Halliday/Resnick/Walker
Fundamentals of Physics 8th edition

Classroom Response System Questions

Chapter 18 Temperature, Heat, and the First Law of Thermodynamics

Reading Quiz Questions
18.1.1. What is the branch of physics called that involves the study and application of the thermal energy of systems?

a) adiabatics

b) thermodynamics

c) theronucleonics

d) isentropics

e) kelvinomics
18.1.1. What is the branch of physics called that involves the study and application of the thermal energy of systems?

a) adiabatics

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d) isentropics

e) kelvinomics
18.2.1. What is unique about the Kelvin temperature scale?

a) It is the most widely used temperature scale around the world.

b) It is divided into temperature units called degrees.

c) It is based on the fact that there is a lower limit to temperature called absolute zero.

d) It is named after a person.

e) It is based on multiples of 10.
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18.2.2. According to the text, what was the temperature at the beginning of the Universe?

a) zero K

b) 3 K

c) 290 K

d) $10^{11}$ K

e) $10^{39}$ K
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a) zero K
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d) $10^{11}$ K
e) $10^{39}$ K
18.3.1. What does the zeroth law of thermodynamics concern?

a) the rate of energy flow from one system to another

b) the process by which an object achieves thermal equilibrium

c) the amount of work done on or by a system

d) the circumstances under which objects are in thermal equilibrium

e) the definition of the Kelvin temperature scale
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18.3.2. Which one of the following variables is the best indicator of thermal equilibrium between two systems in thermal contact?

a) pressure

b) volume

c) temperature

d) mass

e) time
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a) pressure
b) volume
c) temperature
d) mass
e) time
18.3.3. The zeroth law of thermodynamics provides a basis for the use of which one of the following devices?

a) thermometer

b) barometer

c) steam engine

d) refrigerator

e) furnace
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b) barometer

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18.4.1. Which one of the following could not be used as a thermometric property in the construction of a thermometer?

a) the change in length of a metal rod

b) the change in volume of a liquid

c) the change in pressure of a gas at constant volume

d) the change in mass of a solid

e) the change in electrical resistance of a wire
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18.4.2. What is the term used to describe the temperature at which liquid water, ice, and water vapor are all in thermal equilibrium?

a) miscibility gap

b) fusion point

c) meniscus temperature

d) parity temperature

e) triple point
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e) triple point
18.4.3. What is the phase of a substance that is at its triple point temperature?

a) solid

b) liquid

c) gas

d) all of the above

e) none of the above
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18.5.1. Which one of the following temperatures is approximately equal to "room temperature?"

a) 0 K
b) 0 °C
c) 100 °C
d) 212 °F
e) 295 K
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a) 0 K

b) 0 °C

c) 100 °C

d) 212 °F

e) 295 K
18.5.2. Complete the following statement: A temperature decrease of 30 °C is equal to a temperature decrease of

a) 30 °F.

b) 30 K.

c) 17 °F.

d) 26 °F.

e) 303 K.
18.5.2. Complete the following statement: A temperature decrease of 30 °C is equal to a temperature decrease of

a) 30 °F.

b) 30 K.

c) 17 °F.

d) 26 °F.

e) 303 K.
18.5.3. Three thermometers are in the same water bath. After thermal equilibrium is established, it is found that the Celsius thermometer reads 100 °C, the Fahrenheit thermometer reads 212 °F, and the Kelvin thermometer reads 273 K. Which one of the following statements is the most reasonable conclusion?

a) The Kelvin thermometer is incorrect.

b) The Celsius thermometer is incorrect.

c) The Fahrenheit thermometer is incorrect.

d) All three thermometers are incorrect.

e) The three thermometers are at different temperatures.
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b) The Celsius thermometer is incorrect.

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d) All three thermometers are incorrect.

