Problem 1: Let $f(t)$ be a function defined on the interval $[0, \infty)$. The Laplace transform $L[f]$ of $f(t)$ is given by

$$L[f] = \int_0^\infty f(t)e^{-st}dt,$$

where $s$ is a parameter. Show that

1. $L[t] = \int_0^\infty t e^{-st}dt = \frac{1}{s^2}$.
2. $L[e^{3t}] = \int_0^\infty e^{3t}e^{-st}dt = \frac{1}{s-3}$ for $s > 3$.

Problem 2: Projects for Chapter 8 #3: part a) to d) only.

Problem 3: Let $v$ be the speed, in meters/second, of an oxygen molecule, and let $p(v)$ be the density function of the speed distribution of oxygen molecules at room temperature. Maxwell showed that

$$p(v) = av^2e^{-\frac{mv^2}{2kT}},$$

where $k = 1.4 \times 10^{-23}$, $T = 293^0$ K and $m = 5 \times 10^{-26}$ kg.

1. Find the value of $a$.
   (a) Answer this question by following the following steps:
      i. Using integration by parts to show that for any constant $b > 0$
         $$\int_0^\infty x^2e^{-bx^2}dx = \frac{1}{2b} \int_0^\infty e^{-bx^2}dx.$$
      ii. Use (i), $u$ substitution and the fact that $\int_0^\infty e^{-u^2}du = \frac{\sqrt{\pi}}{2}$ to conclude that
         $$\int_0^\infty x^2e^{-bx^2}dx = \frac{\sqrt{\pi}}{4b^\frac{3}{2}}.$$
      iii. Find the value of $a$ using the fact that $p(v)$ is a density function.
   (b) Estimate the median speed using your calculator.
   (c) Find the exact value of the mean speed.

Problem 4: Find the exact value of the length of the spiral $r = e^{-\theta}$ for $\theta \geq 0$.
You may find helpful to use the formula for arc length of polar curves given in Section 8.3, problem 41 (page 415).

Do not miss the LSA Concentration Fair!!
Wednesday March 14, 11-3 pm at the Michigan Ballroom.
**LSA CONCENTRATION FAIR**

Wednesday, March 14, 11am-3pm  
@ The Michigan League Ballroom

sponsored by LSA Student Academic Affairs and LSA Student Government

- In search of a concentration or double concentration that's just right for you?
- Interested in exploring LSA minors?
- Excited by the availability of interdisciplinary concentrations that allow you to focus within and across disciplines that intrigue you?
- Simply looking for interesting courses to help you fulfill your distribution requirements?
- Want some perspective from a pre-health or pre-law advisor?
- Wondering how study abroad might fit into your academic plans?

Come to the **LSA Concentration Fair** to get the information you need to make an informed choice about the programs in the College and clarify your academic goals. Faculty, concentration advisors, staff, and enthusiastic current concentrators are happy to share their information and perspectives with you. After the Fair, make an appointment with a general advisor for further discussion about choosing a concentration, or if you already know the direction you want to pursue, talk with a program representative at the Fair and follow up with a concentration advisor afterward.

Be sure to also check out **Concentration Week** (March 12-16) events.