Alpha
Study Guide and Workbook

The Alpha examinations are 100-question tests which measure important basic abilities for performing the job of firefighter. There are four parts to the examination, and each part has separate instructions: reading comprehension (50 questions); mathematical skills (20 questions); mechanical comprehension (15 questions); and table interpretation (15 questions). The multiple-choice examination has a two-hour time limit. This study guide and workbook is designed to assist you in preparing for the examination.

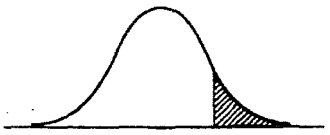
The **reading comprehension** section of the test is based upon several short reading passages. Following each passage are three to four questions which test your comprehension. There are five types of reading comprehension questions in the test: (1) identifying main ideas; (2) reading for key words; (3) determining word meaning; (4) drawing conclusions, and (5) negative questions. Each type of reading comprehension question is discussed in detail in this study guide, and techniques for answering these questions are described.

The **mathematical skills** portion of the test deals with both word problems and the application of formulas. Both types of math problems are covered in some depth in this study guide.

The **mechanical comprehension** part of the Alpha examination tests your comprehension and retention of technical subject matter. The questions in the examination are based on an article on "Gasoline Engines" which appears in this study guide.

The **table interpretation** section of the test is based upon technical information, presented in table form, which you are required to analyze and interpret. Techniques for answering these questions are discussed in the study guide.

The study guide contains several workbook problems which are similar to the questions in the actual examination. These practice questions will help you apply the material covered in the study guide. Answers to the practice questions are provided on the back page of this study guide.



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READING COMPREHENSION

This part of the study guide covers the five types of reading comprehension questions included in the Alpha examination.

Reading for Main Ideas

Every reading passage has a central theme, that is, a **main idea.** Before you consider answering the questions about a reading passage, you should read the passage two or three times. Because the passage is brief, you should have plenty of time to do this. Ask yourself, what is the main idea in this reading passage? Before you look at the questions, be sure that you understand what the reading passage is all about. Don't worry about the details or each specific fact at this point. Look at the following examples of reading passages for which the main ideas have been identified:

Examples	Main Ideas
Nitrogen dioxide is a pulmonary irritant, reddish-brown in color, which when inhaled in sufficient concentration, causes pulmonary edema. Its irritating effects on the nose and throat may be tolerated even though a lethal dose is being inhaled. Therefore, its hazardous effects may not become apparent for several hours after initial exposure.	How nitrogen dioxide works as a pulmonary irritant and toxic agent.
To open a plaster ceiling, the firefighter must first break the plaster and then pull off the lath. Metal and composition ceilings may be pulled from the joist in a like manner. When pulling, the firefighter should not stand under the space to be opened. The pull should be down and away to prevent the ceiling material from dropping on the head of the firefighter.	Techniques which firefighters must follow for opening ceilings.
The fire inspector is a salesperson who is trying to sell the intangible benefits of fire prevention to his or her customer, the general public. This indicates the importance of effective interpersonal skills by the inspector in dealing with the owners or managers of a facility. The inspector serves as an ambassador of the fire department, in that, he/she must advise and assist, but not dictate, to the customer.	The fire inspector plays an important public relations role.

Examples	Main Ideas
The use of proper overhaul techniques provides valuable results. In the handling of contents, merchandise, and debris, hidden fires can be detected. Materials which are apt to rekindle may be detected and removed from the premises. A proper overhaul will also assist greatly in determining the cause of the fire.	The benefits of proper overhaul methods.
Fire prevention is, too often, assumed to be the sole responsibility of the fire department. This view ignores the limitations of the fire service. Effective prevention is possible only if there is substantial community involvement in each and every aspect of the problem.	The community must be involved, along with the fire department, in fire prevention.

A word of advice may be helpful. When a test question asks you to identify the central theme or main idea of a passage, don't be distracted by minor details which are mentioned in the passage. Always look for the major topic which is **repeated** throughout the entire passage.

Example:

In arson investigations, the legal integrity of the evidence is maintained by tight security rules and careful maintenance of records indicating the chain of possession. Whether an investigator forwards material to a laboratory or the materials are returned to the investigator, evidence is "booked" as it travels and then safeguarded. No unauthorized person is allowed in contact with the evidentiary materials, and a record is made of every person making tests on or handling any substance, whether on the fire scene, in the laboratory, or in the transmission of the materials.

What is the main idea in this passage?

A. How experts examine evidence
B. Transmitting evidence of arson
C. How evidence is protected during arson examinations

The correct answer is "C", because it is the main theme repeated throughout the entire passage. Both "A" and "B" are mentioned in the passage, but they are not the main ideas. The concept expressed in the passage, **taken as a whole**, is that evidence must be protected and accounted for during the time that arson examinations are being made. It would be wrong to answer that "A" or "B" are correct just because they are mentioned in the passage. To identify the main idea, look for the central theme of the entire **passage**, not just part of it. The main idea is a general statement which pertains to the entire passage.

Scanning for Key Words

Most reading comprehension test questions require the reader to scan the reading passage for key words. Some examples are given below. Each reading passage is followed by sample questions which require the reader to scan the passage for key words.

Examples:

> Liability arising from the activities of fire departments, including suppression, prevention, and inspection, results from negligence. Negligence may occur as a result of the improper performance of an act or a failure to act. In order for an individual or municipality to be found liable, the injured party must prove negligence. Generally, fire service personnel acting within the scope of their authority and without negligence are not personally liable for damage resulting from their acts.
>
> In general, firefighters are not legally responsible for:
>
> A. a failure to act
> B. official, non-negligent acts
> C. improper performance of an act.
>
> If a firefighter does his/her job incorrectly, that firefighter may be:
>
> A. subject to disciplinary measures by the fire department
> B. required to undergo re-training
> C. legally responsible for his/her mistakes

The correct answer to the first question is "B", i.e., official, non-negligent acts. To determine the correct answer to the question, you must check each of the three possible answers to the question by scanning the reading passage for key words. Choice "A", i.e., a failure to act, is incorrect even though the passage mentions this concept. "A" is incorrect, because it does not answer the question which asks what firefighters are **not** legally responsible for. Choice "C" is also incorrect for the same reason. Answer "B" is correct, because the passage states that fire service personnel are not **personally liable . . . when acting within the scope of their authority and without negligence.** These key words in the passage are **equivalent in meaning** to the correct answer to the test question.

Consider the second sample test question for which the correct answer is "C". When you compare answers "A" and "B" with the passage to find key words which correspond to these answers, you will find that the reading passage does not even mention these concepts. The key words in the passage are: "Liability . . . results from negligence. Negligence may occur as a result of the improper performance of an act." The words **legally responsible** in the question and **liability** in the passage mean the same thing. The word **mistakes** in the question is equivalent in meaning to the words **improper performance of an act** in the passage. Therefore, the correct answer is "C".

The following passage and sample test questions further illustrate how scanning for key words will help you answer most reading comprehension test questions:

Examples:

When people find themselves in cold temperatures without adequate protection, they can suffer surface damage to the skin, known as frostbite, or general cooling of the body, known as hypothermia. Frostbite, if severe, can lead to tissue death (gangrene) and may necessitate amputation of the frozen tissue. Hypothermia is a life-threatening condition that occurs when the body's core temperature cools as a result of exposure to cold.

