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 seven questions, for a total of 100 points. Questions vary in their level of difficulty. I have tried to put harder questions at the end. Partial credit will be given for partially correct answers. Good luck!

1) [20 points] The table below shows the levels of output (y), physical capital (k), and human capital (h) per worker in two countries in the year 2010:

<table>
<thead>
<tr>
<th></th>
<th>y</th>
<th>k</th>
<th>h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freedonia</td>
<td>1200</td>
<td>400</td>
<td>100</td>
</tr>
<tr>
<td>Sylvania</td>
<td>100</td>
<td>100</td>
<td>25</td>
</tr>
</tbody>
</table>

The production function is \( y = Ak^{1/2} h^{1/2} \). The level of efficiency in Freedonia is twice the level of efficiency in Sylvania. Solve for the ratio of technology in the two countries.

2) [5 points] What was the first practical method for converting chemical energy to mechanical energy?

3) [5 points] In what year did the Industrial Revolution in Britain begin? You will get full credit if your answer is with 40 years of the year given in the textbook, and zero points otherwise.

4) [15 points] A country is described by the version of the Solow model with free flow of capital across borders. The production function (in per worker terms) is \( y = Ak^{1/2} \). Suppose that due to some change in technology the value of \( A \) in the country doubles. The world interest rate is unchanged. By what factor do the levels of capital per worker and output per worker in the country increase?
5) [20 points] The textbook discusses the example of “firemen” on diesel locomotives, who were paid a salary even though they did not do any productive work. Similarly, consider the case of somebody who owns a piece of farmland, but does not do any work on the farm. Every month he receives a rent payment from the farmer. Like the fireman, he is being paid even though he doesn’t do any productive work.

A) [10 points] Discuss how these examples relate to the concept of inefficiency as we have been discussing it in the course. Is one an example of inefficiency and not the other? Are both? Neither? Your answer should be three or four sentences long.

B) [10 points] Chapter 10 of the textbook discusses how rents are often associated with inefficiency. Discuss briefly (three or four sentences) how the observation made in the chapter relates to your answer to part (A).

6) [15 points] Consider a country in which there are two sectors, called Sector 1 and Sector 2. The production functions in the two sectors are:

\[ Y_1 = L_1^{1/2} \]

\[ Y_2 = L_2^{1/2} \]

where \( L_1 \) is the number of workers employed in Sector 1 and \( L_2 \) is the number of workers employed in Sector 2. The total number of workers in the economy is \( L = L_1 + L_2 = 8 \). Workers can move freely between sectors.

In sector 2, workers are paid their marginal products. In sector 1, workers are paid their average products.

**Note:** you don’t need to get a solution to part A in order to solve part B.

A. [7 points] Solve for the number of workers employed in each sector (this involves a bit of ugly algebra, and the answer does not look as pretty as my answers usually do. Also, you should not worry if the answer involves fractions of people).

B) [8 points] Having read that a situation like the one described in this problem is inefficient, the government decides to restore efficiency by means of a tax and subsidy plan. Let \( T_1 \) be the per-worker tax in sector 1 and \( T_2 \) be the per-worker tax in sector 2. If the tax in either sector is negative, that is a wage subsidy. The government has to have a balanced budget, so that total tax collections in one sector will have to equal the total subsidy payments in the other. Solve for the values of \( T_1 \) and \( T_2 \) that will produce an efficient allocation of labor. **Hint:** you do not have to do a lot of math to solve this problem!
7) [20 points] Consider the two-country model of technology. The equations are presented below, where I will save space by telling you that country 1 is the technology leader. Also, to make the math easier, I will assume that the labor forces in both countries are equal to one.

\[ y_1 = A_i (1 - \gamma_{A,1}) \]
\[ y_2 = A_2 (1 - \gamma_{A,2}) \]

\[ \hat{A}_i = \frac{\gamma_{A,1}}{\mu_i} \]
\[ \hat{A}_2 = \frac{\gamma_{A,2}}{\mu_c} \]
\[ \mu_c = \mu_i \left( \frac{A_i}{A_2} \right)^{-1/2} \]

Assume that the countries are in steady state (that is, their relative levels of technology are constant). \( \gamma_{A,1} = 0.3 \) and \( \gamma_{A,2} = 0.1 \).

A) [10 points] Solve for the ratio of technology in country 1 to technology in country 2.
B) [10 points] Solve for the ratio of output per worker in country 1 to output per worker in country 2.