1. a. If society becomes more thrifty—meaning that for any given level of income people save more and consume less—then the planned-expenditure function shifts downward, as in Figure 10–9 (note that $C_2 < C_1$). Equilibrium income falls from $Y_1$ to $Y_2$.

![Figure 10–9](image)

b. Equilibrium saving remains unchanged. The national accounts identity tells us that saving equals investment, or $S = I$. In the Keynesian-cross model, we assumed that desired investment is fixed. This assumption implies that investment is the same in the new equilibrium as it was in the old. We can conclude that saving is exactly the same in both equilibria.

c. The paradox of thrift is that even though thriftiness increases, saving is unaffected. Increased thriftiness leads only to a fall in income. For an individual, we usually consider thriftiness a virtue. From the perspective of the entire economy as represented by the Keynesian-cross model, however, thriftiness is a vice.

d. In the classical model of Chapter 3, the paradox of thrift does not arise. In that model, output is fixed by the factors of production and the production technology, and the interest rate adjusts to equilibrate saving and investment, where investment depends on the interest rate. An increase in thriftiness decreases consumption and increases saving for any level of output; since output is fixed, the saving schedule shifts to the right, as in Figure 10–10. At the new equilibrium, the interest rate is lower, and investment and saving are higher.

![Figure 10–10](image)

Thus, in the classical model, the paradox of thrift does not exist.
2. a. 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. Figure 11–8 shows the effect graphically.

![Figure 11–8](image)

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. 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. Figure 11–9 shows the effect of this LM shift graphically.

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. 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. Figure 11–10 shows the effect of this IS shift graphically.

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.

3. a. The \( IS \) curve is given by:

\[
Y = C(Y - T) + I(r) + G.
\]

We can plug in the consumption and investment functions and values for \( G \) and \( T \) as given in the question and then rearrange to solve for the \( IS \) curve for this economy:

\[
Y = 200 + 0.75(Y - 100) + 200 - 25r + 100
\]
\[
Y - 0.75Y = 425 - 25r
\]
\[
(1 - 0.75)Y = 425 - 25r
\]
\[
Y = (1/0.25) (425 - 25r)
\]
\[
Y = 1,700 - 100r.
\]

This \( IS \) equation is graphed in Figure 11–11 for \( r \) ranging from 0 to 8.

b. The \( LM \) curve is determined by equating the demand for and supply of real money balances. The supply of real balances is \( 1,000/2 = 500 \). Setting this equal to money demand, we find:

\[
500 = Y - 100r.
\]
\[
Y = 500 + 100r.
\]

This \( LM \) curve is graphed in Figure 11–11 for \( r \) ranging from 0 to 8.

c. If we take the price level as given, then the \( IS \) and the \( LM \) equations give us two equations in two unknowns, \( Y \) and \( r \). We found the following equations in parts (a) and (b):

\( IS: Y = 1,700 - 100r. \)
\( LM: Y = 500 + 100r. \)

Equating these, we can solve for \( r \):
\[1,700 - 100r = 500 + 100r\]
\[1,200 = 200r\]
\[r = 6.\]

Now that we know \( r \), we can solve for \( Y \) by substituting it into either the \( IS \) or the \( LM \) equation. We find
\[Y = 1,100.\]

Therefore, the equilibrium interest rate is 6 percent and the equilibrium level of output is 1,100, as depicted in Figure 11–11.

d. If government purchases increase from 100 to 150, then the \( IS \) equation becomes:
\[Y = 200 + 0.75(Y - 100) + 200 - 25r + 150.\]

Simplifying, we find:
\[Y = 1,900 - 100r.\]

This \( IS \) curve is graphed as \( IS_2 \) in Figure 11–12. We see that the \( IS \) curve shifts to the right by 200.

