Here are some more problems that are similar in spirit to what you'll probably see tomorrow. As always, inclusion or exclusion of certain topics here should in no way be thought of as an indication of what Prof. Ratner will put on tomorrow's midterm. Ditto for difficulty level of questions.

Sequences: Determine whether each of the following sequences $\{a_n\}$ converge or diverge. For those that converge, find the limit.

1. $a_n = \dfrac{1}{n + (-2)^n}$
2. $a_n = \sqrt{2n^2 + 3} - \sqrt{2n^2 + n + 1}$
3. $a_n = \dfrac{(-1)^n}{3^{(-1)^n} + n}$
4. $a_n = \dfrac{\cos(\sqrt{n+2})}{\sqrt[3]{n^2+3}+1}$
5. $a_n = \left(\dfrac{n + (-1)^n}{n}\right)^n$

Series: Determine whether each of the following series converge or diverge. For those marked with an *, determine whether or not they converge absolutely.

1. $\displaystyle\sum_{n=1}^{\infty} \frac{\sqrt{n^3 + 3n - 1}}{n^2 - n + 1}$
2. $\displaystyle\sum_{n=1}^{\infty} \frac{\tan^{-1} n}{\ln\left(\frac{n+1}{n}\right) n^3}$
3. $\displaystyle\sum_{n=1}^{\infty} \frac{(-2)^{3n+1}}{n^n}$
4. $\displaystyle\sum_{n=1}^{\infty} (-1)^n \sqrt[n]{\frac{n+2}{3n-1}}$
5. $\displaystyle *\sum_{n=4}^{\infty} \frac{(-1)^n}{n \ln n \sqrt[3]{\ln \ln n}}$
6. $\displaystyle *\sum_{n=1}^{\infty} (-1)^n n e^{-n}$
7. $\displaystyle\sum_{n=1}^{\infty} \frac{(3n)!}{n^n (n!)^2 4^{2n}}$
8. $\displaystyle\sum_{n=1}^{\infty} \left(\frac{n+2}{n+1}\right)^{n^2+1}$
9. $\displaystyle\sum_{n=1}^{\infty} (-1)^n \sin(\sqrt{n}) \cos(1 - e^{-n})$
10. $\displaystyle\sum_{n=3}^{\infty} \frac{2 + \sin n}{n \ln n}$
11. $\displaystyle\sum_{n=1}^{\infty} \frac{\sqrt{n+1} - \sqrt{n}}{n}$
12. $\displaystyle\sum_{n=4}^{\infty} \frac{1}{2^{\ln \ln n}}$
13. $\displaystyle * \sum_{n=2}^{\infty} (-1)^n \frac{\ln n}{n^2}$