

STUDYNEST | CLASS 11 PHYSICS QUESTION PAPER 1

Chapter 10: Thermal Properties of Matter

Maximum Marks: 40 | Suggested time: 60 minutes

Instructions: Answer all questions. Show calculation steps and units. Original practice paper, not an official examination.

Section A 1-mark questions - $8 \times 1 = 8$ marks

1. What is temperature's role at equilibrium? [1]
2. Convert 27C to kelvin. [1]
3. Specific heat capacity? [1]
4. Heat for temperature change without phase change? [1]
5. Latent heat relation? [1]
6. Heat transfer through vacuum? [1]
7. Ideal gas equation? [1]
8. Newton's law of cooling? [1]

Section B 2-mark questions - $6 \times 2 = 12$ marks

9. 2 kg warmed 5 K, $c=400$: Q? [2]
10. $=1.2 \times 10^{-5}$, $L=2\text{m}$, $\Delta T=50\text{K}$: extension? [2]
11. 100C in kelvin? [2]
12. Heat capacity of .5 kg with $c=800$? [2]
13. Heat to melt .2 kg ice, $L=3.34 \times 10^5$? [2]
14. Why is temperature constant during boiling? [2]

Section C 3-mark questions - $4 \times 3 = 12$ marks

15. .5 kg water $c=4200$ heated 10C: heat? [3]
16. Rod $L=2\text{m}$, $=1.5 \times 10^{-5}$, $\Delta T=40\text{K}$: expansion? [3]
17. Mix .2 kg at 80C and .3 kg at 20C, equal c, no heat loss: final T? [3]
18. Gas at fixed volume warms 300K to 450K; initial $p=100\text{kPa}$. Final p? [3]

Section D 4-mark questions - $2 \times 4 = 8$ marks

19. Describe three heat-transfer modes. [4]
20. Melt .2 kg ice at 0C then warm water by 20K; $L=3.34 \times 10^5$, $c=4200$. Total Q? [4]

End of question paper.

FORMULA AND EQUATION REFERENCE

Chapter-specific equations and relations

- Temperature conversion: $T(K) = \theta(\text{deg C}) + 273.15$.
- Heat for temperature change: $Q = mc \Delta T$; heat capacity $C = mc$.
- Latent heat during phase change: $Q = mL$.
- Linear expansion: $\Delta L = \alpha L \Delta T$; area expansion approx $2\alpha A \Delta T$; volume expansion approx $3\alpha V \Delta T$ for isotropic solids.
- Calorimetry without heat loss: heat lost = heat gained; for equal specific heat, $T_f = (m_1 T_1 + m_2 T_2) / (m_1 + m_2)$.
- Ideal gas equation $pV = nRT$; at fixed volume $p/T = \text{constant}$.
- Newton cooling (small temperature difference): rate of heat loss proportional to temperature excess.
- Heat-transfer modes: conduction (microscopic interactions), convection (bulk fluid motion), radiation (electromagnetic waves).

Use equations only when their assumptions apply; keep units consistent.

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STEP-BY-STEP SOLUTIONS

Concept questions are answered directly; numerical problems show the governing equation and substitution.

Question 1

Principle / definition: Identify the physical quantity or law asked for, then apply the chapter definition.

Apply it here: No net heat transfer between systems in thermal equilibrium.

Final answer: No net heat transfer between systems in thermal equilibrium.

Question 2

Principle / definition: Identify the physical quantity or law asked for, then apply the chapter definition.

Apply it here: 300.15 K, approximately 300 K.

Final answer: 300.15 K, approximately 300 K.

Question 3

Principle / definition: Identify the physical quantity or law asked for, then apply the chapter definition.

Apply it here: Heat needed to raise 1 kg by 1 K.

Final answer: Heat needed to raise 1 kg by 1 K.

Question 4

Principle / definition: Identify the physical quantity or law asked for, then apply the chapter definition.

Apply it here: $Q = mc\Delta T$.

Final answer: $Q = mc\Delta T$.

Question 5

Principle / definition: Identify the physical quantity or law asked for, then apply the chapter definition.

Apply it here: $Q = mL$.

Final answer: $Q = mL$.

Question 6

Principle / definition: Identify the physical quantity or law asked for, then apply the chapter definition.

Apply it here: Radiation.

Final answer: Radiation.

Question 7

Principle / definition: Identify the physical quantity or law asked for, then apply the chapter definition.

Apply it here: $pV = nRT$.

Final answer: $pV = nRT$.

Question 8

Principle / definition: Identify the physical quantity or law asked for, then apply the chapter definition.

Apply it here: Rate is approximately proportional to excess temperature for small differences.

Final answer: Rate is approximately proportional to excess temperature for small differences.

Question 9

Working: $Q = mc\Delta T = 2(400)(5) = 4000 \text{ J}$.

Final answer: 4000 J.

Question 10

Working: $\Delta L = \alpha L \Delta T = (1.2 \times 10^{-5})(2)(50) = 1.2 \times 10^{-3} \text{ m}$.

Final answer: $1.2 \times 10^{-3} \text{ m}$.

Question 11

Working: $T = \theta + 273.15 = 100 + 273.15 = 373.15 \text{ K}$.

Final answer: 373.15 K.

Question 12

Working: Heat capacity $C = mc = (0.5 \text{ kg})(800 \text{ J kg}^{-1} \text{ K}^{-1}) = 400 \text{ J/K}$.

Final answer: 400 J/K.

Question 13

Working: For melting at constant temperature, $Q = mL = 0.2(3.34 \times 10^5) = 66,800 \text{ J}$.

Final answer: 66,800 J.

Question 14

Working: During boiling, supplied energy is used as latent heat to change liquid into vapour by overcoming intermolecular attractions. Temperature stays constant until the phase change is complete.

Final answer: Energy supplies latent heat for phase change.

Question 15

Working: $Q = mc \Delta T = 0.5(4200)(10) = 21,000 \text{ J}$.

Final answer: 21,000 J.

Question 16

Working: $\Delta L = \alpha L \Delta T = (1.5 \times 10^{-5})(2)(40) = 1.2 \times 10^{-3} \text{ m}$.

Final answer: $1.2 \times 10^{-3} \text{ m}$.

Question 17

Working: Heat lost = heat gained: $0.2c(80 - T) = 0.3c(T - 20)$. Cancel c : $16 - 0.2T = 0.3T - 6$; $22 = 0.5T$; $T = 44 \text{ deg C}$.

Final answer: 44C.

Question 18

Working: At fixed volume, p/T is constant. $T_2/T_1 = 450/300 = 1.5$, so $p_2 = 100 \text{ kPa}(1.5) = 150 \text{ kPa}$.

Final answer: 150 kPa.

Question 19

Working: Conduction transfers energy through microscopic interactions without bulk movement; convection transfers energy by bulk flow in fluids; radiation transfers energy by electromagnetic waves and can occur through vacuum.

Final answer: Conduction via microscopic interactions; convection by bulk flow; radiation via electromagnetic waves.

Question 20

Working: First melt the ice: $Q_1 = mL = 0.2(3.34 \times 10^5) = 66,800 \text{ J}$. Then warm the water: $Q_2 = mc \Delta T = 0.2(4200)(20) = 16,800 \text{ J}$. Total $Q = Q_1 + Q_2 = 83,600 \text{ J}$.

Final answer: $mL + mc\Delta T = 83,600 \text{ J}$.

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