

- 1 Q0 One mole of a monatomic ideal gas is taken from an initial state
 21 Q0 (i) to a final state (f) as shown in figure 1. The curved
 Q0 line is an isotherm. Calculate the increase in entropy
 Q0 of the gas for this process.
 A1 36.5 J/K.
 A2 1.25 J/K.
 A3 25.0 J/K.
 A4 22.5 J/K.
 A5 11.2 J/K.
 Q0
- Q0 One mole of a diatomic ideal gas is taken through the cycle
 Q0 shown in Figure 2. Process b→c is adiabatic, $P_a = 0.3 \text{ atm}$,
 Q0 $P_b = 3.0 \text{ atm}$, $V_b = 1.0 \times 10^{-3} \text{ m}^3$, and $V_c = 4.0 V_b$.
 Q0 What is the efficiency of the cycle?
 Q0
 A1 53%.
 A2 34%.
 A3 28%.
 A4 74%.
 A5 12%.
 Q0
- 3 Q0 You mix two samples of water, A and B. Sample A is 100 g
 Q0 at 20 degree-C and sample B is also 100 g but at 80 degree-C.
 21 Q0 Calculate the change in the entropy of sample B.
 Q0
 A1 - 8.9 cal/K.
 A2 8.9 cal/K.
 A3 - 9.7 cal/K.
 A4 9.7 cal/K.
 A5 zero.
 Q0
- 4 Q0 What mass of water at 0 degrees-C can a freezer make into ice
 21 Q0 cubes in one hour, if the coefficient of performance of the
 Q0 refrigerator is 3.0 and the power input is 0.2 Kilowatt?
 Q0
 A1 6.5 kg.
 A2 9.2 kg.
 A3 1.9 kg.
 A4 0.4 kg.
 A5 3.0 kg.
 Q0
- 5 Q0 Which of the following statements is correct?
 21 Q0
 A1 For an adiabatic process the change in entropy is zero if it
 A1 is done reversibly.
 A2 For an adiabatic process the change in entropy is negative if
 A2 it is done irreversibly.
 A3 For an isothermal expansion the change in entropy of an ideal
 A3 gas is zero.
 A4 A Carnot engine does not reject any heat as waste.
 A5 The efficiency of a Carnot engine is 100%.
 Q0
- 6 Q0 In figure 3, $Q = 60 \text{ micro-C}$, $q = 20 \text{ micro-C}$, $a = 3.0 \text{ m}$,
 22 Q0 and $b = 4.0 \text{ m}$. Calculate the total electric force
 Q0 on q . [i and j are the unit vectors in the positive direction
 Q0 of x-axis and y-axis, respectively].

- Q0
 A1 0.69 i (N).
 A2 -0.69 i (N).
 A3 -0.34 i (N).
 A4 0.34 i (N).
 A5 1.12 j (N).
 Q0
- 7 Q0 In figure 4, a 0.3 g metallic ball hangs from an insulating
 23 Q0 string in a vertical electric field of 4000 N/C directed
 Q0 upward as shown. If the tension in the string is 0.005 N,
 Q0 then the charge on the ball is:
 Q0
 A1 -0.52 micro-C
 A2 0.52 micro-C
 A3 -0.73 micro-C
 A4 0.73 micro-C
 A5 -1.3 micro-C
 Q0
- 8 Q0 In figure 5, four charges are placed on the circumference of a
 23 Q0 circle of diameter 2 m. If an electron is placed at the center
 Q0 of the circle, then the electron will
 Q0 [Take $Q = 60$ micro-C, $q = 20$ micro-C]
 Q0
 A1 stay at the center.
 A2 move to the right.
 A3 move to the left.
 A4 move upward.
 A5 move downward.
 Q0
- 9 Q0 A particle of mass 5.0 g and charge 40 mC moves in a region of
 23 Q0 space where the electric field is uniform and given by
 Q0 $E = -5.5 i$ (N/C). If the velocity of the particle at $t = 0$ is
 Q0 given by $v = 50 j$ (m/s), find the speed of the particle at
 Q0 $t = 2$ s. [i , and j are the unit vectors in the directions of x ,
 Q0 and y respectively].
 Q0
 A1 101 m/s.
 A2 65 m/s.
 A3 34 m/s.
 A4 150 m/s.
 A5 85 m/s.
 Q0
- 10 Q0 At which point can the electric field due to the two charges
 23 Q0 shown in figure 6 be zero?
 Q0
 A1 point E.
 A2 point A.
 A3 point B.
 A4 point C.
 A5 point D.
 Q0
- 11 Q0 A point charge, $q_1 = -2.0 \cdot 10^{(-6)}$ C, is placed inside a cube
 24 Q0 of side 5.0 cm, and another point charge $q_2 = 3.0 \cdot 10^{(-6)}$ C
 Q0 is placed outside the cube. Find the net electric flux
 Q0 through the surfaces of the cube.
 Q0
 A1 $-2.3 \cdot 10^{*5}$ N m²/C

