1) Explain why each of the following statements is true. Discuss the impact of monetary and fiscal policy in each of these special cases:

a) If investment does not depend on the interest rate, the IS curve is vertical.

The IS curve represents the relationship between the interest rate and the level of income that arises from equilibrium in the market for goods and services. That is, it describes the combinations of income and the interest rate that satisfy the equation \( Y = C(Y-T) + I(r) + G \). If investment does not depend on the interest rate, then nothing in the IS equation depends on the interest rate; income must adjust to ensure that the quantity of goods produced, \( Y \), equals the quantity of goods demanded, \( C + I + G \). Thus, the IS curve is vertical at this level.

Monetary policy has no effect on output, because the IS curve determines \( Y \). Monetary policy can affect only the interest rate. In contrast, fiscal policy is effective: output increases by the full amount that the IS curve shifts.

b) If money demand does not depend on the interest rate, the LM curve is vertical.

The LM curve represents the combinations of income and the interest rate at which the money market is in equilibrium. If money demand does not depend on the interest rate, then we can write the LM equation as \( M/P = L(Y) \). For any given level of real balances \( M/P \), there is only one level of income at which the money market is in equilibrium. Thus, the LM curve is vertical.

Fiscal policy now has no effect on output; it can affect only the interest rate. Monetary policy is effective: a shift in the LM curve increases output by the full amount of the shift.

c) If money demand does not depend on income, the LM curve is horizontal.

If money demand does not depend on income, then we can write the LM equation as \( M/P = L(r) \). For any given level of real balances \( M/P \), there is only one level of the interest rate at which the money market is in equilibrium. Hence, the LM curve is horizontal.

Fiscal policy is very effective: output increases by the full amount that the IS curve shifts. Monetary policy is also effective: an increase in the money supply causes the interest rate to fall, so the LM curve shifts down.

d) If money demand is extremely sensitive to the interest rate, the LM curve is horizontal.
The LM curve gives the combinations of income and the interest rate at which the supply and demand for real balances are equal, so that the money market is in equilibrium. The general form of the LM equation is \( M/P = L(r,Y) \). Suppose income \( Y \) increases by $1. How much must the interest rate change to keep the money market in equilibrium? The increase in \( Y \) increases money demand. If money demand is extremely sensitive to the interest rate, then it takes a very small increase in the interest rate to reduce money demand and restore equilibrium in the money market. Hence, the LM curve is (nearly) horizontal.

If money demand is very sensitive to the interest rate, then fiscal policy is very effective: with a horizontal LM curve, output increases by the full amount that the IS curve shifts. Monetary policy is now completely ineffective: an increase in the money supply does not shift the LM curve at all.

2) Use the IS-LM diagram to describe the short-run and long-run effects of the following changes on national income, the interest rate, the price level, consumption, investment, and real money balances.

a) An increase in the money supply.

An increase in the money supply shifts the LM curve to the right in the short run. This moves the economy from point A to point B in the figure: the interest rate falls from \( r_1 \) to \( r_2 \), and output rises from \( Y \) to \( Y_2 \). The increase in output occurs because the lower interest rate stimulates investment, which increases output.
Since the level of output is now above its long-run level, prices begin to rise. A rising price level lowers real balances, which raises the interest rate. As indicated in the figure, the LM curve shifts back to the left. Prices continue to rise until the economy returns to its original position at point A. The interest rate returns to r1, and investment returns to its original level. Thus, in the long run, there is no impact on real variables from an increase in the money supply. (This is what we called monetary neutrality in Chapter 4.)

b) An increase in government purchases.

An increase in government purchases shifts the IS curve to the right, and the economy moves from point A to point B, as shown in the figure below. In the short run, output increases from Y to Y2, and the interest rate increases from r1 to r2.

The increase in the interest rate reduces investment and “crowds out” part of the expansionary effect of the increase in government purchases. Initially, the LM curve is not affected because government spending does not enter the LM equation. After the increase, output is above its long-run equilibrium level, so prices begin to rise. The rise in prices reduces real balances, which shifts the LM curve to the left. The interest rate rises even more than in the short run. This process continues until the long-run level of output is again reached. At the new equilibrium, point C, interest rates have risen to r3, and the price level is permanently higher. Note that, like monetary policy, fiscal policy cannot change the composition of output. For example, the level of investment at point C is lower than it is at point A.

c) An increase in taxes.
An increase in taxes reduces disposable income for consumers, shifting the IS curve to the left, as shown in the figure. In the short run, output and the interest rate decline to $Y_2$ and $r_2$ as the economy moves from point $A$ to point $B$.

Initially, the $LM$ curve is not affected. In the longer run, prices begin to decline because output is below its long-run equilibrium level, and the $LM$ curve then shifts to the right because of the increase in real money balances. Interest rates fall even further to $r_3$ and, thus, further stimulate investment and increase income. In the long run, the economy moves to point $C$. Output returns to $Y$, the price level and the interest rate are lower, and the decrease in consumption has been offset by an equal increase in investment.

3) Use the IS-LM model to predict the effects of each of the following shocks on income, the interest rate, consumption, and investment. In each case, explain what the Fed should do to keep income at its initial level.

a) After the invention of a new high-speed computer chip, many firms decide to upgrade their computer systems.

The invention of the new high-speed chip increases investment demand, meaning that at every interest rate, firms want to invest more. The increase in the demand for investment goods shifts the IS curve out and to the right, raising income and employment.

