Suggested Answers for Mankiw *Questions for Review & Problems*

The answers here will not have graphs, I encourage to refer to the text for graphs. There is a bit of math, however I don’t expect you to replicate these in your exam, but you should understand the intuition.

**Chapter 1**

**Questions for Review**

1. Microeconomics is the study of how individual firms and households make decisions, and how they interact with one another. Microeconomic models of firms and households are based on principles of optimization; firms and households do the best they can given the constraints they face. For example, households choose which goods to purchase in order to maximize their utility, whereas firms decide how much to produce in order to maximize profits. In contrast, macroeconomics is the study of the economy as a whole; it focuses on issues such as how total output, total employment, and the overall price level are determined. These economy-wide variables are based on the interaction of many households and many firms; therefore, microeconomics forms the basis for macroeconomics.

3. A market-clearing model is one in which prices adjust to equilibrate supply and demand. Market-clearing models are useful in situations where prices are flexible. Yet in many situations, flexible prices may not be a realistic assumption. For example, labor contracts often set wages for up to three years. Or, firms such as magazine publishers change their prices only every three to four years. Most macroeconomists believe that price flexibility is a reasonable assumption for studying long-run issues. Over the long run, prices respond to changes in demand or supply, even though in the short run they may be slow to adjust.

**Problems and Applications**

3. We can use a simple variant of the supply-and-demand model for pizza to answer this question. Assume that the quantity of ice cream demanded depends not only on the price of ice cream and income, but also on the price of frozen yogurt:

\[ Q^d = D(P_{IC}, P_{FY}, Y). \]

We expect that demand for ice cream rises when the price of frozen yogurt rises, because ice cream and frozen yogurt are substitutes. That is, when the price of frozen yogurt goes up, I consume less of it and, instead, fulfill more of my frozen dessert urges through the consumption of ice cream. The next part of the model is the supply function for ice cream, \( Q^s = S(P_{IC}) \). Finally, in equilibrium, supply must equal demand, so that \( Q^s = Q^d \). \( Y \) and \( P_{FY} \) are the exogenous variables, and \( Q \) and \( P_{IC} \) are the endogenous variables. A fall in the price of frozen yogurt results in an inward shift of the demand curve for ice cream. The new equilibrium has a lower price and quantity of ice cream.

4. The price of haircuts changes rather infrequently. From casual observation, hairstylists tend to charge the same price over a one- or two-year period irrespective of the demand for haircuts or the supply of cutters. A market-clearing model for analyzing the market for haircuts has the
unrealistic assumption of flexible prices. Such an assumption is unrealistic in the short run when we observe that prices are inflexible. Over the long run, however, the price of haircuts does tend to adjust; a market-clearing model is therefore appropriate. Price of ice cream

Chapter 2

Questions for Review

1 GDP measures both the total income of everyone in the economy and the total expenditure on the economy's output of goods and services. GDP can measure two things at once because both are really the same thing: for an economy as a whole, income must equal expenditure. As the circular flow diagram in the text illustrates, these are alternative, equivalent ways of measuring the flow of dollars in the economy.

2 The consumer price index measures the overall level of prices in the economy. It tells us the price of a fixed basket of goods relative to the price of the same basket in the base year.

3 The Bureau of Labor Statistics classifies each person into one of the following three categories: employed, unemployed, or not in the labor force. The unemployment rate, which is the percentage of the labor force that is unemployed, is computed as follows:

\[
\text{Unemployment Rate} = \frac{\text{Unemployed}}{\text{Labor Force}}.
\]

Note that the labor force is the number of people employed plus the number of people unemployed.

Problems and Applications

3 When a woman marries her butler, GDP falls by the amount of the butler's salary. This happens because measured total income, and therefore measured GDP, falls by the amount of the butler's loss in salary. If GDP truly measured the value of all goods and services, then the marriage would not affect GDP since the total amount of economic activity is unchanged. Actual GDP, however, is an imperfect measure of economic activity because the value of some goods and services is left out. Once the butler's work becomes part of his household chores, his services are no longer counted in GDP. As this example illustrates, GDP does not include the value of any output produced in the home. Similarly, GDP does not include other goods and services, such as the imputed rent on durable goods (e.g., cars and refrigerators) and any illegal trade.

