

*Howard*

PIANO INDUSTRIES

**PIANO TUNING  
THEORY**

*Study Guide*

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# PIANO TUNING THEORY

This study guide is intended for use with our "Piano Tuning Theory"  
YouTube series. You can watch on our website at:  
<https://www.howardpianoindustries.com/piano-tuning-theory/>

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# Introduction

Piano tuning theory is especially important for tuning by ear. Some tuning theory will overlap with basic piano theory in general, so if you are a pianist you may already know some of this information starting out. However, there is some theory that is specific to tuning theory that you otherwise will not probably know.

If you have come to this series not knowing much about piano tuning at all, we would encourage you to first go through our course entitled, “How to Tune A Piano”. That will give you a good foundation on tuning and will likely make this series easier to understand. Here is a link to that series on our website (or scan the QR code below):

<https://www.howardpianoindustries.com/how-to-tune-a-piano/>

Here is an overview of some of the things we will be learning in the coming chapters and videos:

- Notes and intervals
- Partials
- Coincident partials
- Hertz, beats and cents
- Temperament
- Inharmonicity

Throughout this study guide, you will find pages for notes, quizzes to help you remember the material, deeper explanations, and links to products or extra material.

How to Tune a Piano  
Course



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# Introduction

**Notes**

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# Notes and Intervals

This is an overview of the notes, their names, and intervals for those who know very little of the piano. It may be very easy and even unnecessary if you are a pianist, but we will get into the more complicated concepts of tuning theory shortly.

Every piano has the black notes laid out in groups. A set of two, a set of three, etc. You will determine which note you are looking at based on the black notes surrounding it. They are a guide for the rest of the piano.

## Optional Quiz

1. *To find a C on the piano, you:*

- A. Find a group of three black notes and go to the white note on the right
- B. Find a group of three black notes and go to the white note on the left
- C. Find a group of two black notes and go to the white note on the right
- D. Find a group of two black notes and go to the white note on the left
- E. None of the above

2. *There are how many C's on the piano? \_\_\_\_\_*

3. *What is the note to the left of a group of three black notes? \_\_\_\_\_*

4. *If a note is one key away from the note you start on, it is a \_\_\_\_\_-step away.*

5. *If a note is two keys away from the note you start on, it is a \_\_\_\_\_-step away.*

6. *The sharp of any note can be found a half-step to it's:*

- A. Right
- B. Left

7. *The flat of any note can be found a half-step to it's:*

- A. Right
- B. Left

# Notes and Intervals

8. Write the note you would end up on if you were starting with a C in these intervals

- Minor second \_\_\_\_\_
- Perfect fourth \_\_\_\_\_
- Augmented fourth \_\_\_\_\_
- Perfect fifth \_\_\_\_\_
- Major sixth \_\_\_\_\_
- Major seventh \_\_\_\_\_
- Octave (perfect eighth) \_\_\_\_\_





# Notes and Intervals

## Answer Key

1. *D*
2. *eight*
3. *F*
4. *half*
5. *whole*
6. *right*
7. *left*
8. *D, F, F#, G, A, B, C*

## Learning More

If you are looking to become a piano technician part are not sure what tools you may need, try watching this video: [https://youtu.be/8JU9XV0gJkA?si=1fnvV2j\\_u6t8sopC](https://youtu.be/8JU9XV0gJkA?si=1fnvV2j_u6t8sopC)

Learn More About  
Piano Tuning Tools



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# Understanding Partials

Below is a list of the different partials for any given note using C4 as the fundamental pitch.

- C4 - Fundamental or 1st partial
- C5 - 2nd partial (Up an octave)
- G5 - 3rd partial (Up a P5)
- C6 - 4th partial (Up a P4)
- E6 - 5th partial (Up a M3)
- G6 - 6th partial (Up a m3)
- Bb6 - 7th partial (Up a m3)
- C7 - 8th partial (Up a M2)
- D7 - 9th partial (Up a M2)
- E7 - 10th partial (Up a M2)
- F#7 - 11th partial (Up a M2)
- G7 - 12th partial (Up a m2)
- A7 - 13th partial (Up a M2)
- Bb7 - 14th partial (Up a m2)
- B7 - 15th partial (Up a m2)
- C8 - 16th partial (Up a m2)

P5 and P4 are referring to what are called perfect intervals and M2 and M3 are what we consider Major intervals while m2 and m3 are referring to minor intervals. We discuss the different types of intervals in more detail in the first video of this series.

You can apply the intervals above the fundamental note to any note. So if you want to find out the series of partials for A3 as an example you would apply the intervals going up from the fundamental from the chart above starting at A3 and you would then be able to determine what the partials are of A3. These intervals can be applied to any fundamental note.

# Understanding Partials

## Optional Quiz

1. The \_\_\_\_\_ partial is the sound you get from playing just a third of the string. It is an octave and a \_\_\_\_\_ from the fundamental tone.
2. The \_\_\_\_\_ partial is the fundamental tone, the sound you get from playing the full string.
3. The \_\_\_\_\_ partial is the sound you get from playing a fourth of the string and sounds two octaves above the fundamental tone.
4. The \_\_\_\_\_ partial is the octave higher sound you get from playing just half of the string.
5. The \_\_\_\_\_ partial is the sound you get from playing a fifth of the string and sounds two octaves and a major third above the fundamental tone.
6. The third partial of D3 would be:
  - A. D5
  - B. A4
  - C. F#4
  - D. D4

# Understanding Partials

**Notes**

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# Understanding Partials

## Answer Key

1. *third*
2. *first*
3. *fourth*
4. *second*
5. *fifth*
6. *B*

## Learning More

If you are interested in learning some of these concepts in even greater detail, you will want to look at *Pianos Inside Out - A Comprehensive Guide to Piano Tuning, Repairing and Rebuilding*, available here:

<https://www.howardpianoindustries.com/pianos-inside-out-a-comprehensive-guide-to-piano-tuning-repairing-and-rebuilding/>

See "Pianos  
Inside Out"



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# What are the Beats?

