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CLASS 11 PHYSICS · NCERT CHAPTER 10 · IMU CET PRACTICE

Thermal Properties of Matter

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Questions: 45 MCQs

Each question has exactly one correct option. Attempt all questions first, then check the Answer Key and Solutions at the end.

- 1 The temperature at which the Celsius and Fahrenheit scales read the same value is
(A) 40° (B) 0°
(C) -40° (D) -32°
- 2 100°C on the Kelvin scale is
(A) 373.15 K (B) 173.15 K
(C) 273.15 K (D) 100 K
- 3 A temperature of 50°C on the Fahrenheit scale is
(A) 112°F (B) 122°F
(C) 82°F (D) 90°F
- 4 The coefficient of linear expansion α , area expansion β and volume expansion γ are related as
(A) 1 : 3 : 2 (B) 3 : 2 : 1
(C) $\alpha : \beta : \gamma = 1 : 2 : 3$ (D) 1 : 1 : 1
- 5 A steel rod of length 1 m is heated from 20°C to 120°C ($\alpha = 1.2 \times 10^{-5} \text{ K}^{-1}$). The increase in length is
(A) 1.2 mm (B) 0.012 mm
(C) 12 mm (D) 0.12 mm
- 6 Water has maximum density at
(A) -4°C (B) 4°C
(C) 0°C (D) 100°C
- 7 The anomalous expansion of water helps aquatic life because
(A) ice sinks to the bottom
(B) water becomes denser on freezing
(C) water expands uniformly
(D) lakes freeze from the top, insulating water below
- 8 The amount of heat required to raise the temperature of unit mass of a substance by 1°C is
(A) specific heat capacity (B) latent heat
(C) heat capacity (D) thermal conductivity



- 9 The heat required to raise the temperature of 2 kg of water from 20°C to 70°C is ($c = 4200 \text{ J kg}^{-1} \text{ K}^{-1}$)
(A) 42 kJ (B) 840 kJ
(C) 420 kJ (D) 210 kJ
- 10 Latent heat of fusion of ice is about
(A) $2.26 \times 10^6 \text{ J/kg}$ (B) $3.34 \times 10^5 \text{ J/kg}$
(C) 80 J/kg (D) $4.2 \times 10^3 \text{ J/kg}$
- 11 During melting, the temperature of a substance
(A) remains constant (B) first increases then decreases
(C) decreases (D) increases
- 12 Steam at 100°C causes more severe burns than water at 100°C because
(A) steam has higher density
(B) steam is hotter
(C) steam releases additional latent heat on condensing
(D) water has higher specific heat
- 13 10 g of ice at 0°C is mixed with 10 g of water at 80°C. The final temperature is ($L_f = 80 \text{ cal/g}$, $c = 1 \text{ cal/g}^\circ\text{C}$)
(A) 40°C (B) 0°C
(C) 10°C (D) 20°C
- 14 100 g of water at 90°C is mixed with 200 g of water at 30°C. The final temperature is
(A) 45°C (B) 40°C
(C) 50°C (D) 60°C
- 15 Heat transfer in solids takes place mainly by
(A) conduction (B) convection
(C) evaporation (D) radiation
- 16 Sea breeze is an example of
(A) radiation (B) reflection
(C) convection (D) conduction
- 17 Heat from the Sun reaches the Earth by
(A) radiation (B) conduction
(C) convection (D) both conduction and convection
- 18 The rate of heat flow through a rod is $H = KA(T_1 - T_2)/L$. If length is doubled and area halved, the rate becomes
(A) $H/2$ (B) $4H$
(C) H (D) $H/4$
- 19 The SI unit of thermal conductivity is
(A) $\text{W m}^{-1} \text{ K}^{-1}$ (B) $\text{J m}^{-2} \text{ K}^{-1}$
(C) W m K^{-1} (D) $\text{W m}^{-2} \text{ K}$

