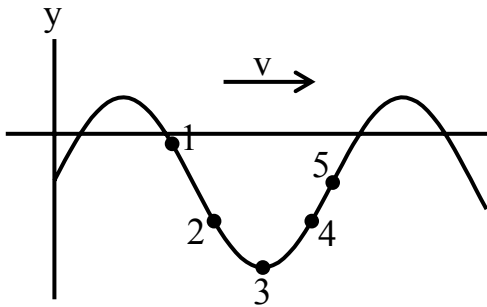


Q1.  
Which statement is correct?



- A) Particle 1 is moving upward.
- B) Particle 3 has zero acceleration.
- C) Particle 5 has zero velocity.
- D) Particle 2 is moving downward.
- E) Particle 4 is moving upward.

Sec# Wave - I - Transverse and Longitudinal Waves  
Grade# 70

Q2.  
A sinusoidal string wave traveling in the negative x direction has an amplitude of 0.20 mm and a frequency of 10 Hz. If the string has a linear mass density 0.50 kg/m and is under a tension of 10 N, what is the equation of the wave?

- A)  $y = (0.20 \text{ mm}) \sin(14 x + 63 t)$ .
- B)  $y = (0.20 \text{ mm}) \sin(14 x - 63 t)$ .
- C)  $y = (0.10 \text{ mm}) \sin(14 x + 63 t)$ .
- D)  $y = (0.20 \text{ mm}) \sin(88 x - 63 t)$ .
- E)  $y = (0.20 \text{ mm}) \sin(88 x + 63 t)$ .

Sec# Wave - I - Wavelength and Frequency  
Grade# 45

Q3.  
A sinusoidal string wave has an amplitude of 6.0 mm and a frequency of 20 Hz. If the string has a linear mass density of 100 g/m and is under a tension of 10 N, what is the average power transmitted by the wave?

- A) 0.28 W.
- B) 0.028 W.
- C) 24 W.
- D) 0.14 W.
- E) 1.4 W.

Sec# Wave - I - Energy and Power of a Traveling String Wave  
Grade# 60

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Q4.

Standing waves are produced on a string at the two consecutive resonant frequencies 120 and 160 Hz. If the string has a length of 3.0 m, what is the distance between two adjacent nodes at the resonant frequency 240 Hz?

- A) 0.50 m.
- B) 1.0 m.
- C) 1.5 m.
- D) 0.25 m.
- E) 0.75 m.

Sec# Wave - I - Standing Waves and Resonance  
Grade# 50

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Q5.

The sound intensity 5.0 m from a point source is  $0.50 \text{ W/m}^2$ . The power output of the source is

- A) 160 W.
- B) 79 W.
- C) 31 W.
- D) 10 W.
- E) 310 W.

Sec# Wave - II - Intensity and Sound Level  
Grade# 90

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Q6.

A tube is open at one end and closed at the other. The shortest length of such a tube that will resonate with a 200 Hz tuning fork is 42.1 cm. The speed of sound in tube must be

- A) 337 m/s.
- B) 343 m/s.
- C) 331 m/s.
- D) 168 m/s.
- E) 84 m/s.

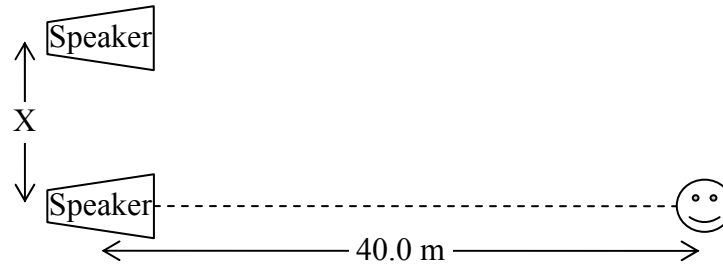
Sec# Wave - II - Source of Musical Sound  
Grade# 50

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Q7.

Two small identical speakers are connected to the same sinusoidal source. At a distance 40.0 m in front of one speaker, the sound intensity is minimum at two consecutive frequencies 4500 Hz and 7500 Hz. What is the distance X between the speakers? The speed of sound in air is 343 m/s.

Fig#



- A) 3.0 m.
- B) 2.1 m.
- C) 1.5 m.
- D) 4.5 m.
- E) 8.5 m.

Sec# Wave - II - Interference  
Grade# 40

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Q8.

