Physics 1401
Chapter 10 Review

11. The coefficient of linear expansion of steel is $12 \cdot 10^{-6}$/C°. A railroad track is made of individual rails of steel 1.0 km in length. By what length would these rails change between a cold day when the temperature is –10 °C and a hot day at 30 °C?
(a) 0.62 cm **(c) 48 cm** (e) 620 cm
(b) 24 cm (d) 480 cm

12. The coefficient of linear expansion of aluminum is $23 \cdot 10^{-6}$/C°. A circular hole in an aluminum plate is 2.725 cm in diameter at 0 °C. What is the diameter of the hole if the temperature of the plate is raised to 100 C?
(a) 0.0063 cm **(c) 2.731 cm** (e) 2.788 cm
(b) 2.728 cm (d) 2.757 cm

14. A copper plate has a length of 0.12 m and a width of 0.10 m at 25 °C. The plate is uniformly heated to 175 °C. If the linear expansion coefficient for copper is $1.7 \cdot 10^{-5}$/C°, what is the *change* in the area of the plate as a result of the increase in temperature?
(a) $2.6 \cdot 10^{-5}$ m^2 (c) $3.2 \cdot 10^{-6}$ m^2 (e) $7.8 \cdot 10^{-7}$ m^2
(b) $6.1 \cdot 10^{-5}$ m^2 (d) $4.9 \cdot 10^{-7}$ m^2

17. A steel string guitar is strung so that there is negligible tension in the strings at a temperature of 24.9 °C. The guitar is taken to an outdoor winter concert where the temperature of the strings decreases to –15.1 °C. The cross-sectional area of a particular string is $5.5 \cdot 10^{-6}$ m^2. The distance between the points where the string is attached does not change. For steel, Young's modulus is $2.0 \cdot 10^{11}$ N/m^2; and the coefficient of linear expansion is $1.2 \cdot 10^{-5}$/C°. Use your knowledge of linear thermal expansion and stress to calculate the tension in the string at the concert.

(a) 530 N
(b) 240 N
(c) 120 N
(d) 60 N
(e) 30 N

24. Complete the following statement: The term *heat* most accurately describes
(a) the internal energy of an object.
(b) a measure of how hot an object is.
(c) the absolute temperature of an object.
(d) the molecular motion inside of an object.
(e) the flow of energy due to a temperature difference.

26. The specific heat capacity of iron is approximately half that of aluminum. Two balls of equal mass, one made of iron and the other of aluminum, both at 80 °C, are dropped into a thermally insulated jar that contains an equal mass of water at 20 °C. Thermal equilibrium is eventually reached. Which one of the following statements concerning the final temperatures is true?
(a) Both balls will reach the same final temperature.
(b) The iron ball will reach a higher final temperature than the aluminum ball.
(c) The aluminum ball will reach a higher final temperature than the iron ball.
(d) The difference in the final temperatures of the balls depends on the initial mass of the water.
(e) The difference in the final temperatures of the balls depends on the initial temperature of the water.

27. Two cubes, one silver and one iron, have the same mass and temperature. A quantity *Q* of heat is removed from each cube. Which one of the following properties causes the final temperatures of the cubes to be different?
(a) density
(b) latent heat of vaporization
(c) specific heat capacity
(d) coefficient of volume expansion
(e) volume

29. A 2.00-kg metal object requires $5.02 \cdot 10^3$ J of heat to raise its temperature from 20.0 °C to 40.0 °C. What is the specific heat capacity of the metal?
(a) 63.0 J/(kg • C°)
(b) 126 J/(kg • C°)
(c) 251 J/(kg • C°)
(d) 502 J/(kg • C°)
(e) $1.00 \cdot 10^3$ J/(kg • C°)

32. A 0.20-kg lead shot is heated to 90.0 °C and dropped into an ideal calorimeter containing 0.50 kg of water initially at 20.0 °C. What is the final equilibrium temperature of the lead shot? The specific heat capacity of lead is 128 J/(kg • C°); and the specific heat of water is 4186 J/(kg • C°).
(a) 4.8 °C
(b) 20.8 °C
(c) 22.4 °C
(d) 27.8 °C
(e) 42.1 °C

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Chapter 11 Review

1. Complete the following statement: The transfer of heat by convection will occur
(a) only in metals.
(b) only in a vacuum.
(c) only in non-metallic solids.
(d) with or without the presence of matter.
(e) only in the presence of a liquid or a gas.

