
Section One: Reading Comprehension

Fundamentals (1)

For an understanding of refrigeration, air conditioning and central heating, it is necessary to know some fundamentals, technical/scientific terms, definitions and measurements. Terms such as density, specific gravity, velocity, etc are frequently used in technical passages related to the subject.

The density of a material is the mass per unit volume of the material. Density is expressed as pounds per cubic foot or grams per cubic centimetre. The relative density or specific gravity of a substance is the ratio of the density of the substance to the density of water of 4°C. The specific volume of a substance is the volume occupied by unit mass of the material. By definition it will be clear that specific volume is the reciprocal of density, i.e.

$$\text{Specific Volume} = \frac{1}{\text{Density}}$$

Velocity is the rate of change of position of the body along a straight line in a particular direction. Temperature is an indication of the level of heat in a substance. However, the temperature of a substance does not give an idea of the amount of heat the substance has. A thermometer is the instrument used for the measurement of temperature.

Force, work and power are three other frequently used terms. When we want to move an object we push it or pull it, i.e., we use force. Anything that (1) sets a body in motion or (2) brings a moving body to rest or (3) changes the direction of a moving body is force. Force is measured in weight units such as newton. When a force is acting on a body, 'work' is said to be done. The amount of work done is the product of the force and distance through which the body is moved. Power is the rate of doing work. So power is the work done divided by the time required to do the work. Power is expressed by the unit of horsepower or watt. One watt is defined as the power required to do work at the rate of one joule per second. One horsepower is equivalent to 764 joules. One horsepower is originally defined as the amount of power required to lift 33,000 pounds 1 foot in 1 minute or 550 pound-foot per second.

Energy and pressure are also common terms used in refrigeration and air conditioning fields. The energy of a body is its capacity to do work. It is measured by the total amount of work that the body can do. There are two types of energy. Kinetic energy is the energy a body possesses by virtue of motion or velocity, such as the moving parts of a machine. Potential energy is the stored energy possessed by a system as a result of the relative position of the components of that system. A body situated at a height is said to have potential energy. All kinds of energy can be classified as either kinetic or potential. However, energy may appear in different forms, such as mechanical, electrical, chemical, heat, etc. These are readily converted from one form to another. Pressure is the force exerted per unit area. Whenever a force is evenly distributed over an area, the pressure at any point on the contact surface is the same and can be calculated by dividing the force by the total area over which the force is applied. Pressure is expressed in units, such as pounds per square inch (PSI), pounds per square foot (PSF), kilograms per square centimetre (kg/cm^2), etc.

Part I. Comprehension Exercises

A. Put "T" for true and "F" for false statements. Justify your answers.

1. The only unit to measure density is gram per cubic centimetre.
2. The reciprocal of density of a substance is known as its specific volume.
3. Velocity is something which sets a body in motion.
4. There is a direct relationship between the distance a body moves and the work done.
5. We can easily change electrical energy to heat energy.
6. Moving parts of a machine have kinetic energy in them.

B. Choose a, b, c, or d which best completes each item.

1. The temperature of a substance
 - a. doesn't show the amount of the heat it has
 - b. is the reciprocal of its density
 - c. is measured in weight units
 - d. indicates the velocity of the substance
2. The density of a substance can be defined as
 - a. the mass per unit volume of it
 - b. the volume occupied by unit mass

- c. its motion along a straight line
- d. a force acting on a body

3. Which sentence is Not true about force?

- a. Force can set a body in motion.
- b. Force expresses the amount of energy.
- c. Force changes the direction of a moving body.
- d. Force brings a moving body to rest.

4. When pressure is exerted on a surface, it will be equal at all points of the surface if it is

- a. calculated correctly
- b. expressed in proper units
- c. evenly distributed over the surface
- d. applied by the total area

5. A body has potential energy because of its

- a. heat
- b. position
- c. direction
- d. motion

C. Answer the following questions orally.

1. Why is it necessary to know technical terms?
2. What are the two common units used to express density?
3. What do we mean by specific volume of a material?
4. How do we calculate the amount of work?
5. What are some forms of energy?
6. What does the temperature of a material tell us about that material?
7. What is the term used to refer to 'the capacity of a body to do work'?