- 20** Two rods of equal length and area with conductivities K_1 and K_2 are joined in series. The equivalent conductivity is
- (A) $(K_1 + K_2)/2$ (B) $K_1 K_2 / (K_1 + K_2)$
(C) $K_1 + K_2$ (D) $2K_1 K_2 / (K_1 + K_2)$
- 21** Two rods of equal length and area with conductivities K_1 and K_2 are joined in parallel. The equivalent conductivity is
- (A) $(K_1 + K_2)/2$ (B) $2K_1 K_2 / (K_1 + K_2)$
(C) $\sqrt{K_1 K_2}$ (D) $K_1 + K_2$
- 22** According to Stefan's law, the energy radiated per second per unit area by a black body is proportional to
- (A) T (B) T^4
(C) T^2 (D) T^3
- 23** If the absolute temperature of a black body is doubled, the power radiated becomes
- (A) 16 times (B) 8 times
(C) 2 times (D) 4 times
- 24** Wien's displacement law states that
- (A) $\lambda_m = \text{constant}$ (B) $\lambda_m T^4 = \text{constant}$
(C) $\lambda_m / T = \text{constant}$ (D) $\lambda_m T = \text{constant}$
- 25** The wavelength of maximum emission from a black body at 2900 K is ($b = 2.9 \times 10^{-3} \text{ m K}$)
- (A) $2.9 \mu\text{m}$ (B) $10 \mu\text{m}$
(C) $1 \mu\text{m}$ (D) $0.1 \mu\text{m}$
- 26** Which colour of a star indicates the highest surface temperature?
- (A) Red (B) Blue
(C) Yellow (D) Orange
- 27** Newton's law of cooling states that the rate of cooling is proportional to
- (A) the fourth power of temperature
(B) the temperature difference between the body and surroundings
(C) the square of temperature difference
(D) the mass of the body
- 28** A body cools from 80°C to 60°C in 5 min. Using Newton's law (average form), the time taken to cool from 60°C to 40°C in surroundings at 20°C is
- (A) about 8.3 min (B) 4 min
(C) 10 min (D) 5 min
- 29** A good absorber of radiation is also a good
- (A) transmitter (B) conductor
(C) emitter (D) reflector
- 30** A perfect black body has absorptivity
- (A) infinity (B) 1
(C) 0.5 (D) 0

- 31** The specific heat of a gas at constant pressure is greater than at constant volume because
 (A) molecules move faster at constant pressure
 (B) pressure increases the mass
 (C) at constant volume work is done by the gas
 (D) at constant pressure, extra heat is needed to do work in expansion
-
- 32** The heat capacity of a body is
 (A) mass $\times$ specific heat
 (B) specific heat/mass
 (C) latent heat $\times$ mass
 (D) specific heat only
-
- 33** A metal sheet with a circular hole is heated. The size of the hole
 (A) increases
 (B) first decreases then increases
 (C) remains the same
 (D) decreases
-
- 34** A bimetallic strip bends on heating because
 (A) the metals have different densities
 (B) the two metals have different coefficients of linear expansion
 (C) the metals have different conductivities
 (D) the metals have different specific heats
-
- 35** The boiling point of water at high altitudes is
 (A) higher than 100°C
 (B) lower than 100°C
 (C) exactly 100°C
 (D) 0°C
-
- 36** In a pressure cooker, food cooks faster because
 (A) heat is conducted faster
 (B) decreased pressure lowers the boiling point
 (C) increased pressure raises the boiling point
 (D) steam has lower temperature
-
- 37** The triple point of water is
 (A) 0 K
 (B) 373.15 K
 (C) 273.15 K
 (D) 273.16 K
-
- 38** A liquid of volume expansivity γ is in a vessel of volume expansivity γ_v . The apparent expansion coefficient is
 (A) $\gamma\gamma_v$
 (B) $\gamma + \gamma_v$
 (C) γ/γ_v
 (D) $\gamma - \gamma_v$
-
- 39** 5 g of steam at 100°C condenses to water at 100°C . Heat released is ($L_v = 540 \text{ cal/g}$)
 (A) 540 cal
 (B) 2700 cal
 (C) 108 cal
 (D) 5400 cal
-
- 40** Heat is transferred from the hot end to the cold end of a metal rod. In steady state, the temperature along the rod
 (A) varies exponentially
 (B) remains constant
 (C) increases from hot to cold end
 (D) decreases linearly (for uniform rod with no heat loss)
-

- 41 Thermos flask reduces heat loss by
- (A) increasing radiation
 - (B) increasing convection
 - (C) minimising conduction, convection and radiation
 - (D) using a metallic outer surface only
-
- 42 The temperature of a body increases from 27°C to 327°C . The ratio of energy radiated per second (initial : final) is
- (A) 1 : 4
 - (B) 1 : 2
 - (C) 1 : 8
 - (D) 1 : 16
-
- 43 The specific heat of water is high. Hence it is used
- (A) as a fuel
 - (B) in thermometers
 - (C) to make ice quickly
 - (D) as a coolant in car radiators
-
- 44 A thermometer uses the property that changes with temperature. A constant-volume gas thermometer uses
- (A) length of a liquid column
 - (B) colour of radiation
 - (C) pressure of a gas
 - (D) resistance of a wire
-
- 45 The coefficient of volume expansion of an ideal gas at constant pressure at temperature T is
- (A) $1/T^2$
 - (B) constant independent of T
 - (C) T
 - (D) $1/T$
-

Answer Key

1	2	3	4	5	6	7	8	9	10
C	A	B	C	A	B	D	A	C	B
11	12	13	14	15	16	17	18	19	20
A	C	B	C	A	C	A	D	A	D
21	22	23	24	25	26	27	28	29	30
A	B	A	D	C	B	B	A	C	B
31	32	33	34	35	36	37	38	39	40
D	A	A	B	B	C	D	D	B	D
41	42	43	44	45					
C	D	D	C	D					

