

Problem 1. Use mathematical induction to show the following:

(a)

$$\sum_{i=1}^n i(i+1) = \frac{n(n+1)(n+2)}{3}$$

(b)

$$\sum_{i=0}^n 2^i = 2^{n+1} - 1$$

Problem 2.

- (a) Assume  $b^x = a$ . What is  $x$  (in terms of  $a$  and  $b$ )?
- (b) Using only part (a), show that  $\log_c(ab) = \log_c a + \log_c b$ .
- (c) Show that  $a^{\log_b n} = n^{\log_b a}$ .

Problem 3. Differentiate the following functions:

- (a)  $\ln(x^2 + 5)$
- (b)  $\lg(x^2 + 5)$  [NOTE: In Computer Science we use  $\lg x$  to mean  $\log_2 x$ .]
- (c)  $\frac{1}{\ln(x^2+5)}$

Problem 4. Integrate the following functions:

- (a)  $\frac{1}{x}$
- (b)  $\frac{1}{7x+3}$
- (c)  $\ln x$  [HINT: Use integration by parts.]
- (d)  $x \ln x$  [HINT: Use integration by parts.]
- (e)  $x \lg x$

Problem 5. Consider the formula  $3n^4 + 7n^3 \log n + 2n^2$ .

- (a) What is the high order term?
- (b) What is the second order term?
- (c) Write the formula in  $\Theta$  notation (in simplest form).