EVALUATING
ACADEMIC READINESS
FOR APPRENTICESHIP TRAINING
Revised for
ACCESS TO APPRENTICESHIP

COMMUNICATIONS SKILLS
CLASSIFICATION OF INFORMATION

AN ACADEMIC SKILLS MANUAL
for
The Industrial Maintenance Mechanic Trades

This trade group includes the following trades:
Boiler Maker,
Facilities Maintenance Mechanic & Technician, and
Industrial Maintenance Mechanic (Millwright)

Workplace Support Services Branch
Ontario Ministry of Education and Training

Revised 2011

In preparing these Academic Skills Manuals, we have used passages, diagrams and questions similar to those an apprentice might find in a text, guide or trade manual.

This trade related material is not intended to instruct you in your trade. It is used only to demonstrate how understanding an academic skill will help you find and use the information you need.

COMMUNICATIONS SKILL
CLASSIFICATION OF INFORMATION

An academic skill required for the study of the The Industrial Maintenance Mechanic Trades

INTRODUCTION

Classification *of information is a system that groups items together based on shared qualities or features, or uses.* When information is divided into topics, when tools are stored by how they are to be used or when fasteners are sorted by size, each collection is classified into a group according to characteristics they have in common.

Classification indicates an underlying similarity in grouped items. If you recognize features in a new material or tool that are similar to features you are familiar with, you will find it easier to figure out how it works and where to use it. By classifying information you learn to see common patterns in the different techniques you are learning. Being able to classify new information assists you in organizing things, finding material, and making good choices.

In this skill sheet, we look at the following aspects of classification:

- Classifying into Categories
- Using Categories to Get Organized
- Using Classification

PART I
CLASSIFYING INTO CATEGORIES

Belonging to a group
The word “tool” is a grouping or category. It is a broad, general category. If someone asked you to hand them a tool, you could give them a centre-punch, a hammer or a hacksaw. You couldn’t make a wrong choice because *any* tool fits the category.

Example:

If someone asked for a screwdriver (a type or class of tool), you would choose a screwdriver. *Screwdrivers* are a smaller, more specific category, so you would choose a screwdriver and exclude every other tool.

If someone asked for a screwdriver and there were dozens to choose from, you would have to ask, "Which one do you want?"

Which one?
When you ask *which one*, you are asking for more information. Because you need to select the right tool, you need a *list of features* or *criteria* that describes that tool. The answer to your question will provide a list. It will be something like this: "I need the Phillips, number 3, the one with the chipped, insulated handle." With these words to guide you, you can match the screwdriver to the description and hand it over.

You can make the right choice. There is probably only one screwdriver that would match the list (the given criteria), chipped handle and all.

Note*: We use the terms "given criteria" and "list of features" to mean the same thing.*

From general to one
To make the right choice, we moved in three steps:

1. from a very broad category which included all types of tools;
2. to a narrower category which included screwdrivers only;
3. to a list of features which described one item: Phillips, number 3, insulated, chipped handle.

Classification involves a process, moving from a broad category of information that gradually narrows to descriptions that apply only to one type or one item only.

> **Example:** Classification may apply to a lesson about *milling machines* in this way:
> - **First,** you learn the different functions and capabilities of this category of machine.
> - **Next,** you learn the functions and capabilities of a *type* of milling machine such as horizontal.
> - **Finally,** you learn about *each* horizontal milling machine in detail.

There is a good reason for these steps. Whether you are learning about milling machines or caring for tools, you need to understand what to expect from a group of items so you can predict results. You need to understand what type of product is best suited to the job and what type is not appropriate. You need to know what is considered odd or unusual behavior in any group of products. This knowledge prepares you to react when something unexpected happens so you can look for the causes. It lets you work from broad patterns in a logical way.

The right information
To make the right choice, we work from information. When you ask questions about a job or tool, the answers will describe the conditions.

> **Example:** You are installing a valve. Before you do anything, you need information. What type of valve check would be best? What are the service conditions? What fluid (or gas) is going through the pipes? What size are the pipe lines? Will frequent inspection mean frequent dismantling?

The answers to these questions outline the conditions. The answers will guide you in your choices for each step of the project. You can select the right information, tables, diagrams, safety guides and tools. You can choose the right metal and make the right cuts for this situation. You can make appropriate choices by matching information to the finished product. You can see that the finished product sets the conditions for all the choices.

