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Exit Examination in Music Theory Review

Contents

I. Four-Part Voice-Leading 3
II. Tonicization and Modulation 9
III. Chromatic Harmony 14
IV. Phrase and Form 22
V. Post-Tonal Topics 29
I. Four Part Voice-Leading

1) Review of chorale format

The standard 4-part chorale will be the format used to review the materials of tonal harmony. Its use is twofold: first, it is a simple and clear way to show triads and seventh chords. Second, the conventions of voice-leading, loosely based on the chorale practice of J.S. Bach, provide a useful tool for learning to “use” both the linear and vertical aspects of tonal music.

Chorale-style format is notated on two staves, with two parts on each staff: soprano and alto voices on top, tenor and bass voices on the bottom. At all times (even when in unison) the voices will be differentiated from one another by stem direction. Soprano and tenor are always notated with stems up; alto and bass with stems down. In general, each voice-part should be restricted to a conservative range. Melodic writing should be smooth, with minimal leaps, and simple rhythms.

2) Voice-leading rules

1) Avoid parallel perfect intervals

2) Never double a leading-tone, seventh, or non-chord tone

3) Avoid diminished or augmented melodic intervals (the diminished 3rd is allowed in the progression bII-V6; the diminished 4th is allowed in i6-V6 in minor)

4) Avoid crossing or overlapping voices (especially if both voices leap)

5) Favor smooth voice-leading; avoid large leaps and leaps by dissonant intervals

6) Favor contrary, similar and oblique over parallel motion

7) Avoid cross-relations (chromatic motion between voices)

8) Keep the upper three voices within an octave of one another; bass and tenor may be as far apart as their ranges allow
9) Emphasize a clear, simple melodic shape in the soprano voice; inner parts should move as smoothly as possible; large leaps should be infrequent, occur predominantly in the bass, and be followed by stepwise motion in the opposite direction.

10) Leading-tones always resolve up in the outer voices (unless there is an overarching melodic trend downward or in the context of a sequence).

11) Non-chord tones and sevenths resolve down by step (except in the unusual case of a retardation).

**PRACTICUM 1A:** the passage below contains several voice-leading errors; circle the errors and write the number of the rule that applies:

![Musical notation image]

3) Root position voice-leading

There are simple guidelines that can be used to confidently predict the smoothest path between two root position chords without breaking the rules. These are:

1) Root motion of a fourth or fifth: keep one common tone; move the other notes by step (in the same direction as each other).

2) Root motion of a third or sixth: keep two common tones; move the other by step.

3) Root motion of a second: move the upper voices in contrary motion to the bass to the nearest chord tone (two voices step, one leaps a third).

These guidelines only work if the root of the chord is doubled.
PRACTICUM 1B: realize the bass with root-position chords; use the three guidelines for smoothest possible voice-leading:

4) Negotiating V-VI in minor

The raised leading-tone in minor creates the potential for a melodic augmented 2\textsuperscript{nd} between it and the natural form of scale degree 6 (“flat 6”). Given that raised 7 is likely to be found in a V chord, the problem occurs approaching or leaving V. Predominant chords containing flat 6 (ii\textsubscript{o}, iv, VI) are vulnerable to this hazard, as well as leading to VI in a deceptive progression. In the latter case, the solution is to allow the leading tone to resolve upward, creating a doubled third in the VI chord. In cases where V is approached by a predominant chord, there are different types of solutions. One solution might be to double something other than scale degree 6. Another might be to raise scale degree 6 (IV\textsubscript{7}-V\textsubscript{7}, a Bach favorite).
**PRACTICUM 1C:** realize each progression in four parts; use the smoothest possible voice-leading without breaking any rules; write the appropriate analysis (roman numeral/quality) below:

5) Non-chord tones

Non-chord tones are notes with a linear rather than harmonic function. They add melodic, rhythmic, and contrapuntal variety and movement to musical textures. Non-chord tones are considered **dissonant**, which means they produce qualities of tension and require specific resolutions. Certain non-chord tones are more idiomatic than others, depending upon the style.

The most common non-chord tone types are the passing and neighbor tones. The **passing tone** (PT) is a non-chord tone that proceeds stepwise from one chord-tone to another in one direction. The **neighbor tone** (NT) is a non-chord tone that moves by step and returns to the same chord tone. Both the PT and NT occur in weaker metric positions than the adjacent chord tones. Also, PT’s and NT’s are possible over a change of chord or within the same chord.