Part II. Language Practice

A. Choose a, b, c, or d which best completes each item.

1. Anything which space and has weight is considered to be matter.
 - a. occupies
 - b. defines
 - c. measures
 - d. relates
2. Raw materials are to finished products in a manufacturing system.
 - a. situated
 - b. divided
 - c. converted
 - d. calculated
3. Unit area is one of the used in measuring pressure.
 - a. substances
 - b. passages

c. weightsd. factors

4.The of heat in a substance is shown by its temperature.

a. capacityb. type

c. heightd. level

5.Energy can be into two types: kinetic and potential.

a. classifiedb. exerted

c. possessedd. removed

B.Fill in the blanks with the appropriate forms of the words given.

1.Dense

a.The of water is the standard criterion to calculate the specific volume of other substances.

b. A substance is very heavy in relation to its unit of volume.

c.Some materials are said to be more structured than the others because of their compact molecular structures.

2.Measure

a.In the field of air conditioning systems there have recently been and significant improvements.

b. Fahrenheit and Centigrade are two of temperature.

c.Atmospheric pressure is with the help of a barometer.

3. Force

a. In moving an object from one place to another we use

b.The teacher's speech and argument made the students understand the concepts of refrigeration very well.

c. The thief the man to hand over the money.

4.Direct

a.The rate of change of position of the body along a straight line in a particular is its velocity.

b.When there is a great difference in temperature between patches of air next to each other, the colder air is towards the warmer air.

c. There is a relationship between work and power.

5. Indicate

a.The temperature of a substance is not an of the amount of heat it possesses.

b.Litmus paper can be used as an of the presence of acid in a solution.

c. A thermometer the temperature of a substance.

C.Fill in the blanks with the following words.

interior convection heater combustion
 transferred coil convey central
 pressure location engine forced

Convection heat transfer is used to move heat from one to another. When heat is moved, it is normally into some substance that is readily movable, such as air or water. Many large buildings have a heating plant where water is heated and pumped throughout the building to the final heated space. Notice the similarity of the words ‘convection’ and ‘.....’ (to carry from one place to another). The automobile heater is a good example of heat. Heat from the engine’s process is passed by conduction to the water. Hot water from the is then passed through a heater coil. The heat in the water is transferred by convection from the water in the engine to the heater The heat is transferred through the coil from the water to air and conveyed to the car’s by the heater fan. When a fan or pump is used to convey the heat, the process is called convection.

D.Put the following sentences in the right order to form a paragraph. Write the corresponding letters in the boxes provided.

- a.Many changes in matter are brought about by such things as heat, light, sound, and electric current.
- b.We have a special word for it; we call it energy.
- c.Matter is anything that takes up space and has mass.
- d.So there is something besides matter in our world which makes matter move or change.
- e.Yet these things are not matter because they do not take up space and do not have mass.
- f.In science, we have a special word for all materials.
- g.Heat, light, sound, and electric currents are just some of its different forms.
- h.We call all materials matter.

1	2	3	4	5	6	7	8

- - -

Section Two: Further Reading

Fundamentals (2)

Temperature

The word 'temperature' is used in everyday discussions or descriptions about comfort, weather, and food preparation. It is used in many conversations and decision-making processes by people who still do not know exactly how far-reaching the word is or what it really means.

Temperature can be thought of as a description of the level of heat. For now, heat can be thought of as energy in the form of molecules in motion. The starting point of temperature is, therefore, the starting point of molecular motion. To describe this in more usable terms, we will describe some more familiar points of reference.

Most people know that the freezing point of water is 32 degrees Fahrenheit (32°F) and that the boiling point is 212 degrees Fahrenheit (212°F). These points are commonly indicated on a thermometer.