When you read Passage 1 about the characteristics and uses of pumps, you can understand that the characteristics of a pump makes it useful for some purposes but not others. Note how classification using the category of characteristics is used to teach you about pumps. Look for information that moves from a general, broad category to smaller categories (or groups). The preview below outlines the passage:

- All pumps have most of the same properties.
- Pumps are classified by their construction or function.
- Every category of pump has a specific operating function and, therefore, specific uses.

Passage 1
Pumps

Pumps are machines that move fluids, exhaust-gases and semi-fluids against the forces of gravity and friction through (into or out of) a system. Pumps designed to compress air or other gases are called compressors; those used to convey air are called blowers.

Pumps serve a variety of functions: they convey water to boilers, convey chemicals, and circulate coolants and condensates. They are classified broadly by the construction or function they are designed for. Most pumps fall into three groups: *dynamic (centrifugal*), *positive displacement (reciprocating)* and *rotary.*

A *dynamic* or *centrifugal pump* moves fluids (generally large volumes) by means of centrifugal force. The pump casing guides the fluid's motion in a smooth, continuous flow. It also . . . **(we have omitted some details)**.

There are four categories of *centrifugal pumps* (also known as *non-positive displacement pumps*). The four categories are based on flow: They are radial, mixed, axial and peripheral.

Radial flow pumps: These move fluids radially from the shaft's axis. See the diagram, Figure 1-1. The most common of this category of radial pump is the *volute pump.*

You can see how this passage uses classification to guide you through learning about an important piece of equipment for your trade. Systematically, it classifies information into more specific groupings. It is like a tree trunk dividing into smaller and smaller branches, yet we can see that everything belongs to the main group – in this case, pumps, specifically dynamic pumps.

Paragraphs one and two:
- define the general category,
- describe various functions and give names based on function, and
- give three basic classifications.

Paragraph three describes one of the three basic classifications. We learn *how* pumps in one category operate.

Paragraph four divides the pumps in that category into four smaller types based on flow.

Paragraph five introduces one of those types. It will define and describe that type of pump.

You are learning to match the characteristics of a tool or product to the right category (or situation) for its use. Because you know how an item, machine, or product works and what it can do and cannot do, you will know when to use it, when **not** to use it, how long it will function, and what conditions are best or worst for it.

Sometimes you go through the process of finding information, only to discover you must compromise.

> **Example:** The steel you want for a particular job is not available for six or eight weeks, and the price is going up. You know the requirements made you choose that material. After discussions with your supervisor, the supplier and, maybe, the client, you decide to make another choice.
>
> But you need to understand your reasons for this choice – how "the next best thing" will perform, delivery time and what it will cost. You must be sure it suits all the conditions and the purpose.

You may not always understand why a product or procedure is recommended or why it might be a bad choice, but you can't ignore directions like the one below:

> ***Greases from different manufacturers should never be mixed in the same bearing.***

These directions are clear: Once you have chosen a brand, you are restricted to the use of that brand of grease in a bearing. You may not know why you should do this, but you can't ignore a direction like this.

> **Example:**
>
> Table 1-2, Maximum Torque Values for Fasteners, assumes some of the oil used in the manufacturing process has remained on the fastener. The values in this table ***do not apply*** if special lubricants such as colloidal copper or molybdenum disulphite are used. The use of special lubricants can reduce the amount of friction, so . . .

Application
Depending on the category of job you are doing, you will decide on the category (type or class) of product you need.

Example: You will use mild steel fasteners in some situations and alloy steel in others. Once you know the type or class of metal, you can decide on the specific item within that category. It might have a ½ or a ¼ inch diameter, or be a Class 1 or Class 2 fit.

Once you know the set of conditions, you can consult the right information or table for that category and for that specific project.

Classifying will give you a base of information to help you understand more about your topic – the purpose of the reading. Classification groups similar things together so, you understand something in general terms first. Then you are ready to learn about the qualities and functions of individual items.

We've looked at the right choice from two directions.

1. When you understand what something is designed to do, you know where it can be correctly used.
2. When you know the specific requirements of a job, you can find the class of material that is best.

Whichever way you look at it, making the right choice is essential to the quality of the completed project.

Read Passage 2 below. Look for the way classification can guide you in a choice. **Answer the questions that follow. Answers are at the end of this skills manual.**

Passage 2
Pipe Valves

Pipe valves are devices that open and close passages thus controlling the flow of liquids and gases through pipes. A variety of valve designs in a variety of materials is available.