**Accented passing tones** (APT) have the same characteristics as passing tones except that they occur on relatively strong metric positions. **Suspensions** (SUS) are formed when a chord tone in one harmony is held over to another where it becomes dissonant. It has three components: preparation (chord tone, weak metric position), suspension (the tone held over, dissonant, strong metric position), and resolution (the tone resolves **down by step** to a consonant note, weak metric position).
The **anticipation** (ANT) is a non-chord tone that belongs to the next harmony but happens early. Anticipations occur on weak metric positions and are held over (often re-articulated) to the next harmony where they are consonant. **Escape tones** (ESC) are similar to upper-neighbor tones except that they *leap down* to the chord of resolution. The **appoggiatura** (APP), on the other hand, is leaped up to and steps down. It occurs on a strong metric position.

**PRACTICUM 1D:** analyze the circled non-chord tones; abbreviate your answer (PT, NT, APT, SUS, ANT, ESC, APP):
II. Tonicization and Modulation

1) Secondary dominant chords

A secondary (or “applied”) dominant chord is a chord altered to produce a V or V7 of a diatonic chord. The idea is that each major or minor triad in a key can be temporarily treated as a tonic in its own key by preceding it with the major triad or Mm7 built on the note a fourth below (or fifth above). This technique greatly enriches the possibility for harmonic movement and variety. Secondary dominants may be used to produce only a momentary inflection of a “secondary key” and proceed as before in the original key (tonicization), or they may serve to move the tonal center to the new key (modulation).

The roman numeral notation of a secondary dominant chord describes its function in the *new* key, rather than simply describe how the quality of the chord has been changed. For instance, the secondary dominant of V in major is produced by changing the ii chord from minor to major (raising the third of the chord to be a *secondary leading-tone*) – rather than designating it as “II” (major two), it is called “V/V” (five of five). If after the chord resolves the music continues in the original key (tonicization), the chord of resolution will maintain its original identity (V rather than I of V, or something like that). Where there is a modulation, a different strategy for Roman numeral analysis is used, discussed below.

![Secondary Dominants in C Major](image)

Above are the secondary dominants in C major. Note that the V/IV requires a 7th to change the effect of the tonic chord into a dominant. Also, there is no V of viio because only major and minor triads can function as tonic chords. V7 of bVII is possible (borrowed from minor).

![Secondary Dominants in C Minor](image)

The secondary dominants in minor offer some interesting possibilities. Note that V/V requires *two* chromatic alterations because of the diminished quality of the iiio chord. In minor, III is an exceedingly common secondary area (relative major key). The VII chord is virtually always used as a V of III and so no added 7th is required to produce the effect of a dominant (but it is certainly possible to do so).
PRACTICUM 2A: write the appropriate secondary dominant chords in closed position:

|---------|---------|---------|---------|---------|---------|---------|---------|

2) Secondary leading-tone chords

A secondary leading-tone chord operates under the same premise as a secondary dominant, only the chord is build on the new leading tone rather than on the secondary fifth scale degree. Thus, secondary leading-tone chords are always found a half-step below the key in which they are functioning.

The quality of all secondary leading-tone triads is diminished, but composers often add a seventh, emphasizing the strong color of the chord. The quality of the seventh depends in part on whether the secondary key is major or minor. If going to a major triad, both the half-diminished and fully-diminished secondary leading tone 7ths are possible, but invariably the fully-diminished 7th is used as a secondary L.T.C. to a minor key.

\[
\begin{align*}
\text{C: vii}^\text{°7/V} & \quad \text{V} & \quad \text{vii}^\text{°7/IV} & \quad \text{IV} & \quad \text{vii}^\text{°7/ii} & \quad \text{ii}
\end{align*}
\]

PRACTICUM 2B: given the indicated key, analyze the chord with roman numerals; be sure to represent chord quality and inversion:

<table>
<thead>
<tr>
<th>Gb:______</th>
<th>G:______</th>
<th>a:______</th>
<th>Db:______</th>
<th>Ab:______</th>
<th>C:______</th>
<th>D:______</th>
<th>Db:____</th>
</tr>
</thead>
</table>
3) Modulation to closely-related keys

Modulation occurs when the secondary functions described above result in a change in tonal center that is maintained for some period (usually at least through a cadence). The most common keys to which tonal pieces modulate are those whose tonic triads are found within the scale of the original key. These keys, it turns out, all reside within one “click” on the circle of fifths; there is no more than one difference in the key signatures between the original key and a closely related key.