Heat loss from exposure to the cold may result in:

A. gangrene
B. hypothermia
C. frostbite

The correct answer is "B", i.e., hypothermia. The key words in the question **heat loss** correspond in meaning to the words **cooling of the body** which appear in the passage. Cooling of the body is related to hypothermia, therefore, "B" is correct.

Hypothermia may result in:

A. death
B. damage to the skin
C. frozen tissue

The correct answer is "A", i.e., **death** which corresponds in meaning to the words **life threatening** which appear in the passage.

Remember, test each possible answer by scanning for key words. When you find key words in the reading passage which are identical to or equivalent in meaning with a given answer, check the context in which the key words appear to see if the key words really address the question being asked. This is an important point. Don't be fooled by answers using the same terminology which appears in the reading passage, **but in a different context.**

Determining Word Meaning

Some of the questions in the reading test will ask you to identify the meaning of certain words used in the passage. When you encounter such questions, you should remember that the meaning of words is often determined from the **context** in which they appear. When you examine the context, you are looking at how the word is used. An example will illustrate this point:

Example:

In the fire service, firefighters must employ good judgment and effective interpersonal skills.

In the above passage, the word **employ** means the same things as:

A. hire
B. utilize
C. deny

The correct answer is "B", i.e., utilize. While the word **employ** also means hire, it does **not** mean hire in the context in which it appears in the above passage. In the passage, employ means utilize or use or apply. Do not jump to conclusions about what a word means until you examine the context in which it is used in the reading passage. Consider another example:

Example:

Fire department policies should reflect both fire service professional standards and legal requirements.

In the above statement, the word **reflect** means the same thing as:

A. be consistent with
B. to shine back
C. to ponder

The correct answer is "A". You can test each answer by substituting the language in the answer with the word in the passage. In the above context, reflect means the same thing as: be consistent with. Do not be fooled by "B" and "C" which are other meanings for the word reflect, **but in different contexts.**

Drawing Conclusions

One of the most important aspects of reading comprehension is the ability to draw conclusions from a reading passage. A conclusion or an inference requires you to **apply** the information in the reading passage. The answer to this type of question does not exist word-for-word in the reading passage. What you must look for in the passage is some **basis** or foundation for supporting your conclusion. In answering test questions which require you to draw conclusions, always look for language in the passage which supports your answer. Never answer the question based upon your "common sense" or information which you have learned from other sources. A correct answer is always a conclusion based on the passage. This is important to remember. You must **interpret** what the passage says. Even though you may not find a word-for-word statement which supports your choice of answer, the correct answer is always based upon the content of the passage.

Example:

> To be considered adequate, a water supply system must be capable of delivering the required fire flow for a number of hours at peak consumption periods. Required fire flow varies according to the type of development in a given district. For example, low-density residential areas need smaller flow than large industrial parks with buildings that are equipped with sprinkler systems.
>
> The adequacy of a water supply system is based upon:
>
> A. demand
> B. research
> C. population

The correct answer is "A".

Example:

> Because some managers are reluctant to allow subordinates the freedom to use their own judgment, subordinates may be prevented from acting on their own. Other managers may delegate to such an extreme that they lose contact with the assignments delegated. The effective manager must consider these competing concerns to best achieve the goals of the department.
>
> The delegation of responsibility from managers to subordinates should be done:
>
> A. infrequently, if at all
> B. in a balanced fashion
> C. to the greatest extent possible

The correct answer is "B".

Example:

Many small fire departments may communicate their policies, procedures, and rules orally to their small staffs. Larger fire departments commonly issue written sets of rules, in the form of Operations Manuals, which provide a detailed and comprehensive statement of current policies and procedures. However, some employees may regard an Operations Manual as an exhaustive set of requirements; therefore, any rule that is not clearly spelled out is open to individual interpretation. Those employees who would digress from departmental policies and procedures might argue that they did so because the behavior in question was not specifically disallowed.

The use of an Operations Manual to detail fire department policies and procedures is:

A. of little benefit
B. a highly effective management tool
C. not without problems

The correct answer is "C". The passage describes how some employees would use the Operations Manual as a justification for inappropriate actions. Even though common sense may suggest that "B" is correct, nothing in the passage supports the conclusions stated in "B" or "A". To be correct, the conclusion must be based upon the content of the reading passage, because this is a test for reading comprehension **not** common sense or general knowledge.

Answering Negative Questions

Negative questions ask you to select, from among the three possible answers, the one that represents an **incorrect conclusion** based upon the reading passage.

Example:

Most provisions of nationally accepted building codes apply to fire safety, with much of the remainder relating to structural safety. Thus, the building code is the cornerstone of protection for the citizens who live, work, and play in a community's buildings. The fire code is intended to work in concert with the building code to ensure that built-in fire protection is maintained properly, but the building code goes beyond fire safety in determining what is built-in and how.

Which of the following conclusions is **not** justified based upon this passage?

A. Building codes and fire codes are intended to complement one another
B. Building codes deal primarily with fire safety
C. Building codes and fire codes duplicate one another

The correct answer is "C". Answers "A" and "B" are mentioned specifically in the reading passage, but answer "C" is not mentioned anywhere. Therefore, "C" is not a justifiable conclusion. Since the question asks you to identify the conclusion which is not justified, "C" is the correct answer.

Based upon the same reading passage, answer the following question:

The passage did **not** refer to:

A. the maintenance of built-in fire protection
B. what building codes mainly cover
C. the penalties for code violations

The correct answer is "C" which was not covered in the passage. Answers "A" and "B" were discussed in the passage.

Answer the following question which is based on the same passage:

The passage does **not** suggest that building codes and fire codes are:

A. controversial
B. protective
C. useful

The correct answer is "A". Nothing in the passage refers to such codes as being controversial.

When you are handling negative questions, you are either: (1) looking for **incorrect conclusions**, or (2) concepts which were **not covered** within the reading passage.

Do the following practice questions, then check your answers on the last page of this booklet.

When a bulge appears in a brick wall, it should be assumed, for reasons of safety, that a collapse will occur. Many brick walls have collapsed without this warning. Cracks in the wall are not a positive indicator of collapse, but they should be regarded as a red flag worthy of respect. Firefighters who disregard such warnings may be held accountable for their actions.

1. When cracks appear in walls, they are _____ a possible collapse.

A. the result of
B. seldom associated with
C. not sure signs of

2. The passage does **not** suggest that wall collapses are:

A. a reason for firefighter caution
B. a frequent cause of firefighter deaths
C. difficult to predict

3. The word **held** in the passage means the same thing as:

A. to grip or grasp
B. to regard or adjudge
C. to take or keep

4. The main idea in this passage deals with:

A. what to do if a brick wall collapses
B. looking for warning signs of a wall collapse
C. fire fighting close to brick walls

When smoke obscures the face of a building, the firefighter may be uncertain whether the water stream is entering the windows or not. It should be remembered that the sound is quite different when the stream strikes the building wall than when it is passing through the window. Water that strikes the wall will run down the side of the building and can be easily detected at the bottom of the wall. Water entering the windows will run down the stairs and will be quite noticeable at the foot of the stairway.

5. The passage suggests that firefighters should use their _____ to determine whether a water stream is entering the window of a smoke-covered building.