4. Which one of the following processes does not occur during the convective transfer of heat within a container of air?
(a) The volume of a warmed part of the air is reduced and its density increases.
(b) A continuous flow of warmer and cooler parts of air is established.
(c) The flow of air molecules results in a flow of heat.
(d) The cooler portion of the air surrounding a warmer part exerts a buoyant force on it.
(e) As the warmer part of the air moves, it is replaced by cooler air that is subsequently warmed.

7. The ends of a cylindrical steel rod are maintained at two different temperatures. The rod conducts heat from one end to the other at a rate of 10 cal/s. At what rate would a steel rod twice as long and twice the diameter conduct heat between the same two temperatures?
(a) 5 cal/s
(b) 10 cal/s
(c) 20 cal/s
(d) 40 cal/s
(e) 80 cal/s

11. At what rate is heat lost through a 1.0 m × 1.5 m rectangular glass windowpane that is 0.5 cm thick when the inside temperature is 20 °C and the outside temperature is 5 °C? The thermal conductivity for glass is 0.80 W/(m • C°).

(a) 18 W
(b) 36 W
(c) 720 W
(d) 3600 W
(e) 7200 W

12. Two cylindrical steel rods A and B have radii of 0.02 m and 0.04 m, respectively. It is found that the two steel rods conduct the same amount of heat per unit time for the same temperature differences between their two ends.
What is the ratio of the lengths of the rods, LA/LB?

(a) 0.25
(b) 0.50
(c) 1.00
(d) 2.00
(e) 4.00

13. A cabin has a 0.159-m thick wooden floor [k = 0.141 W/(m • C°)] with an area of 13.4 m^2. A roaring fire keeps the interior of the cabin at a comfortable 18.0 °C while the air temperature in the crawl space below the cabin is –20.6 °C. What is the rate of heat conduction through the wooden floor?

(a) 31 J/s
(b) 138 J/s
(c) 214 J/s
(d) 245 J/s
(e) 459 J/s

14. A granite wall has a thickness of 0.61 m and a thermal conductivity of 2.1 W/(m • C°). The temperature on one face of the wall is 3.2 °C and 20.0 °C on the opposite face. How much heat is transferred in one hour through each square meter of the granite wall?
(a) 210 000 J/m^2
(b) 106 000 J/m^2
(c) 77 000 J/m^2
(d) 1800 J/m^2
(e) 58 J/m^2

16. Heat is conducted by two cylindrical rods with identical cross-sectional area and length. The temperature difference between the ends of each rod is the same. One of the rods is made of a carbon material that has a thermal conductivity of 1100 J/(s • m • C°). The other rod is silver with a thermal conductivity of 420 J/(s • m • C°). What percentage of the total energy transferred by the two rods each second is conducted by the silver rod?
(a) 64 %
(b) 28 %
(c) 50 %
(d) 36 %
(e) 72 %

17. In an experiment to determine the thermal conductivity of a bar of a new alloy, one end of the bar is maintained at 0.0 °C and the other end at 100.0 °C. The bar has a cross-sectional area of 1.0 cm^2 and a length of 15 cm. If the rate of heat conduction through the bar is 24 W, what is the thermal conductivity of the bar?
(a) 24 W/(m • C°)
(b) 360 W/(m • C°)
(c) 160 W/(m • C°)
(d) 63 W/(m • C°)
(e) 0.029 W/(m • C°)

21. What is the rate of heat transfer through this combination?
(a) 3.0×10^3 J/s
(b) 6.0×10^3 J/s
(c) 9.0×10^3 J/s
(d) 1.2×10^4 J/s
(e) 2.4×10^4 J/s

22. How much heat passes the interface between A and B in 5.0 s?
(a) 6.0×10^4 J
(b) 1.5×10^3 J
(c) 1.2×10^5 J
(d) 4.5×10^4 J
(e) 3.0×10^4 J

13. A sample of a monatomic ideal gas is originally at 20 °C. What is the final temperature of the gas if both the pressure and volume are doubled?
(a) 5 °C
(b) 20 °C
(c) 80 °C
(d) 900 °C
(e) 1200 °C

14. An ideal gas at 0 °C is contained within a rigid vessel. The temperature of the gas is increased by 1 C°. What is P_f/P_i, the ratio of the final to initial pressure?

(a) 273/274 (c) 1/2 (e) 1/273
(b) 274/273 (d) 1/10

15. Neon gas at 20 °C is confined within a rigid vessel. It is then heated until its pressure is doubled. What is the final temperature of the gas?

