

Important Equations will be given as part of the test.

Student Problems – As only 7 were turned in, only four will be used.  
(An 8<sup>th</sup> was turned in but I deemed in not suitable for this class.)

1) Name four types of Vacuum gauges, what pressures they operate at, and how they work.

2) List and describe the four different types of gas flow. Describe ways of approximating what type of flow you will find in a given condition.

3) Calculate the average velocity and mean free path for Ar (40 amu) gas molecules at 300 K and at atmospheric pressure (760 torr).

4) What is Debye Length  $\lambda_{De}$ ? You need to neither derive it nor provide a mathematical expression.

5) Explain the manner in which a simple oil backing pump and a turbomolecular pump would be connected to and operate in a system. Also, explain the necessity of both pumps (a roughing and high vacuum) for high vacuum applications, assuming the system is not blown.

6) Construction of a vacuum system:

Sketch a diagram of a typical vacuum system used for deposition or etching of aluminum. Label the important components of the chamber and describe their function and why they are necessary for the plasma process.

7) A 15-cm-diameter, 15 cm long connects a high vacuum chamber and a pumping system. Which of the following modifications will give the greatest increase in conductance in the molecular flow region? a) reducing the length of the tube to 7.5 cm, b) increasing the length of the tube to 17.5 cm? c) reducing the diameter from 15 to 12 cm? d) increasing the diameter to 17.5 from 15cm.

My review

~3 problems like homework.

Others

What is a plasma? What are characteristics of process plasmas?

What are possible safety concerns with process plasmas?

How does etching work?

How does Plasma assisted chemical vapor deposition work?

How does Physical vapor deposition work?

How do cold dc glow discharges work?

How do hot dc glow discharges work?

How do magnetrons work?

How do ICPs work

How do Capacitively Couple rf plasmas work?

Why is the electron temperature typically higher than the ion temperature?

Which pressure gauges measure pressure directly?

What are the 6 main pressure gauges and what range do they operate over?

How does a Capacitance Manometer work?

How does a thermocouple pressure gauge work?

Which pressure gauges are useful for measuring base pressures?

Which gauges are useful for measuring operational pressures?

Name the 6 main types of pumps and the typical operational range.

How does a rotary mechanical pump work?

How does a turbo pump work?

How does a Cryo pump work?

How does a blower work?

What are the two main types of flange to flange sealants?

What is the typical gas velocity distribution?

Given a Maxwell distribution, determine the average speed, velocity, energy.  
[Careful I might give a drifting distribution...]

Prove the ideal gas law

Derive the mean free path for collisions

Determine if a flow is Fluid/Molecular and Laminar/Turbulent

Name the different types of leaks

Know how to build a pump stack...

Know how to calculate conductances for multiple tubes

Know how to calculate pump speed with tube in front.

What are important characteristics of chamber materials?

Be able to calculate drifts for single particle motion particularly EXB.

How does an RGA work?

How is mass selection done?

What are the three main ion measurement tools at the end on RGAs – Know how they work.

What are the two main mass separation techniques.

For a sector magnet system, Know how to get the mass from the magnetic field strength and the ion energy.

Be able to describe what the gas is from a cracking pattern. (Data tables will be provided.)

Given the appropriate starting equations, know how to derive the Debye length?

What is the physical meaning of the Debye length?

Given the equations, be able to describe the physical interpretation of 1) ion acoustic wave, 2) electromagnetic wave.

Basic Spectroscopy

How do the basic systems work...