Valve Materials
Piping (valves, fittings and pipe) used in industry falls into three basic material groups: bronze, iron and steel. Service characteristics vary and you need to know the pressure, temperature and structural limitations of each material.

Bronze, used in common varieties of valves, is an alloy of copper, tin, lead and zinc. It is not suitable for temperatures above 450^0 F. A special high-grade bronze alloy can be used for piping equipment at temperatures up to 550^0 F and for higher pressures.

Iron valves and fittings come in three grades: cast iron, high-tensile iron (limited to 450^0 F) and malleable iron suitable for slightly higher pressures and temperatures. *Cast iron* is used for small valves and fittings with light metal sections. *High-tensile iron* is a high-strength alloy cast iron primarily used for castings of large valves. *Malleable iron* is suited for screwed fittings and unions as well as valves and flanges. It features pressure tightness, stiffness and toughness. It is especially suited for piping materials subject to expansion and contraction shocks and stresses.

Steel is recommended for high pressures and temperatures and where service conditions (internal or external) may be too severe for bronze or iron. It gives reliable safety and utility protection because of its

superior strength and toughness, resistance to piping strains, vibration shock, low temperature and damage by fire.

Questions:

1. Which type of piping material would **not** be suitable for temperatures in excess of 450^0 F?
    a) higher-grade bronze
    b) high-tensile iron
    c) malleable iron

2. Which of the following would be suitable applications for malleable iron?
    a) piping materials subject to severe external service conditions
    b) screwed fittings with light metal sections
    c) temperatures and pressures above 450^0 F
    d) all of the above

3. Which valve materials would provide the characteristics of toughness?
    a) cast iron and high-tensile iron
    b) malleable iron and steel
    c) steel and bronze
    d) bronze and iron

4. Which of the following lists characteristics of higher-grade bronze? Higher grade bronze is:
    a) suited for temperatures up to 550^0 F and higher pressures
    b) safe under severe internal and external service conditions
    c) superior strength and toughness

Ask questions

The success of your job depends on information: You start with information about the job you are doing, the type of installation, the frequency of dismantling and the conditions of the operation. Then, you choose products and tools correctly based on information about their characteristics and reactions. You understand which situation will call for which type of product – small or large valves; bronze or cast iron. You discover which product within a category of products can or cannot do the job required.

PART II
USING CATEGORIES TO GET ORGANIZED

We all use classification to separate people, things and information into groups and categories. Sorting by categories tells us

1. where to find things - things that are alike are found together: socks are in the socks drawer, tools are in your toolbox, and instructions are in your blue manual;
2. how to use things;
3. how to make good choices; and,
4. how to set priorities.

When you classify things, you organize them in your mind and you get a sense of the big picture. You can start with a general idea – class or type – before dealing with each individual detail.

Example: You have to weld in a confined space, so you have to know what confined space means, in terms of the job you will do. Once you have a picture of the space and what angles you have to work at, you can deal with the details. These details include the choice of tools, equipment, safety gear and the types of materials for this situation.

Example: In your work, you will join the edges of metals. The methods are classified as either *mechanical* or *welded*. In some situations, it is necessary to weld. *Welding* becomes the new category or grouping; it is the given situation. If you start with the big picture, this means you will join metal-to-metal using heat. However, you need a lot more information before you start selecting tools and before you know how long this will take.

***As you read Passage 3, take note of the pattern of categorizing, grouping or classifying*. Answer the questions that follow. The answers are at the end of this skills manual.**

Passage 3
Drill Presses

The drill press grips, revolves and feeds a twist drill to produce a hole in a metal or other material. The revolving drill or cutting tool is generally fed into the workpiece manually on bench-type drill presses and either manually or automatically on floor-type drill presses. A variety of operations is possible with cutting tools and attachments, provided the workpiece is not too large.

The most common drill presses found in machine shops are the *bench-type sensitive drill press* and the *floor-type drill press*. Other types such as the upright, post, radial, horizontal etc. are variations of the standard machine, designed for special purposes.

The *sensitive drill press* has a hand-feed mechanism that allows the operator to "feel" the cutting action and, thus, regulate the down-feed pressure. These drill presses come in two categories: bench and floor type.

