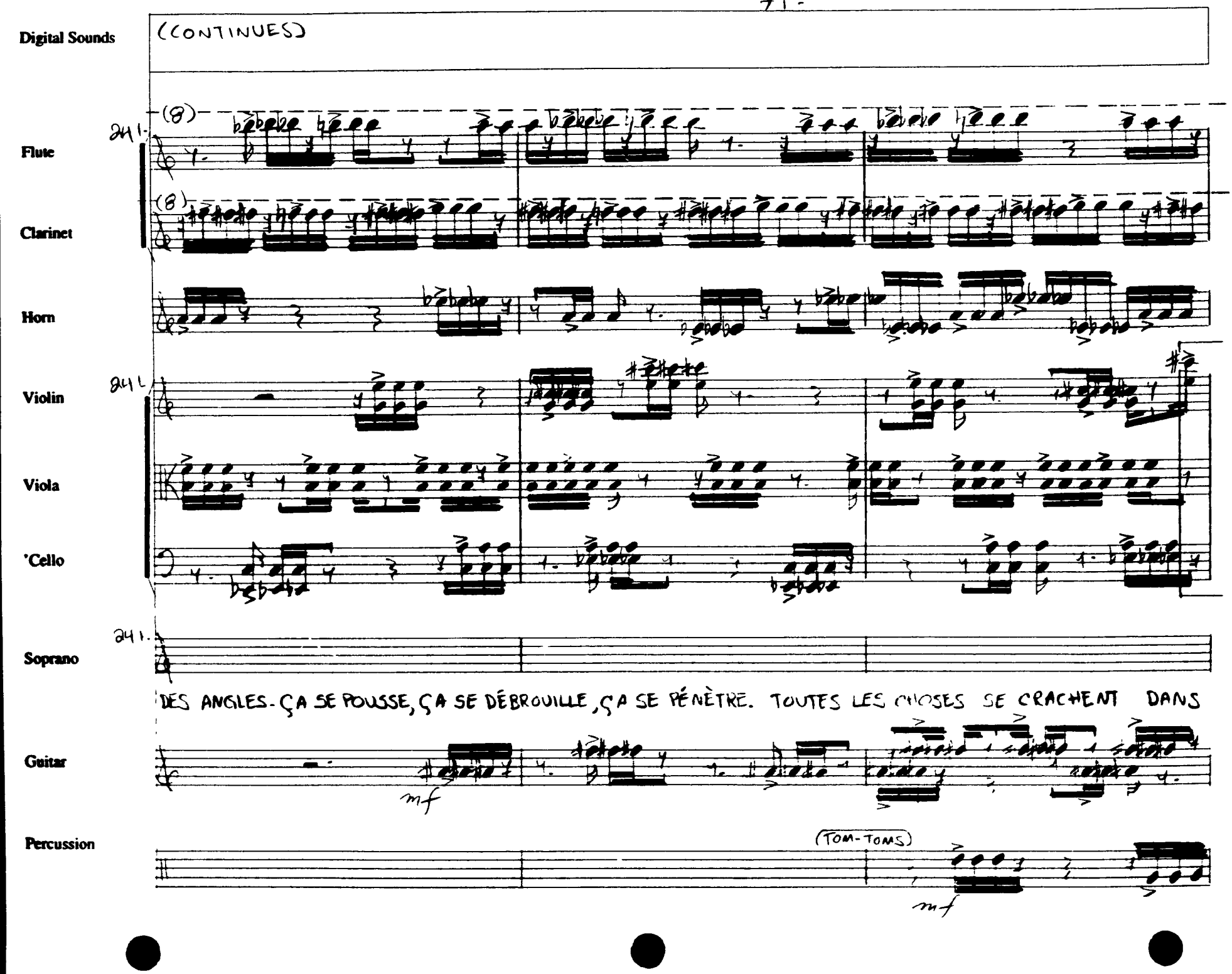
Digital Sounds (CONTINUES)




