HOMEWORK 1, DUE WEDNESDAY APRIL 8TH, 12PM

Calculate:

1.
$$\int_0^\infty \frac{\mathrm{d}x}{(x^2+1)^2}.$$

2.
$$\int_0^\infty \frac{\mathrm{d}x}{x^4+1}.$$

3.
$$\int_0^\infty \frac{\mathrm{d}x}{x^6+1}.$$

4.
$$\int_{-\infty}^\infty \frac{\mathrm{d}x}{x^2+2x+2}.$$

5.
$$\int_0^\infty \frac{\mathrm{d}x}{x^3+1},$$
by integrating over the countour which consists of the line segment from 0 to R, the arc of the circle from R to $Re^{2\pi i/3}$ and the line segment from $Re^{2\pi i/3}$ to 0.

6.
$$\int_{-\infty}^\infty \frac{x\sin x\,\mathrm{d}x}{(x^2+1)(x^2+4)}.$$

7.
$$\int_{-\infty}^\infty \frac{\sin x\,\mathrm{d}x}{x^2+4x+5}.$$

Show that:

8.
$$\int_0^\infty \frac{\cos ax}{(x^2+b^2)^2}\,\mathrm{d}x = \frac{\pi}{4b^3}(1+ab)e^{-ab} \qquad \text{where} \qquad a>0, b>0.$$

Challenge Problems: (Just for fun)

9.
$$\int_0^\infty \frac{x^{2m}}{x^{2n}+1}\,\mathrm{d}x = \frac{\pi}{2n}\csc\left(\frac{2m+1}{2n}\pi\right)$$
where m and n are integers such that $0 \le m < n$.