The *bench type* has a short column and a table to support the workpiece. It is mounted on a table or bench and is used for drilling holes in small workpieces. The *floor type* has a longer column on which the table is adjusted to accommodate longer workpieces. Both types can drill holes up to 12.7mm diameter. Specially designed *super sensitive* or *super speed* machines of this type are used for drilling small holes less than 6.35mm in materials such as copper, brass, aluminum and other non-ferrous metals.

Questions:

1. Which type of drill press would be suitable for drilling holes in small parts?

    a) the bench-type
    b) the floor-type
    c) neither bench- nor floor-type

2. Which of the following type of drill press would ***not*** be suitable for drilling holes up to 12.7mm?

    a) super sensitive type
    b) floor type
    c) bench type

3. For drilling large workpieces, you would choose the floor-type drill press.

    T F

4. Which characteristics describe the floor-type sensitive drill press?

    a) It has a longer column and can drill holes 12.7 or larger.
    b) Has both manual and automatic feed of cutting tool and will accommodate longer workpieces.
    c) It has a shorter column and can drill metals and other materials.

Look at the first sentence in Passage 3 again:

The drill press grips, revolves and feeds a twist drill to produce a hole in a metal or other material.

Note that this information applies to *all* categories of drill press. The general classification starts with a definition that applies to *all* categories of drill presses. From it, we can understand the following:

- the revolving drill (or cutting tool) is generally fed into the workpiece manually on bench-type drill presses...
- the workpiece can be fed either manually or automatically on floor-type drill presses, and
- a variety of operations is possible with cutting tools and attachments, provided the workpiece is not too large.

The general classification prepares you for the more specific categories: the definitions, details and descriptions of the different types of drill press that follow. Look back to the passage and note how each of the paragraphs describes a type of drill press.

To understand the reasons for using one type over another type, you would have to answer all of the questions:

- What is the size of the workpiece?
- What is the size of hole to be drilled?
- What type of metal is the piece?
- What result should I expect if the drill press (or any machine) is not the best choice for this operation?

Which one to choose?
If you have asked and answered all the questions related to the assignment, you will have you a complete list of conditions and factors. Your question and answer list will guide your task and the task of your supplier.

A decision may involve comparing two (or more) lists:

- One list may describe the situation you are facing;
- the other list may describe the features of a material.

The choice you make will depend on your understanding of both the situation and that material. Each result you get depends on the kind of information you select to answer the "which one" question you encountered on page one of this unit.

Passage 3 is an example of how we use classification to learn about something. You are classifying types of drill presses. You can begin to see how types of drill presses are the same, and how they are different. You learn to match the characteristics of a product, tool, or procedure to the right category, and see how that might apply to its use.

Classification in Tables and Charts
Tables and charts also classify information.

Example: You might see tables used in the following ways:
- electrode classification, wire type and applications,
- common problems in troubleshooting guides, and
- shielding gases and wire depending on the type of work you plan.

Note: *Read all the information related to a table or chart. Important or essential explanations and details are often placed above or below the listed details.*

Example:

Table 1-3 **Welding Methods and Categories**

Pressure	**Fusion**	**Brazing**
Electric Resistance	Arc	Soft
Ultrasonic	Gas	Hard
Friction		
Gas Pressure		
Explosion		
Pressure		

*See the appendix, Table 3-5 for more details.

Table 1-3 shows a process divided into the three main categories of **pressure, fusion** and **braze**. Each category is then sub-divided (or classified) into the welding methods that belong to this category. At a glance, you can see that *arc welding* and *gas welding* are methods which belong to the category of **fusion welding**.

The Language of Classification

The language of classification gives you valuable information. It indicates which category a material, design, or technique fits into. This will make some job decisions easier.

Classification is used to limit your choice to one type or category only. You may not know why you should only choose from a certain category or follow a particular procedure, but the directions tell you how to act.

> **Example:** Squaring shears are used to cut ***all*** types of sheet metals.

> **Example:**
> The tables are for mild steel electrodes only. The figures in Table 4.1 are averages of suggested amperages from a number of suppliers. Use these as a starting point. You must fine-tune the amperage setting yourself. Use a piece of scrap that is the same thickness as the job you are to perform. Do this *before* attempting the weld.

Classification can point you to what you should avoid. Restrictions like these direct you to only choose materials or techniques that are allowed and to comply with all relevant codes. You classify materials and operations so you can match codes and standards to appropriate actions.

> **Example:**
> ***Caution!***
> **Do not clean, oil, adjust or repair *any* machine while it is running. Stop the machine and lock the power switch in the "off" position.**

> **Example:**
> When working with other workers, *only one* should operate the switches.

