Instructions: Please answer all questions in the blue books. You may not use notes, books, or calculators. Please show your work. There are a total of six questions, for 100 points. Questions vary in their level of difficulty. Partial credit will be given for partially correct answers. Good luck!

1) [15 points] The TFR in country A is higher than the TFR in country B. Also, life expectancy at birth in country A is higher than in country B. However, the NRR in country B is higher than in country A. Draw pictures of the age specific fertility rates and survivorship functions in the two countries demonstrating how such a thing is possible.

2) [15 points] In a certain country, the return to education is 10% per year. One third of the country’s labor force has zero years of education, one third has seven years of education, and one third has 14 years of education. What is the fraction of labor income that can be attributed to human capital? Please show your work.

3) [15 points] Explain briefly why the concept of “surplus labor” is relevant to the Harrod-Domar model but not to the Solow model. Also, in this context explain, how the two models differ in their predictions about how investment affects the marginal product of capital.

4) [15 points] From 1970 to 2005, China’s GDP per capita grew from $506 to $5,955. This corresponded to an annual rate of growth of approximately 7.3%. What, approximately, would China’s GDP per capita have been in 2005 if instead of an annual rate of growth of 7.3%, the rate of growth had been 5.3%?
5) [20 points] A certain genetic mutation is discovered that provides carriers with immunity to malaria. The mutation has no other effects beyond providing immunity to malaria. In families where one parent is a carrier of this mutation and the other is not, half the children will be carriers and half will not. An economist collects a large data set from the Congo (a country with a high rate of malaria infection) made up of pairs of siblings, one of whom is a carrier and the other of whom is not. The economist follows these siblings into adulthood, and finds that on average, siblings who carry the mutation have earnings that are 1% higher than the earnings of siblings who do not carry the mutation.

What light does this finding cast on the views of Jeffrey Sachs regarding the interaction of health and income? Is this finding largely consistent or inconsistent with his views?

6) [20 points] In a country output is produced with labor and physical capital. The production function in per-worker terms is

\[ y = k^{1/2} \]

There is no population growth. The depreciation rate is two percent.

The investment rate \( y \) is determined as follows:

\[ y = 0.20 \quad if \quad y \leq 10 \]
\[ y = 0.40 \quad if \quad y > 10 \]

Draw a diagram showing the steady state(s) of this model. Calculate the values of any steady state levels of \( k \) and \( y \). Also, indicate on the diagram and describe briefly in words how the levels of \( y \) and \( k \) behave outside of the steady state. Comment briefly on the stability of the steady state(s).