Physics: Principles and Applications, 6e Giancoli
Chapter 14 Heat

Conceptual Questions

1) Which of the following is the smallest unit of heat energy?
A) Calorie
B) Kilocalorie
C) Btu
D) Joule
Answer: D
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.1

2) The amount of heat necessary to raise the temperature of 1 gram of water by 1°C is referred to as the
A) calorie.
B) kilocalorie.
C) British thermal unit.
D) joule.
Answer: A
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.1

3) The measure of the average kinetic energy of individual molecules is referred to as
A) internal energy.
B) thermal energy.
C) temperature.
D) heat.
Answer: C
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.2

4) A cup of water is scooped up from a swimming pool of water. Compare the temperature T and the internal energy U of the water, in both the cup and the swimming pool.
A) T_{Pool} is greater than T_{Cup}, and the U is the same.
B) T_{Pool} is less than T_{Cup}, and the U is the same.
C) T_{Pool} is equal to T_{Cup}, and U_{Pool} is greater than U_{Cup}.
D) T_{Pool} is equal to T_{Cup}, and U_{Pool} is less than U_{Cup}.
Answer: C
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.2

5) The internal energy of an ideal gas depends on
A) its volume.
B) its pressure.
C) its temperature.
D) all of the above
Answer: C
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.2

6) An ideal gas at STP is first compressed until its volume is half the initial volume, and then it is allowed to expand until its pressure is half the initial pressure. All of this is done while holding the temperature constant. If the initial internal energy of the gas is U, the final internal energy of the gas will be

A) U.

B) U/3.

C) U/2.

D) 2U.

Answer: A

Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.2

7) An ideal gas with internal energy U at 200°C is heated to 400°C. Its internal energy then will be

A) still U.

B) 2 U.

C) 1.4 U.

D) 1.2 U.

Answer: C

Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.2

8) The reason ocean temperatures do not vary drastically is that

A) water has a relatively high rate of heat conduction.

B) water is a good radiator.

C) water has a relatively high specific heat.

D) water is a poor heat conductor.

Answer: C

Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.3

9) It is a well-known fact that water has a higher specific heat capacity than iron. Now, consider equal masses of water and iron that are initially in thermal equilibrium. The same amount of heat, 30 calories, is added to each. Which statement is true?

A) They remain in thermal equilibrium.

B) They are no longer in thermal equilibrium; the iron is warmer.

C) They are no longer in thermal equilibrium; the water is warmer.

D) It is impossible to say without knowing the exact mass involved and the exact specific heat capacities.

Answer: B

Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.3

10) A thermally isolated system is made up of a hot piece of aluminum and a cold piece of copper; the aluminum and the copper are in thermal contact. The specific heat capacity of aluminum is more than double that of copper. Which object experiences the greater magnitude gain or loss of heat during the time the system takes to reach thermal equilibrium?

A) the aluminum

B) the copper

C) Neither; both experience the same size gain or loss of heat.

D) It is impossible to tell without knowing the masses.

Answer: C

Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.4

11) Phase changes occur
A) as the temperature decreases.
B) as the temperature increases.
C) as the temperature remains the same.
D) all of the above
Answer: C
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.5

12) The heat required to change a substance from the solid to the liquid state is referred to as the
A) heat of fusion.
B) heat of vaporization.
C) heat of melting.
D) heat of freezing.
Answer: A
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.5

13) The heat required to change a substance from the liquid to the vapor state is referred to as the
A) heat of fusion.
B) heat of vaporization.
C) heat of evaporation.
D) heat of condensation.
Answer: B
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.5

14) If heat is added to a pure substance at a steady rate,
A) its temperature will begin to rise.
B) it will eventually melt.
C) it will eventually boil.
D) More than one of the above is true.
E) None of the above is true.
Answer: D
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.5

15) When a solid melts
A) the temperature of the substance increases.
B) the temperature of the substance decreases.
C) heat energy leaves the substance.
D) heat energy enters the substance.
Answer: D
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.5

16) When a liquid freezes
A) the temperature of the substance increases.
B) the temperature of the substance decreases.
C) heat energy leaves the substance.
D) heat energy enters the substance.