(a) 10 °C (c) 40 °C (e) 586 °C
(b) 20 °C **(d) 313 °C**

16. Argon gas at 305 K is confined within a constant volume at a pressure P_1. If the gas has a pressure P_2 when it is cooled to 195 K, what is the ratio of P_2 to P_1?

(a) 0.410 (c) 0.717 (e) 1.56
(b) 0.639 (d) 1.28

18. An ideal gas is confined within a closed cylinder at atmospheric pressure (1.013×10^5 Pa) by a piston. The piston moves until the volume of the gas is reduced to one-ninth of the initial volume. What is the final pressure of the gas when its temperature returns to its initial value?

(a) 9.117×10^5 Pa
(b) 6.447×10^5 Pa
(c) 4.559×10^5 Pa
(d) 3.102×10^5 Pa
(e) 1.013×10^5 Pa

19. Heat is supplied to a sample of a monatomic ideal gas at 40 °C. It is observed that the gas expands until its volume is doubled and the pressure drops to half of its original value. What is the final temperature of the gas?

(a) 10 °C
(b) 20 °C
(c) 40 °C
(d) 80 °C
(e) 1600 °C

20. An ideal gas with a fixed number of molecules is maintained at a constant pressure. At 30.0 °C, the volume of the gas is 1.50 m^3. What is the volume of the gas when the temperature is increased to 75.0 °C?

(a) 0.60 m^3
(b) 1.30 m^3
(c) 1.72 m^3
(d) 2.45 m^3
(e) 3.75 m^3

21. The volume of a carbon dioxide bubble rising in a glass of beer is observed to nearly double as the bubble rises from the bottom to the top of the glass. Why, according to our textbook, does the volume nearly double?
(a) The temperature at the bottom is cooler than it is at the top.
(b) The amount of carbon dioxide in the bubble increases.
(c) The fluid pressure of the beer is greater at the bottom of the glass than at the top.
(d) The pressure inside the bubble decreases as it rises.
(e) The shape of the glass determines the net force exerted on the bubble.

22. A sealed container has a volume of 0.020 m^3 and contains 15.0 g of molecular nitrogen (N_2) which has a molecular mass of 28.0 u. The gas is at a temperature of 525 K. What is the absolute pressure of the nitrogen gas?
(a) 3.9×10^{-19} Pa
(b) 4.3×10^{-5} Pa
(c) 1.2×10^{5} Pa
(d) 1.9×10^{5} Pa
(e) 4.3×10^{6} Pa

23. The temperature of a monatomic ideal gas with a mass per mole of 0.00750 kg/mol is 294 K. The absolute pressure of the gas is 1.05×10^{5} Pa when its volume is 1.31×10^{-3} m^3. What is the mass of the gas?
(a) 8.04×10^{-5} kg
(b) 1.92×10^{-4} kg
(c) 4.22×10^{-4} kg
(d) 7.66×10^{-4} kg
(e) 1.19×10^{-3} kg

24. An ideal gas is contained in a vessel with a moveable piston. Initially, the gas has a volume of 0.018 m^3, an absolute pressure of 1.5 atm, and a temperature of 30.0 °C. The pressure is 0.75 atm when the volume of the container is decreased to 0.009 m^3. What is the final temperature of the gas?

(a) 76 K (c) 170 K (e) 300 K
(b) 98 K (d) 240 K

49. How many air molecules are in a room at temperature 23.8 °C and standard pressure if the dimensions of the room are 3.66 m × 3.66 m × 2.43 m?

(a) 1330 (c) 3.03 × 1024 (e) 1.00 × 1028
(b) 16 600 **(d) 8.05 × 1026**

50. An automobile tire is inflated to a gauge pressure of 32 lb/in^2 at a temperature of –10.0 °C. Under strenuous driving, the tire heats up to 40.0 °C. What is the new gauge pressure if the volume of the tire remains essentially the same? (atmospheric pressure = 14.7 lb/in^2)

(a) 17.5 lb/in^2 (c) 38.0 lb/in^2 (e) 55.6 lb/in^2
(b) 20.6 lb/in^2 **(d) 40.9 lb/in^2**

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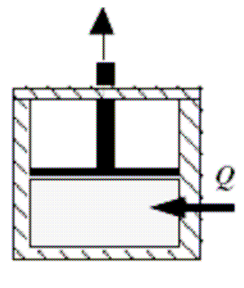
Chapter 12 Review

5. When the gas enclosed beneath the piston shown in the figure receives 1930 J of heat, Q, from its surroundings, it performs 2250 J of work in raising the piston. What is the change in the internal energy of the gas?