Classification can instruct you in how to proceed. To follow directions, you need to know which things are included in the general classification term (solvents, industry standards, safety codes) and which the details you need to classify. Then you can apply the instructions properly.

> **Examples:**
> Clean air regulations prohibit the use of some solvents. Check local regulations.
>
> All work must comply with up to date industry standards and safety codes,

Classification can define a category of items, and what you must know about its use, safety, and handling etc.

> **Example:**
> **Controlled products** fall into six classes of hazards. Each class is identified by a symbol. For each class, identify uses, ingredients, hazards, clean up, etc...

Classification identifies problems and causes. Once you know where to look for the causes of a problem you can begin to classify specific details its cause.

Example:
Using incorrect lubricant fluids could result in tool failure.

If the process of gathering and organizing information seems long, remember the purpose: To make the right choices to meet the standards of your trade.

Pay attention to how classification is used in Passage 4. Pick out and underline examples of *classifying, categorizing or grouping*. Refer to answers at the end of this skills manual.

Passage 4

Chip Formation
Chip formation occurs with machining operations performed on lathes, milling machines or similar machine tools. Chips fall into three basic categories: discontinuous, continuous and continuous with a built up edge.

Type 1: Discontinuous Chip
Discontinuous or segmented chips are produced when brittle metals such as cast iron, hard bronze and some ductile metals are cut under poor cutting conditions. Some compression occurs as the point of the cutting tool contacts the metal. The chip begins to flow along the chip-tool interface. The cutting action results in more stress on the brittle metal causing metal compression to the point where rupture occurs. The chip separates from the unmachined portion. . .

Excessive machine chatter may cause discontinuous chip formation on ductile material.

Type 2: Continuous Chip
The type 2 chip is a continuous ribbon that is produced when the flow of metal . . .

The categories used in Passage 4 help us sort out information with the result that we understand the features and characteristics of:

- a type of operation,
- a group of materials, and
- a cutting process.

This understanding leads us to understand:

- relationships,
- causes, and
- results.

PART III
USING CLASSIFICATION

Use classification to get the right result. What are the results of a wrong or poor choice?

Example: What results can you expect from cutting tools if you use a lubricant only when you happen to think about it? What if you've stored the lubricant in a rusty

container? To maintain the life and performance of tools, you need information about the right type of lubricant, how often to use it, and how to store it.

Getting the wrong information

If you are not using the right information the result of your choice could be very different from the desired one. Tools may be well designed and manufactured, but choosing the wrong lubricant could result in corrosion of metals and excessive wear to parts. In fact, it could result in tool failure.

Getting the right information

Understanding information often involves sorting out one set of details from another. When you read, pay attention to special instructions, manufacturer's directions or textbook directions that use classification to point out or tell you how to proceed.

Example:
Clean air regulations prohibit the use of some solvents. Check local regulations.

Solvents are a class of liquids. To follow the directions above, you need to know what liquids are included in the term *solvents*, and which ones are regulated by local codes (by-laws or ordinances). You then need to read the workplace regulations.

Examine it all to ensure you meet the criteria.

Example: Suppose you are asked to weld two pieces of metal.

1. Understand the conditions. The weld must do the following:
   - meet industry standards,
   - come in at the right cost,
   - be excellent in appearance.
2. Understand the factors or group of factors to get you these results. So, you list the factors that relate to the list above. It will include, but not be limited to the following:
   - proper heat,
   - proper shielding of weld,
   - choice of equipment,
   - condition of equipment,
   - your skill level.
3. Assemble information for a detailed, complete list of conditions and product factors. You can then relate this list to the next task:
   - find the right weld,
   - ensure excellent strength.

4. Search for the recommended weld. This will start you on your third list. You will find information about these topics:
    - types of welds,
    - their characteristics,
    - which types suit these particular requirements,
    - advantages/disadvantages of various types.

As you read to understand characteristics of products and equipment, you will learn how to avoid defects. When you have collected and assessed information, you can find the right fit. You can investigate the range of choices and select the best one.

At some point, you will put two (or several) lists of information together to make a choice. You may also have to decide which feature on your list is the most or least important. Often, you will need one, two or more sources to complete your task.

What is the situation?
To make the right choices, assess the situation:

- ♦ look at a requirement or group of requirements;
- ♦ understand them; and
- ♦ choose a product or process to suit the requirements.

