

Topic: Introduction and basics

Section: Multiple Choice Questions

1. What fundamentally defines heat?

- (a) The average kinetic energy of molecules in a substance.
- (b) The energy transferred due to a temperature difference.
- (c) A measure of the hotness or coldness of an object.
- (d) The total internal energy of a system.

2. Temperature is a measure of:

- (a) The total heat content of a body.
- (b) The average potential energy of molecules.
- (c) The average kinetic energy of the molecules in a substance.
- (d) The rate of heat transfer.

3. Which mode of heat transfer primarily involves the actual movement of particles in fluids?

- (a) Conduction
- (b) Convection
- (c) Radiation
- (d) Absorption

4. Heat transfer through a solid wall primarily occurs via:

- (a) Convection
- (b) Radiation
- (c) Conduction
- (d) Evaporation

5. The process by which heat from the Sun reaches the Earth is primarily:

- (a) Conduction
- (b) Convection
- (c) Radiation
- (d) Absorption

6. Which of the following temperature scales does not have negative values for temperature in its standard range of use?

- (a) Celsius scale
- (b) Fahrenheit scale
- (c) Kelvin scale
- (d) Both (a) and (b)

7. Convert 27 degrees Celsius to Kelvin.

- (a) 273 K
- (b) 300 K
- (c) 246 K
- (d) 27 K

8. The boiling point of water at standard atmospheric pressure is 212 degrees Fahrenheit. What is this temperature in degrees Celsius?

- (a) 0 degrees C
- (b) 100 degrees C
- (c) 32 degrees C
- (d) 180 degrees C

9. If a body has a high specific heat capacity, it means:

- (a) It heats up quickly.

(b) It cools down quickly.

(c) It requires a large amount of heat to change its temperature significantly.

(d) It is a good thermal conductor.

10. What is the S.I. unit of specific heat capacity?

(a) Joule per kilogram (J/kg)

(b) Joule per Kelvin (J/K)

(c) Joule per kilogram-Kelvin (J/kg K)

(d) Watt per meter-Kelvin (W/m K)

11. The amount of heat required to raise the temperature of an entire substance by 1 degree Celsius (or 1 Kelvin) is known as its:

(a) Specific heat capacity

(b) Latent heat

(c) Thermal conductivity

(d) Heat capacity

12. Which of the following materials is generally considered a good thermal insulator?

(a) Copper

(b) Aluminum

(c) Air

(d) Iron

13. A metal rod is heated, and its length increases. This phenomenon is called:

(a) Thermal contraction

(b) Linear thermal expansion

(c) Specific heat

(d) Thermal conductivity

14. The S.I. unit of thermal conductivity is:

(a) J/s m K

(b) W/m K

(c) J/K

(d) J/kg K

15. Absolute zero temperature on the Celsius scale is approximately:

(a) 0 degrees C

(b) -273.15 degrees C

(c) 100 degrees C

(d) 273.15 degrees C

Answers

1. (b)

2. (c)

3. (b)

4. (c)

5. (c)

6. (c)

7. (b)

8. (b)

9. (c)

10. (c)

11. (d)

12. (c)

13. (b)

14. (b)

15. (b)

Topic: Modes of heat transfer

Section: Multiple Choice Questions

16. What is the primary mode of heat transfer in opaque solids?

- (a) Convection
- (b) Conduction
- (c) Radiation
- (d) Evaporation

17. Which of the following modes of heat transfer does NOT require a material medium for its propagation?

- (a) Conduction
- (b) Convection
- (c) Radiation
- (d) Both (a) and (b)

18. Heat transfer in fluids (liquids and gases) primarily occurs through the actual movement of particles from hotter regions to colder regions. This process is known as:

- (a) Conduction
- (b) Convection
- (c) Radiation
- (d) Diffusion

19. The shiny inner surface and the evacuated space between the walls of a thermos flask are designed to reduce heat transfer mainly by:

- (a) Conduction and Convection, respectively.
- (b) Radiation and Conduction, respectively.
- (c) Convection and Radiation, respectively.

(d) Radiation and Convection, respectively.

20. Which of the following statements about thermal conductivity (k) is correct?

(a) It is a measure of a material's ability to transfer heat by convection.

(b) It is generally higher for gases than for metals.

(c) It determines the rate of heat transfer by conduction through a material.

(d) It is independent of the temperature difference across the material.

21. Which of the following scenarios is the best example of heat transfer predominantly by convection?

(a) The handle of a metal spoon becoming hot after being placed in a hot cup of tea.

(b) Feeling the warmth from a campfire without touching the flames.