9 As Senator Robert Kennedy pointed out, GDP is an imperfect measure of economic performance or well-being. In addition to the left-out items that Kennedy cited, GDP also ignores the imputed rent on durable goods such as cars, refrigerators, and lawnmowers; many services and products produced as part of household activity, such as cooking and cleaning; and the value of goods produced and sold in illegal activities, such as the drug trade. These imperfections in the measurement of GDP do not necessarily reduce its usefulness. As long as these measurement problems stay constant over time, then GDP is useful in comparing economic activity from year to year. Moreover, a large GDP allows us to afford better medical care for our children, newer books for their education, and more toys for their play.
Chapter 3

Questions for Review

1 Factors of production and the production technology determine the amount of output an economy can produce. Factors of production are the inputs used to produce goods and services: the most important factors are capital and labor. The production technology determines how much output can be produced from any given amounts of these inputs. An increase in one of the factors of production or an improvement in technology leads to an increase in the economy's output.

2 When a firm decides how much of a factor of production to hire, it considers how this decision affects profits. For example, hiring an extra unit of labor increases output and therefore increases revenue; the firm compares this additional revenue to the additional cost from the higher wage bill. The additional revenue the firm receives depends on the marginal product of labor ($MP_L$) and the price of the good produced ($P$). An additional unit of labor produces $MP_L$ units of additional output, which sells for $P$ dollars. Therefore, the additional revenue to the firm is $P \cdot MP_L$. The cost of hiring the additional unit of labor is the wage $W$. Thus, this hiring decision has the following effect on profits:

$$\Delta \text{Profit} = \text{Revenue} - \Delta \text{Cost} = (P \cdot MP_L) - W.$$

If the additional revenue, $PMP_L$, exceeds the cost ($W$) of hiring the additional unit of labor, then profit increases. The firm will hire labor until it is no longer profitable to do so — that is, until the $MP_L$ falls to the point where the change in profit is zero. In the equation above, the firm hires labor until $\Delta \text{profit} = 0$, which is when $(PMP_L) = W$. This condition can be rewritten as: $MP_L = W/P$. Therefore, a competitive profit-maximizing firm hires labor until the marginal product of labor equals the real wage. The same logic applies to the firm's decision to hire capital: the firm will hire capital until the marginal product of capital equals the real rental price.

4 Consumption depends positively on disposable income—the amount of income after all taxes have been paid. The higher disposable income is, the greater consumption is. The quantity of investment goods demanded depends negatively on the real interest rate. For an investment to be profitable, its return must be greater than its cost. Because the real interest rate measures the cost of funds, a higher real interest rate makes it more costly to invest, so the demand for investment goods falls.

7 When the government increases taxes, disposable income falls, and therefore consumption falls as well. The decrease in consumption equals the amount that taxes increase multiplied by the marginal propensity to consume ($MPC$). The higher the $MPC$ is, the greater is the negative effect of the tax increase on consumption. Because output is fixed by the factors of production and the production technology, and government purchases have not changed, the decrease in consumption must be offset by an increase in investment. For investment to rise, the real interest rate must fall. Therefore, a tax increase leads to a decrease in consumption, an increase in investment, and a fall in the real interest rate.
Chapter 4

Questions for Review

1 Money has three functions: it is a store of value, a unit of account, and a medium of exchange. As a store of value, money provides a way to transfer purchasing power from the present to the future. As a unit of account, money provides the terms in which prices are quoted and debts are recorded. As a medium of exchange, money is what we use to buy goods and services.

3 In many countries, a central bank controls the money supply. In the United States, the central bank is the Federal Reserveoften called the Fed. The control of the money supply is called monetary policy. The primary way that the Fed controls the money supply is through open-market operations, which involve the purchase or sale of government bonds. To increase the money supply, the Fed uses dollars to buy government bonds from the public, putting more dollars into the hands of the public. To decrease the money supply, the Fed sells some of its government bonds, taking dollars out of the hands of the public.

4 The quantity equation is an identity that expresses the link between the number of transactions that people make and how much money they hold. We write it as:

\[ \text{Money} \times \text{Velocity} = \text{Price} \times \text{Transactions} \]
\[ M \times V = P \times T. \]

The right-hand side of the quantity equation tells us about the total number of transactions that occur during a given period of time, say, a year. \( T \) represents the total number of times that any two individuals exchange goods or services for money. \( P \) represents the price of a typical transaction. Hence, the product \( P \times T \) represents the number of dollars exchanged in a year. The left-hand side of the quantity equation tells us about the money used to make these transactions. \( M \) represents the quantity of money in the economy. \( V \) represents the transactions velocity of moneythe rate at which money circulates in the economy.