Example: You are to choose fasteners to join metal sections. Before you get out any tools, you need to understand the conditions and the specific job you have to do. You know that the right fastener installed with the right tool will ensure the right quality of joint. But, which type of fastener should you choose?

- What's being joined? Is the fastener required to connect different metals or the same metals but of a different thicknesses?
- Are there any tricks or problems?
- What's available?

You need to be sure you create solutions, not problems. You will want to avoid:

- redoing the job,
- damage to any part or tool,
- creating safety risks, and
- finding yourself with the wrong tools or short of material.

Passage 5 describes a category of tool. Look at the category, and then the features or group of features to decide which one of the tools might suit a set of conditions.

Read Passage 5 and answer the questions that follow. Answers are at the end of this skills manual.

Passage 5
Pliers

Pliers are normally used in fieldwork for installation or disassembly of retaining rings. Pliers are designed for rapid, economical installation and removal of retaining rings. They grasp the ring securely by the lugs and expand or compress it.

Three general types of pliers are available: internal, external and convertible. These are suitable for rings classified as small to medium in size.

Internal pliers are designed to compress fasteners (rings). This allows for insertion or removal in a bore or housing. Some styles have adjustable stops that can be set so that travel of the tips is limited ensuring automatic alignment with lugholes.

External pliers are designed for assembly or disassembly of external retaining rings over a shaft. Adjustable stops limit travel of the tips that prevent overspreading the retaining ring.

Convertible pliers are designed for assembly and disassembly of different types of axially installed retaining rings. They can be used in two ways: to *compress* internal-type rings for inserting into a bore or housing; or to expand external-type rings for assembly over a shaft. Convertible pliers are used in your trades primarily for repair operations or maintenance.

Questions:

1. Which of the following lists characteristics of internal and convertible pliers?
    a) designed for axially installed retaining rings; compress internal-type rings for inserting into a bore
    b) compress rings for inserting into a bore or housing; used on both small and medium-sized rings
    c) adjustable stops limit tip travel; expand external-type rings for inserting into a bore or housing
    d) all of the above

2. Which are *not* characteristics of external pliers?
    a) adjustable stops limit travel of the tips; designed for assembly or disassembly of external rings over a shaft
    b) designed for assembly or disassembly of axially installed rings; suitable for rings classified in small to medium sizes
    c) adjustable stops limit travel of the tips which prevent overspreading the retaining ring; designed for assembly of external rings over shafts

3. Which pliers would you choose to remove small rings from a housing?
    a) internal or external
    b) external or convertible
    c) internal only
    d) any of the above

4. You could use internal and convertible pliers to compress medium-sized internal-type rings for insertion into a bore or housing.

T F

Make sure you understand the factors or group of factors that affect your goals. In the questions above, you looked at products based on the following criteria:

- product features (question 1)
- features not found (question 2)
- condition for use (questions 3 & 4)

In Passage 5, you had information in front of you to work from. As you looked for answers, you may have underlined words or made notes in the margins that help you eliminate details that don't apply or to highlight something important. Regardless of how you approached this passage, your object is to match the given products and materials to the situation.

To make the right choice, you need to do the following:

- look at a requirement or group of requirements;
- understand them; and
- choose a product or process to suit the requirements.

To make the good decisions, you need to know about each situation in detail. It is just as important to understand why you would **not** choose a product or procedure as it is to understand why you would choose it.

Organize the information

The process of pulling information together will help you make your decisions. Take the time to consider each factor and to understand it. Keep asking questions. Consider the details you would pull together to answer your supervisor's questions. Make sure you cover all possibilities to fit the requirements of a job.

Headings

Apply classification of information to your own notes to organize information. Underline or highlight what is relevant to your project or studies. Eliminate or set aside details that are not. Enter details under headings in a notebook. This is classification of information applied to your own notes.

> **Example:** You can group information about piping metals or types of fasteners together. As you proceed through a course, or a job, you can add to this information in a logical, ordered way. It will help you keep the big picture clearly in sight. As you develop the big picture, it is easier to sort out and understand the details about individual items.

Organize your thoughts
You need to organize information methodically. By classifying information, you can learn why a principle or technique applies to a group of situations or why it applies to one situation only. You can identify types of problems, determine their causes and find solutions. You understand and why a recommended welding technique failed to make a good weld. You can record what changed and whether or not you need to change a product or procedure.