(c) The circulation of air in a room due to a heater placed on the floor.

(d) The Earth being warmed by the Sun's rays.

22. A perfectly black body is characterized by its ability to:

(a) Reflect all incident radiation and absorb none.

(b) Transmit all incident radiation without absorption or reflection.

(c) Absorb all incident radiation and, when heated, emit radiation most efficiently.

(d) Absorb only specific wavelengths of radiation.

23. Metals are generally excellent conductors of heat due to:

(a) The presence of free electrons.

(b) Their high density.

(c) Their crystalline structure.

(d) Their ability to expand significantly upon heating.

24. The phenomenon of sea breezes occurring during the day (wind blowing from sea to land) is primarily due to:

- (a) Conduction
- (b) Convection
- (c) Radiation
- (d) Evaporation

25. The rate of heat conduction through a slab of material is directly proportional to:

- (a) Its thickness.
- (b) The thermal resistance of the material.
- (c) The cross-sectional area perpendicular to the heat flow.
- (d) The specific heat capacity of the material.

26. Among the common temperature scales (Celsius, Fahrenheit, Kelvin), which one does NOT have negative values for any temperature above absolute zero?

- (a) Celsius
- (b) Fahrenheit
- (c) Kelvin
- (d) All three can have negative values.

27. Why do cooking utensils often have handles made of wood or plastic, while their bodies are made of metal?

- (a) Wood and plastic are more durable than metal at high temperatures.
- (b) Metal is a good conductor of heat, while wood and plastic are poor conductors.
- (c) Wood and plastic are lighter, making the utensils easier to handle.
- (d) Metals expand more than wood or plastic when heated, preventing handles from becoming loose.

28. The color of a surface significantly affects its ability to absorb and emit thermal radiation. Which type of surface is generally the best emitter of thermal radiation?

- (a) A polished silver surface.
- (b) A white, rough surface.

(c) A dull black surface.

(d) A transparent glass surface.

29. Linear thermal expansion describes the change in length of a material due to a change in temperature. This phenomenon is primarily relevant in:

(a) Determining the rate of heat flow through a vacuum.

(b) Calculating the energy required to change the state of a substance.

(c) Designing bridges and railway tracks to accommodate temperature fluctuations.

(d) Explaining the formation of convection currents in liquids.

30. Considering the three modes of heat transfer, which mode is typically the slowest for significant heat transfer?

(a) Conduction, especially in gases.

(b) Convection, especially in turbulent fluids.

(c) Radiation, especially through a vacuum.

(d) All modes transfer heat at similar rates.

Answers

16. (b)

17. (c)

18. (b)

19. (d)

20. (c)

21. (c)

22. (c)

23. (a)

24. (b)

25. (c)

26. (c)

27. (b)

28. (c)

29. (c)

30. (a)

Topic: Various temperature scale, conversion of temperature, Kelvin - Celsius, Kelvin - Fahrenheit, Fahrenheit - Celsius and vice versa

Section: Multiple Choice Questions

31. What is the equivalent temperature of 50 degrees Celsius on the Kelvin scale?

- (a) 323.15 K
- (b) 223.15 K
- (c) 300.00 K
- (d) 273.15 K

32. Convert a temperature of 253 K to the Celsius scale.

- (a) -20 C
- (b) 20 C
- (c) -20.15 C
- (d) 253 C

33. A healthy human body temperature is approximately 37 degrees Celsius. What is this temperature in degrees Fahrenheit?

- (a) 98.6 F
- (b) 96.8 F
- (c) 89.6 F
- (d) 100 F

34. The boiling point of water is 212 degrees Fahrenheit. What is this temperature in degrees Celsius?

- (a) 100 C
- (b) 90 C
- (c) 112 C

(d) 0 C

35. Convert a temperature of 68 degrees Fahrenheit to the Kelvin scale.

(a) 293.15 K

(b) 273.15 K

(c) 300.15 K

(d) 283.15 K

36. At what temperature do the Celsius and Fahrenheit scales read the same numerical value?

(a) -40

(b) 0

(c) 32

(d) -273

37. An object's temperature increases by 20 degrees Celsius. What is the corresponding temperature increase in Kelvin?

(a) 20 K

(b) 293.15 K

(c) 200 K

(d) 273.15 K

38. If the temperature of a substance decreases by 10 degrees Celsius, what is the corresponding decrease in degrees Fahrenheit?