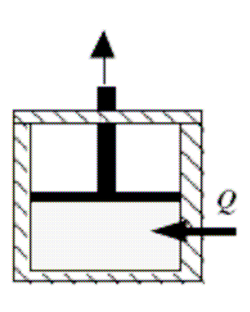


(a) –320 J
(b) +320 J
(c) –4180 J
(d) +4180 J
(e) zero joules.

6. An ideal gas absorbs 750 J of heat as it performs 625 J of work. What is the resulting change in temperature if there is 1.3 moles of the gas?

(a) –8.6 K	**(c) 7.7 K**	(e) 23 K
(b) –4.3 K	(d) 9.6 K	

7. Enclosed beneath the moveable piston in the figure is 4.8 moles of a monatomic ideal gas. The gas performs work on the piston as 2300 J of heat are added from the surroundings. During the process, the temperature of the gas decreases by 45 K. How much work does the gas perform?

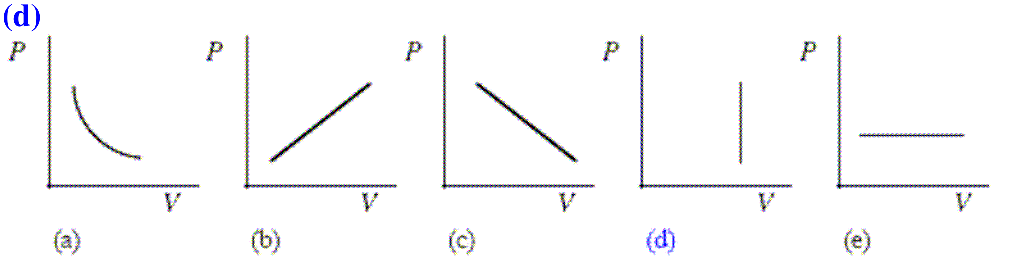


(a) 5.0×10^3 J	(d) 6.0×10^2 J
(b) 3.2×10^3 J	(e) 4.0 × 102 J
(c) 1.4×10^3 J	

9. A match is placed in an oxygen-filled cylinder that has a movable piston. The piston is moved so quickly that no heat escapes as the match ignites. What kind of change is demonstrated in this process?

(a) an isobaric change
(b) an adiabatic change
(c) an isothermal change
(d) an isochoric change
(e) a change of heat capacity

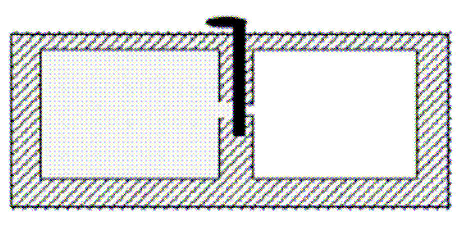
10. Which one of the following pressure-volume graphs represents an isochoric process?
(d)



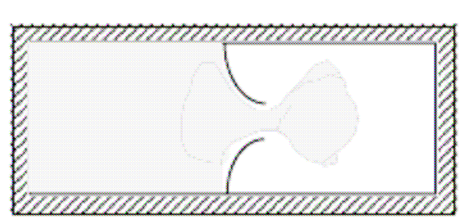
12. A system containing an ideal gas at a constant pressure of 1.22×10^5 Pa gains 2140 J of heat. During the process, the internal energy of the system increases by 2320 J. What is the change in volume of the gas?

(a) $+1.48 \times 10^{-3}$ m^3
(b) -1.48×10^{-3} m^3
(c) $+3.66 \times 10^{-3}$ m^3
(d) -3.66×10^{-3} m^3
(e) zero m^3

13. A container is divided into two chambers that are separated by a valve. The left chamber contains one mole of a monatomic ideal gas. The right chamber is evacuated. At some instant, the valve is opened and the gas rushes freely into the right chamber. Which one of the following statements concerning this process is true?
(a) Work is done by the gas.
(b) The temperature of the gas decreases.
(c) The change in the entropy of the gas is zero.
(d) The walls of the containing vessel must get colder.
(e) The change in the internal energy of the gas is zero.



14. A thermally isolated sample of an ideal gas at a fixed is confined to one half of a container by an impermeable membrane. The other half of the container is evacuated. The membrane is then pierced and the gas is allowed to expand freely and to double its volume as shown. Which one of the following statements is true concerning this situation?
(a.)The process is reversible
(b.)This is an isothermal process.
(c) The entropy of the gas decreases. half of its original value.
(d) The internal energy of the gas must decrease.
(e) The temperature of the gas decreases to one-



18. Heat is added to a sample of an ideal monatomic gas. Which one of the following statements is necessarily true?
(a) The gas must expand.
(b) The gas must do work.
(c) The type of change that will occur depends on the conditions of the gas when the heat was added.
(d) The gas must change phase.
(e) The temperature of the gas must increase.