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18.5.4. Which of the following temperatures is equivalent to zero degrees on the Celsius temperature scale?

a) 0 K  
b) 100 K  
c) 32 K  
d) 273 K  
e) 469 K
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b) 100 K

c) 32 K

d) 273 K

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18.6.1. A rod with an initial length 3.000 cm is heated so that its temperature increases by 89° C. When the length is measured again, the length has increased by 0.006 cm. This behavior is an example of which one of the following material properties?

a) specific heat capacity

b) thermal stress

c) thermal expansion

d) thermometry

e) thermal diffusion
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18.6.2. Complete the following statement: Bimetallic strips used as adjustable switches in electric appliances consist of metallic strips that must have different

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b) specific heat capacities.

c) lengths.

d) volumes.

e) mass.
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c) lengths.

d) volumes.

e) mass.
18.6.3. A square plate made of lead has an oval-shaped hole. The oval may be described by the lengths $a$ and $b$ as shown in the drawing. Which of the following correctly describes the plate after its temperature is increased by two hundred Celsius degrees?

a) The size of the plate will increase, but $a$ and $b$ will both decrease.

b) The size of the plate will remain unchanged, but $a$ and $b$ will both increase.

c) The size of the plate will increase, and $a$ and $b$ will both increase.

d) The size of the plate will remain unchanged, but $a$ and $b$ will both decrease.

e) The size of the plate will increase, but only $a$ will increase.
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18.6.4. A circular hole is drilled through a penny. Complete the following statement: When the penny is heated,

a) the hole decreases in diameter.

b) the metal part of the penny expands outward, but the size of the hole does not change.

c) the area of the hole increases by the same amount as a similar area of the metal does.

d) linear expansion causes the shape of the hole to become slightly oval-shaped.

e) the area of the hole increases more than a similar area of the metal does
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18.6.5. Which one of the following statements explains why it is difficult to measure the coefficient of volume expansion for a liquid?

a) Liquids are more compact than gases.

b) The liquid will lose heat to the containing vessel.

c) Liquids tend to expand more slowly than solids.

d) Liquids are more compact than solids.

e) The volume of the containing vessel will also increase.
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e) The volume of the containing vessel will also increase.
18.6.6. On one very cold winter evening, iron pipes containing water burst open. What caused this catastrophe?

a) In the cold, the iron pipe contracted more than the water.

b) The outside of the pipe contracted more than the inside because the outside temperature was less than the inside temperature.

c) When water freezes, it expands. This expansion of the water could not be stopped by the iron pipe.

d) The iron pipe became brittle and broke under the weight of the water.

e) When water freezes, it chemically reacts with the iron and weakens it.
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18.7.1. Complete the following statement: The term heat most accurately describes

a) the flow of energy due to a temperature difference.

b) the molecular motion inside of an object.

c) the internal energy of an object.

d) a measure of how hot an object is.

e) the absolute temperature of an object.
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a) the flow of energy due to a temperature difference.

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18.7.2. Heat is expressed in the same units as which one of the following quantities?

a) temperature

b) power

c) force/time

d) specific heat capacity

e) work
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18.8.1. Two balls, one made of copper and one made of gold, have the same mass and temperature. The same amount of heat is added to each sphere, but the final temperature of the two spheres is different. Which one of the following statements best explains the reason for these temperature differences?

a) The specific heat capacity of the two spheres is different.

b) The density of the two spheres is different.

c) The volumes of the two spheres are different.

d) The coefficient of volume expansion of the two spheres is different.

e) The latent heat of vaporization of the two spheres is different.
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18.8.2. During a certain thermal process a solid object’s temperature changes. Which of the following quantities is not related to the amount of the temperature change?

a) mass

b) the amount of heat added or removed

c) volume

d) the material of which the object is composed

e) the specific heat capacity
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18.8.3. Which one of the following statements is the definition of the specific heat capacity of an object?

a) The specific heat capacity is the amount of energy per unit mass to raise the temperature of the object from its freezing point to its boiling point.

b) The specific heat capacity is the amount of energy per unit mass to raise the temperature of the object by 1°C.

c) The specific heat capacity is the temperature of the object divided by its density.

d) Given one gram of the material, the specific heat capacity is the amount of energy to change the material from solid to liquid.

e) Given one gram of the material, the specific heat capacity is the amount of energy to change the material from a solid to a gas.
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18.8.4. At the steel factory, the hot steel began to show signs of fusion. Which one of the following statements is another way of expressing what the steel did?

a) The hot steel began to sublime as it cooled.

b) The hot steel began to vaporize as it was heated further.

c) The hot steel began to condense as it was cooled.