(a) 18 F

(b) 10 F

(c) 5.56 F

(d) 32 F

39. Absolute zero is defined as 0 Kelvin. What is the equivalent temperature in degrees Celsius?

(a) -273.15 C

(b) 0 C

(c) -32 C

(d) -100 C

40. Which of the following statements about the Kelvin scale is true?

(a) It has negative temperatures.

(b) It is a relative temperature scale.

(c) Its zero point corresponds to the absence of all thermal energy.

(d) Its freezing point of water is 273 K.

41. The temperature of a furnace is measured as 1832 degrees Fahrenheit. What is this temperature in degrees Celsius?

(a) 1000 C

(b) 900 C

(c) 1200 C

(d) 980 C

42. A mercury thermometer shows a reading of -4 degrees Fahrenheit. What is this temperature in degrees Celsius?

(a) -20 C

(b) -32 C

(c) -4 C

(d) 20 C

43. Which temperature corresponds to the freezing point of water on the Fahrenheit scale?

(a) 0 F

(b) 32 F

(c) 100 F

(d) 212 F

44. A temperature reading of 373.15 K is equivalent to which of the following?

(a) 0 C and 32 F

(b) 100 C and 212 F

(c) 273.15 C and 373.15 F

(d) 0 C and 0 F

45. How many degrees Celsius are equivalent to a temperature difference of 54 degrees Fahrenheit?

(a) 30 C

(b) 54 C

(c) 18 C

(d) 97.2 C

Answers

31. (a)

32. (c)

33. (a)

34. (a)

35. (a)

36. (a)

37. (a)

38. (a)

39. (a)

40. (c)

41. (a)

42. (a)

43. (b)

44. (b)

45. (a)

Topic: Heat capacity and specific heat

Section: Multiple Choice Questions

46

The specific heat capacity of a substance is defined as the amount of heat required to:

- (a) change the temperature of 1 gram of the substance by 1 degree Celsius.
- (b) change the temperature of any mass of the substance by 1 degree Celsius.
- (c) melt 1 gram of the substance.
- (d) boil 1 gram of the substance.

47

The SI unit of specific heat capacity is:

- (a) Joules per degree Celsius (J/C)
- (b) Joules per kilogram Kelvin (J/kg K)
- (c) Joules per Kelvin (J/K)
- (d) Calories per gram degree Celsius (cal/g C)

48

Which of the following statements correctly defines the heat capacity of an object?

- (a) It is the amount of heat required to raise the temperature of a unit mass of the object by one degree.
- (b) It is the amount of heat required to change the state of the object.
- (c) It is the amount of heat required to raise the temperature of the entire object by one degree.
- (d) It is the rate at which heat is transferred through the object.

49

The SI unit of heat capacity is:

(a) $\text{J kg}^{-1} \text{K}^{-1}$

(b) J K^{-1}

(c) $\text{J mol}^{-1} \text{K}^{-1}$

(d) J s^{-1}

50

Which of the following statements is true regarding heat capacity (C) and specific heat capacity (c)?

(a) Heat capacity is an intensive property, while specific heat capacity is an extensive property.

(b) Heat capacity depends on the mass of the object, while specific heat capacity depends only on the material.

(c) Both heat capacity and specific heat capacity depend on the mass of the object.

(d) Specific heat capacity is always greater than heat capacity for any given object.

51

How much heat energy is required to raise the temperature of 2 kg of water from 20 degree Celsius to 60 degree Celsius? (Specific heat capacity of water = $4200 \text{ J/kg degree Celsius}$)

(a) 16800 J

(b) 33600 J

(c) 336000 J

(d) 168000 J

52

Two objects, A and B, made of different materials but having the same mass, absorb the same amount of heat. If the specific heat capacity of A is greater than that of B, then:

(a) The temperature increase of A will be greater than B.

(b) The temperature increase of B will be greater than A.

(c) Both A and B will experience the same temperature increase.

(d) Object A will expand more than object B.

53

When 100 g of water at 80 degree Celsius is mixed with 100 g of water at 20 degree Celsius, the final temperature of the mixture will be:

- (a) 40 degree Celsius
- (b) 50 degree Celsius
- (c) 60 degree Celsius
- (d) 70 degree Celsius

54

Water is commonly used as a coolant in automobile engines and power plants primarily because of its:

- (a) high boiling point.
- (b) low specific heat capacity.
- (c) high specific heat capacity.
- (d) ability to evaporate quickly.

55

A substance with a high specific heat capacity will:

- (a) heat up quickly and cool down quickly.
- (b) heat up slowly and cool down quickly.
- (c) heat up quickly and cool down slowly.
- (d) heat up slowly and cool down slowly.