Early thermometers were of glass-stem types operating on the theory that when the substance in the bulb was heated it would expand and rise up in the tube (Figure 1-1). Mercury and alcohol are still commonly used today for this application, though more progressed electronic instruments are also used for the measurement of temperature.

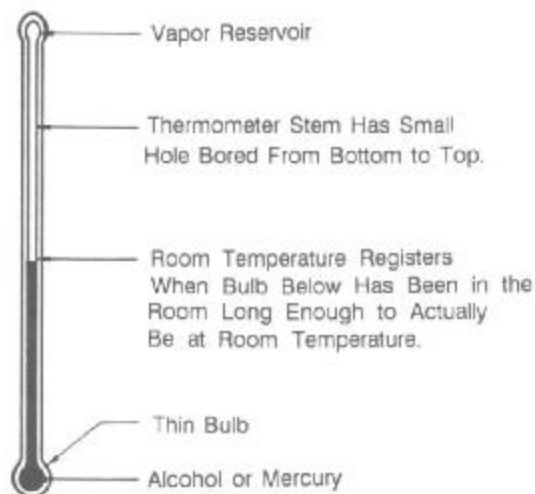


Figure 1-1. Thermometer

We must qualify the statement that water boils at 212°F. Pure water boils at precisely 212°F at sea level when the atmosphere is 70°F. This qualification concerns the relationship of the earth's atmosphere to the boiling point. The statement that water boils at 212°F at sea level when the atmosphere is 70°F is important because these are standard conditions applied to actual practice.

Pure water has a freezing point of 32°F. Obviously the temperature can go lower than 32°F, but the question is, how much lower?

The theory is that molecular motion stops at -460°F . This is theoretical because molecular motion has never been totally stopped. The complete stopping of molecular motion is recorded as absolute zero. This has been calculated to be -460°F . Scientists have actually come within a few degrees of reaching absolute zero.

Fahrenheit is a system of temperature measurement used in the English measurement system. Celsius is a term used in the metric measurement system.

Our earlier statement that temperature describes the level of heat or molecular motion can now be explained. As a substance becomes warmer, the molecular motion, and therefore the temperature, increases.

Introduction to Heat

The laws of thermodynamics can help us to understand what heat is all about. One of these laws states that heat can neither be created nor destroyed. This means that all of the heat that the world experiences is not created but is merely converted to usable heat from something that is already here. This heat can also be accounted for when it is transferred from one substance to another.

Heat can now be more fully explored by using temperature as one of the describing factors. Remember, temperature describes the level of heat with reference to no heat. The term used to describe the quantity of heat is known as the British thermal unit (Btu). This term explains how much heat is contained in a substance.

The Btu is defined as the amount of heat required to raise the temperature of 1 lb of water 1°F. For example, when 1 lb of water (about 1 pint) is heated from 68°F to 69°F, 1 Btu of heat energy is absorbed into the water. To actually measure how much heat is absorbed in a process like this, we need an instrument of laboratory quality. This instrument is called a calorimeter.

When there is a temperature difference, heat transfer will take place. Temperature difference is the driving force behind heat transfer. The greater the temperature difference, the greater the heat transfer. Heat flows naturally from a warmer substance to a cooler substance.

Sensible Heat

Heat level can readily be measured when it changes the temperature of a substance (remember the example of changing 1 lb of water from 68°F to 69°F). This process can be measured with a thermometer and can easily be seen. When a change of temperature can be registered, we know that the level of heat has changed and is called sensible heat.

Latent Heat

Another type of heat is called latent or hidden heat. In this process heat is known to be added but no temperature rise is noticed. A good example is heat added to water while it is boiling in an open container. Once water is brought to the boiling point, adding more heat only makes it boil faster; it does not raise the temperature.

Specific Heat

It was mentioned that when 1 Btu of heat energy is added to 1 lb of water, it changes the temperature 1°F. This only holds true for water. When other substances are heated, different values occur. For instance, adding 0.5 Btu of heat energy to either ice or steam (water vapour) causes a 1°F rise per pound while in these states. They are heated at twice the rate. Adding 1 Btu would cause a 2°F rise. This difference in heat rise is known as specific heat.

