HVAC (47.0201) T-Chart

Compare fractional and decimal values	=	Apply properties of rational and irrational numbers to solve real world or mathematical problems

Program Task: Solve trade related problems.

Program Vocabulary:
SAE, STANDARD, DECIMAL, METRIC

Program Formulas and Procedures:
Whether the HVAC technician is working with time, weights, dimensions, or some other measure, the ability to determine numerical values and to compare, order, and convert values (e.g., from fractions to decimals and vice-versa) is a fundamental skill in HVAC.

Example:
Scramble the fractions and their decimal equivalents below. Have students reorder the scrambled fractions and decimals, and have the students show equal value pairs in an ascending (or descending) order.

1/16 = 0.0625
1/8 = 0.125
1/4 = 0.25
5/16 = 0.3125
1/3 = 0.33
3/8 = 0.375
7/16 = 0.4375
1/2 = 0.5
9/16 = 0.5625
5/8 = 0.625
2/3 = 0.67
3/4 = 0.75
7/8 = 0.875
15/16 = 0.9375

Then scramble a mixed set of SAE/Metric sockets and have students reorder by size in one continuous line of sockets.

PA Core Standard: CC.2.1.HS.F.2

Description: Apply properties of rational and irrational numbers to solve real world or mathematical problems.

Math Associated Vocabulary
REAL NUMBER, RATIONAL NUMBER, IRRATIONAL NUMBER, DECIMAL, FRACTION, SQUARE ROOT

Formulas and Procedures
It is relatively simple to compare numbers when they are in the same form. For example 0.15 is smaller than 0.25. The numbers are both in decimal form so are easily comparable. It becomes more difficult to compare numbers that are either in different forms, such as a fraction to a decimal, or in fractional form with different denominators, such as 3/5 and 5/9.

The easiest way to compare numbers that are in different forms is to convert each number to its decimal form.

Example: Which of the following numbers is largest?

6/25 3/14 0.2

1. Convert each number to its decimal equivalent:

   0.24 0.2142857... 0.2

2. Compare the digits in the tenth place, if they are the same move to the hundredths place, and so on until the order can be determined.

   For instance, we cannot round to the nearest tenth, because it would give us the same value of .2 for all of the numbers.

   Rounding to the nearest hundredth would make the numbers:

   0.24 0.21 0.2

3. Add zeroes to make all numbers have the same number of digits after the decimal.

   0.24 0.21 0.20

   For comparative purposes, it is important to add a zero so that the numbers 20/100, 21/100, and 24/100 can be compared.

   Since 24/100 is larger than 21/100 and 20/100, 0.24 (6/25) is the largest number.

Instructor's Script - Comparing and Contrasting
The HVAC technician must be able to order and compare numbers. Much like what is taught in the math classroom, the HVAC technician must be able to represent numbers in similar forms, by converting all numbers to decimals or representing fractions with common denominators.

Common Mistakes Made By Students
Comparing decimals: Decimals are easier to compare if the number of digits after the decimal point is the same. For instance, students often think that 0.6 is less than 0.34 because 6 is less than 34. A zero must be added to the 6 to make the number .60 so that the student can compare 0.60 and 0.34

Comparing fractions: Fractions can be compared when they have a **common denominator**. For instance, 5/16 inches and 3/8 inches are two measurements on a ruler. In order to compare the two fractions, they must have a common denominator, 16. 3/8 is larger than 5/16.

$$\frac{3}{8} = \frac{\quad}{16} \qquad \frac{3\times 2}{8\times 2} = \frac{6}{16}$$

CTE Instructor's Extended Discussion
The HVAC professional must be able to measure and formulate solutions that require fluid movement between fractions and decimals. Basic mathematical processes are typically much easier and the results are more likely to be accurate when fractional components of a problem are represented in decimal format.