![Figure 11–12](image)

By equating the new \( IS \) curve with the \( LM \) curve derived in part (b), we can solve for the new equilibrium interest rate:
\[1,900 - 100r = 500 + 100r\]
\[1,400 = 200r\]
\[7 = r.\]

We can now substitute \( r \) into either the \( IS \) or the \( LM \) equation to find the new level of output. We find
\[Y = 1,200.\]

Therefore, the increase in government purchases causes the equilibrium interest rate to rise from 6 percent to 7 percent, while output increases from 1,100 to 1,200. This is depicted in Figure 11–12.

e. If the money supply increases from 1,000 to 1,200, then the \( LM \) equation becomes:
\[(1,200/2) = Y - 100r,\]
or
\[Y = 600 + 100r.\]
This \( LM \) curve is graphed as \( LM_2 \) in Figure 11–13. We see that the \( LM \) curve shifts to the right by 100 because of the increase in real money balances.

\[ r \]

\[ IS \]

\[ IM_1 \]

\[ IM_2 \]

\[ Y \]

\[ Income, output \]

\[ 0 \]

\[ 500 \]

\[ 600 \]

\[ 1,100 \]

\[ 1,150 \]

\[ 1,700 \]

\[ 6.0 \]

\[ 5.5 \]

\[ 100 \]

To determine the new equilibrium interest rate and level of output, equate the \( IS \) curve from part (a) with the new \( LM \) curve derived above:

\[ 1,700 - 100r = 600 + 100r \]
\[ 1,100 = 200r \]
\[ 5.5 = r. \]

Substituting this into either the \( IS \) or the \( LM \) equation, we find

\[ Y = 1,150. \]

Therefore, the increase in the money supply causes the interest rate to fall from 6 percent to 5.5 percent, while output increases from 1,100 to 1,150. This is depicted in Figure 11–13.

f. If the price level rises from 2 to 4, then real money balances fall from 500 to \( 1,000/4 = 250 \). The \( LM \) equation becomes:

\[ Y = 250 + 100r. \]

As shown in Figure 11–14, the \( LM \) curve shifts to the left by 250 because the increase in the price level reduces real money balances.

To determine the new equilibrium interest rate, equate the \( IS \) curve from part (a) with the new \( LM \) curve from above:

\[ 1,700 - 100r = 250 + 100r \]
\[ 1,450 = 200r \]
\[ 7.25 = r. \]

Substituting this interest rate into either the \( IS \) or the \( LM \) equation, we find

\[ Y = 975. \]
Therefore, the new equilibrium interest rate is 7.25, and the new equilibrium level of output is 975, as depicted in Figure 11–14.

4. a. 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, as shown in Figure 11–16.

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. 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, as shown in Figure 11–17.

![Figure 11–17](image)

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, 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, as shown in Figure 11–18.

![Figure 11–18](image)
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, as shown in Figure 11–18.

d. 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

\[ \frac{M}{P} = L(r, Y). \]

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, as shown in Figure 11–19.

An example may make this clearer. Consider a linear version of the LM equation:

\[ \frac{M}{P} = eY - fr. \]

Note that as \( f \) gets larger, money demand becomes increasingly sensitive to the interest rate. Rearranging this equation to solve for \( r \), we find

\[ r = (e/f)Y - (1/f)(M/P). \]

We want to focus on how changes in each of the variables are related to changes in the other variables. Hence, it is convenient to write this equation in terms of changes:

\[ \Delta r = (e/f)\Delta Y - (1/f)\Delta(M/P). \]

The slope of the LM equation tells us how much \( r \) changes when \( Y \) changes, holding \( M \) fixed. If \( \Delta(M/P) = 0 \), then the slope is \( \Delta r / \Delta Y = (e/f) \). As \( f \) gets very large, this slope gets closer and closer to zero.

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. We see this in our example.
by considering what happens if $M$ increases. For any given $Y$ (so that we set $\Delta Y = 0$), $\Delta r / \Delta (M/P) = (-1/f)$; this tells us how much the $LM$ curve shifts down. As $f$ gets larger, this shift gets smaller and approaches zero. (This is in contrast to the horizontal $LM$ curve in part (c), which does shift down.)