A2 $+3.4 \times 10^{15} \text{ N m}^2/\text{C}$
A3 $1.1 \times 10^{17} \text{ N m}^2/\text{C}$
A4 $-1.1 \times 10^{15} \text{ N m}^2/\text{C}$
A5 $2.3 \times 10^{15} \text{ N m}^2/\text{C}$
Q0

12 Q0 Figure 7 shows portions of two large, parallel, nonconducting
24 Q0 sheets, A and B. The surface charge densities are:
Q0 $\sigma_1 = -4.5 \text{ micro-C/m}^2$ and $\sigma_2 = -6.5 \text{ micro-C/m}^2$.
Q0 Find the electric field at any point between the two sheets.
Q0

A1 $1.1 \times 10^{15} \text{ N/C}$ towards B.
A2 $1.4 \times 10^{15} \text{ N/C}$ towards A.
A3 $1.4 \times 10^{15} \text{ N/C}$ towards B.
A4 $1.1 \times 10^{15} \text{ N/C}$ towards A.
A5 zero.
Q0

13 Q0 A hollow metallic sphere, of radius 2.0 cm, is filled
24 Q0 with a non-conducting material which carries a charge of
Q0 5.0 pico-C distributed uniformly throughout its volume.
24 Q0 What is the magnitude of the electric field 1.5 cm from
Q0 the center of the sphere?
Q0

A1 84 N/C.
A2 68 N/C.
A3 17 N/C.
A4 90 N/C.
A5 zero.
Q0

14 Q0 A total charge of $5.00 \times 10^{(-6)} \text{ C}$ is uniformly distributed
24 Q0 inside an irregularly-shaped insulator. The volume of the
Q0 insulator is 3.0 m^3 . Now, imagine a cube of volume 0.50 m^3
Q0 inside the insulator. What is the total electric flux
Q0 through the surfaces of the cube?
Q0

A1 $9.4 \times 10^{14} \text{ N m}^2/\text{C}$.
A2 Zero.
A3 $2.5 \times 10^{13} \text{ N m}^2/\text{C}$.
A4 $4.5 \times 10^{15} \text{ N m}^2/\text{C}$.
A5 $8.1 \times 10^{15} \text{ N m}^2/\text{C}$.
Q0

15 Q0 A 40 N/C uniform electric field points perpendicularly toward
24 Q0 a large neutral conducting sheet, as shown in figure 8. The
Q0 surface charge densities (in C/m^2) on the right, σ_R
Q0 and left, σ_L , respectively are:
Q0

A1 $-3.5 \times 10^{(-10)}$; $+3.5 \times 10^{(-10)}$.
A2 $+3.5 \times 10^{(-10)}$; $-3.5 \times 10^{(-10)}$.
A3 $-7.0 \times 10^{(-10)}$; $+7.0 \times 10^{(-10)}$.
A4 $+7.0 \times 10^{(-10)}$; $-7.0 \times 10^{(-10)}$.
A5 zero ; zero.
Q0

16 Q0 Find the electrostatic potential at $x = 0$ for the following
25 Q0 distribution of charges: $-2q$ at $x = 10 \text{ cm}$ and $-2q$ at $x = -10 \text{ cm}$.
Q0 [Take $q = 1.0 \times 10^{(-9)} \text{ C}$, and the electrostatic potential at
Q0 infinity = 0]
Q0

A1 -360 V.

