PHYS 105 · Chapter 18: Temperature, Heat, and the First Law of Thermodynamics

Past-Exam Review — questions from PSU past midterm (Major 1 & 2) and final exams

Constant: g = 9.81 m/s² · The source of each question is shown in [brackets].

Part 1: Multiple-Choice Questions (18)

Indicate the answer choice that best completes the statement or answers the question.

18.1 Temperature and Heat

Q1. *Heat is defined as:* **[Final 221]**

A *the highest temperature of objects in contact*
B *the lowest temperature of objects in contact*
C *energy transferred between objects in thermal contact because of a temperature difference*
D *a change in temperature of objects in thermal contact*

Q2. *Heat is energy in transit from:* **[Final 242]**

A *the hotter coffee cup to the colder hand*
B *the warmer hand to the colder glass of ice water*
C *Both of the above*
D *None of the above*

Q3. *Heat always travels from _____ to _____ objects.* **[Final 222]**

A *cold, cold*
B *hot, cold*
C *hot, hot*
D *cold, hot*

Q4. *When you touch a cold piece of ice with your finger, heat:* **[Final 231]**

A *flows from your finger to the ice*
B *flows from the ice to your finger*
C *flows both ways*
D *does not flow*

Q5. *A thermometer shows that two objects in thermal contact have the same temperature. You can conclude that:* **[Final 232]**

A *the objects are in thermal equilibrium*
B *no heat will flow between them*
C *Both of the above*
D *None of the above*

18.2 The Celsius, Fahrenheit and Kelvin Scales

Q6. *On the Fahrenheit scale, water boils at:* [Final 241]

A *32 °F*
B *180 °F*
C *212 °F*
D *100 °F*

Q7. *The temperature in a room is 77 °F. What is it on the Celsius scale?* [Final 221]

A *81 °C*
B *77 °C*
C *25 °C*
D *43 °C*

Q8. *The temperature in a room is 77 °F. What is it on the Kelvin scale?* [Final 232]

A *444 K*
B *298 K*
C *25 K*
D *77 K*

Q9. *Convert 90 °C to the Fahrenheit scale.* [Final 222]

A *194 °F*
B *130 °F*
C *32 °F*
D *90 °F*

Q10. *Convert 194 °F to kelvins.* [Final 231]

A *194 K*
B *654 K*
C *363 K*
D *399 K*

Q11. *On a very cold day the temperature is –25 °C. What is this in Fahrenheit?* [Final 242]

A *–46 °F*
B *–77 °F*
C *18 °F*
D *–13 °F*

18.3 Thermal Expansion

Q12. *The linear expansion of a material depends on:* [Final 241]

A *its initial length*
B *the temperature change*
C *the type of material*
D *All of the above*

Heat Transfer Mechanisms

Q13. *Heat exchange by conduction occurs only in:* [Final 221]

A *fluids*
B *solids*
C *liquids*
D *gases*

Q14. *Heat transfer within boiling water in a kettle is by:* [Final 232]

A *convection*
B *conduction*
C *radiation*
D *None of the above*

Q15. *The flow of a fluid due to a difference in temperature is called:* [Final 241]

A *conduction*
B *convection*
C *radiation*
D *insulation*

Q16. *How does a microwave oven transfer heat to food?* [Final 231]

A *Convection*
B *Conduction*
C *Radiation*
D *All of the above*

Q17. *Which of the following is an example of heat transfer by radiation?* [Final 242]

A *Warm air circulating when a heater is on*
B *The warmth you feel near a hot stove burner*
C *Heat moving along a metal rod heated at one end*
D *The heating of water in a pot on a stove*

Q18. *The walls of a vacuum flask contain two layers of glass separated by a vacuum. Which methods of heat transfer does the vacuum prevent?* [Final 222]

A *Radiation*
B *Conduction and radiation*
C *Convection and radiation*
D *Conduction and convection*

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Part 2: Problems (6)

Solve the following problems and show your work in detail.

Problem 1. *An aluminum sphere has a volume of 30 cm^3 at 30 °C. $\alpha = 24 \times 10^{-6}\ K^{-1}$. Its final volume is 30.5 cm^3.* **[Final 221]**

a) *Find the change in volume.*

b) *Find the change in temperature.*

c) *Find the final temperature.*

Problem 2. *An aluminum wing is 36 m long at 29 °C. $\alpha = 24 \times 10^{-6}\ K^{-1}$. At what final temperature (in K) does its length change by 0.02 m?* **[Final 222]**

a) *Find ΔT and the final temperature.*

Problem 3. *A copper rod with initial length 1.5 cm ($\alpha = 17 \times 10^{-6}\ K^{-1}$) is heated from 22 °C. By how much must the temperature rise for the rod to expand by 0.19 mm?* **[Final 242]**

a) *Find ΔT.*

Problem 4. *A copper kettle contains water at 25 °C. When heated to 100 °C, the volume of the kettle expands by $\Delta V = 5.73 \times 10^{-6}\ m^3$. Given $\alpha = 17 \times 10^{-6}\ K^{-1}$, what was its initial volume?* **[Final 241]**

a) *Find V_0.*

Problem 5. *A brass dallah (Arabic coffee pot) of volume 600 cm^3 is filled to the brim with water and heated from 22 °C to 90 °C. $\beta_{water} = 0.21 \times 10^{-3}\ K^{-1}$, $\alpha_{brass} = 19 \times 10^{-6}\ K^{-1}$.* **[Final 231]**

a) *Find ΔV for the dallah.*

b) *Find ΔV for the water.*

Problem 6. *A 0.0189 m^3 steel can is filled to the top with gasoline at 15 °C and warms to 30 °C. $\beta_{gasoline} = 0.95 \times 10^{-3}\ K^{-1}$, $\alpha_{steel} = 12 \times 10^{-6}\ K^{-1}$.* **[Final 232]**

a) *Find ΔV for the gasoline.*

b) *Find ΔV for the steel can.*

c) *How much gasoline spills out?*

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