INSTRUCTIONS:

- Please read each question below carefully and respond to the questions on a separate sheet of paper. You must show your work.
- Please write clearly and indicate your answers
- When finished with the test, staple your scratch paper with your answers together and turn it in. You may keep the exam questions.
- You may use a calculator, but not the calculator on a phone or a graphing calculator.
- This midterm consists of the following two sections that total 100 points:
  - Part 1: Short answer, 60 points possible
  - Part 2: Analytical problems, 40 points possible
- Good luck.

Part 1: Short Answer
(60 points possible, 3 points each)

1. Define macroeconomics.

   Things about the study of the economy as a whole. Studying how decisions of households, firms, and government affect aggregate economic activity.

2. In our model determining national income in a closed economy, we had $\bar{Y} = F(\bar{K}, \bar{L}) = C(\bar{Y} - \bar{T}) + I(r) + \bar{G}$ (where variables with bars over them are fixed). In this model, what are the exogenous variables? The endogenous variables?

   - Exogenous = \{\bar{K}, \bar{L}, \bar{Y}, \bar{G}, \bar{T}\}. Endogenous = \{I, r\}

3. In the U.S., which component of GDP in each pair below is a larger share of GDP?

   (a) G and C $\rightarrow$ C
   (b) C and I $\rightarrow$ C
   (c) I and NX $\rightarrow$ I

4. Explain why we might want to look at real GDP instead of nominal GDP in some circumstances.
• Nominal GDP helps us to see the growth in the amount of output, without the influence of prices that change over time. Thus real GDP would give us a better measure of changes in the resources available to individuals over time.

5. Show that the production function \( Y = AK^\alpha L^{1-\alpha} \) displays constant returns to scale.

• Note that \( A(zK)^{\alpha} (zL)^{1-\alpha} = Az^{\alpha} K^{\alpha} z^{1-\alpha} L^{1-\alpha} = z^{\alpha+1-\alpha} AK^\alpha L^{1-\alpha} = zAK^\alpha L^{1-\alpha} = zY \). That means that increasing each factor of production by a constant \( z \) increases output by that same constant. That is the definition of constant returns to scale.

6. In words, equations, or a picture, explain the crowding out effect of government spending.

• Crowding out of investment comes from the effect of government spending to reduce national savings. This reduction in national savings shifts the supply of loanable funds in. Investment demand must then decline so that it is equal to this supply of loanable funds. Thus the interest rate increases, moving us up and to the left of the investment curve. As a result investment falls, i.e., it is crowded out by government spending.

7. Describe in words or with an equation, the Fisher Equation.

• The Fisher Equation related real and nominal interest rates and inflation. In particular, it says that nominal interest rates equal the real interest rate plus the rate of inflation: \( i = r + \pi \). Recall that the Fisher Effect is that if the inflation rate goes up by one percentage point, then nominal interest rates move up by one percentage point.

8. Explain how a business’ use of leverage affects its return on equity.

• Leverage amplifies the return on equity. This is because leverage is where borrowed funds support asset purchases. With more assets, the total earnings (or losses) on assets is greater for any given rate of return on those assets. Leverage increases the return on equity because there are more earnings on assets for a given amount of capital/equity. The return on equity is simply the ratio of earnings on assets to capital/equity, thus it is amplified by leverage.

9. What ratios summarizing the behaviors of depositors and banks affect the money multiplier? What changes in these behaviors increase the money multiplier?
10. Milton Friedman once quipped that “Inflation is always and everywhere a monetary phenomenon.” What did he mean? Describe with words or an equation the long run theory of money that relates.

- Friedman meant that in the long run, inflation is directly linked to growth in the money supply. The Quantity Theory of Money captures this idea. The equation defining this theory is \( MV = PY \). Assuming that the velocity of money is constant, then in the long run we have \( \% \Delta P = \% \Delta M \).