A. sight and hearing
B. smell and sight
C. hearing and smell

6. Which conclusion is most justified based upon this passage?

A. When heavy smoke is present, firefighters may have difficulty fighting fires effectively
B. Water found inside a burning building may indicate a serious problem
C. Water that strikes a building wall will run down the stairs

7. The word **foot** as used in this passage, means the same thing as:

A. base or bottom
B. top or upper portion
C. measure or distance

8. Water that runs down the walls of a building can:

A. create significant amounts of smoke
B. hinder fire fighting efforts
C. be readily observed

When a hose nozzle is opened for the first time, air trapped in the hose line will be expelled. If the nozzle is aimed at the fire, this burst of air may actually accelerate burning. Therefore, when opening the nozzle for the first time, it should be directed at the floor in order to discharge the air. When this has been done, close it, aim at the fire and reopen the nozzle.

9. Based upon this passage, you can conclude that air:

   A. may make a fire worse
   B. has no effect on fire
   C. can be used to fight fires

10. The main idea of this passage concerns:

   A. how to select a hose nozzle
   B. what to do when fighting a fire
   C. how to open a hose nozzle in a fire

11. The passage did **not** refer to:

   A. air trapped in hose lines
   B. the difficulty of controlling a hose stream
   C. where to direct the hose stream

12. The reason for first directing the hose stream away from the fire is to:

   A. expel air
   B. accelerate burning
   C. discharge water

At times, inexperienced or untrained firefighters are inclined to aim hose streams at flames wherever they show. Streams directed from aerial ladders into roof openings nullify the beneficial effects of roof ventilation. Such streams not only act as a cover which arrests ventilation, but also drive the heat and products of combustion back into the building. This results in driving the firefighters out and spreading the fire.

13. The word **arrest** as used in the passage means the same thing as:

   A. attract
   B. extinguish
   C. stop

14. Ventilating a roof has a _____ effect on the fire.

   A. negative
   B. uncertain
   C. positive

15. The main idea of this passage is that hose streams should **not** be:

A. misdirected
B. excessive
C. aimed at fires

16. Hose streams directed into roof openings do **not**:

A. drive out firefighters
B. spread the fire
C. facilitate roof ventilation

Smoke ejectors can be valuable when properly employed, but they are best used as an adjunct to natural ventilation or in cases when natural ventilation is ineffective. If not properly used, smoke ejectors will do more harm than good. These fans, when used in the exhaust mode, will draw the smoke and fire toward the place where the fan is located. In many instances, the time required to put fans to work would be better used opening windows and cutting roof holes.

17. Fans, if placed incorrectly while in the exhaust mode, will:

A. promote roof collapse
B. misdirect smoke and fire
C. block windows

18. Which of the following is **not** a natural method of ventilation?

A. smoke ejectors
B. windows
C. roof holes

19. Fans should be used to ventilate fires when other means of ventilation:

A. have not been attempted
B. do not work
C. are completely effective

20. The main theme of this passage concerns how to best:

A. extinguish fires
B. apply water to the fire
C. ventilate smoke and heat

See last page for correct answers.

MATHEMATICAL SKILLS

This part of the study guide covers the two kinds of math problems found in the Alpha examination: word problems and formulas.

Word Problems

Many people find math word problems to be difficult, but they are not--providing that you recognize the type of word problem with which you are dealing. There are three kinds of math word problems in the Alpha examination: (1) weight-length problems; (2) quantity-time-rate problems, and (3) percentage problems.

Weight-length problems deal with either the weight or length of objects. They will require either **multiplication** or **division.**

All problems dealing with **length** follow the same form. There are three elements to these problems:

T = Total length
L = Length of each separate unit
N = Number of units

In each problem, you will be given two of the three elements and you will be required to solve for the third element. The key to solving these problems is your ability to recognize which element you are solving for.

Example:

A hose line, made up of 50-foot sections, extends for a distance of 3,500 feet. How many sections are used to make up the line?

In the example above, you are given L, the length of each separate unit (i.e., 50 feet), and T, the total length (i.e., 3,500 feet). You must find N, the number of units or sections used to make up the line.

The formulas for solving these problems are as follows:

$$L = \frac{T}{N}$$

$$N = \frac{T}{L}$$

$$T = L \times N$$

Since, in the example above, you must find N, the number of units:

$$N = \frac{T}{L} = \frac{3{,}500 \text{ feet}}{50 \text{ feet}} = 70 \text{ sections}$$

Example:

A chain is made up of 57 sections, each 50 feet in length. How far does the chain extend?

You have been given N, the number of units or sections, and L, the length of each section. You must find T, the total length of the chain. Therefore:

$$T = L \times N = 50 \text{ feet} \times 57 \text{ sections} = 2{,}850 \text{ feet}$$

Example:

A hose line which extends 6,250 feet is made up of 125 sections. How long is each section? Therefore:

$$L = \frac{T}{N} = \frac{6{,}250 \text{ feet}}{125 \text{ sections}} = 50 \text{ feet}$$

These problems may deal with **weight** rather than length, but they are solved in the same way:

T = Total weight
W = Weight of each unit
N = Number of units

The formulas for solving these problems are as follows:

$$W = \frac{T}{N}$$

$$N = \frac{T}{W}$$

$$T = W \times N$$

Example:

A truck is carrying 2,500 gallons of material. Each gallon weighs 7.2 pounds. What is the total weight of the liquid in the truck?

$$T = W \times N = 7.2 \text{ pounds} \times 2{,}500 \text{ gallons} = 18{,}000 \text{ pounds}$$

Remember, the key to solving weight-length problems is to read the problem carefully. Before you begin, you must decide what you are solving for.

Quantity-time-rate problems are similar to weight-length problems:

$$Q = \text{Quantity}$$
$$T = \text{Time}$$
$$R = \text{Rate}$$

The formulas for solving these problems are:

$$R = \frac{Q}{T}$$

$$T = \frac{Q}{R}$$

$$Q = R \times T$$

Example:

A truck has pumped 675 gallons of water in 15 minutes. How many gallons per minute are being pumped?

In this problem, you are solving for gallons per minute (gpm) which is a measure of **rate**. Therefore:

$$R = \frac{Q}{T} = \frac{675 \text{ gallons}}{15 \text{ minutes}} = 45 \text{ gpm}$$

Example:

A total of 3,500 gallons of water have been pumped at the rate of 250 gallons per minute. How long did it take to pump this amount of water?

The key words are **how long.** You are solving for **time.**

$$T = \frac{Q}{R} = \frac{3{,}500 \text{ gallons}}{250 \text{ gpm}} = 14 \text{ minutes}$$

Example:

The fire department has pumped fire retardant for 37 minutes at the rate of 90 gallons per minute. How much material has been pumped?

$$Q = R \times T = 90 \text{ gpm} \times 37 \text{ minutes} = 3{,}330 \text{ gallons}$$

Percentage problems

Percentage problems require you to calculate the percent increase or decrease in some value.

Percent of difference between two values is calculated as follows:

$$H = \text{Higher Value}$$
$$L = \text{Lower Value}$$

To compute the **percentage increase** between two values:

$$100 \times \left(\frac{H}{L} - 1\right)$$

To compute the **percentage decrease** between two values:

$$100 \times \left(1 - \frac{L}{H}\right)$$

Example:

A chemical which freezes at 26 degrees Fahrenheit is combined with another chemical which raises the freezing point to 40 degrees. By what percentage has the freezing point been increased?