CONCLUSION

Your job is to assemble information as thoroughly as possible to help answer the question: "Which is the best choice for this situation?" By starting from broad categories and working toward the specifics of single products, you can investigate the range of choices and select the best one.

Which information choice?
Work from reliable sources found in text and trade books, tables, manufacturers, suppliers and the experts in your field. If the desired result is a sturdy bin with smooth joints and yours will not stand straight and has a seam you'd like to hide, you haven't achieved your goal. In addition, it probably cost you just as much money, time and energy as the right result would have.

Summary
1. **Classification is a process**. A general, broad group or category contains a large number of items. A narrower category will hold fewer items.

2. **Match a list of features against a list of requirements**. Match products, information, and methods to a list of features. The question, "*which one",* narrowly defines the items that will fit.

3. **Use questions in your research to find relevant factors and conditions**. Look for the items that fit the grouping or classification.

4. **Know your purpose for classifying information**. Some of the details fit what you want; others can be eliminated because they do not fit the criteria.

5. **Classify features and conditions to determine errors, inappropriate or unsuitable choices**. Your own experience, knowledge and access to experts will help direct your search.

6. **You may have to decide which feature is the most important**. A choice may mean a compromise or a balance of factors.

7. **Understand characteristics of products**; understand the advantages and disadvantages of features. This will help you understand why something is a good choice, the best choice or *the only choice* for a particular situation.

Answers to Questions:

PART I Passage 2, Valve Materials

1. Which type of piping material would **not** be suitable for temperatures in excess of 450^0 F?
   b) high-tensile iron.

   The information about high-tensile iron is found in paragraph two. Sentence one states *iron* comes in three grades, (this is a form of classification), and then states that high-tensile iron is *limited* to 450^0 F. Therefore, it is not suitable for temperatures "in excess" of this. **Note:** No figures are given for "higher pressure," so we have no idea the exact pressures or pressure ranges. Look for a table to give this information.

2. Which of the following would be suitable applications for malleable iron?
   c) temperatures and pressures exceeding 450^0 F.

   Malleable iron is suitable for "slightly higher . . . temperatures." How much higher? We don't know the range of temperatures from this passage. Look for information at the beginning of paragraphs and under the titles or headings.

3. Which valve materials would provide the characteristics of toughness?
   b) malleable iron and steel.

   These metals share the characteristics of toughness. This is a process of elimination. You compare the details (features) to match with the question - the desired features.

4. Which of the following lists characteristics of higher-grade bronze?
   a) suited for temperatures up to 550^0 F and higher pressures.

   The answer is found in paragraph one. You need to check the other paragraphs to be sure you have all the relevant details.

PART II Passage 4, Chip Formation page

The underlined words indicate examples of classification.

Chip formation occurs with machining operations performed on lathes, milling machines or similar machine tools. Chips fall into three basic categories: discontinuous, continuous and continuous with a built up edge.

Type 1: Discontinuous Chip
Discontinuous or segmented chips are produced when brittle metals such as cast iron, hard bronze and some ductile metals are cut under poor cutting conditions. Some compression occurs as the point of the cutting tool contacts the metal. The chip begins to flow along the chip-tool

interface. The cutting action results in more stress on the brittle metal causing metal compression to the point where rupture occurs. The chip separates from the unmachined portion. . . Excessive machine chatter may cause discontinuous chip formation on ductile material.

Type 2: Continuous Chip

The type 2 chip is a continuous ribbon that is produced when the flow of metal . . .

PART III Passage 5, Pliers

1. Which of the following lists characteristics of internal and convertible pliers?

b) compress rings for inserting into a bore or housing; used on both small and medium-sized rings.

Here you compare two types of pliers for similar functions. See note at end of Question 4, regarding the use of internal and external rings.

2. Which are *not* characteristics of external pliers?

b) designed for assembly or disassembly of axially installed rings; suitable for rings classified in small to medium sizes.

Here you are looking to eliminate or set aside a product which does not fit the criteria. We don't know from this passage whether axially installed rings can be assembled with external pliers.

3. Which pliers would you choose to remove small rings from a housing?

c) internal only.

b) might look promising but they "are for assembly and disassembly of external rings over a shaft."

4. You could use internal and convertible pliers to compress medium-sized internal-type rings for insertion into a bore or housing.

T True appears to be correct *except for* the word *internal-type* rings.

Under **Internal pliers** no mention of the type of ring is given (internal or external). You will have to check this question with another source or expert to know if **T** is correct.