An ambulance with speed  $v/8$ , where  $v$  is the speed of sound, emits a siren of frequency 700 Hz. What is the frequency heard by a stationary observer toward whom the ambulance is moving?

- A) 800 Hz.
- B) 622 Hz.
- C) 788 Hz.
- D) 612 Hz.
- E) 700 Hz.

Sec# Wave - II - The Doppler Effect  
Grade# 65

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Q9.

The coefficient of linear expansion of steel is  $11 \times 10^{-6}$  per  $^{\circ}\text{C}$ . A steel ball has a volume of  $100.00 \text{ cm}^3$  at  $0^{\circ}\text{C}$ . When heated to  $100^{\circ}\text{C}$ , its volume becomes

- A)  $100.33 \text{ cm}^3$ .
- B)  $100.11 \text{ cm}^3$ .
- C)  $100.22 \text{ cm}^3$ .
- D)  $0.11 \text{ cm}^3$ .
- E)  $0.33 \text{ cm}^3$ .

Sec# Temperature, Heat, and the First Law of Thermodynamics - Thermal Expansion  
Grade# 70

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Q10.

Ten grams of ice at  $-20^{\circ}\text{C}$  is to be changed to steam at  $130^{\circ}\text{C}$ . The specific heat of water is  $1\text{ cal/g }^{\circ}\text{C}$ , and the specific heats of both ice and steam are  $0.5\text{ cal/g }^{\circ}\text{C}$ . The heat of fusion is  $80\text{ cal/g}$  and the heat of vaporization is  $540\text{ cal/g}$ . The entire process requires

- A) 7450 cal.
- B) 750 cal.
- C) 1250 cal.
- D) 6950 cal.
- E) 7700 cal.

Sec# Temperature, Heat, and the First Law of Thermodynamics - The Absorption of Heat by Solids and Liquids

Grade# 45

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Q11.

According to the first law of thermodynamics, applied to a gas, the change in the internal energy during any process is

- A) equal to the heat input plus the work done on the gas.
- B) equal to the heat input plus the work done by the gas.
- C) equal to the work done on the gas minus the heat input.
- D) independent of the heat input.
- E) independent of the work done on the gas.

Sec# Temperature, Heat, and the First Law of Thermodynamics - The First Law of Thermodynamics

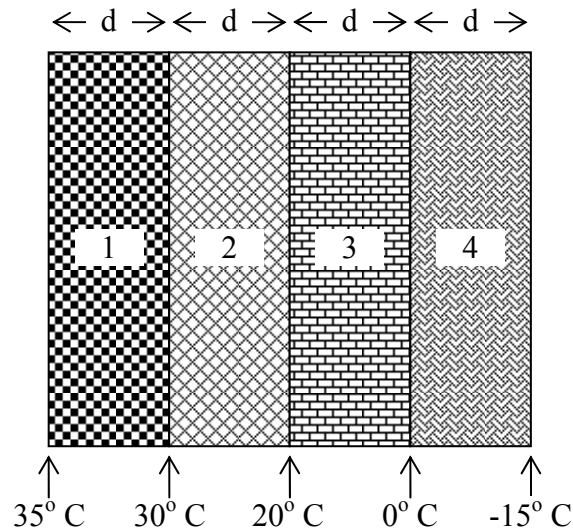
Grade# 60

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Q12.

The diagram shows four slabs of different materials with equal thickness and equal cross sectional area, placed side by side. Heat flows from left to right and steady-state temperatures of the interfaces are given. Rank the materials according to their thermal conductivities, smallest to largest.

Fig#



- A) 3, 4, 2, 1.
- B) 1, 2, 4, 3.
- C) 3, 4, 1, 2.
- D) 1, 2, 3, 4.
- E) 4, 3, 2, 1.

Sec# Temperature, Heat, and the First Law of Thermodynamics - Heat Transfer Mechanisms  
Grade# 65

Q13.

500 cm<sup>3</sup> of an ideal gas at 40 °C and 200 kPa is compressed to 250 cm<sup>3</sup> and cooled to 20 °C. What is the final pressure?

- A) 374 kPa.
- B) 748 kPa.
- C) 200 kPa.
- D) 100 kPa.
- E) 512 kPa.

Sec# The kinetic Theory of Gases - Ideal Gases  
Grade# 50

Q14.