Hints & Solutions

- (C) $F = 9C/5 + 32$. Setting $F = C \rightarrow C = -40$.
- (A) $T = 100 + 273.15 = 373.15$ K.
- (B) $F = 9 \times 50/5 + 32 = 122^\circ\text{F}$.
- (C) For isotropic solids, $\beta = 2\alpha$ and $\gamma = 3\alpha$.
- (A) $\Delta L = L\alpha\Delta T = 1 \times 1.2 \times 10^{-5} \times 100 = 1.2 \times 10^{-3}$ m.
- (B) Due to anomalous expansion, water is densest at 4°C .
- (D) Ice (less dense) floats on top and insulates, so water below stays near 4°C .
- (A) Definition of specific heat capacity, $c = Q/(m\Delta T)$.
- (C) $Q = mc\Delta T = 2 \times 4200 \times 50 = 420000$ J.
- (B) $L_f \approx 336\text{--}334$ kJ/kg (80 cal/g).
- (A) Heat supplied is used as latent heat to change the phase, not to raise temperature.
- (C) Each gram of steam gives 540 cal of latent heat on condensing plus sensible heat.
- (B) Heat from water cooling to $0^\circ\text{C} = 10 \times 80 = 800$ cal = heat to melt 10 g ice exactly. Final temperature 0°C .
- (C) $100(90 - T) = 200(T - 30) \rightarrow 9000 + 6000 = 300T \rightarrow T = 50^\circ\text{C}$.
- (A) In solids, heat flows by conduction (molecular vibrations and free electrons).
- (C) Land heats faster during the day; warm air rises and cooler sea air moves in — convection currents.
- (A) Space is nearly a vacuum, so only radiation (EM waves) can transfer heat.
- (D) $H \propto A/L \rightarrow (1/2)/2 = 1/4$.
- (A) $K = HL/(A\Delta T) \rightarrow \text{W m}^{-1} \text{K}^{-1}$.
- (D) Thermal resistances add: $2L/(K_{\text{eq}} A) = L/(K_1 A) + L/(K_2 A) \rightarrow K_{\text{eq}} = 2K_1 K_2 / (K_1 + K_2)$.
- (A) $K_{\text{eq}}(2A) = K_1 A + K_2 A \rightarrow K_{\text{eq}} = (K_1 + K_2)/2$.
- (B) $E = \sigma T^4$.

23. (A) $P \propto T^4 \rightarrow 2^4 = 16$.
24. (D) $\lambda_{\max} \times T = b \approx 2.9 \times 10^{-3} \text{ m K}$.
25. (C) $\lambda_m = 2.9 \times 10^{-3}/2900 = 10^{-6} \text{ m} = 1 \mu\text{m}$.
26. (B) By Wien's law, shorter $\lambda_{\max}$ means higher T ; blue stars are the hottest.
27. (B) $dT/dt = -k(T - T_s)$, valid for small temperature differences.
28. (A) $20/5 = k(70 - 20) \rightarrow k = 0.08 \text{ /min}$. $20/t = 0.08(50 - 20) = 2.4 \rightarrow t \approx 8.3 \text{ min}$.
29. (C) Kirchhoff's law: a good absorber is a good emitter.
30. (B) A perfect black body absorbs all incident radiation.
31. (D) $C_p - C_v = R$, the work done by the gas in expanding at constant pressure.
32. (A) $C = mc$, measured in J/K.
33. (A) On heating, every linear dimension expands, including the hole, like a photographic enlargement.
34. (B) Unequal expansion makes the strip bend with the more-expanding metal on the outside.
35. (B) Atmospheric pressure is lower, so water boils at a lower temperature.
36. (C) Higher pressure raises the boiling point above 100°C .
37. (D) The triple point of water (ice, water and vapour in equilibrium) is 273.16 K at 0.006 atm.
38. (D) $V_{\text{apparent}} = V_{\text{real}} - V_{\text{vessel}}$.
39. (B) $Q = mL = 5 \times 540 = 2700 \text{ cal}$.
40. (D) For constant heat current through a uniform rod, the temperature gradient is constant.
41. (C) Vacuum between double walls stops conduction and convection; silvered walls reduce radiation.
42. (D) $T: 300 \text{ K} \rightarrow 600 \text{ K}$. $E \propto T^4 \rightarrow (1/2)^4 = 1/16$.
43. (D) High specific heat lets water absorb a lot of heat with small temperature rise.
44. (C) At constant volume, $P \propto T$ for an ideal gas.
45. (D) $V \propto T \rightarrow \gamma = (1/V)(dV/dT) = 1/T$.

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