Because the number of transactions is difficult to measure, economists usually use a slightly different version of the quantity equation, in which the total output of the economy \( y \) replaces the number of transactions \( T \):

\[ \text{Money} \times \text{Velocity} = \text{Price} \times \text{Real GDP} \]
\[ M \times V = P \times y. \]

\( P \) now represents the price of one unit of output, so that \( P \times Y \) is the dollar value of output nominal GDP. \( V \) represents the income velocity of moneythe number of times a dollar bill becomes a part of someones income.

5 If we assume that velocity in the quantity equation is constant, then we can view the quantity equation as a theory of nominal GDP. The quantity equation with fixed velocity states that \( MV = PY \). If velocity \( V \) is constant, then a change in the quantity of money \( M \) causes a proportionate change in nominal GDP \( Py \). If we assume further that output is fixed by the factors of production and the production technology, then we can conclude that the quantity of money determines the price level. This is called the \textit{quantity theory of money}. 
The Fisher equation expresses the relationship between nominal and real interest rates. It says that the nominal interest rate $i$ equals the real interest rate $r$ plus the inflation rate $\pi$:

$$i = r + \pi.$$ 

This tells us that the nominal interest rate can change either because the real interest rate changes or the inflation rate changes. The real interest rate is assumed to be unaffected by inflation; as discussed in Chapter 3, it adjusts to equilibrate saving and investment. There is thus a one-to-one relationship between the inflation rate and the nominal interest rate: if inflation increases by 1 percent, then the nominal interest rate also increases by 1 percent. This one-to-one relationship is called the Fisher effect. If inflation increases from 6 to 8 percent, then the Fisher effect implies that the nominal interest rate increases by 2 percentage points, while the real interest rate remains constant.

Problems and Applications

2 The real interest rate is the difference between the nominal interest rate and the inflation rate. The nominal interest rate is 11 percent, but we need to solve for the inflation rate. We do this with the quantity identity expressed in percentage-change form:

$$\gamma_M + \gamma_V = \pi + \gamma_y.$$ 

Rearranging this equation tells us that the inflation rate is given by:

$$\pi = \gamma_M + \gamma_V - \gamma_y.$$ 

Substituting the numbers given in the problem, we thus find: $\pi = 14\% + 0\% - 5\% = 9\%$.

4 The major benefit of having a national money is seigniorage—the ability of the government to raise revenue by printing money. The major cost is the possibility of inflation, or even hyperinflation, if the government relies too heavily on seigniorage. The benefits and costs of using a foreign money are exactly the reverse: the benefit of foreign money is that inflation is no longer under domestic political control, but the cost is that the domestic government loses its ability to raise revenue through seigniorage. (There is also a subjective cost to having pictures of foreign leaders on your currency.) The foreign countrys political stability is a key factor. The primary reason for using another nations money is to gain stability. If the foreign country is unstable, then the home country is definitely better off using its own currency—the home economy remains more stable, and it keeps the seigniorage.

Chapter 6

Questions for Review

1 The rates of job separation and job finding determine the natural rate of unemployment. The rate of job separation is the fraction of people who lose their job each month. The higher the rate of job separation, the higher the natural rate of unemployment. The rate of job finding is the fraction of unemployed people who find a job each month. The higher the rate of job finding, the lower the natural rate of unemployment.

\footnote{Note that $\gamma_X$ is shorthand for the percentage change in variable $X$, $\gamma_X = \frac{X_t - X_{t-1}}{X_{t-1}} = \% \text{ change in } X.$}
2 Frictional unemployment is the unemployment caused by the time it takes to match workers and jobs. Finding an appropriate job takes time because the flow of information about job candidates and job vacancies is not instantaneous. Because different jobs require different skills and pay different wages, unemployed workers may not accept the first job offer they receive. In contrast, wait unemployment is the unemployment resulting from wage rigidity and job rationing. These workers are unemployed not because they are actively searching for a job that best suits their skills (as in the case of frictional unemployment), but because at the prevailing real wage the supply of labor exceeds the demand. If the wage does not adjust to clear the labor market, then these workers must wait for jobs to become available. Wait unemployment thus arises because firms fail to reduce wages despite an excess supply of labor.