An ideal gas that initially occupies 0.140 m<sup>3</sup> at a pressure of 204.0 kPa is expanded isothermally to a pressure of 202.3 kPa. The work done by the gas is

- A) 239 J.
- B) 140 J.
- C) - 140 J.
- D) 533 J.
- E) Zero.

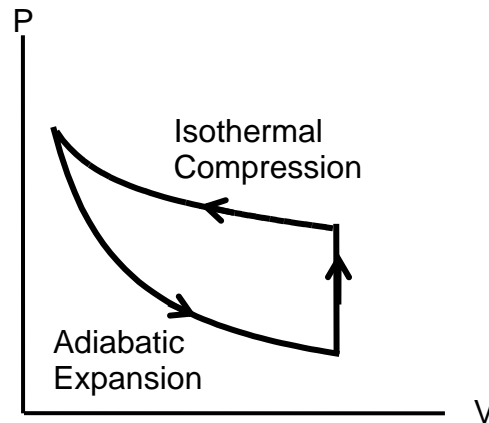
Sec# The kinetic Theory of Gases - Ideal Gases

Grade# 55

Q15.

For the cyclic process shown in the figure,

Fig#



- A) net thermal energy is transferred from the gas to the surroundings.
- B) the net work done by the gas on the surroundings is positive.
- C) the net work done by the gas on the surroundings is zero.
- D) the internal energy of the gas increases.
- E) the internal energy of the gas decreases.

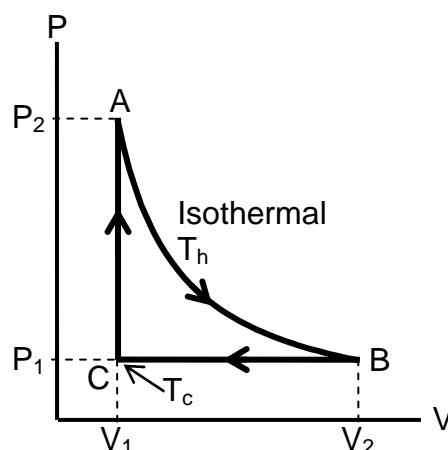
Sec# The kinetic Theory of Gases - The Adiabatic Expansion of an Ideal Gas

Grade# 35

Q16.

Suppose one mole of an ideal gas undergoes the reversible cycle ABCA as shown in the figure, where AB is an isotherm and the temperature at point C is  $T_c$ . The net heat added to the gas during the cycle is equal to

Fig#



- A)  $RT_h \ln V_2 / V_1 - R(T_h - T_c)$ .
- B)  $-C_p (T_h - T_c)$ .
- C)  $-C_v (T_h - T_c)$ .
- D)  $RT_h \ln V_2 / V_1 - C_p (T_h - T_c)$ .
- E)  $RT_h V_2 / V_1$ .

Sec# The kinetic Theory of Gases - The Molar Specific Heats of an Ideal Gas  
Grade# 50

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Q17.

A piece of metal at 80 °C is placed in 1.2 kg of water at 72 °C. The system is thermally isolated and reaches to a final temperature of 75 °C. Find the change in entropy for the metal. The specific heat of water is 4.19 kJ/kgK.

- A) - 43.0 J/K.
- B) + 43.0 J/K.
- C) - 200 J/K.
- D) - 194 J/K.
- E) + 194 J/K.

Sec# Entropy and the Second Law of Thermodynamics - Change in Entropy  
Grade# 35

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Q18.

Two moles of an ideal gas undergo an adiabatic free expansion from an initial volume of 0.60 L to 1.2 L. Calculate the change in entropy of gas.

- A) + 12 J/K.
- B) - 24 J/K.
- C) + 24 J/K.
- D) - 12 J/K.
- E) Zero.

Sec# Entropy and the Second Law of Thermodynamics - Change in Entropy  
Grade# 45

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Q19.

An ideal Carnot heat engine operates between 40 °C and 300 °C. If the engine absorbs heat at a rate of 40 kW, at what rate does it exhaust heat?

- A) 22 kW.
- B) 5.3 kW.
- C) 73 kW.
- D) 300 kW.
- E) 35 kW

Sec# Entropy and the Second Law of Thermodynamics - Entropy in the Real World:  
Engines  
Grade# 55

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Q20.