The increase in income from the higher investment demand also raises interest rates. This happens because the higher income raises demand for money; since the supply of money does not change, the interest rate must rise in order to restore equilibrium in the money market. The rise in interest rates partially offsets the increase in investment demand, so that output does not rise by the full amount of the rightward shift in the IS curve. Overall,
Income, interest rates, consumption, and investment all rise. If the Federal Reserve wants to keep output constant, then it must decrease the money supply and increase interest rates further in order to offset the effect of the increase in investment demand. When the Fed decreases the money supply, the LM curve will shift up and to the left. Output will remain at the same level and the interest rate will be higher. There will be no change in consumption and no change in investment. The interest rate will increase by enough to completely offset the initial increase in investment demand.

b) A wave of credit-card fraud increases the frequency with which people make transactions in cash.

The increased demand for cash shifts the LM curve up. This happens because at any given level of income and money supply, the interest rate necessary to equilibrate the money market is higher.

The upward shift in the LM curve lowers income and raises the interest rate. Consumption falls because income falls, and investment falls because the interest rate rises due to the increase in money demand. If the Federal Reserve wants to keep output constant, then they must increase the money supply in order to lower the interest rate and bring output back to its original level. The LM curve will shift down and to the right and return to its old position. In this case, nothing will change.

c) A best-seller titled *Retire Rich* convinces the public to increase the percentage of their income devoted to saving.

At any given level of income, consumers now wish to save more and consume less. Because of this downward shift in the consumption function, the IS curve shifts inward.

Income, interest rates, and consumption all fall, while investment rises. Income falls because at every level of the interest rate, planned expenditure falls. The interest rate falls because the fall in income reduces demand for money; since the supply of money is unchanged, the interest rate must fall to restore money-market equilibrium. Consumption falls both because of the shift in the consumption function and because income falls. Investment rises because of the lower interest rates and partially offsets the effect on output of the fall in consumption. If the Federal Reserve wants to keep output constant, then they must increase the money supply in order to reduce the interest rate and increase output back to its original level. The increase in the money supply will shift the LM curve down and to the right. Output will remain at its original level, consumption will be lower, investment will be higher, and interest rates will be lower.

4) Explain briefly (2 or 3 sentences) why a monetary contraction for a small open economy under *fixed* exchange rates will have no effect on real income.
Monetary contraction means that the central bank buys the local currency. However, this puts upward pressure on the exchange rate; people then wish to buy the local currency back from the central bank. Thus with a fixed exchange rate, the central bank of a small open economy cannot really decrease the money supply, and therefore cannot influence output even in the short run.

5) If a small open economy with a flexible exchange rate is experiencing a recession, what will automatically happen over time to its trade balance, foreign exchange rate, and national output? Illustrate graphically.

A recession means that there is downward pressure on aggregate demand – if this is happening due to weak demand for consumer goods or investments, for example, this will shift the IS* curve to the left. However, this also lowers the exchange rate, making domestic goods more competitive internationally. This raises net exports. In a small open economy, the two effects exactly cancel each other out, and GDP remains unchanged. In other words, in a global economy, weak domestic demand can be offset by stronger international demand – international trade serves as a kind of automatic stabilizer.

6) The Mundell-Fleming model takes the world interest rate r* as an exogenous variable. Let’s consider what happens when this variable changes.

a) What might cause the world interest rate to rise?

The Mundell–Fleming model takes the world interest rate r* as an exogenous variable. However, there is no reason to expect the world interest rate to be constant. In the closed-economy model of Chapter 3, the equilibrium of saving and investment determines the real interest rate. In an open economy in the long run, the world real interest rate is the rate that equilibrates world saving and world investment demand. Anything that reduces world saving or increases world investment demand increases the world interest rate. In addition, in the short run with fixed prices, anything that increases the worldwide demand for goods or reduces the worldwide supply of money causes the world interest rate to rise.

b) In the Mundell-Fleming model with a floating exchange rate, what happens to aggregate income, the exchange rate, and the trade balance when the world interest rate rises?

The figure below shows the effect of an increase in the world interest rate under floating exchange rates. Both the IS* and the LM* curves shift. The IS* curve shifts to the left, because the higher interest rate causes investment I(r*) to fall. The LM* curve shifts to the right because the higher interest rate reduces money demand. Since the supply of real
balances $M/P$ is fixed, the higher interest rate leads to an excess supply of real balances. To restore equilibrium in the money market, income must rise; this increases the demand for money until there is no longer an excess supply. Intuitively, when the world interest rate rises, capital outflow will increase as the interest rate in the small country adjusts to the new higher level of the world interest rate. The increase in capital outflow causes the exchange rate to fall, causing net exports and hence output to increase, which increases money demand.

\[\text{We see from the figure that output rises and the exchange rate falls (depreciates). Hence, the trade balance increases.}\]

\[\text{c) In the Mundell-Fleming model with a fixed exchange rate, what happens to aggregate income, the exchange rate, and the trade balance when the world interest rate rises?}\]

\[\text{The figure below shows the effect of an increase in the world interest rate if exchange rates are fixed. Both the IS* and LM* curves shift. As in part (b), the IS* curve shifts to the left since the higher interest rate causes investment demand to fall. The LM* schedule, however, shifts to the left instead of to the right. This is because the downward pressure on the exchange rate causes the central bank to buy dollars and sell foreign exchange. This reduces the supply of money M and shifts the LM* schedule to the left. The LM* curve must shift all the way back to LM*2 in the figure, where the fixed exchange-rate line crosses the new IS* curve.}\]
In equilibrium, output falls while the exchange rate remains unchanged. Since the exchange rate does not change, neither does the trade balance.