Answer: C
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.5

17) When a liquid evaporates
A) the temperature of the substance increases.
B) the temperature of the substance decreases.
C) heat energy leaves the substance.
D) heat energy enters the substance.
Answer: D
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.5

18) When a vapor condenses
A) the temperature of the substance increases.
B) the temperature of the substance decreases.
C) heat energy leaves the substance.
D) heat energy enters the substance.
Answer: C
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.5

19) In a cloud formation, water vapor condenses into water droplets which get bigger and bigger until it rains. This will cause the temperature of the air in the clouds to
A) increase.
B) decrease.
C) stay constant.
D) freeze.
Answer: A
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.5

20) Turning up the flame under a pan of boiling water causes
A) the water to boil away faster.
B) the temperature of the boiling water to increase.
C) both the water to boil away faster and the temperature of the boiling water to increase.
D) none of the above
Answer: A
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.5

21) Equal masses of water at 20°C and 80°C are mixed. What is the final temperature of the mixture?
A) 40°C
B) 50°C
C) 60°C
D) 70°C
Answer: B
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.5

22) A chunk of ice (T = -20°C) is added to a thermally insulated container of cold water (T = 0°C). What happens in the container?
A) The ice melts until thermal equilibrium is established.
B) The water cools down until thermal equilibrium is established.
C) Some of the water freezes and the chunk of ice gets larger.
D) none of the above
Answer: C
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.5

23) The process whereby heat flows by means of molecular collisions is referred to as
A) conduction.
B) convection.
C) radiation.

D) inversion.
Answer: A
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

24) By what primary heat transfer mechanism does one end of an iron bar become hot when the other end is placed in a flame?
A) natural convection
B) conduction
C) radiation
D) forced convection
Answer: B
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

25) On a cold day, a piece of metal feels much colder to the touch than a piece of wood. This is due to the difference in which one of the following physical property?
A) density
B) specific heat
C) latent heat
D) thermal conductivity
Answer: D
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

26) If you double the thickness of a wall built from a homogeneous material, the rate of heat loss for a given temperature difference across the thickness will
A) become one-half its original value.
B) also double.
C) become one-fourth its original value.
D) none of the above
Answer: A
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

27) A layer of insulating material with thermal conductivity K is placed on a layer of another material of thermal conductivity 2K. The layers have equal thickness. What is the effective thermal conductivity of the composite sheet?
A) 3K
B) 1.5K
C) K/3
D) 2K/3
Answer: D
Diff: 3 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

28) The process whereby heat flows by the mass movement of molecules from one place to another is referred to as
A) conduction.
B) convection.
C) radiation.
D) inversion.
Answer: B
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

29) By what primary heat transfer mechanism is a pot of water heated on a stove?
A) convection
B) conduction
C) radiation
D) all of the above in combination
Answer: A
Diff: 3 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

30) Convection can occur
A) only in solids.
B) only in liquids.
C) only in gases.
D) only in liquids and gases.
E) in solids, liquids, and gases.
Answer: D
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

31) Which of the following best explains why sweating is important to humans in maintaining suitable body temperature?
A) Moisture on the skin increases thermal conductivity, thereby allowing heat to flow out of the body more effectively.
B) Evaporation of moisture from the skin extracts heat from the body.
C) The high specific heat of water on the skin absorbs heat from the body.
D) Functioning of the sweat glands absorbs energy that otherwise would go into heating the body.
E) None of the above explains the principle on which sweating depends.
Answer: B
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

32) A spaceship is drifting in an environment where the acceleration of gravity is essentially zero. As the air on one side of the cabin is heated by an electric heater, what is true about the convection currents caused by this heating?
A) The hot air around the heater rises and the cooler air moves in to take its place.
B) The hot air around the heater drops and the cooler air moves in to take its place.
C) The convection currents move about the cabin in a random fashion.
D) There are no convection currents.
Answer: C
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

33) Consider two neighboring rectangular houses built from the same materials. One of the houses has twice the length, width, and height of the other. Under identical climatic conditions, what would be true about the rate that heat would have to be supplied to maintain the same inside temperature on a cold day?
Compared to the small house, the larger house would need heat supplied at
A) twice the rate.
B) 4 times the rate.
C) 8 times the rate.
D) 16 times the rate.
Answer: B
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

34) If the absolute temperature of a radiator is doubled, by what factor does the radiating power change?
A) 2
B) 4
C) 8
D) 16
Answer: D
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

35) The process whereby heat flows in the absence of any medium is referred to as
A) conduction.
B) convection.
C) radiation.
D) inversion.
Answer: C
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

36) By what primary heat transfer mechanism does the Sun warm the Earth?
A) convection
B) conduction
C) radiation
D) all of the above in combination
Answer: C
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