To solve for the percentage increase:

$$100 \times \left(\frac{H}{L} - 1\right) = 100 \times \left(\frac{40}{26} - 1\right) = 100 \times (1.54 - 1) = 100 \times .54 = 54\%$$

The freezing point has been increased 54 percent by the addition of the second chemical.

Example:

In 1984, there were 312 structure fires in Oregon. In 1985, the number of structure fires in the state decreased by 26. By what percentage did structure fires decrease in Oregon?

You must solve this problem for percentage **decrease**. The correct formula is:

$$100 \times \left(1 - \frac{L}{H}\right)$$

The higher value, H, is 312. The lower value, L, is 286 (i.e., 312-26 = 286). Therefore:

$$100 \times \left(1 - \frac{L}{H}\right) = 100 \times \left(1 - \frac{286}{312}\right) = 100 \times \left(1 - (.92)\right) = 100 \times .08 = 8\%$$

There was an 8 percent decrease in structure fires between 1984 and 1985.

Formulas

In the fire service, the use of mathematical formulas is fairly commonplace. You do **not** need to know algebra in order to solve these problems. Just some basic math is required. Do your calculations carefully to avoid silly mistakes, and **always check your work!**

Example:

$$Y = .25 \times \left(\frac{Q \times 15}{R}\right)$$

in which Q = 10 and R = 100

In the example above, you must solve the formula for Y. You have been given the value for Q, which is 10, and R, which is 100. You must substitute these numbers for Q and R before solving the problem.
Therefore:

$$Y = .25 \times \left(\frac{10 \times 15}{100}\right)$$

In solving these formulas, always complete all the required calculations which appear inside a parenthesis before doing the calculations outside the parenthesis.
Therefore:

$$Y = .25 \times \left(\frac{150}{100}\right)$$

$$= .25 \times (1.5)$$

$$= .375$$

The correct answer is Y = .375

Example:

$$Y = 48 \times \left(\frac{C}{D^2}\right)$$

in which C = 18 and D = 6

In the formula above, you must substitute the values for C and D. Please note that you are required to calculate D^2 which is the value of D squared. When you square a number, you must multiply it by itself. Therefore:

$$Y = 48 \times \left(\frac{18}{6 \times 6}\right)$$

$$Y = 48 \times \left(\frac{18}{36}\right)$$

$$= 48 \times .5$$

$$= 24$$

The correct answer is Y = 24

Example:

$$Y = (6 \times S) - \left(\frac{T^2}{.5}\right)$$

in which S = 11.5 and T = 4

$$Y = (6 \times 11.5) - \left(\frac{4 \times 4}{.5}\right)$$

$$Y = 69 - \left(\frac{16}{.5}\right)$$

$$= 69 - 32$$

$$= 37$$

The correct answer is Y = 37

Example:

$$Y = \left(\frac{M^2 \times N}{10}\right) \times \left(\frac{M - 1}{16}\right)$$

in which M = 9 and N = 2

Therefore:

$$Y = \left(\frac{81 \times 2}{10}\right) \times \left(\frac{9 - 1}{16}\right)$$

$$= \left(\frac{162}{10}\right) \times \left(\frac{8}{16}\right)$$

$$= 16.2 \times .5$$

$$= 8.1$$

The correct answer is Y = 8.1

Example:

$$Y = \frac{H \times (.25 \times G)}{\left(\frac{G^2 - 14}{12.5}\right)}$$

in which H = 175 and G = 8

$$Y = \frac{175 \times (.25 \times 8)}{\left(\frac{64 - 14}{12.5}\right)}$$

$$= \frac{175 \times 2}{4}$$

$$= \frac{350}{4}$$

$$= 87.5$$

The correct answer is Y = 87.5.

The key to working with formulas is remembering the correct **sequence** of operations. Always do **all** the calculations inside of parentheses **before** performing the other calculations.

Working with Decimals

Some of the problems in the test require you to work with decimals. If you are **adding** or **subtracting** decimals, the operations are pretty much the same as for whole numbers. The decimal point in the answer is placed directly below its position in the columns of numerals to be added or subtracted. The decimal point makes no difference in "carrying" or "borrowing" numbers from one place to another.

Examples:	14.275	8.71	7.702	14.070
	+ 10.418	6.29	− 1.611	− 9.162
	24.693	+ 4.16	6.091	4.908
		19.16		

When you **multiply** fractions, the operations are the same as the multiplication of whole numbers, but you must know where to place the decimal point in the answer. The number of decimal places in the answer (or product) is the sum of the decimal places in the two numbers multiplied.

Examples:

.061	234.62	1.962	7.02
× .32	× 2	× .001	× 1.1
122	469.24	.001962	702
183			702
.01952			7.722

Division of decimals is a little trickier, but easily learned. Look at the example below to brush up on terminology.

$$\frac{32}{8} = 4 \text{ is the same as } 8\overline{)32}^{\,4}$$

The number into which you are dividing (32 in the example) is called the **dividend.** The number by which you are dividing (8 in the example) is called the **divisor.** The answer (4 in the example) is called the **quotient.**

The example below illustrates the rules for dividing decimals.

$$\frac{318}{7.5} = 7.5\overline{)318}$$

To divide decimals, you must move the decimal point in the **divisor** to the right to form a whole number. In this example, the divisor is 7.5. By moving the decimal point **one place** to the right, the divisor 7.5 becomes 75. You must also move the decimal point in the **dividend** the same number of places, i.e., one place to the right. Therefore, the dividend 318 becomes 3180. Put the decimal point after 3180 and divide this number by 75:

$$\begin{array}{r} 42.4 \\ 75\overline{)3180.0} \\ \underline{300} \\ 180 \\ \underline{150} \\ 300 \end{array}$$

Remember, <u>whatever you do to the divisor you must also do to the dividend</u>. If it is necessary to move the decimal point three places in the divisor to form a whole number, you must also move the decimal point three places in the dividend.

Examples:

$$2.125\overline{)40.750} = 2125\overline{)40750.00}\quad 19.18$$

$$3.46\overline{)52.109} = 346\overline{)5210.90}\quad 15.06$$

$$.03\overline{)1.0781} = 3\overline{)107.81}\quad 35.94$$

Do the following math problems for practice.

1. A hose line of 5,550 feet is made up of 50-foot sections. How many sections must be removed for the hose line to equal 2,200 feet?

   A. 44 sections
   B. 67 sections
   C. 111 sections

2. If a gallon of water weighs 8.4 pounds, how much weight will be added to a truck when a 600-gallon tank is full?

   A. 71.42 pounds
   B. 2742 pounds
   C. 5040 pounds

3. A fire is burning 35 acres per hour. At this rate, how long will it take to burn 4,200 acres?

   A. 120 hours
   B. 642 hours
   C. 147,000 hours

4. The thickness of a sheet of material is 1.065 inches. A stack of 150 such sheets will be how high?

   A. 15.975 inches
   B. 140.85 inches
   C. 159.75 inches

5. A water tank containing 36,750 gallons is being emptied at the rate of 42 gallons per minute. How long will it take for the tank to be one quarter full, if it is now full?

   A. 218.75 minutes
   B. 656.25 minutes
   C. 875 minutes

6. A gauge is decreasing by .048 units per minute. At the present, the gauge is reading 5.762 units. What will the reading be in 30 minutes?