Digital Sounds
(CONTINUES)
235.
Flute
(8)
Clarinet
Horn
235.
Violin
Viola
'Cello
235.
Soprano
NOW SWELLING PANT AND ROAR, NOW TAPERING IN THE DISTANCE, THY GREAT PROTRUDING HEAD-LIGHT FIX'D IN
Guitar
Percussion

Digital Sounds (CONTINUES)

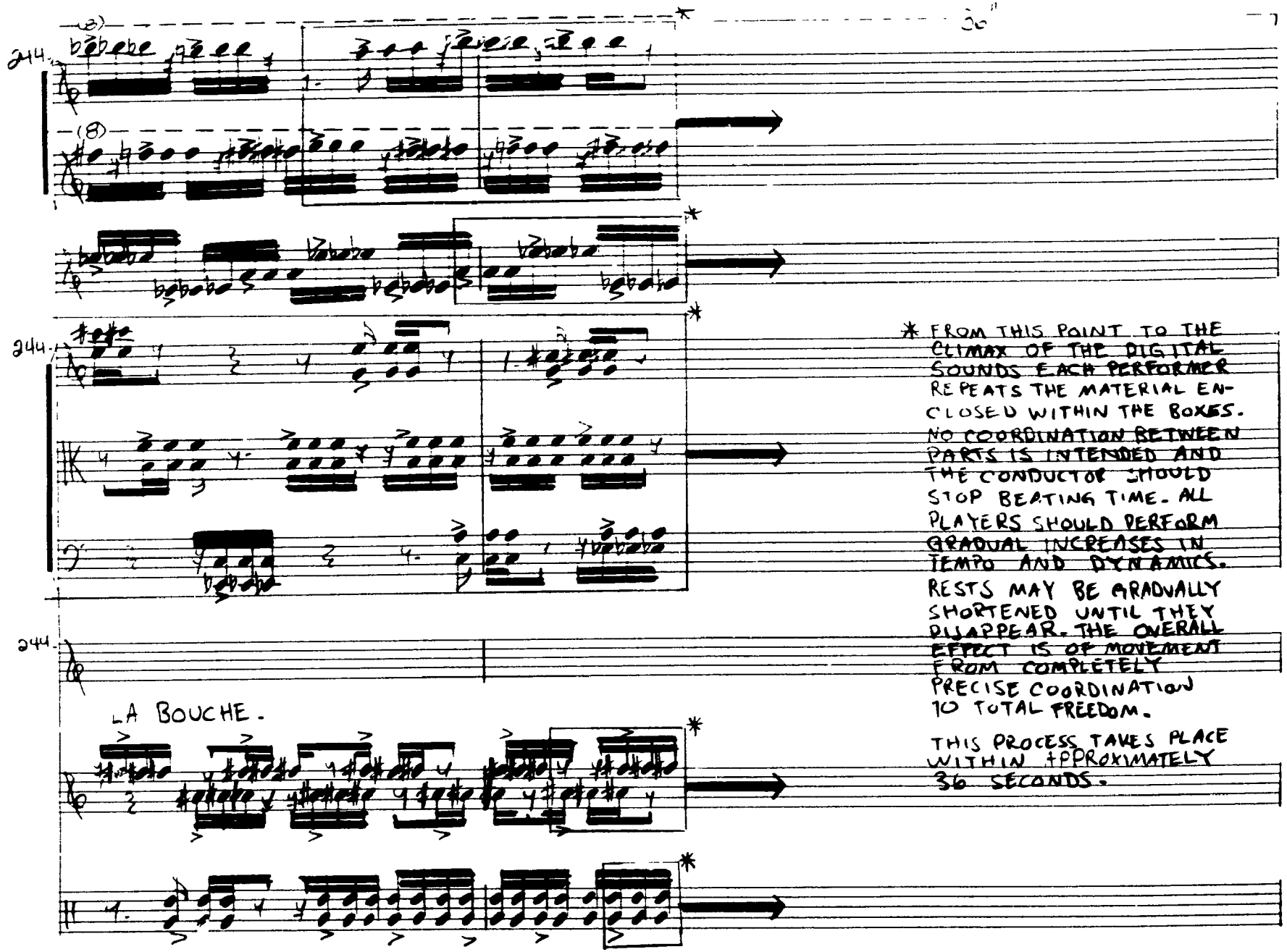



Digital Sounds
(CONTINUES)
241.
Flute
(8)
Clarinet
(8)
Horn
241.
Violin
Viola
'Cello
241.
Soprano
DES ANGLES - ÇA SE POUSSE, ÇA SE DÉBROUILLE, ÇA SE PÉNÈTRE. TOUTES LES CHOSES SE CRACHENT DANS
Guitar
mf
Percussion
(TOM-TOMS)
mf

Digital Sounds — CONTINUE.

JET SOUND GRADUALLY INCREASES IN VOLUME TO END OF SECTION

36"



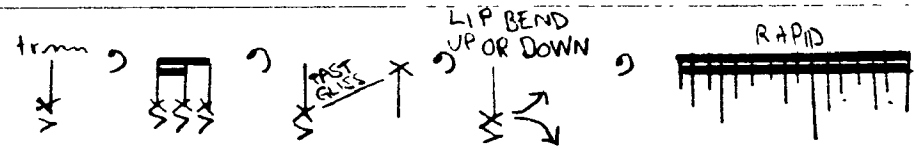