d) The hot steel began to freeze as it cooled.

e) The hot steel began to melt as it was heated further.
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18.8.5. The fresh seafood was shipped in dry ice. By the time the package arrived at its destination, half of the dry ice had sublimed. Which one of the following statements is another way of expressing what the dry ice did?

a) The dry ice had gone from a solid to a liquid state.

b) The dry ice had gone from a solid to a gaseous state.

c) The dry ice had condensed.

d) The dry ice had gone from a liquid into a gaseous state.

e) The dry ice had chemically reacted with the seafood and was absorbed by it.
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18.8.6. What does the heat capacity of an object measure?

a) the amount of energy required to change the temperature of an object

b) the total amount of energy an object can store

c) the thermal potential energy of the object

d) the amount of work done by the object

e) the amount of energy required to melt a solid object
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- b) the total amount of energy an object can store
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18.10.1. Complete the following statement: The first law of thermodynamics states that

a) the entropy of the universe is increasing.

b) entropy is a function of the state of a system.

c) heat is a form of energy.

d) the change in the internal energy of a system is given by $Q - W$.

e) two systems in thermal equilibrium with a third system are in equilibrium with each other.
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18.10.2. When applying the first law of thermodynamics to a system, when is heat a positive quantity?

a) when the system does work

b) when the system has work done on it

c) when the system absorbs heat

d) when the system loses heat

e) when no work is done either on the system or by the system
18.10.2. When applying the first law of thermodynamics to a system, when is heat a positive quantity?

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18.11.1. Which one of the following phrases correctly describes an adiabatic process?

a) no loss of energy occurs

b) no transfer of energy as heat

c) no change in temperature occurs

d) no change in system volume occurs

e) no change in system pressure occurs
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e) no change in system pressure occurs
18.11.2. The product of the pressure and volume of a system $PV$ has the same SI units as which one of the following choices?

a) force

b) work

c) acceleration

d) momentum

e) impulse
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18.11.3. In a certain isothermal process, the pressure and volume vary as shown on the graph. The shaded area under the isotherm curve is equal to which of the following choices?

a) work

b) force

c) kinetic energy

d) momentum

e) temperature
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18.12.1. Which one of the following statements concerning thermal conductors is true?

a) A good thermal conductor often exhibits a very low thermal expansion coefficient.

b) A good thermal conductor is often a poor electrical conductor.

c) A good thermal conductor is often more likely to be a gas rather than a solid.

d) A good thermal conductor often exhibits a very low specific heat capacity.

e) A good thermal conductor is often also a good electrical conductor.
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e) A good thermal conductor is often also a good electrical conductor.
18.12.2. Under which one of the following circumstances is heat transferred via convection?

a) A steel disc is heated to 800 °C within an evacuated furnace chamber.

b) Ice cubes dropped into a glass of water at room temperature begin to melt.

c) An electrically heated rod is plugged into a metal plate used for cooking. The temperature of the metal plate then increases.

d) As a jogger runs, heat generated in her body passes through fat cells under her skin before passing through her skin.

e) The temperature of a black cast iron frying pan increases as sunlight shines on it.
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e) The temperature of a black cast iron frying pan increases as sunlight shines on it.
18.12.3. Under which one of the following circumstances will heat transfer occur via convection?

a) Convection occurs within metal objects.

b) Convection only occurs in non-metallic solids.

c) Convection occurs only within a vacuum.

d) Convection occurs in the presence of a liquid or a gas.

e) Convection can occur whether matter is present or not.
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d) Convection occurs in the presence of a liquid or a gas.

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18.12.4. Which one of the following is not an example of convection?

a) An eagle soars on an updraft of wind.

b) Spaghetti is cooked in water.

c) Smoke rises above a fire.

d) An electric heater warms a room.

e) A person gets a suntan on a beach.
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18.12.5. The rate of heat flow through the wall of a house does not depend on which one of the following quantities?

a) The dimensions of the wall.

b) The thickness of the wall.

c) The specific heat capacity of the wall.

d) The temperatures outside and inside the house.

e) The thermal conductivity of the wall.
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a) The dimensions of the wall.

b) The thickness of the wall.

c) The specific heat capacity of the wall.

d) The temperatures outside and inside the house.

e) The thermal conductivity of the wall.
18.12.6. Suppose you are sitting next to a fireplace in which there is a fire burning. One end of a metal poker has been left in the fire. Which one of the following statements concerning this situation is true?

a) Heat escapes through the chimney primarily through conduction.

b) The other end of the poker is warmed through convection.

c) You can feel the heat of the fire primarily because of conduction.

d) The other end of the poker is warmed through conduction.

e) You can feel the heat of the fire primarily because of convection.
18.12.6. Suppose you are sitting next to a fireplace in which there is a fire burning. One end of a metal poker has been left in the fire. Which one of the following statements concerning this situation is true?