Modulations require more rhythmic and harmonic control to pull off than do tonicizations. A significant concern is the question of how the secondary dominant chord is approached. It is usually possible to prepare the secondary dominant with its own predominant chord, directing already the motion towards the new key. Many chords in the original key are also diatonic predominant chords in the key to which the modulation is heading. These chords then, diatonic in both keys, are known as diatonic “pivot” chords.
In cases where there is a modulation, if the chord preceding the secondary dominant is also diatonic in the new key (a pivot chord), we begin the analysis on this chord, giving it two interpretations, one in the old key, and one in the new:

**PRACTICUM 2C**: analyze the chord progressions as modulations from the given key to another; label the dual function of pivot chords with brackets:
SOLUTIONS

PRACTICUM 2A:


PRACTICUM 2B:


PRACTICUM 2C:

e: i  VI
G: IV  V  I  Bb: I  ii7

b: i  III
f#: VI  V7  i
III. Chromatic Harmony

1) Mixture

Change of mode; borrowed chords

Modal mixture is the importation of harmony from the parallel key. This event may be as temporary as a chord or two (borrowed chords), or may continue for a phrase or more (change of mode).

Mixture in minor keys is uncommon. In major most instances of borrowing involve scale degree b6 (oii, iv, bVI and their seventh-chords). These borrowed chords typically function as altered pre-dominants with scale degree b6 moving expressively to 5. bVI is used often as a chromatic embellishment of I or as a deceptive progression.

2) Neapolitan and Augmented 6th chords

Neapolitan chord in root position and first inversion; Italian, French, and German augmented 6th chords

The Neapolitan chord is a chromatically altered subdominant chord (bII) via a lowered scale degree 2. Its quality is major, which, in the major mode, requires lowering scale degree 6 as well. The Neapolitan functions most commonly as a predominant chord and may occur in root position (less common) or first inversion (more common).

Whether in rp or 1st inversion, it is best to double the bass. The b2 scale degree must proceed to #7 (of V), a melodic diminished 3rd. In the case of a Neapolitan in root position (doubled b2), one of the doubled voices should move to 2 in order to avoid P8’s and a doubled leading tone. Beware of parallel 5ths.

Another class of chromatic pre-dominant chords resembles the Phrygian progression (iv6—V) with an upper voice #4—5 (rather than 4—5). The #4 in the soprano against the b6 in the bass produces an augmented sixth interval, thus the designation of this type of chord: the augmented 6th chord. Aug 6th chords come in three forms. The “basic” form, (the so-called Italian 6th), adds
a 3rd: b6 – 1 – #4. The **French 6th** adds a common-tone with the V chord, scale degree 2: b6 – 1 – 2 – #4. The **German 6th** instead adds scale degree b3: b6 – 1 – b3 – #4. Note that the Ger 6th is enharmonically equivalent with a dominant 7th chord.

![Augmented sixth chords in C major](image)

Aug 6th chords resolve to V, with the notes of the aug 6th interval resolving outwards to an octave scale degree 5. As the b6 and #4 are strong tendency tones, they should not be doubled. Scale degree 1 (common to all types) resolves to #7. The b3 of the Ger 6th presents the only exception to the prohibition against parallel 5ths: it may move down to 2 (P5 with bass b6—5). However, a more common resolution of the Ger 6th is to V via the cadential 6/4:

![Ger6 resolutions](image)

Though the notes forming the aug 6th interval virtually always proceed outwards to the octave 5 of the V chord, it is possible for the upper voice to resolve *down chromatically* to the seventh of V7.
PRACTICUM 3A: realize the progression in four parts; complete the analysis below:

3) Chromatic Modulations

Chromatic pivot chords; enharmonic reinterpretation of the Ger+6; enharmonic reinterpretation of viio7

Chromatic modulations often involve motion between distantly related keys (2 or more accidentals of difference in key signature). These modulations are made using chromatic pivot chords.

Chromatic pivot chords operate on the same principle as diatonic pivot chords in that the same chord has two different functions: one in the key before it, another in the key to which it is going. The difference is that diatonic pivot chords are diatonic in both keys (a potentiality of closely related keys). Chromatic pivot chords are chromatic in at least one of the two keys. [To review, chromatic chords include secondary dominants, secondary leading-tone chords, augmented 6th chords, and Neapolitan chords.]