   A. 1.44 units
   B. 2.76 units
   C. 4.32 units

7. Chemical X takes 62.5 seconds to extinguish a fire of a given size. Chemical Y takes 66 seconds to extinguish the same fire. Chemical X is quicker acting than Chemical Y by what percentage?

   A. 5.6%
   B. 4.2%
   C. 1.1%

8. In 1987, there were 625 grass fires in the state. In 1988, 120 fewer grass fires were reported than for the previous year, a decrease of what percent?

   A. 17.2%
   B. 19.2%
   C. 21.2%

9. A drive shaft makes 385 revolutions per minute. A lubricant is used which increases the speed of the drive shaft by 11.5 percent. How many revolutions per minute will the drive shaft now make?

   A. 401.2 rpm
   B. 408.5 rpm
   C. 429.3 rpm

10. A hose line has a discharge of 125 gallons per minute. How many gallons will be discharged in 2.4 hours?

    A. 300 gallons
    B. 11,250 gallons
    C. 18,000 gallons

For questions 11 to 20, you must solve the following formulas to determine the correct value of Y.

11. $Y = .001 \times \left(\frac{J \times K \times 10}{50}\right)$

    in which J = 25 and K = 15

    A. .075
    B. .75
    C. 7.5

12. $Y = 16 \times \left(\frac{S^2}{T}\right)$

in which S = 6 and T = 3

A. 192
B. 194.4
C. 1944

13. $Y = \left(\frac{4 \times Q^2}{10}\right) + \left(\frac{Q}{4}\right)$

in which Q = 12

A. 7.8
B. 17.4
C. 60.6

14. $Y = \left(\frac{A \times B}{B^2}\right) \times \left(\frac{A - 2}{.05}\right)$

in which A = 6 and B = 3

A. 1.6
B. 16
C. 160

15. $Y = \frac{(7 \times L) - (L^2 - 9)}{M^2 - (3 \times M)}$

in which L = 7 and M = 4

A. 2.25
B. 1.96
C. 1.58

16. $Y = 6.1 \times \left(\frac{(3 \times M^2) - 15}{N^2 - 10}\right)$

in which M = 5 and N = 4

A. 6.1
B. 10
C. 61

17. $Y = \left(\frac{8 \times B}{C^2 \times D}\right) \times \left(\frac{B^2 + 3}{D}\right)$

in which B = 9, C = 6, and D = .5

A. 128
B. 672
C. 944

18. $$Y = \frac{F \times (.25 \times F)}{\left(\frac{G^2 - 100}{100}\right)}$$

in which F = 20 and G = 15

A. 42
B. 64
C. 80

19. $$Y = 100 \times \left(\frac{1.5 \times W}{.25}\right)$$

in which W = .05

A. .075
B. 7.5
C. 30

20. $$Y = .4 \times \left(\frac{1.25 \times M}{3.125}\right)$$

in which M = .025

A. .004
B. .04
C. .4

See last page for correct answers.

MECHANICAL COMPREHENSION

Firefighters frequently encounter technical materials concerning mechanical subject matter. Such materials include: equipment manuals, manufacturer's instructions, technical specifications, and so forth. The firefighter must **comprehend** and **remember** such mechanically-oriented materials in order to operate various types of equipment.

The mechanical comprehension section of the Alpha examination measures your ability to understand, remember, and apply technical information dealing with mechanical subject matter. The following article entitled: **Gasoline Engines** covers the basic design and function of simple gasoline engines. You are expected to read and **study** the material in this article. When you take the Alpha examination, you will be asked a number of questions about this article on gasoline engines. You will be expected to remember detailed facts of a highly specific nature. Unlike the reading comprehension section of the Alpha examination, you will **not** be given the article on gasoline engines when taking this portion of the test. This is true, because the mechanical comprehension part of the test is specifically intended to measure your ability to retain what you have read. Therefore, study the article carefully.

The following is the article which you must study. When you are satisfied that you are sufficiently familiar with the material in this article, you should attempt the practice problems which appear after the article. While answering the practice questions, **do not** refer back to the article until you have completed all the practice questions. To do so would not be helpful, as this part of the test measures your ability to remember and apply what you have read.

Gasoline Engines

There are two types of gasoline engines, reciprocating and rotary. Reciprocating engines have pistons that move up and down or back and forth. A part called a crankshaft changes this reciprocating motion into rotary motion to turn wheels. A rotary engine uses devices called rotors instead of pistons. The rotors produce rotary motion directly.

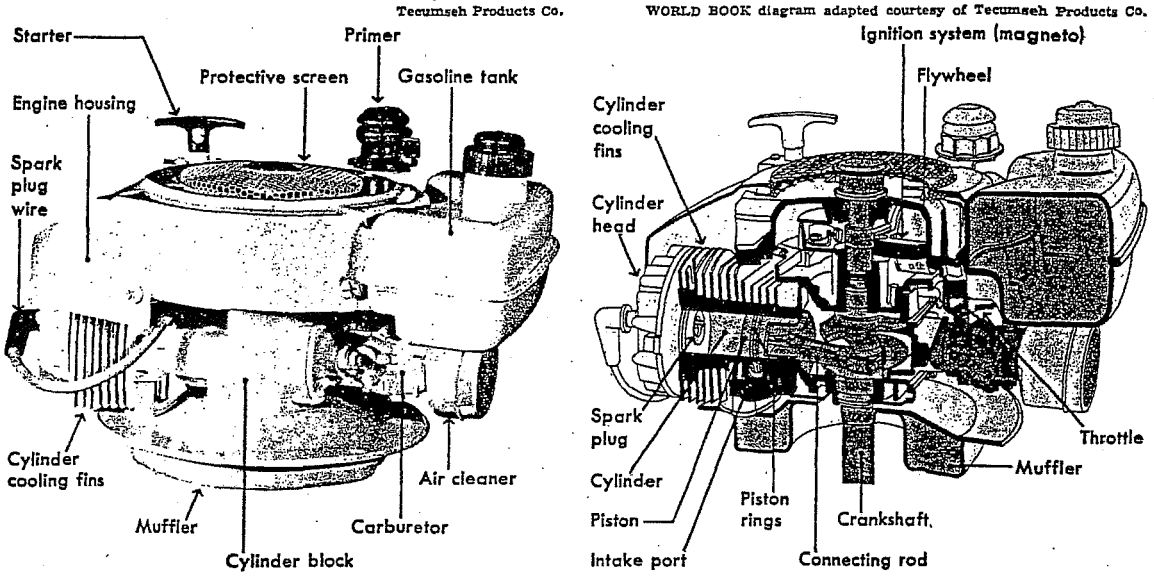
Reciprocating gasoline engines are classified in a number of ways. These include (1) by the number of piston strokes per cycle, (2) by the type of compression, (3) by the way they are cooled, (4) by their valve arrangement, (5) by their cylinder arrangement, and (6) by the way they are supplied with air and fuel.

Cycle. All gasoline engines operate on either a two-stroke or a four-stroke cycle. Cycle means the steps that must be repeated for each combustion of the fuel-air mixture in the cylinders. Stroke means the up-and-down movements of the pistons. A four-stroke cycle engine has intake, compression, power, and exhaust strokes. A two-stroke cycle engine combines the exhaust and intake steps near the end of the power stroke. Although two-stroke cycle engines are inefficient, they are simpler and cheaper to build than four-stroke cycle engines. They are used where low cost is important, as in a power lawn mower.