56

A metal block of mass 0.5 kg is heated from 27 degree Celsius to 77 degree Celsius. If its specific heat capacity is 400 J/kg K, the heat absorbed by the block is:

- (a) 10000 J

(b) 20000 J

(c) 100 J

(d) 200 J

57

Which of the following requires the most heat energy to raise its temperature by 1 degree Celsius, assuming equal masses?

(a) Copper (specific heat = 385 J/kg K)

(b) Iron (specific heat = 450 J/kg K)

(c) Aluminum (specific heat = 900 J/kg K)

(d) Water (specific heat = 4200 J/kg K)

58

Molar specific heat capacity of a substance refers to:

(a) the heat required to raise the temperature of 1 gram of the substance by 1 K.

(b) the heat required to raise the temperature of 1 mole of the substance by 1 K.

(c) the heat required to raise the temperature of the entire substance by 1 K.

(d) the heat required to change the state of 1 mole of the substance.

59

For most substances, the specific heat capacity in the liquid state is generally:

(a) less than its specific heat capacity in the solid state.

(b) greater than its specific heat capacity in the solid state.

(c) equal to its specific heat capacity in the solid state.

(d) always zero.

60

When a metallic rod is heated, its length increases. This phenomenon is governed by which material property?

- (a) Its specific heat capacity.
- (b) Its thermal conductivity.
- (c) Its coefficient of linear thermal expansion.
- (d) Its density.

Answers

46. (a)

47. (b)

48. (c)

49. (b)

50. (b)

51. (c)

52. (b)

53. (b)

54. (c)

55. (d)

56. (a)

57. (d)

58. (b)

59. (b)

60. (c)

Topic: Thermal conductivity, coefficient of thermal conductivity, linear thermal expansion

46. Thermal conductivity is a measure of a material's ability to:

- a) Absorb heat energy.
- b) Store heat energy.
- c) Transfer heat energy by conduction.
- d) Radiate heat energy.

47. The SI unit of the coefficient of thermal conductivity is:

- a) $\text{J s}^{-1} \text{m}^{-1} \text{K}^{-1}$
- b) $\text{W m}^{-1} \text{K}^{-1}$
- c) $\text{J m}^{-1} \text{s K}^{-1}$
- d) W m K^{-1}

48. The rate of heat flow through a uniform rod by conduction is directly proportional to:

- a) Its length.
- b) Its cross-sectional area.
- c) The time for which heat flows.
- d) The specific heat capacity of the material.

49. Which of the following materials has the highest coefficient of thermal conductivity?

- a) Wood
- b) Glass
- c) Copper
- d) Air

50. In the analogy between heat flow and electric current, the quantity analogous to electrical resistance is:

- a) Thermal conductivity.
- b) Thermal diffusivity.
- c) Thermal resistance.
- d) Temperature gradient.

51. Linear thermal expansion refers to the change in an object's:

- a) Volume due to temperature change.
- b) Surface area due to temperature change.
- c) Length due to temperature change.
- d) Density due to temperature change.

52. The SI unit of the coefficient of linear thermal expansion is:

- a) K
- b) K-1
- c) m K-1
- d) J K-1

53. If a rod of initial length L_0 is heated such that its temperature changes by dT , and its coefficient of linear expansion is α , the change in its length (dL) is given by:

- a) $dL = L_0 / (\alpha * dT)$
- b) $dL = \alpha * dT / L_0$
- c) $dL = L_0 * \alpha * dT$
- d) $dL = L_0 * dT / \alpha$

54. Gaps are left between railway tracks to:

- a) Increase friction.

- b) Allow for thermal expansion in summer.
- c) Prevent theft of metal.
- d) Reduce noise during train movement.

55. When a solid material is heated, its density generally:

- a) Increases.
- b) Decreases.
- c) Remains unchanged.
- d) First increases, then decreases.

56. In metals, heat conduction is primarily due to:

- a) Vibrations of lattice atoms only.
- b) Movement of free electrons only.
- c) Both vibrations of lattice atoms and movement of free electrons.
- d) Electromagnetic radiation.

57. On a cold day, a metal object feels colder to touch than a wooden object of the same temperature because:

- a) Metal has a lower specific heat capacity.
- b) Metal has a higher thermal conductivity.
- c) Wood has a higher specific heat capacity.
- d) Wood has a higher thermal conductivity.