There are three possible ways chromatic pivot chords can relate to the keys of a given modulation: 1) diatonic-chromatic [diatonic in first key, chromatic in second]:

```plaintext
C: V7
B: Ger6 V6/4 5/3
C: IV
E: bII V6/5
C: I
Bb: V/V V7 I
```
2) chromatic-diatomic [chromatic in first key, diatomic in second]:

![Musical notation]

3) chromatic-chromatic [chromatic in both keys]:

![Musical notation]

**PRACTICUM 3B:** write the chromatic pivot chord implied by the analysis; spell the chord in closed position with accidentals (not key signatures); fill in the missing analysis:

![Musical notation]

The viio7 chord offers interesting possibilities for chromatic modulations. Because a fully diminished 7th chord is symmetrically constructed from minor thirds, it is enharmonically equivalent to the viio7 of three additional keys at once (each note can be reinterpreted as a leading-tone in some key).
The reinterpretation of the third, fifth, and seventh of the chord to a l.t. in the new key means that the o7th chord is functioning in a primary—primary relationship; that is, it functions as the viio7 for two keys at once.

The possibilities multiply greatly when other types of relationships are considered. For instance, all the tonic chords to which the viio7 above resolved could instead be dominants of entirely different keys. The same root resolutions would then produce primary—secondary relationships:

![Diagram](image)

Often o7th chords appear as secondary dominant-function chords (such as viio7/ii, viio7/iii, viio7/iv, viio7/V, or viio7/vi). These secondary chords (moving to closely-related keys) can also be reinterpreted so that the third, fifth, or seventh function as a l.t. in a distantly related key. Indeed, these chords may also function secondarily in an entirely different set of keys as well (as viio7/V/…).

![Diagram](image)

A viio7 chord may appear in any inversion, regardless of its pivot status, so long as there is proper resolution of the chord-tones in relation to its destination. Reinterpreted viio7 chords may proceed to major and minor keys alike.
4) Other Chromatic Functions

Triads are related by *chromatic third* if their roots are a major or minor third apart and are the same quality (major or minor). The chromatic third relation is used to describe a type of progression from a tonic chord to some chromatic variant of VI or III.

Most chromatic third relationships feature a common tone. The common tone can function as a pivot pitch between two chromatic keys, moving directly from one to another in what is called a *common-tone modulation*.

Chromatic alterations are commonly used to create linear embellishments of standard chords – referred to generally as *altered chords*. The V7-I progression is given a special color by flatting the fifth of the V7 chord. The altered version is designated with the diminished symbol (V₀ or V₀7), although it isn’t technically diminished in quality. Instead, it sounds exactly like a French 6⁰, but built on scale degree 2 and having a dominant, rather than pre-dominant, function. This type of altered dominant is usually spelled over the b2 – V₀7 4/3.
Finally, there is a class of 07th chords that are created by common tone motion to or from another chord called common-tone diminished seventh chords (CTo7). The only condition necessary to establish this relationship is that the common tone occurs between the tonic of the prolonged chord and a member of the 07th chord. Regardless of which member of the 07th chord bears the common tone, there will be only one enharmonic 07th chord possible for any given prolonged chord (remember there are only 3 possible 07th collections). Any major or minor triad may be prolonged by a CTo7 chord.

**PRACTICUM 3C:** choose the answer from the list that best describes the harmonic function of the boxed chords; consider what precedes and follows each chord:

A. chromatic third  
B. reinterpretation of viio7  
C. common-tone 07 chord  
D. V07 (altered dominant)  
E. reinterpretation of V7/GER6  
F. neapolitan chord  
G. augmented 6th chord  
H. mixture

![Musical notation with options for Practicum 3C]
III. Chromatic Harmony

**PRACTICUM 3A:** realize the progressions in chorale style; complete the analysis

**PRACTICUM 3B:** write the chromatic pivot chord indicated by the analysis; spell in closed position with accidentals (not key signatures); fill in the missing analysis

**PRACTICUM 3C:** choose the answer from the given list that best describes the harmonic function of the boxed chord; consider what precedes as well as what follows it:

- chromatic third
- reinterpretation of vo57
- common-tone vo7 chord
- vo57 (altered dominant)
- reinterpretation of vo7/vo6
- Neapolitan chord
- augmented vo6 chord
- mixture

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[D: F] [C: E] [G: B] [A: F]
IV. Phrase and Form

1) Cadence

authentic cadences (PAC, IAC), half cadence, deceptive cadence, plagal cadence

Cadences in tonal music are specific harmonic formulae used to close a phrase. This closure may be more or less conclusive, depending on a variety of factors, including which type of cadence is used. The use of the standard V-I progression is called an authentic cadence. A half-cadence is formed when a phrase closes on V. Deceptive cadences are those in which the V harmony proceeds to a chord other than I, usually vi. Plagal cadences are rare or decorative, consisting of the progression IV-I.