* FROM THIS POINT TO THE CLIMAX OF THE DIGITAL SOUNDS EACH PERFORMER REPEATS THE MATERIAL ENCLOSED WITHIN THE BOXES. NO COORDINATION BETWEEN PARTS IS INTENDED AND THE CONDUCTOR SHOULD STOP BEATING TIME. ALL PLAYERS SHOULD PERFORM GRADUAL INCREASES IN TEMPO AND DYNAMICS. RESTS MAY BE GRADUALLY SHORTENED UNTIL THEY DISAPPEAR. THE OVERALL EFFECT IS OF MOVEMENT FROM COMPLETELY PRECISE COORDINATION TO TOTAL FREEDOM.

THIS PROCESS TAKES PLACE WITHIN APPROXIMATELY 36 SECONDS.

Digital Sounds

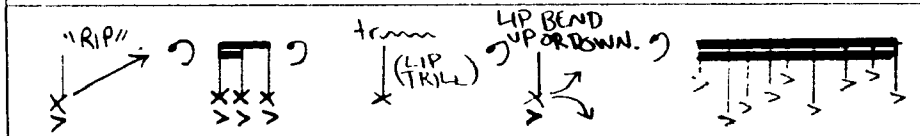
* TEXTURE CHANGES FOLLOWING JET CRESCENDO, TO CONSTANT MACHINE SOUNDS. LASTS 60" TO SUDDEN ATTACK AND ORGAN. -CHANGE TO 100% EFFECT DURING THIS SECTION (FULL PLATE REVERB)

Flute and Clarinet



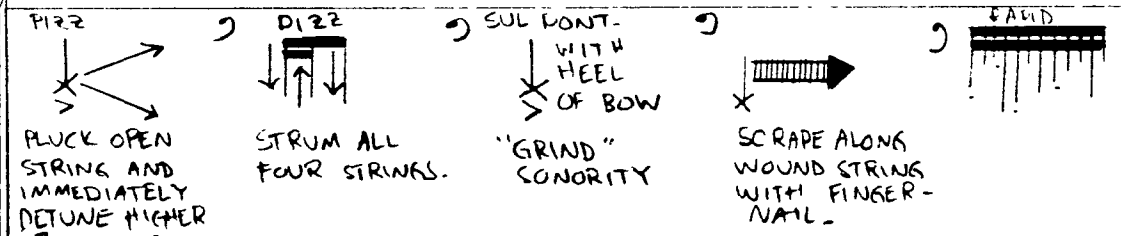
ALTERNATE REGULAR TONE PRODUCTION AND FLUTTERTONGUE. USE EXTREME REGISTERS. MOVE QUICKLY BETWEEN MOTIVES.