BASIC PARTS OF A GASOLINE ENGINE

All gasoline piston engines have the same basic parts. The photograph at the left shows a two-stroke cycle lawn mower engine. A cutaway diagram of the same engine, *right*, identifies its basic parts. Some parts may look different in other engines, but they perform the same function.

Tecumseh Products Co. WORLD BOOK diagram adapted courtesy of Tecumseh Products Co.



A two-stroke cycle engine delivers more power for a given weight and size than does a four-stroke cycle engine. Each cylinder in a two-stroke cycle engine produces a power stroke for every turn of the crankshaft. But in a four-stroke cycle engine, a cylinder produces a power stroke on every other turn.

High and Low Compression. As a piston moves from the bottom to the top of a cylinder, it compresses the air and gasoline mixture. A number called the compression ratio, tells how much the mixture is compressed. A high-compression engine may have a compression ratio of 10 to 1. Such an engine compresses the mixture to a tenth of its original volume. A low-compression engine may have a ratio of 8 to 1.

High-compression engines burn gasoline more efficiently than do low-compression engines. But high-compression engines require high-octane gasoline. High-octane gasoline may contain lead additives. These additives harm devices called catalytic converters placed in the exhaust system to remove pollutants. In the early 1970's, for this and other reasons, manufacturers reduced the compression ratios--and the octane requirements--of car engines.

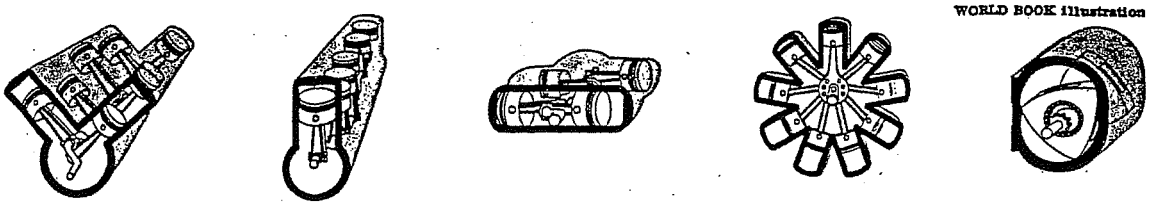
Cooling. The burning fuel-air mixture in a cylinder produces gas temperatures of about 4500°F (2500° C). Therefore, the metal parts of the engine must be cooled or they would melt. Most automotive gasoline engines are liquid cooled. A liquid, usually water, is circulated around the cylinders to cool the metal. The heated liquid is then pumped through a radiator. A fan driven by the engine draws air through the radiator to cool the liquid.

Most aircraft gasoline engines in small planes are air cooled to reduce weight. Air is not so effective a coolant as liquids, so the outside of the cylinders have many metal fins. These fins conduct heat out of the cylinder and offer a large surface area for the air to sweep over.

GASOLINE ENGINE CYLINDER ARRANGEMENT

V-type engines have two rows of cylinders set at an angle. In-line engines have one row of cylinders. The cylinders of horizontal opposed engines are opposite one another. Those of radial engines are set around the crankshaft. Rotary engines have rotor chambers instead of cylinders.

WORLD BOOK illustration



V-type | In-line | Horizontal opposed | Radial | Rotary

Valve Arrangement. The two most common valve arrangements are (1) L-head and I-head. An L-head, or underhead, valve engine has the intake and exhaust valves side by side in the cylinder block. The intake valve admits the air-fuel mixture into the cylinder and the exhaust valve lets out the exhaust gases. An I-head, or overhead, valve engine has the two valves side by side in the cylinder head, the cylinder block's top cover.

Cylinder Arrangement. Engines are also classified by the number and arrangement of cylinders. The most common types include in-line, V, radial, and horizontal opposed. Radial engines have an odd number of cylinders, such as 3, 5, 7, or 9. Most other engines have an even number of cylinders--4, 6, 8, or 12.

Air and Fuel. Fuel may be metered, or sent, to the cylinders by either a carburetor or an injection pump. Therefore, reciprocating engines are also classified as carbureted or as fuel-injection engines. Because combustion depends upon both air and fuel, the power of an engine is limited by the amount of air reaching the cylinders. To increase power, an engine may be supercharged. A supercharger is a pump that forces extra air to the cylinders. The air needed to burn 1 unit of gasoline weighs about 15 times as much as the gasoline.

Parts of a Reciprocating Gasoline Engine

Cylinder Block is a rigid frame that holds the cylinders in proper alignment. If the engine is liquid cooled, the block is jacketed, or has passages for the liquid around each cylinder. In automotive engines, the cylinder block and crankcase form a single unit. Most cylinder blocks are made of cast iron or aluminum.

Cylinders are tubes which serve as a bearing for the pistons that move up and down inside them. They have highly polished surfaces. This permits a close fit between pistons and cylinder and prevents gases from leaking past the piston. The cylinders in most automobile engines are part of the block. Some engines have a cylinder sleeve made of specially hardened steel or cast iron pressed into the cylinder block.

Cylinder Head is a casting bolted to the top of the cylinder block. The cylinder head, together with the upper end of the cylinder and the top of the piston, form the combustion chamber where the fuel-air mixture burns. A cylinder head and block may also be one unit.

Crankcase is a rigid frame that holds the crankshaft and the crankshaft bearings. In small engines, all or part of the crankcase may be a part of the cylinder block. An oil pan bolted to the bottom of the crankcase holds the oil that lubricates the engine.

Pistons and Connecting Rods. When the fuel-air mixture burns, the expanding gases exert a force on the piston. This force is then transmitted through a connecting rod to the crankshaft. The piston has from three to six or more rings to prevent the gases from escaping past the piston and to keep lubricating oil from getting into the combustion chamber.

Crankshaft changes the reciprocating motion of the pistons into rotary motion. The crankshaft has a number of cranks, or throws. These cranks are displaced at angles to each other. For example, a six-cylinder, in-line, four-stroke cycle engine delivers six power strokes in two revolutions of the crankshaft. The cranks are displaced at 120° angles from each other so that the power strokes are evenly spaced in the two revolutions.

Flywheel stores energy during a piston's power stroke and releases it during other strokes. This helps turn the crankshaft at a constant speed.

Valves. In a four-stroke cycle engine, each cylinder has an intake valve to let the air-fuel mixture into the combustion chamber and an exhaust valve to let the burned gases escape. These are called poppet valves, because they pop up and down as they open and close. The opening in the cylinder block or head uncovered by the valve is called the port. The rim of the port is ground to form the valve seat. In many two-stroke cycle engines, the movement of the piston takes the place of separate valves. As the piston moves, it covers and uncovers the ports.

Camshaft opens and closes the valves. It runs the length of the engine and has two cams at each cylinder--one for the intake valve and one for the exhaust valve. In a four-stroke cycle engine, the camshaft is geared to the crankshaft so that it runs at half the crankshaft's speed. The camshaft may be located in the head of an overhead valve engine, or in the crankcase. Each cam acts through a follower, tappet, or push rod to open a valve at the proper point in the engine cycle.