In actual music, the authentic cadence can appear in various inversions with different melodic patterns in the upper voice. These differences qualify and inflect the cadence with various shades of closure. The most conclusive sounding authentic cadence occurs when both the V and I chords are in root position and the upper line comes to rest on scale degree 1 from either 2 or 7. This is called a perfect authentic cadence, or PAC. Any other variation of the progression is labeled an imperfect authentic cadence, or IAC.

2) Phrase

phrase, motive, sub-phrase

The phrase is the basic contiguity of musical expression. It consists of a purposeful passage of harmonic motion. In tonal music, the harmonic meaning of a phrase is understood largely by its point of arrival, its cadence. Cadences are identifiable not only by their specific harmonic content, but often by their rhythmic and textural features as well. The most straightforward way to identify a phrase is to pinpoint its cadence. What precedes the cadence should be a purposeful passage of harmonic movement toward it.

The quality of motion through the passage of a phrase is not only a harmonic matter, but rhythmic as well. The rhythmic direction of a phrase is produced through the creation and repetition of short, distinctive melodic/rhythmic ideas called motives. Whereas harmonic progressions tend to be fairly standard, motives give uniqueness and energy to the phrase. As motives join together in the course of the passage of a phrase, other rhythmic divisions are often produced. Medium-range rhythmic units articulated within a phrase are sub-phrases.

3) Period Structure

period structure, antecedent-consequence relationship, parallel period
In music, phrases are not isolated events. They join together into groups. A group of phrases is called a *period structure*. Period structures are formed when a phrase (or phrases) with a relatively weak cadence (or cadences) is followed by a phrase ending on a PAC. The idea is that weaker cadential endings leave something undone, creating the expectation for a more conclusively ended phrase. The eventual PAC of the more conclusive phrase articulates closure for itself as well as for the overall period.

The *antecedent-consequence* relationship is a common form of period structure. It consists of two phrases where the interior phrase closes specifically on a half-cadence. This configuration condenses the rhetorical process of the period structure to its most robust design: the strongest articulation away from the tonic is immediately answered by the strongest articulation of the tonic.

Many antecedent-consequence periods have an additional feature, which is that the consequence phrase repeats the motivic/melodic material of the antecedent phrase, but ends instead on a PAC. This is called a *parallel period*.

4) **Small forms**

**binary, reprise, rounded binary, ternary, compound ternary**

Period structures of various types may be grouped together to create small pieces. Many pieces follow traditional rhetorical processes known as *forms*. The *binary form* consists of two repeated sections called *reprises*. A reprise is usually marked with a repeat sign, although sometimes the repeat is written out. Reprises often contain contrasting melodic material. Sometimes the second reprise brings back material from the first. When the *first* set of materials in the first reprise comes back as the *last* set of material in the second, the form is considered to be “rounded,” or *rounded binary*.

*Ternary forms* in general follow a simple strategy. They consist of three distinct sections, each of which is typically articulated with a PAC. A specific type of ternary form, the *compound ternary*, is common to minuet and trio movements. It is a design that joins three binary forms together into one form.

The most important factor in the analysis of form is not finding the right “label” – there will never be enough labels – it is the particular way a piece articulates its linear and harmonic materials into phrases, groups of phrases, and sections. The analysis of form is best done from the ground up, rather than the top down.

5) **Sonata form**

**sonata form, exposition, development, recapitulation, first group, second group, bridge, retransition, coda**
The sonata form is perhaps the most prestigious of all tonal forms. It is also the most difficult to define. The reason for this is that the overall formation of phrases, periods, and sections is quite free, determined much more by the content of the piece than by a pre-given mold. What characterizes most sonata form pieces is not a particular external architecture but an underlying harmonic process. Generally, this process unfolds as an establishment of the tonic key, a departure to a contrasting key (usually the dominant), a continuation of the departure through more distant keys, and a return to the tonic key.