Horn



ALTERNATE OPEN, STOPPED, CUIVRÉ, AND FLUTTER-TONGUE. USE ENTIRE RANGE. MOVE QUICKLY BETWEEN MOTIVES

Strings



ALTERNATE ARCO, PIZZ. TREMOLO STYLES OF PLAYING. USE COL LEGNO BATTUTO ON STRINGS AND ON BODY OF INSTRUMENT (CAREFULLY). MOVE QUICKLY BETWEEN MOTIVES

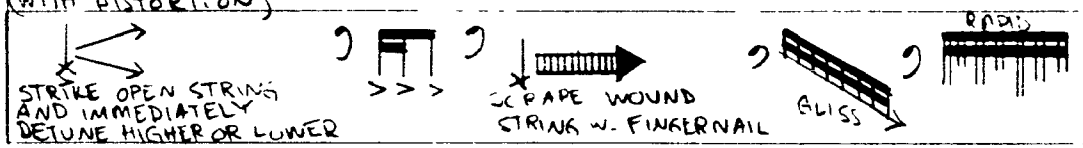
Soprano

12"

ALL IS SEARED WITH TRADE, BLEARED, SMEARED WITH TOIL; AND WEARS MAN'S SMUDGE AND SHARES MAN'S

Guitar

(WITH DISTORTION)



ALTERNATE SINGLE NOTES, CHORDS, AND KNOCKING INSTRUMENT BODY. MOVE QUICKLY BETWEEN MOTIVES

Percussion

USE HEAD AND HANDLE OF MED-YARN MALLETS ON ALL PARTS OF INSTRUMENTS INCLUDING RIMS, BODIES, STANDS, ETC. MOVE QUICKLY BETWEEN MOTIVES

*Note from this point each player improvises freely using the given motives, as well as other material if desired The overall effect should be chaotic, like a number of machines which are running out of control. All pitches are to be improvised over the entire range of the instruments The strings and guitar should be careful not to detune their instruments too much to avoid putting stress on the instrument bodies This section lasts for exactly 60 seconds and should end abruptly with the forte attack in the digital sounds which begins the epilogue

Digital Sounds (MACHINE SOUNDS)

Instrumental Ensemble — Continue Improvising

Soprano — 12"

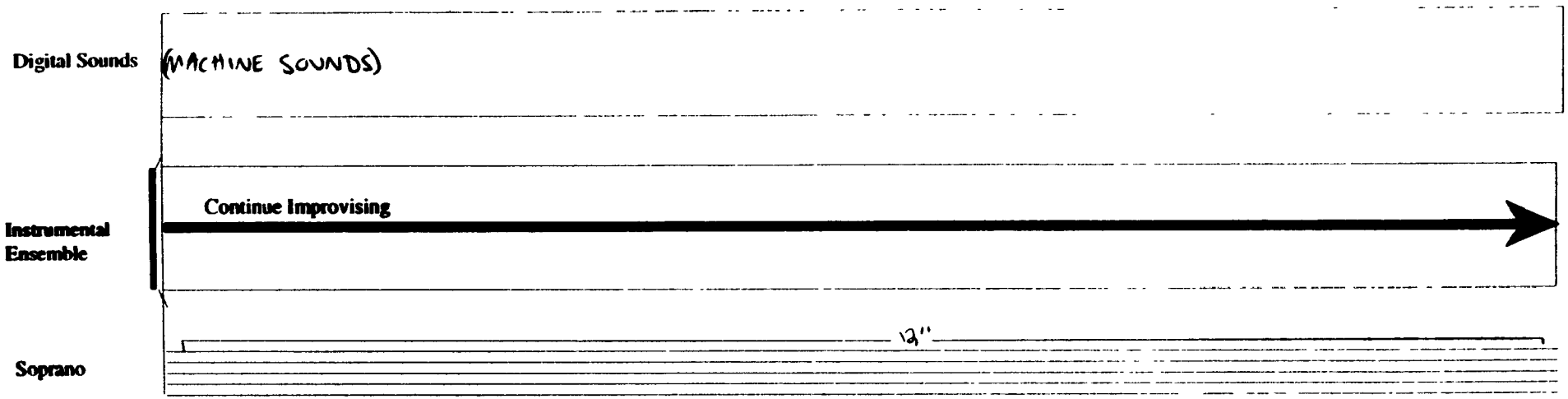
SMELL. C'EST UN NOIR PAYS FORÉ DE PUITS, QUI FUME PAR SES LOURDS HAUT-FOURNEAUX, PAR SES