Every note has its own sound wave that is unique to it and gives it the sound it has. You can think of it like a footprint or fingerprint. The diagrams below show two different sound waves. The one on the left would have less waves per second (thus, a lower sound), and the one on the right has more waves per second (thus, a higher sound).



Beats appear when multiple strings are almost in tune, but not quite together. When two strings need to be tuned to the same note (unisons), they must have the same exact sound wave or they will create a warbling sound. This warbling or tense sound you're hearing is the beat. An out of tune unison that creates a beat might look like the diagram below on the left, while in tune will look like the diagram on the right.



## Optional Quiz

1. A4 is tuned to 440, which means the sound wave for A4 waves:

- A. 440 times per minute
- B. 40 times per minute
- C. 44 times per second
- D. 440 times per second

2. True or false: Learning to listen for beats is not necessary to tune a piano by ear.

\_\_\_\_\_

3. True or false: Beats are created from two sound waves coming from separate notes. \_\_\_\_\_

# What are the Beats?

## Notes

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# What are the Beats?

## **Answer Key**

1. *D*

2. *False*

3. *False (Beats are created from two sound waves coming two strings on the same note. Each piano note is made up of two or three strings set to the same note. When these strings aren't exactly the same, you hear the beats.)*



# Coincident Partials

A coincident partial is a partial found in two strings. For example, D2 and A2 share the partial A3

## Optional Quiz

1. *Partials are sometimes known as \_\_\_\_\_.*
2. *You can use partials to tune when you use \_\_\_\_\_ partials.*
3. *True or false: Coincident partials help you tune more precisely because it reveals beats that you otherwise would not hear. \_\_\_\_\_*
4. *In a “three-two” stretch, the “three” and “two” signify \_\_\_\_\_.*



# Coincident Partials

## **Answer Key**

1. *overtones*
2. *coincident*
3. *True*
4. *partials*

# Hertz, Beats, and Cents

Cents in piano tuning is a representation of how close to a pitch your note is. The number of cents between each half-step on the piano is 100. So, if a note is 25 cents flat, it is  $1/4$  below pitch or  $1/4$  of the way to the note below it.

## Optional Quiz

1. Match the word to its definition.

Hertz \_\_\_\_

A. The amount a note is off from its pitch

Cents \_\_\_\_

B. The number of vibrations per second in a note

2. True or false: When going up an octave, the note will have twice the number of vibrations as your starting note. \_\_\_\_\_

3. True or false: A half-step is equal to 50 cents. \_\_\_\_\_

# Hertz, Beats, and Cents

## Notes

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# Hertz, Beats, and Cents

## Answer Key

1. *B, A*
2. *True*
3. *False* (a half-step is equal to 100 cents)

## Learning More

The iPad app being displayed on this video is TuneLab. To view this app, its compatibility and its prices, visit their website here (or scan the QR code below): <https://tunelab-world.com>

TuneLab  
Website



SCAN QR



# Temperament

Since beats become faster as you go further up in partials, you cannot tune a piano so that there are no beats in any of the notes. Because of this, you must temper the beats between the notes in a certain range so that they are “spread out” and are not as noticeable the further up you play intervals. As a result of this process, some intervals (fourths, fifths, and octaves) will end up sounding more pure than others (thirds and sixths). This is called equal temperament.

Below is a list of the different intervals and how they should be tuned for temperament.

Perfect fourth	<i>wide</i>
Perfect fifth	<i>narrow</i>
Perfect octave	<i>pure</i>
Major third	<i>wide</i>
Minor third	<i>narrow</i>
Major sixth	<i>wide</i>
Minor sixth	<i>narrow</i>

## Optional Quiz

1. To create a narrow perfect fifth interval:

- A. Tune each note exact and beatless
- B. Bring the notes' pitches closer together (raise the bottom or lower the top note)
- C. Bring the notes' pitches apart (lower the bottom or raise the top note)

2. Fifth intervals are tuned \_\_\_\_\_ while fourths are tuned \_\_\_\_\_.

3. True or false: Using A3 as your starting note, tune E3 to be a beatless fifth and then raise it to give it a slight beat. \_\_\_\_\_





# Temperament

## **Answer Key**

1. *B*
2. *narrow, wide*
3. *False*

# Inharmonicity

As you play the notes for the partials of a string further up the piano, you will hear the notes becoming slightly more sharp. This is because it is vibrating less and less of your starting string (fundamental tone), thus becoming stiffer and sounding more sharp. This is called inharmonicity.

When tuning, you must “stretch” the tuning of each note as we tune up or down the piano. The base note for this stretch is typically A4. All notes above A4 will be tuned increasingly sharp and all notes below A4 will be tuned increasingly flat. This will make the partials in all of the notes across the piano match.

## Optional Quiz

1. *True or false: A longer piano will have a better sounding bass section because the bass strings will have less thickness and more length.* \_\_\_\_\_
2. *The taller the upright piano or the longer a grand piano is, you will have \_\_\_\_\_ (more/less) inharmonicity.*
3. *True or false: The bass notes will be stretched just as much the high notes.*  
\_\_\_\_\_

# Inharmonicity

## Notes

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# Inharmonicity

## **Answer Key**

1. *True*
2. *less*
3. *False*