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d) The other end of the poker is warmed through conduction.

e) You can feel the heat of the fire primarily because of convection.
18.12.7. One end of an aluminum rod is maintained at 0 °C in an ice water bath. The other end of the rod is maintained at 100 °C in a boiling water bath. The amount of heat that flows through the rod via conduction during a time interval $t$ is not dependent on which one of the following parameters?

a) the mass of the rod

b) the length of the time interval

c) the length of the rod

d) the temperatures at the ends of the rod

e) the thermal conductivity of aluminum
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c) the length of the rod

d) the temperatures at the ends of the rod

e) the thermal conductivity of aluminum
18.12.8. You are looking for a material that is a very good conductor of heat. Select from the following choices the best material for this purpose.

a) concrete

b) lead

c) copper

d) air

e) steel
18.12.8. You are looking for a material that is a very good conductor of heat. Select from the following choices the best material for this purpose.

a) concrete
b) lead
c) copper
d) air
e) steel
18.12.9. Which one of the following objects will be most efficient in losing heat? Assume that all of the objects are at the same temperature initially.

a) a graphite cube with a black, rough surface surrounded by air

b) a polished silver cube in an evacuated chamber

c) a polished silver cube surrounded by air

d) a graphite cube with a black, rough surface in an evacuated chamber

e) a polished graphite cube surrounded by air
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c) a polished silver cube surrounded by air

d) a graphite cube with a black, rough surface in an evacuated chamber

e) a polished graphite cube surrounded by air
18.12.10. Which of the following describes the energy radiated from an object at Kelvin temperature $T$?

a) Planck distribution

b) Stefan-Boltzmann law

c) Maxwell blackbody law

d) Bose-Einstein equation

e) Klein-Gordon equation
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a) Planck distribution

b) Stefan-Boltzmann law

c) Maxwell blackbody law

d) Bose-Einstein equation

e) Klein-Gordon equation
18.12.11. Which one of the following statements concerning emissivity is false?

a) Emissivity depends on the condition of the surface.

b) Emissivity is a dimensionless quantity.

c) Emissivity depends on the surface area of the object.

d) The emissivity is 1.0 for a perfect absorber.

e) The emissivity is 1.0 for a perfect radiator.
18.12.11. Which one of the following statements concerning emissivity is false?

a) Emissivity depends on the condition of the surface.

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d) The emissivity is 1.0 for a perfect absorber.

e) The emissivity is 1.0 for a perfect radiator.
18.12.12. Which one of the following statements concerning the Stefan-Boltzmann equation is true?

a) The equation can be used to calculate the power absorbed by any surface.

b) The equation applies only to perfect absorbers.

c) The equation applies only to perfect radiators.

d) The equation is valid with any temperature units.

e) The equation describes the transport of thermal energy by conduction.
18.12.12. Which one of the following statements concerning the Stefan-Boltzmann equation is true?

a) The equation can be used to calculate the power absorbed by any surface.

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d) The equation is valid with any temperature units.

e) The equation describes the transport of thermal energy by conduction.
18.12.13. The three objects shown have machined out of a block of brass. The cube and pyramid have sides of length $L$. The sphere has a radius equal to $L$. The three objects are all maintained at the same temperature $T$ that is much hotter than that of the surroundings and they are sitting on a thermally insulating slab. Which object(s) exhibit(s) the greatest rate of radiative heat transfer?

a) cube only
b) pyramid only
c) sphere only
d) cube and sphere
e) cube and pyramid
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a) This is done to minimize heat transfer by radiation.

b) This is done to protect the wall of the bottle that is silvered.

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