An ideal refrigerator has a coefficient of performance of 5. If the temperature inside the refrigerator is  $-20^{\circ}\text{C}$ , what is the temperature at which it releases heat?

- A)  $31^{\circ}\text{C}$ .
- B)  $-5^{\circ}\text{C}$ .
- C)  $20^{\circ}\text{C}$ .
- D)  $27^{\circ}\text{C}$ .
- E)  $42^{\circ}\text{C}$ .

Sec# Entropy and the Second Law of Thermodynamics - Entropy in the Real World:  
Refrigerators  
Grade# 50

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Test Expected Average = 54

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# Physics 102 Major1

## Formula sheet

### Summer Semester 2007-2008 (Term 073)

$$v = \lambda f = \frac{\omega}{k}$$

$$v = \sqrt{\frac{\tau}{\mu}} \quad v = \sqrt{\frac{B}{\rho}}$$

$$y = y_m \sin(kx \pm \omega t + \phi)$$

$$P = \frac{1}{2} \mu \omega^2 y_m^2 v$$

$$S = S_m \cos(kx - \omega t)$$

$$\Delta P = \Delta P_m \sin(kx - \omega t), \Delta P_m = \rho v \omega S_m$$

$$I = \frac{1}{2} \rho (\omega S_m)^2 v$$

$$\beta = 10 \log\left(\frac{I}{I_0}\right), \quad I_0 = 10^{-12} \text{ W/m}^2$$

$$I = \frac{\text{Power}}{\text{Area}}$$

$$f' = f \left( \frac{v \pm v_D}{v \pm v_s} \right)$$

$$y = \left( 2y_m \cos\left(\frac{\phi}{2}\right) \right) \sin\left(kx - \omega t + \frac{\phi}{2}\right)$$

$$y = (2y_m \sin kx) \cos \omega t$$

$$f_n = \frac{nv}{2L}, \quad n = 1, 2, 3, \dots$$

$$f_n = \frac{nv}{4L}, \quad n = 1, 3, 5, \dots$$

$$\Delta L = \alpha L \Delta T \quad \Delta V = \beta V \Delta T$$

$$PV = nRT = NkT$$

$$\Delta L = \frac{\lambda}{2\pi} \phi$$

$$\Delta L = m\lambda \quad m = 0, 1, 2, \dots$$

$$\Delta L = \left(m + \frac{1}{2}\right)\lambda, \quad m = 0, 1, 2, \dots$$

$$PV^\gamma = \text{constant}; \quad TV^{\gamma-1} = \text{constant}$$

$$C_v = \frac{3}{2} R \text{ for monatomic gases,}$$

$$= \frac{5}{2} R \text{ for diatomic gases.}$$

$$T_F = \frac{9}{5} T_C + 32$$

$$Q = mL$$

$$Q = mc\Delta T$$

$$Q = nc\Delta T$$

$$\Delta E_{\text{int}} = Q - W$$

$$\Delta E_{\text{int}} = nC_v \Delta T$$

$$C_p - C_v = R$$

$$W = \int PdV$$

$$P_{\text{cond}} = \frac{Q}{t} = \kappa A \frac{T_H - T_C}{L}$$

$$\frac{mv^2}{2} = (3/2)kT, \quad v_{\text{rms}} = \sqrt{\frac{3RT}{M}}$$

$$W = Q_H - Q_L$$

$$\varepsilon = \frac{W}{Q_H} = 1 - \frac{Q_L}{Q_H}$$

$$K = \frac{Q_L}{W}$$

$$\frac{Q_L}{Q_H} = \frac{T_L}{T_H}, \quad \Delta S = \int \frac{dQ}{T}$$

#### Constants:

$$1 \text{ Liter} = 10^{-3} \text{ m}^3$$

$$R = 8.31 \text{ J/mol K}$$

$$N_A = 6.02 \times 10^{23} \text{ molecules/mole}$$

$$1 \text{ atm} = 1.01 \times 10^5 \text{ N/m}^2$$

$$k = 1.38 \times 10^{-23} \text{ J/K}$$

$$1 \text{ calorie} = 4.190 \text{ Joule}$$

$$g = 9.8 \text{ m/s}^2$$

for water:

$$c = 4190 \frac{\text{J}}{\text{kg.K}}$$

$$L_F = 333 \frac{\text{kJ}}{\text{kg}}, \quad L_V = 2256 \frac{\text{kJ}}{\text{kg}}$$