The various stages of this process are known as the exposition (establishes the tonic key, departs to a contrasting key), the development (continuation of departure through more distant keys), and the recapitulation (the return of the tonic key). Within the exposition, the material through which the tonic is laid out is called the first group. The material of the contrasting key (usually the dominant) is called the second group. Between these two groups is music that moves harmonically from one to the other, the bridge. In the development section much can happen. From a strategic point of view, though, a process of preparing the recapitulation is always necessary by way of the dominant. This process is known as the retransition. The recapitulation takes the form of the exposition, except that both the first and second groups remain in the tonic key. Sometimes the recapitulation adds additional, cadential material at the end, known as a coda.

PRACTICUM 4A: study the given score and answer questions below:
1) What is the form of this piece? 

2) What term describes the two sections divided by the repeat signs? 

3) How many phrases are there? 

4) What type of cadence is used in the first phrase? 

5) How many sub-phrases are in the first phrase? 

6) What is the melodic function of A? 

7) What is the harmonic function of B? 

8) What is the harmonic function of C? 

9) What is the harmonic formula used at D? 

PRACTICUM 4B: study the musical excerpt and answer questions below:

1) What is the melodic function of A? 

2) What is the harmonic function of B? 

3) What is the harmonic function of C?
4) What harmonic device is used at D? _______________

5) What is the harmonic function of E? _______________

6) What kind of cadence happens in the last bar? _______________

7) Does this passage consist of one phrase or two? ______________

PRACTICUM 4C: study the given score and answer questions below:
1) What is the harmonic function of A?_______________
2) What is the melodic function of B?_______________
3) What harmonic event characterizes C?______________
4) What harmonic formula is used at D?______________
5) What important role does the Ab at E have?__________
6) This passage is the exposition of a sonata form piece. What are the bar numbers of the phrase that serves as the bridge?______________
SOLUTIONS

PRACTICUM 4A:

1) binary
2) ritornello
3) two
4) half cadence
5) two
6) suspension ("re-struck")
7) V7 of IV
8) viiø7 of V
9) cadential 6/4

PRACTICUM 4B:

1) appoggiatura
2) viio/ii
3) V6/5 of IV
4) mode mixture
5) It+6 (augmented sixth)
6) half cadence
7) one

PRACTICUM 4C:

1) mode mixture, pivot chord to dominant (Eb: i6, Bb: iv6/V)
2) appoggiatura
3) deceptive progression
4) cadential 6/4
5) returns the dominant key area to V7 of I
6) measures 4-7 serve as the bridge
V. Post-Tonal Topics

1) Scales and Collections

Diatonic, Whole-Tone, Octatonic, Hexatonic

The octave can be divided into configurations of intervals which serve as the raw materials for various styles and systems of music. The term *collection* refers to a group of pitches as a whole, regardless of how they are ordered or which pitch functions like a “tonic.” Music using these kinds of collections often differentiates the importance of pitches through a process known as *centricity*. Centricity is the contextual establishment of a pitch or pitches as referential or important in the absence of conventional tonal function. Since these collections are defined by pitch content and not by any particular order, it is helpful to imagine them in terms of a circle:

The *diatonic* collection underlies the major and minor scale, as well as those of the modes. It is a heptagonal (7) division of the octave, using only whole and half steps. These constraints result in the familiar step pattern: \( \text{w w h w w w h} \).

The *Whole-tone* collection divides the octave entirely into whole steps, resulting in a hexagonal (6) division. Taking into account enharmonic spellings, there are only 2 possible whole-tone collections.

An alternating pattern of whole and half steps produces the *octatonic* collection: \( \text{w h w h w h w h} \). There are 3 possible octatonic collections.

*Hexatonic* collections also divide the octave hexagonally but through alternating \( \frac{1}{3} \) steps and minor thirds. There are 4 possible hexatonic.

PRACTICUM 5A: name the collection implied by the given notes:

1) \[ \text{[Notes]} \]
2) \[ \text{[Notes]} \]
3) \[ \text{[Notes]} \]
4) \[ \text{[Notes]} \]
PRACTICUM 5B: identify the collection used in each boxed section of the score:

2) 12-Tone Techniques

A 12-tone row is a particular ordering of the 12 chromatic pitch-classes (also known as a 12-tone series or set). Pitch-classes are the names of notes without regard to register or enharmonic spelling. Middle C (C₄), for instance, belongs to pitch-class C, along with C₁, C₂, C₃, etc. The identification of all octave-related pitches as pitch-classes assumes the principle of octave equivalence.