Problems	Occupational (Contextual) Math Concepts	Solutions
1. Sort the following copper 45^{o} street elbows by outer diameter size from smallest to largest for organization in the material room: 3/4”, 3/8”, 7/8”, 1/2”		
2. A hole must be drilled in a piece of very hard stainless steel stock. Choose the smallest drill bit to make a pilot hole, then progress in increments to the largest bit size. 3/32”, 1/16”, 3/8”, 3/16”, 1/4"		
3. An existing part has a 10 mm (.394”) diameter hole. The hole must be reproduced in another part with the closest 1/64” size drill but cannot be smaller than the hole in the original part. What size drill can be used to produce the hole?		
Problems	**Related, Generic Math Concepts**	**Solutions**
4. Which of the following measurements is longest? 2 ½ inches, $2\ ^{3}/_{8}$ inches, $2\ ^{7}/_{16}$ inches		
5. Order the following measurements from least to greatest: $\sqrt{7}$ feet, 2 ½ feet, 2.6 feet		
6. Which of the following measurements is largest? 2π cm., $\sqrt{41}$ cm., 6.25 cm.		
Problems	**PA Core Math Look**	**Solutions**
7. Order the following numbers from least to greatest: 2.4, $\sqrt{5}$, $2\ ^{7}/_{8}$		
8. Order the following numbers from largest to smallest: 0.02, 0.223, 0.24, 0.243		
9. Order the following numbers from least to greatest: $\sqrt{10}$, π, $3\ ^{1}/_{5}$, 3.25		

Problems	Occupational (Contextual) Math Concepts	Solutions
1. Sort the following copper 45^{o} street elbows by outer diameter size from smallest to largest for organization in the material room: 3/4, 3/8, 7/8, 1/2	Use lowest common denominator to make the job easier. 3/8" = 3/8 1/2" = 4/8 3/4" = 6/8 7/8" = 7/8	
2. A hole must be drilled in a piece of very hard stainless steel stock. Choose the smallest drill bit to make a pilot hole, then progress in increments to the largest bit size. 3/32", 1/16", 3/8", 3/16", 1/4"	Use lowest common denominator to make the job easier. 1/16" = 2/32" 3/32" = 3/32" 3/16" = 6/32" 1/4" = 8/32" 3/8" = 12/32"	
3. An existing part has a 10 mm (.394") diameter hole. The hole must be reproduced in another part with the closest 1/64" size drill but cannot be smaller than the hole in the original part. What size drill can be used to produce the hole?	$.394 \times 64 = 25.216 \rightarrow$ Round up to $26 \rightarrow \frac{26}{64}$ $\frac{26}{64} = \frac{13}{32}$ Diameter drill	

Problems	Related, Generic Math Concepts	Solutions
4. Which of the following measurements is longest? 2 ½ inches, $2\ ^{3}/_{8}$ inches, $2\ ^{7}/_{16}$ inches	List numbers: 2 ½ inches, $2\ ^{3}/_{8}$ inches, $2\ ^{7}/_{16}$ inches Rewrite as decimals: 2.5 inches 2.375 inches, 2.4375 inches Round to the hundredth: 2.50 2.38 2.44 2 ½ inches is longest	
5. Order the following measurements from least to greatest: $\sqrt{7}$ feet, 2 ½ feet, 2.6 feet	List numbers: $\sqrt{7}$ ft. 2 ½ ft. 2.6 ft. Rewrite as a decimal: 2.646 2.5 2.6 Round to the nearest hundredth: 2.65 2.50 2.60 Least to greatest: 2 ½ ft., 2.6 ft., $\sqrt{7}$ ft.	
6. Which of the following measurements is largest? 2π cm., $\sqrt{41}$ cm., 6.25 cm.	2π cm. $\sqrt{41}$ cm. 6.25 cm. 6.28 cm. 6.40 cm. 6.25 cm. $\sqrt{41}$ cm is largest	

Problems	PA Core Math Look	Solutions
7. Order the following numbers from least to greatest: 2.4, $\sqrt{5}$, $2\ ^{7}/_{8}$	List numbers: 2.4 $\sqrt{5}$ $2\ ^{7}/_{8}$ Rewrite as a decimal: 2.4 2.2360… 2.875 Round to nearest tenth: 2.4 2.2 2.9 Least to greatest: $\sqrt{5}$, 2.4, $2\ ^{7}/_{8}$	
8. Order the following numbers from largest to smallest: 0.02, 0.223, 0.24, 0.243	Convert to thousandths: 0.020, 0.223, 0.240, 0.243 Order the converted numbers from largest to smallest: 0.243, 0.240,0.223, 0.020 Place final answer with numbers in original form: 0.243, 0.24, 0.223, 0.02	
9. Order the following numbers from least to greatest: $\sqrt{10}$, π, $3\ ^{1}/_{5}$, 3.25	List numbers: $\sqrt{10}$ π $3\frac{1}{5}$ 3.25 Rewrite as a decimal 3.16228… 3.14286… 3.2 3.25 Round to the hundredth: 3.16 3.14 3.20 3.25 Least to greatest: π, $\sqrt{10}$, $3\ ^{1}/_{5}$, 3.25	