Specific heat is the amount of heat necessary to raise the temperature of 1 lb of a substance 1°F. Every substance has a different specific heat.

Whitman (1988), pp. 1-8.

Comprehension Exercises

A. Put “T” for true and “F” for false statements. Justify your answers.

1. Temperature is in fact the same as heat.
2. A substance at absolute zero has some kind of slow molecular motion.
3. In the process of changing ice to liquid water, the temperature remains constant.

4.The heat absorbed by the ice to increase its temperature from -5°C to 0°C is its sensible heat.

5.According to one of the laws of thermodynamics heat can be produced or destroyed.

6.Pure water boils at 212°F at sea level regardless of the temperature of the atmosphere.

B.Choose a, b, c, or d which best completes each item.

1.The energy needed to change ice to liquid is known as

- a.latent heat
- b. sensible heat
- c.specific heat
- d. melting point

2.Heat flows

- a. from a higher to a lower point
- b. as the temperature changes
- c. from a warmer substance to a colder one
- d. wherever there is space

3.When heat is added to a substance and the substance gets warmer, the heat is called heat.

- a. latent
- b. absolute
- c. specific
- d. sensible

4.Some people think that temperature is the same as heat, because

- a. temperature is an indicator of heat in an object
- b. heat and temperature are two terms to show the same concept
- c. temperature and heat are two forms of energy
- d. they don't know anything about absolute zero

5.A calorimeter is used to measure the

- a. temperature of a substance being heated
- b. amount of heat absorbed by a heated substance
- c. specific heat differences of various substances
- d. rate of heat transfer from a hot substance to a colder one

C.Write answers to the following questions.

1.What is the term used to the heat detected by touching?

2.What happens to the temperature during the change of solid to liquid?

3.Define temperature.

4.What is another term for latent heat?

5. What is calorimeter used for?

6. What do we mean by 1 Btu?

- - -

Section Three: Translation Activities

A. Translate the following passage into Persian.

Conduction

Conduction is described as the transfer of heat between the closely packed molecules of a substance or between substances that are touching or in good contact with one another. When the transfer of heat occurs in a single substance, such as a metal rod with one end in a fire or flame, movement of heat continues until there is a temperature balance throughout the length of the rod.

If the rod is immersed in water, the rapidly moving molecules on the surface of the rod will transmit some heat to the molecules of water, and still another transfer of heat by conduction takes place. As the outer surface of the rod cools off, there is still some heat within the rod, and this will continue to transfer to the outer surfaces of the rod and then to the water, until a temperature balance is reached.

The speed with which heat will transfer by means of conduction will vary with different substances if the substances are of the same dimensions. The rate of heat transfer will vary according to the ability of the material to conduct heat. Solids, on the whole, are much better conductors than liquids; liquids conduct heat better than gases or vapors.

Most metals, such as silver, copper, steel, and iron, conduct heat fairly rapidly, whereas other solids such as glass, wood, or other building materials, transfer heat at a much slower rate and therefore are used as insulators.

Metals with a high conductivity are used within the refrigeration systems because it is desirable that rapid transfer of heat occur in both evaporator and condenser. The evaporator is where heat is removed from the conditioned space or substance or from air that has been in direct contact with the substance; the condenser dissipates this heat to another medium or space.

B.Find the Persian equivalents of the following terms and write them in the spaces provided.

- 1.central heating.....
- 2.component.....
- 3.conduction.....
- 4.conductor.....
- 5.convert.....
- 6.cross-sectional area.....
- 7.density.....
- 8.distribute.....
- 9.enclosed space.....
- 10.force.....
- 11.gravity.....
- 12.heat flow.....
- 13.measurement.....
- 14.medium.....
- 15.power.....
- 16.rate.....
- 17.ratio.....
- 18.reciprocal.....
- 19.refrigeration.....
- 20.relative density.....
- 21.square inch.....
- 22.substance.....
- 23.temperature.....
- 24.transfer.....
- 25.volume.....