Practice Exam 1

Instructions: Please read carefully.

- You have 70 minutes to complete this exam. There are 4 questions totaling 140 points (20 point bonus). <u>Before you begin, please make sure that you all the 7 pages of this exam stapled together. The last page is blank and can be used as scratch paper.</u>
- This is a closed book/notes exam. You may not use a calculator.
- There will be partial credit awarded if part of your work is correct. To receive partial credit, you must show your work in the space provided after each question.
- Write legibly and only in the space provided. Mentioning extra things that are wrong can hurt your score. Part of the challenge here is to provide a short, precise answer. Good luck!

<u>QUESTION 1</u> **[30 points]**

Suppose that you are assigned to a new project where your goal is to forecast the growth prospects of the state of Minnesota. The production function for this state has the Cobb-Douglas form: $Y = 5\,K^{1/2}\,L^{1/2}$, the depreciation rate is 10 percent, and the savings rate is 20 percent. The population is constant at $L=1$, and everyone in the economy works. Suppose that capital-labor ratio in the first (initial) year is 16 units. Also assume that other assumptions of the Solow model remain applicable (such as a closed economy).
[Note: If you end up with an expression that is in a square root and does not simplify further without a calculator, leave it like that. You'll still get full credit if the expression is correct.]

a. What is the marginal product of capital in the first period? [10 points]

b. How much is the capital-labor ratio going to grow between this year and next year in this economy? [10 points]

c. How much is output per person going to grow during the same period? [10 points]

QUESTION 2 [20 points]

Increasing returns-to-scale in production (also called *increasing* marginal product of capital) seems like a good thing in general: you double your inputs and output increases by more than twice.

a. Can you think of a situation where increasing returns might be detrimental to the growth prospects of a poor country? Draw the appropriate diagram in the context of the Solow model and explain clearly. [12 points]

b. Recall that in the standard Solow model there is not much reason for financial aid to poor countries since all countries eventually converge to their steady states independent of their initial capital stock. Can you make a case for aid if there are in fact increasing returns? [8 points]

QUESTION 3 [30 points]

Consider a country where TFP is growing annually at constant rate **g**. The economy is currently growing along the Balanced Growth Path, supported by this TFP growth. Now at time t*, the **TFP level** experiences a **one-time jump** due to a one time big technological breakthrough. After the jump however, TFP continues to grow at the same constant rate, g, as before.

a) Plot the path of the TFP over time described here.

b) Draw the appropriate diagram for analyzing transitions (the phase diagram we drew in class), and analyze what impact this one time TFP jump will have on the evolution of the capital stock. Draw the time path of the capital stock during this period (before t*, at t* and after t*).

c) Does this TFP jump entail a growth rate effect or a level effect on output per person?

QUESTION 4 [40 points+20 points bonus]

After graduating from U of M, you have been called upon by the World Bank to act as a high-level consultant to resolve some allegations against a developing economy, named Country 2. To resolve this issue, you decide to compare Country 2 to another country that is similar to it in many respects. Here are the details.

You observe that both countries operate according to the Solow growth model with the production function $Y = AK^{1/2}L_w^{1/2}$, where K is aggregate capital and L_w is labor devoted to production (<u>which may or may not be equal to the total population, L</u>). Both countries are identical in all respects, except that country 2 is suspected of suffering from a "shirking" problem by its labor force. Specifically, although its prime minister would not admit, independent observes suspect that a fraction (denote by R) of the population of country 2 simply shirks on the job and do not produce anything. The *remaining* workers in country 2 produce output according to the production function given above. In country 1, all workers work to produce Y, so that $L_w = L$. You also know that both countries are currently in their respective steady states with $y_1/y_2 = 4/3$, where y_1, and y_2 refer to country 1's and 2's output-per-person respectively. There is no TFP growth in either country.

     a. Derive the appropriate expressions for steady state output-per-person in each country. [15 points]

b. Given the information above, what is R? [Hint: You need to answer part (a) correctly to answer part (b)!] [25 points]

c. BONUS: What is the ratio of aggregate capital stocks in steady state: K_1/K_2? [20 points]