Digital Sounds (MACHINE SOUNDS)

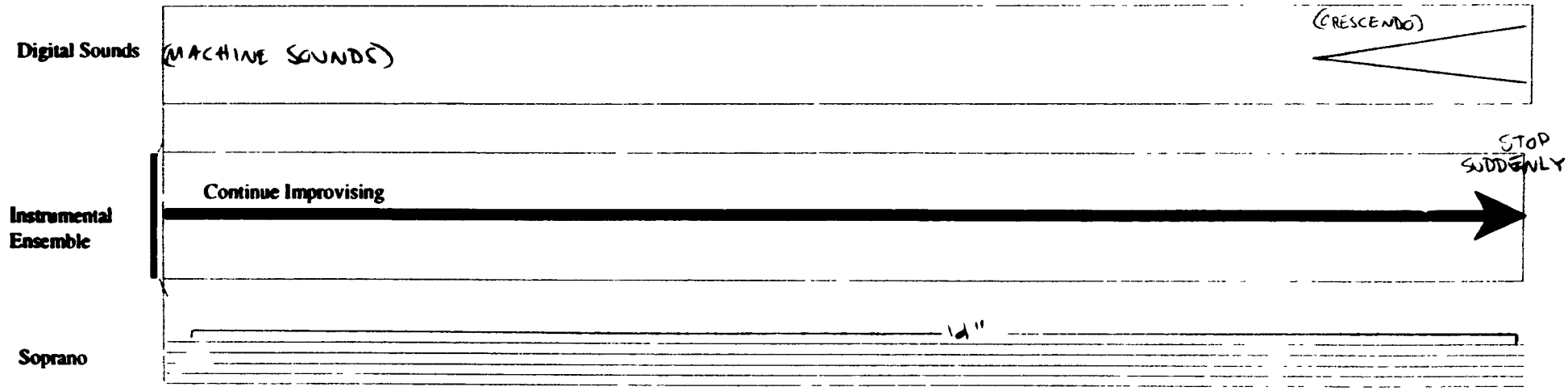
Instrumental Ensemble — Continue Improvising

Soprano — 12"

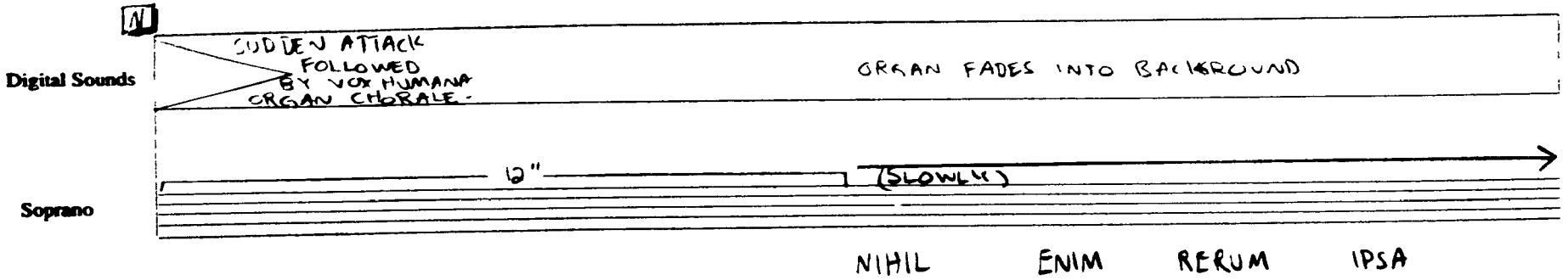
LARGE CORONS, SES TRAINS DONT LES SIFFLETS VRILLENT DE TROUS LA BRUME ET CASSENT LE CIEL BAS QUE