Quantitative Problems

1) 1700 J of work is equivalent to how much heat?
A) 7,116,000 cal
B) 7.116 kcal
C) 406 cal
D) 406 kcal
Answer: C
Diff: 1 Type: BI Var: 3 Page Ref: Sec. 14.1

2) 16.5 kcal of heat is equivalent to how much work?
A) 3.94 J
B) 3940 J
C) 69.1 J
D) 69100 J
Answer: D
Diff: 1 Type: BI Var: 3 Page Ref: Sec. 14.1

3) Gasoline yields 4.8×10^7 joules per kg when burned. The density of gasoline is approximately the same as that of water, and 1 gal = 3.8 L. How much energy does your car use on a trip of 100 mi if you get 25 mi per gallon?
A) 3.7×10^8 J
B) 4.6×10^8 J
C) 6.2×10^8 J
D) 7.3×10^8 J
Answer: D
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.1

4) How much heat is needed to raise the temperature of 100 g of lead (c = 0.11 kcal/kg· C°) by 15C°?
A) 16.5 cal

B) 165 cal
C) 1500 cal
D) 15 kcal
Answer: B
Diff: 1 Type: BI Var: 3 Page Ref: Sec. 14.3-14.4

5) If 40 kcal of heat is added to 2.0 kg of water, what is the resulting temperature change?
A) 80C°
B) 40C°
C) 20C°
D) 0.05C°
Answer: C
Diff: 1 Type: BI Var: 1 Page Ref: Sec 14.3-14.4

6) A 4.0-kg aluminum block is originally at 10°C. If 160 kJ of heat is added to the block, what is its final temperature?
A) 24°C
B) 34°C
C) 44°C
D) 54°C
Answer: D
Diff: 1 Type: BI Var: 3 Page Ref: Sec. 14.3-14.4

7) 150 kcal of heat raises the temperature of 2.0 kg of material by 400 F°. What is the material's specific heat capacity?
A) 1.35 kcal/kg· °C
B) 0.75 kcal/kg· °C
C) 0.34 kcal/kg· °C
D) 0.19 kcal/kg· °C
Answer: C
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.3-14.4

8) A person tries to heat up her bath water by adding 5.0 L of water at 80°C to 60 L of water at 30°C. What is the final temperature of the water?
A) 34°C
B) 36°C
C) 38°C
D) 40°C
Answer: A
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.3-14.4

9) A machine part consists of 0.10 kg of iron and 0.16 kg of copper. How much heat is added to the gear if the temperature increases by 35 C°?
A) 9.1×10^2 J
B) 3.8×10^3 J
C) 4.0×10^3 J
D) 4.4×10^3 J
Answer: B
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.3-14.4

10) 50 g of lead (c = 0.11 kcal/kg·°C) at 100°C is put into 75 g of water at 0°C. What is the final temperature of the mixture?

A) 2°C
B) 6.8°C
C) 25°C
D) 50°C
Answer: B
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.3-14.4

11) A 0.600-kg piece of metal is heated to 100°C and placed in an aluminum can of mass 0.200-kg which contains 0.500 kg of water initially at 17.3°C. The final equilibrium temperature of the mixture is 20.2°C, what is the specific heat of the metal?
A) 140 J/kg·C°
B) 270 J/kg·C°
C) 450 J/kg·C°
D) 900 J/kg·C°
Answer: A
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.3-14.4

12) A 0.10-kg piece of copper, initially at 95°C, is dropped into 0.20 kg of water contained in a 0.28-kg aluminum can; the water and aluminum are initially at 15°C. What is the final temperature of the system?
A) 19.2°C
B) 18.3°C
C) 17.8°C
D) 23.7°C
Answer: C
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.3-14.4

13) If 50 g of material at 100°C is mixed with 100 g of water at 0°C, the final temperature is 40°C. What is the specific heat of the material?
A) 0.33 kcal/kg·°C
B) 0.75 kcal/kg·°C
C) 1.33 kcal/kg·°C
D) 7.5 kcal/kg·°C
Answer: C
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.3-14.4

14) Two equal mass objects make up a system that is thermally isolated from its surroundings. One object has an initial temperature of 100°C and the other has an initial temperature of 0°C. What is the equilibrium temperature of the system, assuming that no phase changes take place for either object? (The hot object has a specific heat capacity that is three times that of the cold object.)
A) 25°C
B) 50°C
C) 75°C
D) 67°C
Answer: C
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.3-14.4

15) On his honeymoon, James Joule attempted to explore the relationships between various forms of energy by measuring the rise of temperature of water which had fallen down a waterfall on Mount Blanc.

