Physics 244 Fall 1997

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Class meets: Lecture: MWF 2:25 - 3:15 PM 3425 Sterling
Disc(Opt): W: 3:30 - 4:20 PM 3425 Sterling
T: 1:20 - 2:10 PM 3425 Sterling
M: 1:20 - 2:10 PM 1327 Sterling

Text: R. A. Serway, C. J. Moses, and C. A. Moyer, Modern Physics (Saunders 1997) 2nd edn.

References: Tipler, Elementary Modern Physics
Tipler, Modern Physics
Sproull and Phillips, Modern Physics
Krane, Modern Physics
Ohanion, Modern Physics
Atomic Physics: Herzberg, Atomic Physics and Atomic Structure
Kinetic Theory: Sears, Thermodynamics
Reif: Statistical Physics (Berkeley Vol 5)
Solid State: Kittel, Introduction to Solid State Physics
Quantum Mechanics: Eisberg and Resnick, Quantum Physics

Homework: The attached syllabus has problems designated for each lecture hour. Those assigned in a given week will be collected in lecture on the following Monday. Solutions to the assignment will then be placed on reserve in the Physics Library, 4220 Chamberlin. Please STAPLE your homework pages.

Exams: There will be three hour exams at the class hour, dates are Monday September 29; Wednesday October 29; and Wednesday December 3. The final exam is Sunday December 14 at 7:45 AM.

Grading: Each hour exam counts 20% and the final exam counts 40%. The homework will be used to resolve grades for those students near boundaries. Exceptionally good or poor homework can make a change of one-half a letter grade. The course will be distributed on a normal curve, with the average equal to that given in previous semesters.

Kinetic Theory Problems for September 3, 5, 12, and 15.

N1. In the calculation of the pressure on a wall, only the collisions of gas molecules with that wall were included. Why are we able to omit discussion of the collisions with the other walls of the container?

N2. a.) Find the total kinetic energy of translation of 1 mole of N_2 molecules in 22.4 liters at 273 K. b.) How does the result change if the gas is I_2 ? Ar?

N3. Estimate the time to deposit a monolayer film on a surface at 300 K in a vacuum at pressure 10^{-6} atmosphere and at 10^{-10} atm. Assume that all incident atoms/molecules stick to the surface.

N4. If the probability distribution p(x) is symmetric about the origin, so p(-x) = p(x), the average of x is zero. Does it follow that the most probable value of x is also zero? Use sketches of symmetric functions p(x) to justify your answer.

N5. H_2 molecules escape so freely from the earth's gravitational field that H_2 is not found in the earth's atmosphere. The mean speed of H_2 at 300 K is much less than the escape speed. Explain how the H_2 can escape. How is it that O_2 and N_2 remain in the earth's atmosphere?

N6. For an ideal ("sufficiently dilute") gas, the specific heats per mole at constant pressure and at constant volume are related by $C_P = C_V + R$, and the ratio of specific heats is defined to be $\gamma = C_P/C_V$. Find γ (a) for an inert gas such as He or Ar; (b) for a diatomic gas such as O_2 or N_2.

N7. The specific heats in cal/gm K at 20 C are 0.214,0.21, 0.074, 0.093, 0.0558, and 0.031 for solids of Al, Si, Ge, Cu, Ag, and Pb. Discuss this in terms of the equipartition of energy. Note that the valence of the metals is 3, 1, 1, and 4 for Al, Cu, Ag, and Pb, respectively.

N8. For a monatomic ideal gas of atoms of mass m at Kelvin temperature T, find the thermal averages $\langle v_x \rangle$, $\langle v_y \rangle$, $\langle v_x v_y \rangle$, $\langle v_x^2 \rangle$, and $\langle v_x^2 v_y^2 \rangle$. [You should be able to do this without resorting to integral tables!]

N9. The coefficient of thermal conductivity in a gas is expressed in terms of the number density n, mean speed v, mean free path ℓ and specific heat per atom c_V by $K = (1/3)\, n\, v\, \ell\, c_V$. In a moderately dilute gas, what effect is the effect on K of reducing the density to 1/2 the initial density? Explain.

N10. The diameter of an argon atom may be taken as about 3.8 Å = 0.38 nm. Compare the size of the argon atom, its mean free path and mean spacing in argon gas at 1 atm pressure and 273 K. Compare the duration of a collision and the time between collisions in this gas.

Physics 244 Syllabus / Fall 1997

Notations: Q denotes questions; problems are identified by number; asterisk(*) denotes algebraically more complex problem

Date	Topic	Text	Homework
Sep 3	Gas pressure	Notes	...
5	flux,transport	Notes	Notes:N1,N2,N3
Sep 8	Maxwell distribn I.	9.1	9:2,3,6;N4
10	Maxwell II	9.1	9:7,8,9;N5
12	equipartition	Notes	Notes:N6,N7,N8
Sep 15	diffusion, thermal cond	Notes	Notes:N9,N10
17	waves; diffraction	4.3,4.7	4:15,16
19	light quanta	2.4-2.6	2:Q3,7,10,19,30
Sep 22	electron waves	4.1,4.2	4:2,5,31,32
24	packets,uncertainty	4.5,4.7	4:22,25,29,35
26	open/review		....
Sep 29	EXAM I		
Oct 1	Schrödinger, free part.	5.1,5.2	5:Q2,1,6
3	Schrödinger, potential	5.3,5.4	5:9,11,16
Oct 6	square well	5.5	5:Q3,20,23*
8	oscillator	5.6	5:25,26,34
10	expect. value/operator	5.7,5.8	5:27,31,35
Oct 13	square barrier	6.1	6:1,4,11*
15	tunneling; 3D free part.	6.2,7.1	6:13,14*;7:3,6
17	Bohr atom	3.2-3.4	3:Q3,14,23,24
Oct 20	central force	7.2	7:Q1,9
22	quantized ang mom	7.3,7.4	7:Q4,Q5,17
24	Hydrogen atom	7.5	7:12,23,31
Oct 27	open/review		....
29	EXAM II		
31	Pauli;periodic table	8.4,8.6	8:Q6,Q10,16,21
Nov 3	quantum statistics	9.2,9.3	9:10*,11,14
5	black body, photon gas	2.2,2.3	2:2,4,5*
7	molecule,Xtal bonds	10.1,10.4,11.1	10:Q1,2,12;11:1

Date	Topic	Text	Homework
Nov 10	el cond (Drude)	11.2	11:9,10,11,Q14
12	Fermi gas	9.4,11.3	9:15,22;11:13
14	energy bands	11.4	11:Q1,15,16
Nov 17	energy bands II	11.4, notes	....
19	semiconductors	11.5	11:Q3,Q8,18
21	devices	11.5	....
Nov 24	lasers	11.6	11:Q16,Q17,20
26	superconductors	12.2-12.5	....
28	[Recess]		....
Dec 1	open/review		
3	EXAM III		
5	nuclear constituents	13.1,13.2	....
Dec 8	radioactivity	13.4,13.5	....
10	nuclear reactions	14.1-14.6	....
12	space physics	....	

FINAL EXAM: DECEMBER 14 7:45 AM