The basic fact on growth

1. Assume that the average consumer in Mexico and the average consumer in the United Kingdom buy the quantities and pay the prices indicated in the following table:

			Transportation services	
	Food	Price	Quantity	Price	Quantity
Mexico		5 pesos	400	20 pesos	200
UK		£1	1,000	£2	2,000

   a) Compute UK consumption per capita in pounds.
   b) Compute Mexican consumption per capita in pesos.
   c) Suppose that £1 is worth 10 pesos. Compute Mexico's consumption per capita in pounds.
   d) Using the purchasing power parity method and UK prices, compute Mexican consumption per capita in pounds.
   e) Under each method, how much lower is the standard of living in Mexico than in the United Kingdom? Does the choice of method make a difference?

2. Consider the production functon $Y = \sqrt{K}\sqrt{N}$.
   a) Compute output when K = 49 and N = 81.
   b) If both capital and labour double, what happens to output?
   c) Is this production function characterised by constant returns to scale? Explain.
   d) Write this production function as a relation between output per worker and capital per worker.
   e) Let K/N = 4. What is Y/N? Now double K/N to 8. Does Y/N double as a result?
   f) Does the relation between output per worker and capital per worker exhibit constant returns to scale?
   g) Plot the relation between output per worker and capital per worker.

3. Consider the production function given in Problem 2. Assume that N is constant and equal to one. Note that if $z = x^a$, then $gz \approx gx$, where gz and gx are the growth rates of z and x.
   a) Given the growth approximation here, derive the relation between the growth rate of output and capital growth rate.
   b) Suppose we want to achieve output growth equal 2% per year. What is the required rate of growth of capital?
   c) In (b), what happens to the capital to output ratio over time?
   d) Is it possible to sustain output growth of 2% forever in this economy? Why or why not?

4. Between 1950 and 1973, France, Germany, and Japan experienced growth rates at least two percentage points higher than those in the United States. Yet the most important technological advances of that period were made in the United States. How can this be?

5. In the Penn World Tables available on the University of Groningen website at www.rug.nl/research/ggdc/data/pwt/pwt-8.1, find GDP per capita in Germany and the United States in 1960, 1990 and the most recent year.
   a) Compute the average annual growth rates of GDP per person for Germany and the United States for two time periods: 1960 to 1990 and 1990 to the most recent year available. Did the level of real output per person in Germany tend to converge to the level of real output per person in the United States in both these periods? Explain.

   b) Suppose that every year since 1990, Germany and the United States have each continued to have their average annual growth rates for the period 1960 to 1990. How would real GDP per person compare in Germany and the United States today?

   c) What actually happened to the growth in real GDP per capita in Germany and the United States from 1990 to 2011? Go to the Penn World Table website and collect data on real GDP per person (chained series) from 1950 to 2011 (or the most recent year available) for the United States, France, Belgium, Italy, Ethiopia, Kenya, Nigeria and Uganda. You will need to download the total real GDP in chained 2005 US dollars and population. Define for each country for each year the ratio of its real GDP per person to that of the United States for that year (so that this ratio will be equal to one for the United States for all years).

6. Go to the website containing the Penn World Table and collect data on real GDP per person (chained series) from 1950 to 2011 (or the most recent year available) for the United States, France, Belgium, Italy, Ethiopia, Kenya, Nigeria and Uganda. You will need to download the total real GDP in chained 2005 US dollars and population. Define for each country for each year the ratio of its real GDP per person to that of the United States for that year (so that this ratio will be equal to one for the United States for all years).
   a) Plot these ratios for France, Belgium and Italy over the period for which you have data. Does your data support the notion of convergence among France, Belgium and Italy with the United States?
   b) Plot these ratios for Ethiopia, Kenya, Nigeria and Uganda. Does this data support the notion of convergence among Ethiopia, Kenya, Nigeria and Uganda with the United States?

7. Go to the website containing the Penn World Table and collect data on real GDP per capita (chained series) for 1970 for all available countries. Do the same for a recent year of data, say one year before the most recent year available in the Penn table. (If you choose the most recent year available, the Penn table may not have the data for some countries relevant to this question.)

   a) Rank the countries according to GDP per person in 1970. List the countries with the ten highest levels of GDP per person in 1970. Are there any surprises?

b) Carry out the analysis in part (a) for the most recent year you collected data. Has the composition of the ten wealthiest countries changed since 1970?
c) Use all the countries for which there are data in both 1970 and the latest year. Which five countries have the highest proportional increase in real GDP per capita?
d) Use all the countries for which there are data in both 1970 and the latest year. Which five countries have the lowest proportional increase in real GDP per capita?
e) Do a brief Internet search on either the country from part (c) with the most significant increase in GDP per capita or the country from region (d) with the smallest increase. Can you ascertain any reasons for this country's economic success, or lack of it?

ADDITIONAL QUESTIONS:
Label each of the following statements as true, false or uncertain. Explain briefly.

1. On a logarithmic scale, a variable that increases at 5% per year will move along an upward-sloping line with a slope of 0.05.
2. The price of food is higher in poor countries than in rich countries.
3. Evidence suggests that happiness in rich countries increases with output per person.
4. In virtually all the countries of the world, output per person converges to the output level per person in the United States.
5. For about a thousand years after the fall of the Roman Empire, there was essentially no growth in output per person in Europe because any increase in output led to a proportional increase in population.
6. Capital accumulation does not affect the level of output, in the long run, only technological progress does.
7. The aggregate production function is a relation between output on one hand and labour and capital on the other