

Solutions to Chen's Plasma Physics

Kalman Krizhnik

1-1. Compute the density (in units of m^{-3}) of an ideal gas under the following conditions:

a) At 0°C and 760 Torr pressure (1 Torr = 1mm Hg). This is called the Loschmidt number.

b) In a vacuum at 10^{-3} Torr at room temperature (20°C). This number is a useful one for the experimentalist to know by heart (10^{-3} Torr = 1 micron).

a) Avogadro's number is $N_A = 6.022 \times 10^{23}$. One mole of gas at STP occupies 22.4 liters. 1 liter is 1×10^{-3} cubic meters. Thus, the number per cubic meter is $N_A/n = 6.022 \times 10^{23}/(22.4 \times 10^{-3}) = 2.66 \times 10^{25} m^{-3}$. Thus, the Loschmidt number is 2.66×10^{25} \square

b) Using $PV=NkT$, we obtain (with $R = 1.4 \times 10^{-23} \text{ J } K^{-1}$ and 1 Torr = 133 Pa):

$$n = \frac{N}{V} = \frac{P}{kT} = \frac{10^{-3} \times 133}{1.4 \times 10^{-23} \times (20 + 273)} = 3.3 \times 10^{19} m^{-3} \quad \square \quad (1)$$

1-2. Derive the constant A for a normalized one-dimensional Maxwellian distribution

$$f(u) = Ae^{-mu^2/2kT} \quad (2)$$

such that

$$\int_{-\infty}^{\infty} f(u) du = 1 \quad (3)$$

This one is straightforward. Just integrate:

$$1 = \int_{-\infty}^{\infty} Ae^{-mu^2/2kT} du = A \sqrt{\frac{2\pi kT}{m}} \Rightarrow A = \sqrt{\frac{m}{2\pi kT}} \quad \square \quad (4)$$

1-4. Compute the pressure, in atmospheres and in tons/ft^2 , exerted by a thermonuclear plasma on its container. Assume $kT_e = kT_i = 20\text{keV}$, $n = 10^{21} m^{-3}$ and $p = nkT$, where $T = T_i + T_e$.

This is just unit conversion, albeit with units that nobody really ever remembers. For reference, $1 \text{ keV} = 1.6 \times 10^{-19} \text{ J}$, so

$$p = 10^{21} \times (20\text{keV} + 20\text{keV}) = 4 \times 10^{22} m^{-3} \text{ keV} = 4 \times 10^{22} m^{-3} \text{ J} = 4 \times 10^3 N/m^2 \quad (5)$$

But $1 \text{ atm} = 10^5 N/m^2 = 1 \text{ ton}/ft^2$, so (Note: I think there is a mistake in Chen's solutions here. If I am mistaken, please let me know).

$$p = 0.04 \text{ atm} = 0.04 \text{ ton}/ft^2 \quad \square \quad (6)$$

1-5. In a strictly steady state situation, both the ions and the electrons will follow the Boltzmann relation

$$n_i = n_0 e^{-e\phi/kT_i} \quad (7)$$

For the case of an infinite, transparent grid charged to a potential ϕ , show that the shielding distance is given approximately by

$$\lambda_D^{-2} = \frac{ne^2}{\epsilon_0} \left(\frac{1}{kT_e} + \frac{1}{kT_i} \right) \quad (8)$$

Show that λ_D is determined by the temperature of the colder species.

We'll use Poisson's equation

$$\nabla^2 \phi = \frac{en_e - en_i}{\epsilon_0} = \frac{en_0}{\epsilon_0} (e^{e\phi/kT_e} - e^{-e\phi/kT_i}) \approx \frac{en_0}{\epsilon_0} \left(1 + \frac{e\phi}{kT_e} - 1 - \frac{-e\phi}{kT_i} \right) = \frac{e^2 n}{\epsilon_0} \left(\frac{\phi}{kT_e} + \frac{\phi}{kT_i} \right) \quad (9)$$

Solution Manual Of Plasma Physics

F Rizvi



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Solutions Manual for Controlled Fusion and Plasma Physics Miyamoto Kenro, Miyamoto Kenro Staff, 2006-07

Plasma Physics Richard Fitzpatrick, 2022-12-13 Encompasses the Lectured Works of a Renowned Expert in the Field Plasma Physics An Introduction is based on a series of university course lectures by a leading name in the field and thoroughly covers the physics of the fourth state of matter This textbook provides a concise and cohesive introduction to plasma physics theory and offers a solid foundation for students of physics wishing to take higher level courses in plasma physics Mathematically Rigorous but Driven by Physics The author provides an in depth discussion of the various fluid theories typically used in plasma physics presenting non relativistic fully ionized nondegenerate quasi neutral and weakly coupled plasma This second edition has been fully updated to include new content on collisions and magnetic reconnection It contains over 80 exercises carefully selected for their pedagogical value with fully worked out solutions available in a separate solutions manual for professors The material presents a number of applications and works through specific topics including basic plasma parameters the theory of charged particle motion in inhomogeneous electromagnetic fields collisions plasma fluid theory electromagnetic waves in cold plasmas electromagnetic wave propagation through inhomogeneous plasmas kinetic theory magnetohydrodynamical fluid theory and magnetic reconnection Features Discusses fluid theory illustrated by the investigation of Langmuir sheaths Explores charged particle motion illustrated by the investigation of charged particle trapping in the earth's magnetosphere Examines the MHD and WKB theories *Engineering Education*, 1983 **Plasma Kinetic Theory - Solutions Manual** Donald Gary Swanson, 2008-02-22 Lectures on Numerical Methods for Non-Linear Variational Problems R. Glowinski, 2008-01-22 When Herb Keller suggested more than two years ago that we update our lectures held at the Tata Institute of Fundamental Research in 1977 and then have it published in the collection Springer Series in Computational Physics we thought at first that it would be an easy task Actually we realized very quickly that it would be more complicated than what it seemed at first glance for several reasons 1 The first version of Numerical Methods for Nonlinear Variational Problems was in fact part of a set of monographs on numerical mathematics published in a short span of time by the Tata Institute of Fundamental Research in its well known series Lectures on Mathematics and Physics as might be expected the first version systematically used the material of the above monographs this being particularly true for Lectures on the Finite Element Method by P G Ciarlet and Lectures on Optimization Theory and Algorithms by J Cea This second version had to be more self contained This necessity led to some minor additions in Chapters I IV of the original version and to the introduction of a chapter namely Chapter V of this book on relaxation methods since these methods play an important role in various parts of this book **Advance Elements of Laser Circuits and Systems** Ofer Aluf, 2021-03-09 This book on Advance Elements of Laser circuits and systems Nonlinearity applications in engineering addresses two separate engineering and scientific areas and presents advanced analysis methods for Laser

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web aug 17 2023 elemental doğanın güçleri türkçe dublaj ve elemental türkçe altyazılı seçenekleriyle 1080p kalitesinde hd izle film Özeti ember ve wade çifti ateş su kara ve hava insanların bir arada yaşadığı bir şehirde yaşamaktadır coşkulu genç kadın ve bu sağduyulu genç adam temel bir şeyi keşfetmek üzeredir onlar

elemental rotten tomatoes - Mar 11 2023

web water fire earth and air are like ethnic inhabitants of distinctive neighborhoods in this imaginatively designed element city with the periodic table like skyline but the story line gets

elemental doğanın güçleri elemental filmi sinemalar com - Apr 12 2023

web elemental doğanın güçleri film konusu disney in yeni animasyonu elemental ateş su kara ve hava elementleri sakinlerinin bir arada yaşadığı bir şehirde ember ateş ve wade i su konu almakta