What maximum temperature rise would one expect for a waterfall with a vertical drop of 20 m?
A) 0.047 C°
B) 0.053 C°
C) 0.064 C°
D) 0.071 C°
Answer: A
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.3-14.4

16) The water flowing over Niagara Falls drops a distance of 50 m. Assuming that all the gravitational energy is converted to thermal energy, by what temperature does the water rise?
A) 0.10 C°
B) 0.12 C°
C) 0.37 C°
D) 0.42 C°
Answer: B
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.3-14.4

17) A 200-L electric water heater uses 2 kW. Assuming no heat loss, how long would it take to heat water in this tank from 23°C to 75°C?
A) 5 hours
B) 6 hours
C) 7 hours
D) 8 hours
Answer: B
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.3-14.4

18) A 5000-W heater is used to heat water. How long will it take to heat 20 kg of water from 20°C to 100°C?
A) 2 minutes
B) 12 minutes
C) 22 minutes
D) 32 minutes
Answer: C
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.3-14.4

19) An aluminum kettle (mass 1000 g, c = 0.22 kcal/kg °C) holds 400 g of pure water at 20°C. The kettle is placed on a 1000 W electric burner and heated to boiling. Assume that all the heat from the burner heats the kettle and its contents, and that a negligible amount of water evaporates before boiling begins. Calculate the amount of time required to bring the water to boil.
A) 3.5 min
B) 4.0 min
C) 7.3 min
D) 8.1 min
Answer: A
Diff: 3 Type: BI Var: 1 Page Ref: Sec. 14.3-14.4

20) In grinding a steel knife blade (specific heat = 0.11 cal/g-°C), the metal can get as hot as 400°C. If the blade has a mass of 80 g, what is the minimum amount of water needed at 20°C if the water is not to rise above the boiling point when the hot blade is quenched in it?
A) 22 g
B) 33 g
C) 44 g
D) 55 g
Answer: B
Diff: 3 Type: BI Var: 1 Page Ref: Sec. 14.3-14.4

21) How much heat must be removed from steam to change it to liquid?
A) 540 cal/g
B) 600 cal/g
C) 1 kcal/g
D) 1.8 kcal/g
Answer: A
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.5

22) Ice has a latent heat of fusion of 80 kcal/kg. How much heat is required to melt 200 g of ice?
A) 400 J
B) 160 J
C) 67 kJ
D) 16 kJ
Answer: C
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.5

23) How much heat energy is needed to change 10 kg of ice at -20°C to water at 50°C?
A) 4.2×10^5 J
B) 3.3×10^6 J
C) 4.2×10^6 J
D) 5.8×10^6 J
Answer: D
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.5

24) How much heat needs to be removed from 100 g of 85°C water to make -5°C ice?
A) 255 cal
B) 8.5 kcal
C) 16.5 kcal
D) 16.8 kcal
Answer: D
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.5

25) The heat of fusion of ice is 80 kcal/kg. When 50 g of ice at 0°C is added to 50 g of water at 25°C, what is the final temperature?
A) 0°C
B) 12.5°C
C) 17.5°C
D) 20°C
Answer: A
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.5

26) Eight grams of water initially at 100°C are poured into a cavity in a very large block of ice initially at 0°C. How many g of ice melt before thermal equilibrium is attained?
A) 100 g
B) 10 g
C) 1 g

D) An unknown amount; it cannot be calculated without first knowing the mass of the block of ice.
Answer: B
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.5

27) A block of ice at 0°C is added to a 150-g aluminum calorimeter cup that holds 200 g of water at 10°C. If all but 2.00 g of ice melt, what was the original mass of the block of ice?
A) 31.1 g
B) 38.8 g
C) 42.0 g
D) 47.6 g
Answer: A
Diff: 3 Type: BI Var: 1 Page Ref: Sec. 14.5

28) If 2.0 kg of water at 0°C is to be vaporized, how much heat must be added?
A) 1080 cal
B) 1080 kcal
C) 1280 cal
D) 1280 kcal
Answer: D
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.5

29) How much heat energy is needed to change 10 kg of water at 50°C to steam at 120°C?
A) 4.2×10^5 J
B) 2.3×10^7 J
C) 4.2×10^6 J
D) 2.5×10^7 J
Answer: D
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.5

30) How much heat is required to change one gram of 0°C ice to 120°C steam?
A) 48.7 cal
B) 120 cal
C) 730 cal
D) 1505 cal
Answer: C
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.5