Below is a musical statement of a 12-tone row:

```
Schoenberg Op. 23, No. 5 (opening, right hand only)

the row:

C#  A  B  G  Ab  Gb  Bb  D  E  Eb  C  F
```

30
12-tone rows may be manipulated to produce a variety of related forms. The common 12-tone operations are transposition, retrograde, inversion, and retrograde inversion. In order to perform 12-tone operations, it is useful to convert the pitches of the row to integers 0-11. In integer notation, the note C, along with any enharmonic spelling (such as B#), is “0.” C#/Db is “1,” D is “2,” D#/Eb is “3,” etc. Sometimes the integers 10 and 11 are substituted with letters so as not to confuse them with single-digit integers (in this case, 10 and 11 are substituted with T and E). The row form of the Schoenberg example in integer notation is:

1 9 E 7 8 6 T 2 4 3 0 5

The original form of the row is called prime form. Since there are twelve possible transpositions of the prime form, they are differentiated by the first pitch class of each transposed form. The row form in the Schoenberg example is thus “P1.” In actual music, the prime forms of the row occur forwards and backwards. The backwards order of a prime form is called retrograde. Each retrograde is designated in terms of the prime form it belongs to. The retrograde of P1 is this R1, even though R1 starts on 5:

R1: 5 0 3 4 2 T 6 8 7 E 9 1

The simplest way to transpose a row form is to first determine the smallest difference between the first integer of the given row and the first integer of the transposed row. Let’s say we want to transpose the Schoenberg row from P1 to P0. There are two ways to get from 1 to 0. We could count upwards:

1 → 2 3 4 5 6 7 8 9 T E 0 (= +11)

Or we could count downwards:

0 ← 1 (= -1)

Obviously -1 is a smaller difference than +11. The next step is to transpose each pitch-class integer of the original row by this factor, -1. The resulting row form is P0:

P1: 1 9 E 7 8 6 T 2 4 3 0 5

(-1)

P0: 0 8 T 6 7 5 9 1 3 2 E 4

There are a few ways to calculate the inverted form of a row. The operation of inversion means to reverse the direction of an interval while keeping its “size” or value intact. The inversion of +1 is -1, +2 is -2, and so on. If we calculate the difference between each successive pitch-class integer of the prime form in the same direction, reversing the direction of all the intervals will produce the inverted form. (This is a slightly more cumbersome method than is needed. It is used for the sake of simplicity.) For reasons that will be clear shortly, it is best to find the inversion of P0, rather than some other prime form.
First, calculate the *upward* difference between each successive pitch class integer of P0:

$$P0: \begin{array}{ccccccccc}
0 & (+8) & 8 & (+2) & T & (+8) & 6 & (+1) & 7 & (+10) & 5 & (+4) & 9 & (+4) & 1 & (+2) & 3 & (+11) & 2 & (+9) & E & (+5) & 4 \\
\end{array}$$

Next, take the series of intervals and reverse their direction:

$$+8 \quad +2 \quad +8 \quad +1 \quad +10 \quad +4 \quad +4 \quad +2 \quad +11 \quad +9 \quad +5$$

becomes

$$-8 \quad -2 \quad -8 \quad -1 \quad -10 \quad -4 \quad -4 \quad -2 \quad -11 \quad -9 \quad -5$$

Beginning with pitch class 0, use the series of intervals to calculate a new row:

$$\begin{array}{cccccccccccc}
0 & 0 & \pm & 8 & = & 4 \\
0 & -8 & = & 4 \\
4 & -2 & = & 2 \\
2 & -8 & = & 6 \\
6 & -1 & = & 5 \\
5 & -T & = & 7 \\
7 & -4 & = & 3 \\
3 & -4 & = & E \\
E & -2 & = & 9 \\
9 & -E & = & T \\
T & -9 & = & 1 \\
1 & -5 & = & 8 \\
\end{array}$$

The integers in the right column, top to bottom, form the inverted row I0:

$$I0: \begin{array}{cccccccccccc}
0 & 4 & 2 & 6 & 5 & 7 & 3 & E & 9 & T & 1 & 8 \\
\end{array}$$

The retrograde if I0 is also possible, R10:

$$R10: \begin{array}{cccccccccccc}
8 & 1 & T & 9 & E & 3 & 7 & 5 & 6 & 2 & 4 & 0 \\
\end{array}$$

There are 48 possible row forms under $P$ (*transposition*), $I$ (*inversion*), $R$ (*retrograde*), $RI$ (*retrograde inversion*). These may be systematically displayed in a 12-tone matrix. To produce a matrix, P0 is written as the top row, left to right, and I0 is written as the first column, top to bottom:
The matrix can be completed by transposing P0 to each pitch class of I0 by the process discussed above. (Complete the matrix for practice.)