- A2 180 V.
 A3 360 V.
 A4 zero.
 A5 -180 V.
 Q0
- 17 Q0 Three point charges are initially infinitely far apart.
 24 Q0 Two of the point charges are identical and have charge Q . If
 Q0 zero net work is required to assemble the three charges at
 Q0 the corners of an equilateral triangle of side d , then the
 Q0 value of the third charge is
 Q0
- A1 $-Q/2$.
 A2 $-2*Q$.
 A3 $-Q/3$.
 A4 $Q/2$.
 A5 $Q/3$.
 Q0
- 18 Q0 Consider two concentric conducting shells of radii (a) and
 25 Q0 (b), $b > a$. The smaller (inner) shell has a positive charge
 Q0 (q) and the larger (outer) shell has a charge (Q). If the
 Q0 potential of the inner shell is zero, what is the value of Q ?
 Q0
- A1 $Q = -b*q/a$.
 A2 $Q = -a*q/b$.
 A3 $Q = b*q/a$.
 A4 $Q = a*q/b$.
 A5 $Q = -q$.
 Q0
- 19 Q0 In figure 9, two equal positive charges, each of magnitude
 25 Q0 $5.0*10^{*-5}$ C, are fixed at point A and B separated by a
 Q0 distance of 6 m. An equal and opposite charge moves towards
 Q0 them along the line CO. At point C, 4.0 m from O, the
 Q0 kinetic energy of the moving charge is 4.0 J. What is the
 Q0 kinetic energy of this charge when it passes point O?
 Q0
- A1 10.0 J.
 A2 4.3 J.
 A3 2.2 J.
 A4 12.5 J.
 A5 19.0 J.
 Q0
- 20 Q0 The potential of a charge distribution is given by:
 25 Q0 $V(x,y) = A [y*(x**2) - x*(y**2)]$,
 Q0 where A is in appropriate units. The electric field will
 Q0 be zero at the point:
 Q0
- A1 $x = 0$, and $y = 0$.
 A2 $x = 1$, and $y = 0$.
 A3 $x = 0$, and $y = 1$.
 A4 $x = 1$, and $y = 1$.
 A5 $x = 1$, and $y = -1$.

Physics 102
Formula Sheet for 2nd Major Exam
Second Semester 2003-2004 (Term 032)

<p> $Q = mc\Delta T, \quad Q = mL$ $Q = nc_p\Delta T, \quad Q = nc_v\Delta T$ $W = Q_h - Q_c$ $\epsilon = \frac{W}{Q_h} = 1 - \frac{Q_c}{Q_h}$ $K = \frac{Q_c}{W}$ $\frac{Q_c}{Q_h} = \frac{T_c}{T_h}, \quad \Delta S = \int \frac{dQ}{T}$ <hr style="border-top: 1px dashed black;"/> $F = k \frac{q_1 q_2}{r^2}, \quad \Phi = \int_{\text{Surface}} \vec{E} \cdot d\vec{A}$ $E = \sigma / 2\epsilon_0, \quad E = \sigma / \epsilon_0$ $E = k \frac{q}{r^2}, \quad E = k \frac{q}{R^3} r, \quad E = \frac{2k\lambda}{r}$ $\Phi_c = \oint \vec{E} \cdot d\vec{A} = \frac{q_{in}}{\epsilon_0}$ $E_x = -\frac{\partial V}{\partial x}, \quad E_y = -\frac{\partial V}{\partial y}, \quad E_z = -\frac{\partial V}{\partial z}$ $\Delta V = V_B - V_A = -\int_A^B \vec{E} \cdot d\vec{S} = \frac{\Delta U}{q_0}$ $V = k \frac{q}{r}$ $U = k \frac{q_1 q_2}{r_{12}}$ $PV^\gamma = \text{constant}; \quad TV^{\gamma-1} = \text{constant}$ $C_V = \frac{3}{2} R$ for monatomic gases, $= \frac{5}{2} R$ for diatomic gases. </p>	<p> $v = v_0 + at$ $x - x_0 = v_0 t + \frac{1}{2} a t^2$ $v^2 = v_0^2 + 2 a (x - x_0)$ Constants: $\text{Pi} = \pi$ $k = 9.0 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2$ $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N}\cdot\text{m}^2$ $e = -1.6 \times 10^{-19} \text{ C}$ $m_e = 9.11 \times 10^{-31} \text{ kg}$ $m_p = 1.67 \times 10^{-27} \text{ kg}$ $k_B = 1.38 \times 10^{-23} \text{ J/K}$ $N_A = 6.022 \times 10^{23} \text{ molecules/mole}$ $R = 8.314 \text{ J/mol}\cdot\text{K}$ $1 \text{ atm} = 1.013 \times 10^5 \text{ N/m}^2$ $g = 9.8 \text{ m/s}^2$ <hr style="border-top: 1px solid black;"/> $\text{micro} = 10^{-6}$ $\text{nano} = 10^{-9}$ $\text{pico} = 10^{-12}$ $\text{Sigma} = \sigma$ $a*b**c = ab^c$ $\text{Sqrt}(a) = \sqrt{a}$ $1 \text{ calorie} = 4.186 \text{ Joule}$ $\text{for water: } L_f = 80 \text{ cal/g}$ $L_v = 540 \text{ cal/g}$ $c = 1 \text{ cal/g}\cdot\text{K}$ </p>
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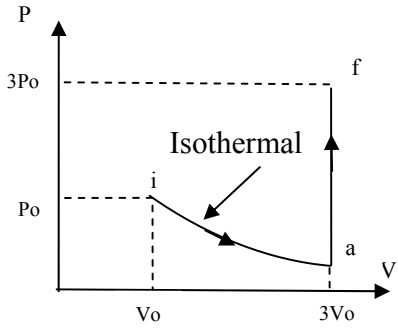