3 The real wage may remain above the level that equilibrates labor supply and labor demand because of minimum wage laws, the monopoly power of unions, and efficiency wages. Minimum-wage laws cause wage rigidity when they prevent wages from falling to equilibrium levels. Although most workers are paid a wage above the minimum level, for some workers, especially the unskilled and inexperienced, the minimum wage raises their wage above the equilibrium level. It therefore reduces the quantity of their labor that firms demand, and an excess supply of workersthat is, unemploymentresults.

The monopoly power of unions causes wage rigidity because the wages of unionized workers are determined not by the equilibrium of supply and demand but by collective bargaining between union leaders and firm management. The wage agreement often raises the wage above the equilibrium level and allows the firm to decide how many workers to employ. These high wages cause firms to hire fewer workers than at the market-clearing wage, so wait unemployment increases.

Efficiency-wage theories suggest that high wages make workers more productive. The influence of wages on worker efficiency may explain why firms do not cut wages despite an excess supply of labor. Even though a wage reduction decreases the firms wage bill, it may also lower worker productivity and therefore the firms profits.

Problems and Applications

4 Consider the formula for the natural rate of unemployment,:\[
\frac{U}{L} = \frac{s}{s + f}.
\]

If the new law lowers the chance of separation s, but has no effect on the rate of job finding f, then the natural rate of unemployment falls. For several reasons, however, the new law might tend to reduce f. First, raising the cost of firing might make firms more careful about hiring workers, since firms have a harder time firing workers who turn out to be a poor match. Second, if searchers think that the new legislation will lead them to spend a longer period of time on a particular job, then they might weigh more carefully whether or not to take that job. If the reduction in f is large enough, then the new policy may even increase the natural rate of unemployment.

7 The vacant office space problem is similar to the unemployment problem; we can apply the same concepts we used in analyzing unemployed labor to analyze why vacant office space exists. There is a rate of office separation: firms that occupy offices leave, either to move to different
offices or because they go out of business. There is a rate of office finding: firms that need office space (either to start up or expand) find empty offices. It takes time to match firms with available space. Different types of firms require spaces with different attributes depending on what their specific needs are. Also, because demand for different goods fluctuates, there are sectoral shifts that change the composition of demand among industries and regions that affect the profitability and office needs of different firms.

Chapter 7

Questions for Review

1 In the Solow growth model, a high saving rate leads to a large steady-state capital stock and a high level of steady-state output. A low saving rate leads to a small steady-state capital stock and a low level of steady-state output. Higher saving leads to faster economic growth only in the short run. An increase in the saving rate raises growth until the economy reaches the new steady state. That is, if the economy maintains a high saving rate, it will also maintain a large capital stock and a high level of output, but it will not maintain a high rate of growth forever.

2 It is reasonable to assume that the objective of an economic policymaker is to maximize the economic well-being of the individual members of society. Since economic well-being depends on the amount of consumption, the policymaker should choose the steady state with the highest level of consumption. The Golden Rule level of capital represents the level that maximizes consumption in the steady state. Suppose, for example, that there is no population growth or technological change. If the steady-state capital stock increases by one unit, then output increases by the marginal product of capital $MP_K$; depreciation, $\delta$, however, increases by an amount $\delta$, so that the net amount of extra output available for consumption is $MP_K \delta$. The Golden Rule capital stock is the level at which $MP_K = \delta$, so that the marginal product of capital equals the depreciation rate.

3 When the economy begins above the Golden Rule level of capital, reaching the Golden Rule level leads to higher consumption at all points in time. Therefore, the policymaker would always want to choose the Golden Rule level, because consumption is increased for all periods of time. On the other hand, when the economy begins below the Golden Rule level of capital, reaching the Golden Rule level means reducing consumption today to increase consumption in the future. In this case, the policymakers decision is not as clear. If the policymaker cares more about current generations than about future generations, he or she may decide not to pursue policies to reach the Golden Rule steady state. If the policymaker cares equally about all generations, then he or she chooses to reach the Golden Rule. Even though the current generation will have to consume less, an infinite number of future generations will benefit from increased consumption by moving to the Golden Rule.