19. Neon is a monatomic gas with a molar heat capacity at constant volume of 12.66 J/(mol • K). Two moles of neon gas enclosed in a constant volume system receive 5250 J of heat. If the gas was initially at 293 K, what is the final temperature of the neon?

(a) 200 K	(c) 400 K	(e) 600 K
(b) 300 K	**(d) 500 K**	

20. If one complete cycle of a reversible process is carried out on a sample of an ideal gas so that its final state is the same as its initial state, which of the following quantities is the only one which can be non-zero?
(a) the change in volume of the sample
(b) the net heat absorbed by the sample
(c) the change in the entropy of the sample
(d) the change in temperature of the sample
(e) the change in the internal energy of the sample

21. In one stage of a reversible process, the temperature of an ideal gas remains constant as its volume is decreased. Which one of the following statements concerning this situation is true?
(a) The process is adiabatic.
(b) The pressure of the gas decreases in this process.
(c) Heat flows out of the gas and into the surroundings.
(d) The gas does "positive" work on its surroundings.
(e) The average kinetic energy of the gas molecules increases.

24. An ideal monatomic gas undergoes an adiabatic process. Its internal energy increases by 50 J. Which pair of choices below is the correct for this process?

	work done	heat exchanged
(a)	50 J by the system	zero joules
(b)	50 J on the system	zero joules
(c)	50 J by the system	100 J supplied
(d)	zero joules	50 J removed
(e)	**zero joules**	**50 J added**.

29. One mole of a monatomic gas at 400 K is reversibly taken to half of its original volume by an isobaric process. How much work is done by the gas?
(a) +1700 J
(b) –1700 J
(c) +3300 J
(d) –3300 J
(e) –8300 J

30. An ideal gas is taken from state A to state B through process shown on the pressure-volume graph. How much heat is added to the gas in this process?

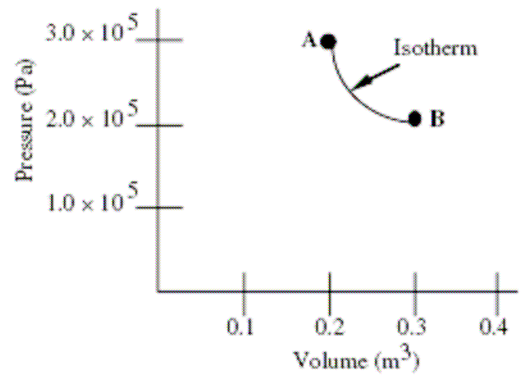
(a) zero joules

(b) 1.0×10^4 J

(c) 2.4×10^4 J

(d) 6.0×10^4 J

(e) This cannot be determined since n and T are not specified.



44. Which one of the following statements is true concerning the ratio of the molar heat capacities Cp/Cv for an ideal gas?

(a) The ratio is always 1.

(b) The ratio is always less than 1.

(c) The ratio is always greater than 1.

(d) The ratio is sometimes less than 1.

(e) The ratio is sometimes greater than 1.

45. Determine the quantity of heat added to 3.5 moles of the ideal gas argon if the temperature increases from 75 °C to 225 °C during an isobaric process. Note: The molar specific heats of argon are CV = 3.0 cal/K•mol and CP = 5.0 cal/K•mol.

(a) 2600 cal	(c) 1600 cal	(e) 750 cal
(b) 2100 cal	(d) 1100 cal	

46. What change in temperature occurs when 1200 J of heat are removed from 4.0 moles of monatomic
gas under constant pressure?

(a) –8.3 K
(b) –11 K
(c) –14 K
(d) –28 K
(e) –36 K

72. A 1.00-kg sample of steam at 100.0 °C condenses to water at 100.0 °C. What is the entropy change of the sample if the heat of vaporization of water is 2.26×10^6 J/kg?

(a) -6.06×10^3 J/K
(b) $+6.06 \times 10^3$ J/K
(c) -2.26×10^4 J/K
(d) $+2.26 \times 10^4$ J/K
(e) zero J/K

73. In an isothermal and reversible process, 945 J of heat is removed from a system and transferred to the surroundings. The temperature is 314 K. What is the change in entropy of the system?

(a) –3.01 J/K
(b) +3.01 J/K
(c) –0.332 J/K
(d) +0.332 J/K
(e) +2.97 × 105 J/K