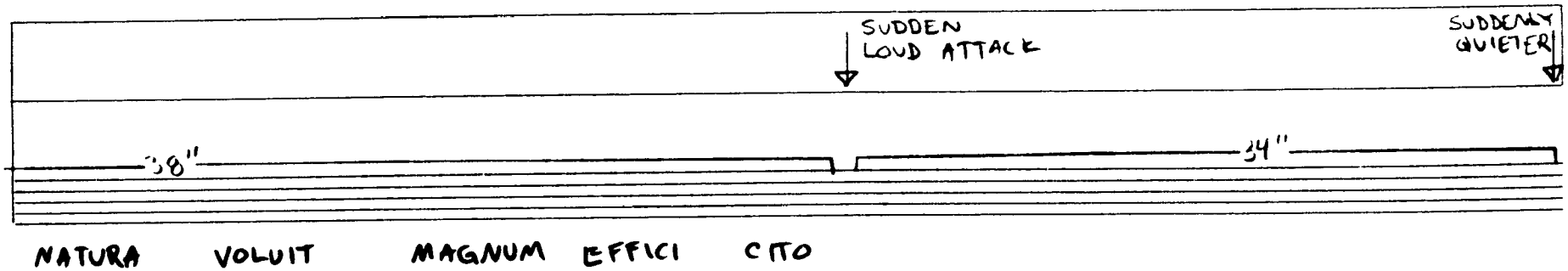


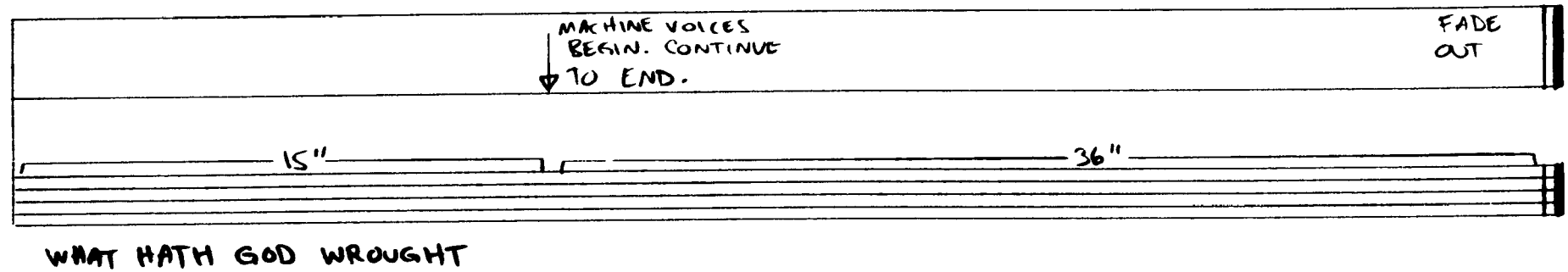
L'AIR HOUILLEUX CORROMPT ... CE MONDE NE MÉRITE PAS D'ÊTRE CONNU! THE WORLD IS DYING OF



MACHINERY; THAT IS THE GREAT DISEASE, THAT IS THE PLAGUE THAT WILL SWEEP AWAY AND DESTROY CIVILIZATION.


A
Digital Sounds
SUDDEN ATTACK FOLLOWED BY VOX HUMANA ORGAN CHORALE.
ORGAN FADES INTO BACKGROUND
Soprano
12"
(SLOWLY)
NIHIL ENIM RERUM IPSA


SUDDEN LOUD ATTACK
SUDDENLY QUIETER
38"
34"
NATURA VOLUIT MAGNUM EFFICI CITO


MACHINE VOICES BEGIN. CONTINUE TO END.
FADE OUT
15"
36"
WHAT HATH GOD WROUGHT