58. If α is the coefficient of linear expansion, then the coefficient of volume expansion (γ) for an isotropic solid is approximately:

- a) α
- b) 2α

c) 3α

d) α^2

59. Two rods, P and Q, of the same length and cross-sectional area are joined end-to-end. If their thermal conductivities are k_P and k_Q respectively, and $k_P > k_Q$, then the temperature drop across rod P will be:

a) Greater than the temperature drop across rod Q.

b) Less than the temperature drop across rod Q.

c) Equal to the temperature drop across rod Q.

d) Insufficient information to determine.

60. A 10 m long steel rod is subjected to a temperature increase of 20 K. If the coefficient of linear expansion for steel is $1.2 \times 10^{-5} \text{ K}^{-1}$, the change in its length will be:

a) 2.4 mm

b) 2.4 cm

c) 0.24 mm

d) 0.24 cm

Answers

46. (c)

47. (b)

48. (b)

49. (c)

50. (c)

51. (c)

52. (b)

53. (c)

54. (b)

55. (b)

56. (c)

57. (b)

58. (c)

59. (b)

60. (a)

Topic: Summary (quick revision)

Section: Multiple Choice Questions

61. Which of the following statements correctly differentiates between heat and temperature?

- (a) Heat is a form of energy, while temperature is a measure of the average kinetic energy of particles.
- (b) Heat is a measure of the average kinetic energy of particles, while temperature is a form of energy.
- (c) Both heat and temperature are forms of energy.
- (d) Both heat and temperature measure the same physical quantity.

62. The SI unit of specific heat capacity is:

- (a) Joule per kilogram per Kelvin
- (b) Calorie per gram per degree Celsius
- (c) Joule per degree Celsius
- (d) Watt per meter per Kelvin

63. Which of the following modes of heat transfer does not require a material medium?

- (a) Conduction
- (b) Convection
- (c) Radiation
- (d) Both Conduction and Convection

64. At what temperature do Celsius and Fahrenheit scales read the same value?

- (a) 0 degrees
- (b) 32 degrees
- (c) -40 degrees
- (d) 100 degrees

65. The coefficient of linear thermal expansion for a material represents:

- (a) The fractional change in length per unit change in temperature.
- (b) The total change in length for any temperature change.
- (c) The fractional change in volume per unit change in temperature.
- (d) The total change in volume for any temperature change.

66. A bimetallic strip bends on heating because of:

- (a) Uniform thermal expansion of both metals.
- (b) Different coefficients of linear expansion of the two metals.
- (c) Change in the specific heat of the metals.
- (d) Convection currents within the strip.

67. Which of the following substances has the highest specific heat capacity?

- (a) Iron
- (b) Copper
- (c) Water
- (d) Mercury

68. If the temperature of an object increases by 10 degrees Celsius, what is the equivalent increase in Kelvin?

- (a) 10 K
- (b) 273.15 K
- (c) 283.15 K
- (d) 100 K

69. In a double-pane window, the air trapped between the two glass panes reduces heat transfer primarily by:

- (a) Minimizing radiation only.

(b) Minimizing conduction and convection.

(c) Maximizing conduction.

(d) Eliminating all forms of heat transfer.

70. Absolute zero temperature is defined as:

(a) The freezing point of water.

(b) The boiling point of water.

(c) The temperature at which molecular motion ceases.

(d) The temperature at which all substances become gases.

71. A block of metal is heated from 20 degrees Celsius to 80 degrees Celsius. If its initial length was 100 cm and its coefficient of linear expansion is 2×10^{-5} per degree Celsius, what is the increase in its length?

(a) 0.012 cm

(b) 0.12 cm

(c) 1.2 cm

(d) 12 cm

72. Which of the following is an example of heat transfer by convection?

(a) Heat from the sun reaching the Earth.

(b) A metal spoon becoming hot when left in a hot cup of tea.

(c) Boiling water in a pot on a stove.

(d) Heat radiating from a light bulb.

73. The thermal conductivity of a material is a measure of:

(a) Its ability to absorb heat energy.

(b) Its ability to transfer heat by conduction.

(c) Its ability to reflect heat radiation.

(d) Its ability to expand upon heating.

74. If a substance has a high specific heat capacity, it means:

(a) It heats up and cools down quickly.

(b) It heats up and cools down slowly.

(c) It can store a large amount of heat with a small temperature change.

(d) Both (b) and (c).

75. Convert 68 degrees Fahrenheit to Celsius.

(a) 10 degrees Celsius

(b) 20 degrees Celsius

(c) 30 degrees Celsius

(d) 40 degrees Celsius

Answers

61. (a)

62. (a)

63. (c)

64. (c)

65. (a)

66. (b)

67. (c)

68. (a)

69. (b)

70. (c)

71. (b)

72. (c)

73. (b)

74. (d)

75. (b)