Econ 1560 Second Midterm Exam

Instructions: Please answer all questions in the blue books. You may not use notes, books, or calculators. Please show your work. There are six questions (some with multiple parts), for a total of 100 points. Questions vary in their level of difficulty. I have done my best to put harder questions at the end, but I cannot guarantee that my sense of what it hard corresponds to yours. Partial credit will be given for partially correct answers. Good luck!

1) [15 points] In a certain country, over a certain period, the size of the labor force grew at an annual rate of 1% per year while income per worker grew at an annual rate of 2% per year. In the country during this period, output was produced using only labor and land. The production function was

\[ Y = AX^{1/3}L^{2/3}, \]

where \( L \) is the size of the labor force and \( X \) is the quantity of land. The quantity of land did not change over this period.

What was the annual growth rate of productivity? Show how you got your answer.

2) [15 points] Consider the two country model of technology transfer. Labor is the only input into production. There are two countries, 1 and 2. They have equal sized labor forces. County 1 is the technology leader, with 2/3 of its labor force doing R&D and the other 1/3 of the labor force producing output. Country 2 is the technology follower, with 1/3 of its labor force doing R&D (copying, in this case), and the other 2/3 into producing output. The two countries are in steady state, both growing at 1% per year. Amazingly, the two countries have exactly equal levels of output per capita.

What is the gap in technology, as measured in years, between the two countries? Show how you got your answer.
3) A. [10 points] The college premium is defined as the ratio of the wages of workers with a college education to those of a worker who has only a high school degree. Define the return to college as the ratio of the wages that a typical worker would earn if he/she completed college to what his/her wages would be if his/her education stopped at high school.

Which of these two measures do you expect to be bigger, and why?

Note: we have traditionally defined the return to education as being measured in percent, i.e. 13.4% for the first year of schooling and so on. By contrast the college premium is obviously a number bigger than one, so the comparison seems obvious, and you might think that this was a trick question. However, for the purposes of this question, I have redefined the return to college to be in the same units as the college premium, so the comparison is not so obvious.

B) [10 points] How would you expect the gap between the college premium and the return to college (as defined above) to change in each of the following circumstances. In each case take a few sentences to explain your reasoning.

B.1) [5 points] Colleges decide to change their admission standards. In addition to grades and test scores, they decide to also base admission on where a person’s last name falls in the alphabet, with names that fall near the end being given preference.

B.2) [5 points] A new sort of robot is invented that can replace humans in many of the jobs currently performed by college graduates.

4) [15 points] The “Rockstar Consortium” is a firm created by Microsoft, Apple, Blackberry, Ericsson, and Sony. In 2011, Rockstar successfully purchased a portfolio of patents that had belonged to the technology firm Nortel in a bankruptcy auction. Rockstar itself does not make any products, but rather it aims to earn money from licensing and litigation. Rockstar has recently sued Google as well as most manufacturers of Android phones for patent infringement. Possible consequences of this legal action include large legal expenses, high licensing fees, fines, and the possibility that Google would have to eliminate its search-linked advertising business, which is an enormous source of revenue. [All of the facts in this paragraph are true; the remainder of the question is made up.]

In response to cases like this, it has recently been proposed that patent laws be amended so that when a company that was awarded a patent goes bankrupt, the intellectual property covered by the patent immediately becomes part of the public domain. The logic for this proposal is that patents serve to incentivize innovation by offering the inventor a monopoly, but if the inventing firm is bankrupt, that incentive is no longer relevant.

Your job is to write a brief argument against the proposal just described. Your argument should be one or two paragraphs long.
Consider the model of economies open to capital flows, as discussed in Ch. 11. There are two countries, called 1 and 2. Their production functions are

\[ Y_1 = A_1 K_1^{1/2} L_1^{1/2} \]
\[ Y_2 = A_2 K_2^{1/2} L_2^{1/2} \]

The two countries have equal sized labor forces. The level of productivity in country 1 is twice as large as in country 2.

The two countries are open to a world capital market, where there is a fixed rental rate of capital. Capital can flow freely in or out of either country (note: there are many other countries in the world, so the capital flow into one country does not have to equal the capital flow out of the other).

A) [8 points] What is the ratio of capital in country 1 to capital in country 2? Be sure to show your work.

B) [7 points] What is the ratio of wages in country 1 to wages in country 2? Be sure to show your work.
6) [20 points] Consider the model of technology transfer from Chapter 8. There are three countries, called 1, 2, and 3. They have equal populations. The fractions of their labor forces devoted to R&D are related as follows:

\[ y_{A,1} = \frac{3}{2} y_{A,2} = 3 y_{A,3} \]

We will only consider the steady states, so clearly country 1 will be the technology leader, country 2 will have the second highest level of technology, and country 3 will have the lowest level. The cost of copying function has the following unusual form:

\[ \mu_c = \mu_i \times \left( \frac{A_f}{A_l} \right) \quad \text{if} \quad \frac{A_f}{A_l} > \frac{1}{2} \]

\[ = \frac{\mu_i}{2} \quad \text{if} \quad \frac{A_f}{A_l} \leq \frac{1}{2} \]

We will assume that both country 2 and country 3 can only copy from country 1. In other words, country 3 cannot copy from country 2. As far as country 3 is concerned, country 1 is the technology leader.

Describe the steady state of this model. How will the growth rates of the countries compare? If countries do not have the same growth rate, you should be able to characterize the differences both qualitatively (higher vs. lower) and also quantitatively (for example, country x will have a growth rate that is such and such a percentage of growth in country y). Also, what will the ratios of technology levels (i.e. the value of A) in the countries look like over time. You should not try to say anything about the ratio of income levels.