Fuel System includes (1) a storage tank for gasoline, (2) fuel lines to carry the gasoline to the carburetor, (3) a carburetor to mix air with the gasoline, (4) an intake manifold to distribute the fuel mixture to the cylinders, and (5) an exhaust manifold to carry away the burned gases. The fuel system also includes (1) a gasoline filter to clean dirt out of the fuel, (2) an air cleaner to take dirt out of the air that is mixed with the gasoline, (3) a muffler to silence the noise of exhaust gases from the cylinders, and (4) an exhaust pipe to carry off exhaust gases. A governor may be included in the system to limit the engine's speed.

The Ignition System is the electrical circuit necessary to set fire to, or ignite, the fuel mixture in the different cylinders at different times. In an automobile a storage battery provides electric current, which is increased in voltage by an induction coil. The high-voltage current is carried through a distributor, which delivers the electricity to each cylinder at about the

moment the piston reaches the top of the compression stroke. There the electric current jumps a gap between two terminals and sets fire to the gasoline-air mixture. The terminals are encased in insulating material and called a spark plug. Some automobile engines have an electronic ignition system. These systems use electronic parts, such as capacitors and transistors, to produce the ignition voltage and to control it. Electronic systems require less maintenance than do ordinary systems, and they provide better engine performance.

In an airplane engine, the high-voltage electric current is generated by a magneto and carried to the spark plugs.

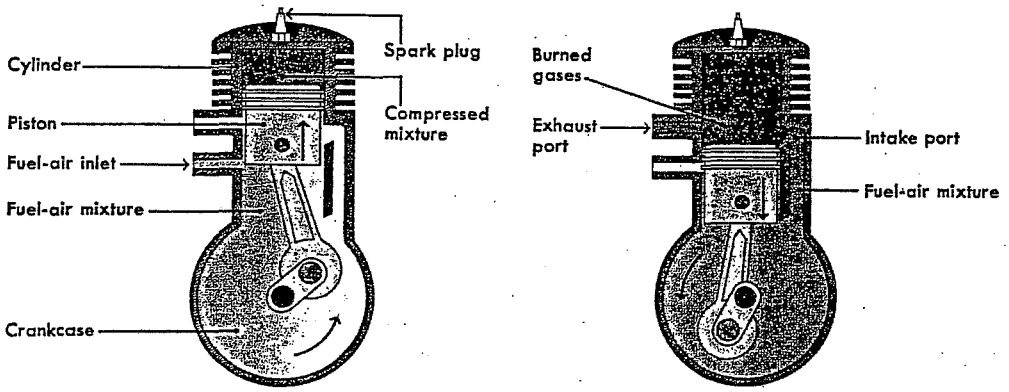
Lubrication System provides oil as a film between the moving parts of the engine to prevent wear from friction and to keep the engine cool. The two common types of four-stroke cycle engine lubrication systems are the wet sump and the dry sump. In the wet-sump engine, the oil supply is contained within the engine, in the bottom of the crankcase. In the dry-sump engine, the oil supply is contained in a separate oil tank.

Most two-stroke cycle engines have no separate lubrication system. Users of these engines mix a small amount of lubricating oil with the gasoline. The oil lubricates the moving parts as the mixture flows through the crankcase.

HOW A TWO-STROKE CYCLE GASOLINE ENGINE WORKS

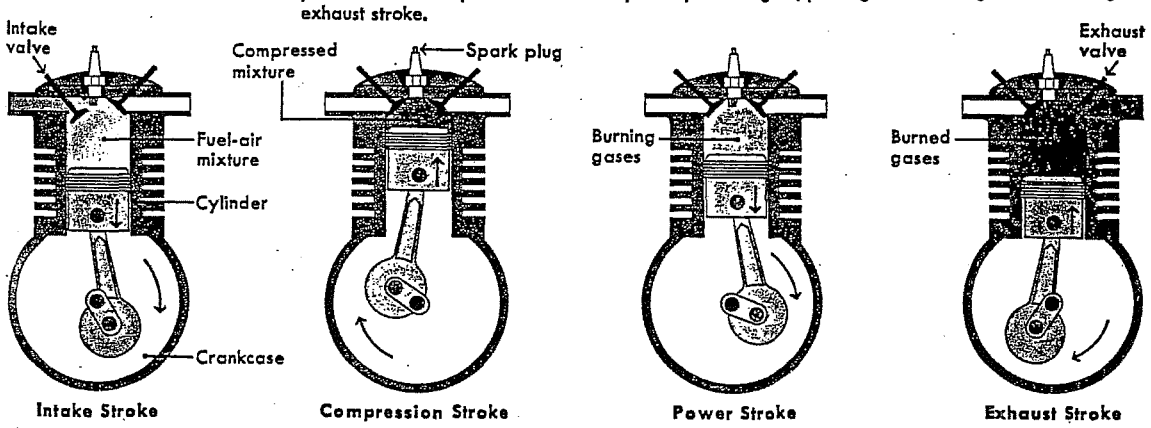
A cycle begins when the piston moves up the cylinder during the intake-compression stroke, *below left*. The piston sucks a fuel-air mixture into the crankcase for the next cycle and compresses the mixture already in the cylinder. When the piston reaches the top, the spark plug ignites the mixture. Burning gases push the piston down for the power-exhaust stroke, *below right*. As the piston uncovers the exhaust port, the gases escape and a fresh mixture enters the cylinder through the intake port.

WORLD BOOK diagram



HOW A FOUR-STROKE CYCLE GASOLINE ENGINE WORKS

A cycle begins with the intake stroke as the piston moves down the cylinder and draws in a fuel-air mixture. Next, the piston compresses the mixture while moving up the cylinder. At the top of the compression stroke, the spark plug ignites the mixture. Burning gases push the piston down for the power stroke. The piston then moves up the cylinder again, pushing the burned gases out during the exhaust stroke.



Answer the following questions for practice.

1. There are two main types of gasoline engines.

   A. reciprocating and rotary
   B. rotary and catalytic
   C. air cooled and reciprocating

2. All gasoline engines operate on either a _____ stroke or a _____ stroke cycle.

   A. 1; 2
   B. 2; 4
   C. 4; 6

3. Which of the following is not part of the four-stroke cycle?

   A. intake stroke
   B. compression stroke
   C. reverse stroke

4. Each cylinder in a two-stroke cycle engine produces a power stroke for every _____ turn(s) of the crankshaft.

   A. one
   B. two
   C. four

5. An engine with a compression ratio of 8 to 1 is considered to be a _____ compression engine.

   A. high
   B. low
   C. moderate

6. The cylinders on air-cooled engines may have metal fins to compensate for the fact that such engines are:

   A. not cooled as effectively as are liquid-cooled engines
   B. much larger than liquid-cooled engines
   C. smaller than liquid-cooled engines

7. The _____ valve arrangement has the intake and exhaust valves side by side in the cylinder block.

   A. overhead
   B. underhead
   C. radial

8. A cylinder block is jacketed to provide:

   A. more horsepower
   B. less friction
   C. circulation of coolant

9. Which of the following is **not** considered to be part of the combustion chamber?

   A. the top of the piston
   B. the crankshaft
   C. the cylinder head

10. You will find the oil pan bolted to the bottom of the:

   A. crankcase
   B. crankshaft
   C. crankshaft bearings

11. The piston rings:

   A. prevent gases from escaping
   B. keep lubricating oil out of the combustion chamber
   C. both of the above

12. The rim of the port is ground to form the:

   A. camshaft
   B. valve seat
   C. exhaust manifold

13. In a four-stroke cycle engine, the _____ run(s) at half the crankshaft's speed.

   A. valves
   B. pistons
   C. camshaft

14. The _____ distributes the fuel mixture to the cylinders:

   A. intake manifold
   B. fuel line
   C. exhaust manifold

15. Some automobiles have _____ ignition systems.

A. chemical
B. magnetic
C. electronic

16. Wet sump and dry sump are two types of:

A. cooling systems
B. ignition systems
C. lubrication systems

17. In a two-stroke cycle engine, when the piston reaches the top of the cylinder:

A. the gases escape
B. the spark plug ignites the mixture
C. fuel enters the cylinder

18. In a four-stroke cycle gasoline engine, burning gases push the piston down for the _____ stroke.

A. power
B. compression
C. exhaust

19. The exhaust valve on a four-stroke cycle gasoline engine is located at the _____ of the cylinder.

A. top
B. middle
C. bottom

20. Capacitors and transistors may be used to produce:

A. added horse power
B. ignition voltage
C. better combustion

See last page for correct answers.