**PRACTICUM 5C:** given a row form, write the new row form indicated:

1) row: P0  0 7 T E 4 6 9 2 1 3 8 5
   P7________________________________________

2) row: R0  8 T 6 7 9 2 E 5 1 4 3 0
   P3________________________________________

3) row: P5  5 0 8 7 3 1 T 9 2 6 E 4
   I8________________________________________

4) row: I8  8 4 3 9 6 T 2 1 0 E 7 5
   RI4________________________________________
**PRACTICUM 5D:** Given the 12-tone set $P: 0\ E\ 7\ 6\ 2\ 1\ 9\ 8\ 4\ 3\ 5\ T$, generate a 12 x 12 matrix, then circle and label all row forms found in the passage below:
3) Basic Set Theory

pitch space, pitch-class space; mod-12; pitch interval; interval class; pitch-class sets

Set theory differentiates pitch space, the full range of hearable notes, from a virtual space called pitch-class (pc) space.

This property is known as modular, or mod 12, because every division of 12 is equal (0=12=24=-12=-24, etc). In the mod 12 system, intervals of 1, 2, 3,…all the way up to 11 are possible (the conventional major 7th), but the octave is not possible; it becomes 0 (or “unison,” the same). Mod 12 is easiest to understand arranged like a clockface:

Starting with any integer, ascending intervals are calculable moving clockwise and descending intervals moving counterclockwise. For example, pitch class 3 moving up 2 (mod +2) becomes pc 5. Pc 8 mod – 2 is pc 6. Pc 11 mod +1 produces pc 0. Pc 11 mod -11 also produces pitch 0. Any pc plus or minus 12 revolves back to itself.

If we wish to calculate the distance (interval) between two pc’s, we can choose between clockwise (ascending) and counterclockwise (descending) routes between them. If the pc’s are ordered, the following formula applies: pc x to pc y, subtract x from y [y – x]. Thus, C to D is 2 – 0 (2), G to Eb is 3 – 7 (8), etc. For unordered pc intervals the shortest path applies (pc1 – pc2 or pc2 – pc1, whichever yields a smaller number). The unordered pc interval can never be greater than 6 (any sum greater than 6 may be inverted to a smaller interval). An unordered pc interval is more commonly called interval class (ic), because it is the most efficient, compact way to represent “distance” in the octave-less pc space. Many different pitch intervals can collapse into the same ic. Indeed, there are only 6 ic’s possible.
PRACTICUM 5E: analyze the interval class represented by the given harmonic pitch intervals:

Pitch-class sets

A pitch-class set (pc set) is an unordered collection of pitch classes (a scale, for instance, is a pc set). Pitch-class sets are usually shown in normal form, which is the most compact way of writing the collection within an octave. Below is an illustration of how a pc set is derived from a musical context:

Though there are several ways to write the notes of this chord within an octave, the normal form places the high and low extremes of the collection as closely as possible. Where the smallest interval between the lowest and highest notes is the same for two or more orderings of a pc-set, the ordering most “packed to the left” is considered the normal form. Note also that the pc set is written like a scale.
**PRACTICUM 5F:** re-write the given chords as pitch-class sets in normal form:

1)  

2)  

3)  

4)  

PC set (normal form):

**PRACTICUM 5G:** circle and label all instances of pitch-class set 01246 (T0) or 02456 (I0), including any transpositions:

flute

horn

 mf

 mf

 f

 p

 mp
SOLUTIONS

PRACTICUM 5A:
1) whole tone
2) octatonic
3) hexatonic
4) diatonic

PRACTICUM 5B:
1) whole tone
2) octatonic
3) hexatonic
4) diatonic

PRACTICUM 5C:
1) 7 2 5 6 E 1 4 9 8 T 3 0
2) 3 6 7 4 8 2 5 0 T 9 1 E
3) 8 1 5 6 T 0 3 4 E 7 2 9
4) 1 3 7 8 9 T 6 2 5 E 0 4

PRACTICUM 5D:

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PRACTICUM 5E:

1) 3  2) 5  3) 3  4) 2  5) 4  6) 1  7) 5  8) 5  9) 2  10) 1  11) 4  12) 2

PRACTICUM 5F:

1) [musical notation]

2) [musical notation]

3) [musical notation]

4) [musical notation]