4 The higher the population growth rate is, the lower the steady-state level of capital per worker is, and therefore there is a lower level of steady-state income. Consider the solution for two levels of population growth, a low level $n_1$ and a higher level $n_2$. The higher population growth $n_2$ means that the line representing population growth and depreciation is higher, so the steady-state level of capital per worker is lower. Be sure you can draw this.
Problems and Applications

4 Suppose the economy begins with an initial steady-state capital stock below the Golden Rule level. The immediate effect of devoting a larger share of national output to investment is that the economy devotes a smaller share to consumption; that is, “living standards” as measured by consumption fall. The higher investment rate means that the capital stock increases more quickly, so the growth rates of output and output per worker rise. The productivity of workers is the average amount produced by each worker – that is, output per worker. So productivity growth rises. Hence, the immediate effect is that living standards fall but productivity growth rises. In the new steady state, output grows at rate $n + g$, while output per worker grows at rate $g$. This means that in the steady state, productivity growth is independent of the rate of investment. Since we begin with an initial steady-state capital stock below the Golden Rule level, the higher investment rate means that the new steady state has a higher level of consumption, so living standards are higher. Thus, an increase in the investment rate increases the productivity growth rate in the short run but has no effect in the long run. Living standards, on the other hand, fall immediately and only rise over time. That is, the quotation emphasizes growth, but not the sacrifice required to achieve it.

5 As in the text, let $k = K/L$ stand for capital per unit of labor. The equation for the evolution of $k$ is

$$\Delta k = Saving - (\delta + n)k.$$ 

If all capital income is saved and if capital earns its marginal product, then saving equals $MP_K \cdot k$. We can substitute this into the above equation to find

$$\Delta k = MP_K k - (\delta + n)k.$$ 

In the steady state, capital per efficiency unit of capital does not change, so $\Delta k = 0$. From the above equation, this tells us that

$$MP_K k = (\delta + n)k \Rightarrow MP_K = (\delta + n).$$

Equivalently,

$$MP_K - \delta = n.$$ 

In this economy’s steady state, the net marginal product of capital, $MP_K - \delta$, equals the rate of growth of output, $n$. But this condition describes the Golden Rule steady state. Hence, we conclude that this economy reaches the Golden Rule level of capital accumulation.

Chapter 8

Questions for Review

1 In the Solow model, we find that only technological progress can affect the steady-state rate of growth in income per worker. Growth in the capital stock (through high saving) has no effect on the steady-state growth rate of income per worker; neither does population growth. But technological progress can lead to sustained growth.

2 To decide whether an economy has more or less capital than the Golden Rule, we need to compare the marginal product of capital net of depreciation ($MP_K \delta$) with the growth rate of total output ($n + g$). The growth rate of GDP is readily available. Estimating the net marginal
product of capital requires a little more work but, as shown in the text, can be backed out of available data on the capital stock relative to GDP, the total amount of depreciation relative to GDP, and capital's share in GDP.

3 Economic policy can influence the saving rate by either increasing public saving or providing incentives to stimulate private saving. Public saving is the difference between government revenue and government spending. If spending exceeds revenue, the government runs a budget deficit, which is negative saving. Policies that decrease the deficit (such as reductions in government purchases or increases in taxes) increase public saving, whereas policies that increase the deficit decrease saving. A variety of government policies affect private saving. The decision by a household to save may depend on the rate of return; the greater the return to saving, the more attractive saving becomes. Tax incentives such as tax-exempt retirement accounts for individuals and investment tax credits for corporations increase the rate of return and encourage private saving.

4 The rate of growth of output per person slowed worldwide after 1972. This slowdown appears to reflect a slowdown in productivity growth—the rate at which the production function is improving over time. Various explanations have been proposed, but the slowdown remains a mystery. In the second half of the 1990s, productivity grew more quickly again in the United States and, it appears, a few other countries. Many commentators attribute the productivity revival to the effects of information technology.

5 Endogenous growth theories attempt to explain the rate of technological progress by explaining the decisions that determine the creation of knowledge through research and development. By contrast, the Solow model simply took this rate as exogenous. In the Solow model, the saving rate affects growth temporarily, but diminishing returns to capital eventually force the economy to approach a steady state in which growth depends only on exogenous technological progress. By contrast, many endogenous growth models in essence assume that there are constant (rather than diminishing) returns to capital, interpreted to include knowledge. Hence, changes in the saving rate can lead to persistent growth.