TABLE INTERPRETATION

Firefighters are required, at times, to read and interpret technical information in the form of tables and charts. The table below illustrates the type of technical information which appears in the Alpha examination. This table, which describes the chemical and physical properties of various sulfur compounds, lists six such compounds, their flash points, ignition temperatures, boiling points, melting points, lower and upper flammable limits, vapor densities, and specific gravities.

Properties of Sulfur Compounds

Compound	Flash Point	Ignition Temp.	Boiling Point	Melting Point	Flammable Limits Lower	Flammable Limits Upper	Vapor Density	Specific Gravity
Amyl mercaptan	18°C	--	127°C	-76°C	--	--	3.6	0.8
Carbon disulfide	30°C	100°C	46°C	-111°C	1.3	44.0	2.2	1.3
Dimethyl sulfate	83°C	450°C	188°C	-27°C	1.4	7.5	4.4	1.3
Dimethyl sulfide	-18°C	206°C	37°C	-98°C	2.2	19.7	2.1	0.8
Hydrogen sulfide	--	260°C	-61°C	-116°C	4.3	45.0	1.2	1.08
Sulfur chloride	118°C	234°C	138°C	-80°C	--	--	4.7	1.7

The following are some examples of the types of questions you might encounter in the Alpha examination. The tables in the actual examination will differ from the table presented here, however, you can expect the information in the tables and the questions in the actual test to be highly similar to the material contained in this study guide.

Example:

Which compound has a boiling point above 40°C and flammable limits closest to that of hydrogen sulfide?

A. carbon disulfide
B. dimethyl sulfate
C. dimethyl sulfide

The correct answer is "A", carbon disulfide. Answer "C", dimethyl sulfide is incorrect, because it does not have a boiling point above 40°C. Answer "B", dimethyl sulfate, does have a boiling point above 40°C, however, its flammable limits are not as close to that of hydrogen sulfide as are those of carbon disulfide.

Example:

Which compound has a flash point below 80°C, a melting point of -75°C to -100°C, and a vapor density nearest to 2.0?

A. amyl mercaptan
B. dimethyl sulfide
C. sulfur chloride

Break the question down into separate parts. The first part of the question in the example above asks you to find which compound or compounds have a flash point below 80°C. By consulting the table, you will find that amyl mercaptan and dimethyl sulfide both have flash points below 80°C, but sulfur chloride does not. The flash point of sulfur chloride is **above** 80°C, therefore, this answer cannot be correct. Draw a line through answer "C" in the booklet.

The second part of the question asks which compound or compounds have a melting point of -75°C to -100°C? The table shows that both amyl mercaptan and dimethyl sulfide have melting points within this temperature range. So both "A" and "B" are correct so far.

The third part of the question asks you to find the compound which has a vapor density nearest to 2.0. Of the two remaining compounds, amyl mercaptan has a vapor density of 3.6 and dimethyl sulfide has a vapor density of 2.1. Since the latter is closer to 2.0, the correct answer is "B", dimethyl sulfide.

Example:

Which compound has a boiling point of 30°C to 125°C, a melting point -100°C to -125°C, and a specific gravity of greater than 1.0?

A. carbon disulfide
B. dimethyl sulfide
C. hydrogen sulfide

Of the three possible choices, "C", hydrogen sulfide, does not have a boiling point of 30°C to 125°C. Therefore, this choice is incorrect. Draw a line through choice "C" in the booklet. Of the two remaining choices, only "A", carbon disulfide, has a melting point of -100°C to -125°C. Draw a line through choice "B", because it, too, is incorrect. By the process of elimination, "A" must be correct--even though we have not yet checked the table to determine if its specific gravity is greater than 1.0. If you follow this process of breaking each question down into its separate parts, it will greatly simplify solving these problems!

Do the following problems for practice.

1. Which compound has the greatest difference in temperature when comparing boiling point and melting point?

A. carbon disulfide
B. dimethyl sulfide
C. hydrogen sulfide

2. Which compound has a lower flammable limit which is less than dimethyl sulfide and a boiling point closest to sulfur chloride?

   A. carbon disulfide
   B. hydrogen sulfide
   C. dimethyl sulfate

3. Which compound with a specific gravity of 1.0 to 1.5 has the highest ignition temperature?

   A. dimethyl sulfate
   B. hydrogen sulfide
   C. carbon disulfide

4. Which compound has a temperature difference of more than 25°C between the flash point and the boiling point and an upper flammable limit closest to hydrogen sulfide?

   A. dimethyl sulfide
   B. dimethyl sulfate
   C. carbon disulfide

5. Which compound has a boiling point above amyl mercaptan and a specific gravity which is closest to carbon disulfide?

   A. hydrogen sulfide
   B. dimethyl sulfate
   C. sulfur chloride

6. Which compound has a vapor density and a specific gravity higher than dimethyl sulfide, but an ignition temperature which is lower?

   A. dimethyl sulfate
   B. hydrogen sulfide
   C. carbon disulfide

7. How many compounds have both flash points and melting points below dimethyl sulfide?

   A. none
   B. one
   C. two

8. Which compound has an upper flammable limit and a specific gravity which are lower than carbon disulfide?

   A. hydrogen sulfide
   B. dimethyl sulfate
   C. dimethyl sulfide

9. Which compound has a boiling point, melting point, and vapor density closest to sulfur chloride?

   A. dimethyl sulfide
   B. carbon disulfide
   C. amyl mercaptan

10. Of the compounds with ignition temperatures of less than 250°C, how many have both a vapor density and a specific gravity above 1.2?

   A. one
   B. two
   C. three

CORRECT ANSWERS TO EXERCISES

Reading Comprehension

1. C	11. B
2. B	12. A
3. B	13. C
4. B	14. C
5. A	15. A
6. A	16. C
7. A	17. B
8. C	18. A
9. A	19. B
10. C	20. C

Mathematical Skills

1. B	11. A
2. C	12. A
3. A	13. C
4. C	14. C
5. B	15. A
6. C	16. C
7. A	17. B
8. B	18. C
9. C	19. C
10. C	20. A

Mechanical Comprehension

1. A	11. C
2. B	12. B
3. C	13. C
4. A	14. A
5. B	15. C
6. A	16. C
7. B	17. B
8. C	18. A
9. B	19. A
10. A	20. B

Table Interpretation

1. A
2. C
3. A
4. A
5. B
6. C
7. A
8. C
9. C
10. B