11. Give two policy tools that the Federal Reserve can use to affect the monetary base.

- We discuss as many as three tools the Fed has to affect the monetary base:
  
  (a) Open market operations - affects \( B \), the monetary base by changing the amount of currency, \( C \) in circulation.
  
  (b) Discount window lending - affects \( B \) by changing \( R \), the amount of reserves in the banking system.
  
  (c) The Term Auction Facility - affects \( B \) by changing the amount of \( R \) in the system.

12. Explain why viewing monetary policy through its effects on the money supply or on interest rates are generally equivalent.

- These two are equivalent in general because the way the Fed manages interest rates is by buying and selling bonds. Doing so affects both the money supply and market interest rates at the same time.

13. With words, equations, or pictures, show how tariffs and quotas affect the balance of trade in a small open economy.

- Tariffs and quotas have no net effect on the balance of trade. While they shift the \( NX \) curve out because the demand for imports falls, they push up the exchange rate, lowering demand for exports by the same amount. Thus, total trade falls, but there is not change in the balance of trade as imports and exports fall by the same amount. You might draw the foreign exchange market to show this.
14. A country has a capital account surplus. What can we say about its trade balance?

- If a country runs a capital account surplus, it must have a current account (or trade) deficit. That is, to balance the outflow of money from the trade deficit, money flows into the country as foreigners purchase assets (e.g. gov’t debt, real estate, equities).

15. Should we expect textbooks to cost the same in India and the U.S.? Why or why not?

- Since textbooks are tradable goods, we would expect the law of one price to apply. However, shipping costs, tariffs, and laws regarding the resale of foreign textbooks may limit the ability of arbitrageurs to move prices in the two countries together.

16. What are two theories of long run unemployment?

- The two theories we considered were the theory of frictional unemployment and the theory of structural unemployment. In the frictional unemployment story, unemployment is caused by “churn” in the labor market - people separating from jobs - and it taking time for employees and employers who are compatible to find each other. In the structural unemployment story, there are rigidities in wages that prevent them from falling to the market clearing level.

17. Give an example of a policy or institution that affects the long-run unemployment rate. Which theory of unemployment named above does this example relate to?

- In the frictional unemployment story, we might think of things like training programs, unemployment insurance, or limitations on firing workers. In the structural unemployment story, we might think of things like minimum wage laws, unions, or efficiency wages resulting from information asymmetries in between employers and employees.

18. Which group in the pair usually has higher unemployment rates:

(a) Those with less than a high school education or those with a college degree or higher? Less than high school
(b) Those in the US labor market or those in the French labor market? French
(c) Those who majored in economics or those who majored in sociology? Sociologists, of course

19. Describe the three parts of the Solow growth model (with words of equations).
The three parts are:
(a) The capital accumulation equation: \( k_{t+1} = (1 - \delta)k_t + i_t \).
(b) The savings/investment function: \( i_t = sy_t \).
(c) The per capita production function: \( y_t = f(k_t) \).

20. Describe, with words or an equation, what we mean by the economy’s steady state in the Solow Growth model?

The steady state is the point at which the economy’s growth rate is constant. In the simple Solow growth model, without population growth, this is the point at which the capital stock doesn’t change from one period to the next. That is, where investment in new capital just offsets the depreciation of old capital: \( i_t = \delta k_t \). In the simple model, there is no growth in output per capita or output. In the model with population growth, the steady state displays growth in output, but not output per capita (since output grows at the rate of population growth).

Part 2: Analytical Problems
(40 points possible)

21. Solow Growth Model (20 points). Consider the Solow Growth Model without population growth or technological change. Let \( f(k) = k^{1/2} \) (recall that \( x^{1/2} = \sqrt{x} \)), \( \delta = 0.1 \), \( s = 0.2 \), and \( k_1 = 4 \).

(a) What is output per worker in period 1, \( y_1 \)?
- \( y_1 = k_1^{1/2} = 4^{1/2} = 2 \).

(b) What is investment per worker in period 1, \( i_1 \)?
- \( i_1 = sy_1 = 0.2 \times 2 = 0.4 \).