31) How much heat is required to change 100 g of -10°C ice to 150°C steam?
A) 74.9 kcal
B) 54 kcal
C) 749 cal
D) 594 cal
Answer: A
Diff: 3 Type: BI Var: 1 Page Ref: Sec. 14.5

32) A person makes ice tea by adding ice to 1.8 kg of hot tea, initially at 80°C. How many kilograms of ice, initially at 0°C, are required to bring the mixture to 10°C?
A) 1.0 kg
B) 1.2 kg
C) 1.4 kg

D) 1.7 kg
Answer: C
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.5

33) The heat of fusion of lead is 5.9 kcal/kg, and the heat of vaporization is 207 kcal/kg, and its melting point is 328°C. How much heat is required to melt 50 g of lead initially at 23°C? (The specific heat of lead is 0.031 kcal/kg-°C.)

A) 678 cal

B) 687 cal

C) 768 cal

D) 876 cal

Answer: C

Diff: 3 Type: BI Var: 1 Page Ref: Sec. 14.5

34) The thermal conductivity of concrete is 0.8 W/m-°C and the thermal conductivity of wood is 0.1 W/m-°C. How thick would a solid concrete wall have to be in order to have the same rate of flow through it as an 8-cm thick wall made of solid wood? (Assume both walls have the same surface area.)

A) 53 cm

B) 64 cm

C) 71 cm

D) 85 cm

Answer: B

Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

35) The thermal conductivity of aluminum is twice that of brass. Two rods (one aluminum and the other brass) are joined together end to end in excellent thermal contact. The rods are of equal lengths and radii. The free end of the brass rod is maintained at 0°C and the aluminum's free end is heated to 200°C. If no heat escapes from the sides of the rods, what is the temperature at the interface between the two metals?

A) 76°C

B) 133°C

C) 148°C

D) 155°C

Answer: B

Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

36) A window glass 0.50-cm thick has dimensions of 3.0 m by 1.5 m. If the outside temperature is -10°C and the inside temperature 20°C, what is the rate of heat conduction through the window?

A) 13 kW

B) 20 kW

C) 23 kW

D) 30 kW

Answer: C

Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

37) A window glass 0.50-cm thick has dimensions of 3.0 m by 1.5 m. If the outside temperature is -10°C and the inside temperature is 20°C, how much heat flows through the window in one hour by conduction only?

A) 50 MJ

B) 60 MJ

C) 70 MJ

D) 80 MJ

Answer: D

Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

38) How much heat will flow in 1.0 hour through a 2.0 m × 2.0 m section of concrete ($k = 2.0 \times 10^{-4}$ kcal/s·m·°C) 10 cm thick if the inside temperature is 21°C and the outside temperature is 4°C?
A) 0.136 cal
B) 136 cal
C) 490 cal
D) 490 kcal
Answer: D
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

39) How long will it take to transfer 1,000,000 cal of heat through a 2.0 m^2 pane of 0.30 cm thick glass ($k = 2.0 \times 10^{-4}$ kcal/s·m·°C) if the temperature differential is 10°C?
A) 208 hr
B) 20.8 hr
C) 12.5 min
D) 75 s
Answer: C
Diff: 2 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

40) What is the outside temperature if 4000 kcal of heat is lost through a 4.0 m^2 pane of 0.30 cm thick glass ($k = 2.0 \times 10^{-4}$ kcal/s·m·°C) in one hour from a house kept at 20°C?
A) 0°C
B) 4°C
C) 16°C
D) 24°C
Answer: C
Diff: 3 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

41) In an electric furnace used for refining steel, the temperature is monitored by measuring the radiant power emitted through a small hole of area 0.5 cm^2. The furnace acts like a blackbody radiator. If it is to be maintained at a temperature of 1650°C, at what level should the power radiated through the hole be maintained?
A) 20 W
B) 30 W
C) 40 W
D) 50 W
Answer: C
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

42) At what rate is the human body radiating energy when it is at 33°C? Take the body surface area to be 1.4 m^2, and approximate the body as a blackbody.
A) 600 W
B) 700 W
C) 800 W
D) 900 W
Answer: B
Diff: 1 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8

43) What temperature exists inside a solar collector (effective collection area of 15 m^2) on a bright sunny day when the outside temperature is +20°C? Assume that the collector is thermally insulated, that the Sun radiates the collector with a power per unit area of 600 W/m^2, and that the collector acts as a perfect blackbody.

A) 73°C

B) 93°C

C) 107°C

D) 154°C

Answer: B

Diff: 3 Type: BI Var: 1 Page Ref: Sec. 14.6-14.8