

Place your name on the back of this sheet of paper and nowhere else. Staple your answers on the front of this sheet of paper. Failure to follow these directions will cost you 1 point. Your assignment will be typed, except graphs can be drawn by hand and mathematical equations can be done by hand. Failure to type it will cost you 10 points. If you use double-sided printing or print on the back of scrap paper, I will give you one additional point.

1) (20 points) Explain the equation below. You can treat each fraction as one variable, providing

you define it first. Also explain the  $a_K$  and  $a_N$ . 
$$\frac{\Delta Y}{Y} = \frac{\Delta A}{A} + a_K \frac{\Delta K}{K} + a_N \frac{\Delta N}{N}$$

2) (20 points) Suppose that output grew 50%, capital grew 30%, labor grew 10%. What was the improvement in technology if we use the historic estimates of the elasticities of output with respect to capital and labor? Show all work.

3) (25 points) Draw the per-worker production function and the per-worker investment line. Show the per-worker level of consumption. Explain how you got that.

4) (25 points) Why does the capital stock have to increase at the rate  $n+d$  to keep a constant capital-labor ratio?

5) (10 points) When we draw the  $y_t = f(k_t)$  line, what are we implicitly assuming about the marginal productivity of capital.