(c) What is depreciation in period 1?
- \( \text{depreciation} = \delta k_1 = 0.1 \times 4 = 0.4 \).

(d) What is \( k_2 \) (capital at the start of period 2)?
- \( k_2 = (1 - \delta)k_1 + i_1 = (0.9) \times 4 + 0.4 = 3.6 + 0.4 = 4 \).

(e) What is the steady state capital stock, \( k^* \)?
- You may have figured the answer from above. In general, you solve for the steady state by finding the \( k^* \) that solves: \( sf(k^*) = \delta k^* \). This can be rearranged as: \( \frac{s}{\delta} = \frac{k^*}{k^*^{1/2}} \). With the parameter values specified here, this becomes: \( \frac{0.2}{0.1} = \frac{k^*}{k^*^{1/2}} \implies 2 = k^*^{1/2} \implies k^* = 2^2 = 4 \).
22. Theory of National Income (20 points). Assume that real GDP, \( Y \), can be decomposed into aggregate consumption, \( C \), aggregate investment, \( I \), and government spending, \( G \), in the following way: \( Y = C + I + G \). Furthermore, assume that real GDP is fixed because capital and labor are fixed: \( \bar{Y} = F(\bar{K}, \bar{L}) = \bar{K}^\alpha \bar{L}^{1-\alpha} \). Let \( \alpha = \frac{1}{2} \) (and note that \( x^{1/2} = \sqrt{x} \)). Assume that government spending, \( \bar{G} \), is fixed and that net taxes, \( \bar{T} \), are fixed. Also, assume that consumption is a positive function of disposable income in the following way; \( \bar{C} = C(\bar{Y} - \bar{T}) = 0.7(\bar{Y} - \bar{T}) \), and is therefore fixed. Lastly, assume that investment, \( I(r) \), is a negative function of the real interest rate \( r \), such that when \( r \) goes up, \( I \) goes down, and vice versa. Specifically, let \( I(r) = 100 - 10r \). Let the exogenous variables take on the following values: \( \bar{K} = 225 \), \( \bar{L} = 400 \), \( \bar{G} = 100 \), \( \bar{T} = 100 \).

(a) How much of national income goes to owners of capital? How much to those who supply labor?

- Given the production function, we know each factor receives half of the total income (you can either remember this result from the Cobb-Douglas production function or you can derive it from the equilibrium conditions that \( MPK = r \) and \( MPL = w \)). Total income = \( \bar{Y} = \bar{K}^{1/2} \bar{L}^{1/2} = 225^{1/2}400^{1/2} = 15 \times 20 = 300 \). So owners of capital and labor providers both received \$150.

(b) Solve for public savings, private savings, and national savings in this model.

- Private savings = \( Y - C - T = Y - 0.7(\bar{Y} - \bar{T}) - \bar{T} = 300 - 0.7(300 - 100) - 100 = 300 - 140 - 100 = 60 \). Public savings = \( T - G = 100 - 100 = 0 \). National Savings = Private Savings + Public Savings = \( 60 + 0 = 60 \).

(c) Solve for the equilibrium real interest rate.

- Recall that \( S = I(r) \), where \( S \) is National Savings. Thus we have, \( 60 = I(r) = 100 - 10r \). We can solve this for \( r \) to find that \( r = 4 \).

(d) What happens to private and public saving and the equilibrium real interest rate if the government lowers taxes, \( \bar{T} \), to 0 with no change in government spending?

- Private Savings increases to 90. Public Savings falls to -100. National Savings therefore falls to -10. Solving \( -10 = 100 - 10r \) for \( r \), we find \( r = 11 \).

(e) What do we call the effect observed in the previous part of the question?

- This is also an example of crowding out. In this case, gov’t spending didn’t change, but the increase in gov’t deficits reduced national savings and drove the interest rate up and investment down. Note that the effects were not as bad as an increase in deficits due purely to more gov’t spending, since the lower taxes resulted in households saving more.