Figure 1

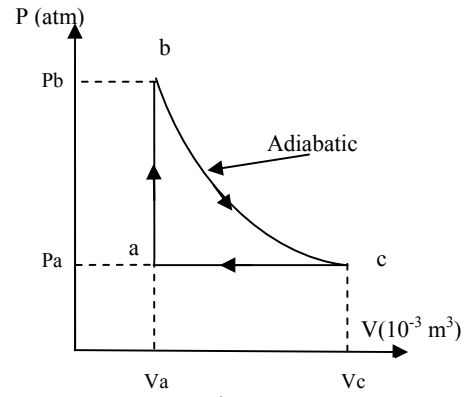


Figure 2

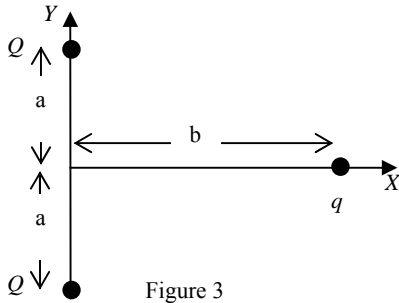


Figure 3

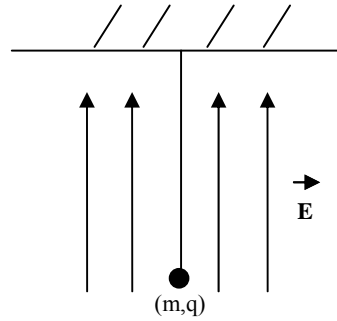


Figure 4

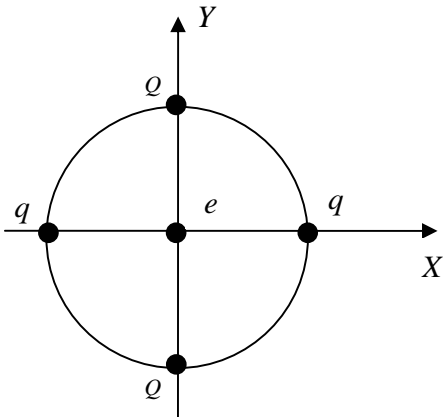


Figure 5



Figure 6

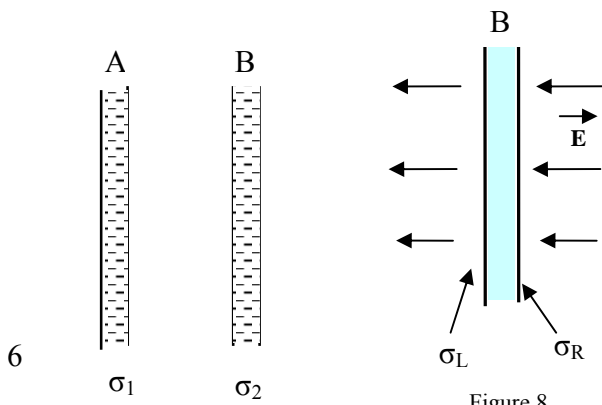


Figure 8

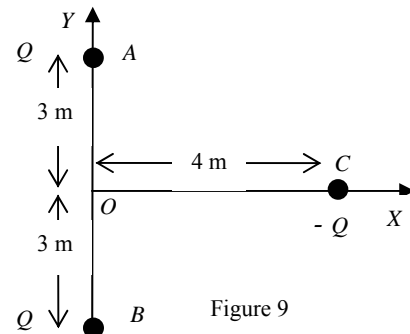


Figure 9