I. ESSAY QUESTIONS (25 points each)

1. Consider a closed economy in which the investment and consumption functions are given by the following:

\[
I(r) = \frac{1}{r};
\]

\[
C(Y - T) = 10 + 0.6(Y - T);
\]

Suppose that government spending, G, equals 20, total output, Y, equals 120, and that total tax revenue, T, equals 30.

(A) Calculate the equilibrium interest rate, \( r \), and investment, \( I \). Show your result on a diagram. What is the marginal propensity to save?

\[
S = Y - G - C
\]

\[
= 120 - 20 - \left(10 + 0.6(120 - 30)\right)
\]

\[
= 100 - 64 = 36
\]

\[
I = S \quad \Rightarrow \quad \frac{1}{r} = 36 \quad \Rightarrow \quad r^* = \frac{1}{36}
\]

\[
MPS = 1 - MPC = 0.4
\]
(B) Suppose that the desire to invest in the economy increases such that \( I(r) \) now becomes \( I(r) = 3/r \). Show what happens to the equilibrium interest rate, \( r \), and investment, \( I \).

\[
I = S \Rightarrow \frac{3}{r} = 36 \Rightarrow r^* = \frac{1}{12}
\]

(C) Suppose that government spending decreases to 10. Discuss the effects on the equilibrium values of \( r \) and \( I \). Show your results on a diagram.

\[
S = Y - 6 - C = 120 - 10 - 64 = 46
\]

\[
S = I \Rightarrow s = 46 \Rightarrow r = \frac{1}{46}
\]
(D) Suppose that income taxes are proportional rather than lump sum, where \( t \), \( 0 < t < 1 \), denotes the average tax rate. Let that tax rate equal 50 percent (i.e., \( t = 0.5 \)). How would you alter the consumption function? What is the equilibrium amount of investment, \( I \), and real interest rate, \( r \), under this specification?

\[
C = 10 + 0.6 \left[ (1-t)Y \right]
\]
\[
= 10 + 0.6 \left[ 0.5Y \right]
\]

\[
S = Y - G - C
\]
\[
= 120 - 20 - \left[ 10 + 0.6 \times 0.5 \times 120 \right]
\]
\[
= 100 - 46 = 54
\]

\[
I = S \quad \Rightarrow \quad 1/r = 54 \quad \Rightarrow \quad r = 1/54
\]
2. Consider the Solow economic growth model with population growth. The production function is given by

\[ Y = F(K, L) = K^{1/2} L^{1/2}, \]

where \( Y \) denotes total output, \( K \) denotes the capital stock, \( L \) denotes the number of workers, and \( \epsilon \) is the technology parameter. Over time, \( L \) is growing at the rate \( n \), the saving rate equals \( s \), and the depreciation rate of capital is \( \delta \).

(A) Determine the steady state for this model. Show your result on a diagram.
Label the steady-state values of per capita capital, \( k \), output, \( y \), consumption, \( c \), and investment, \( i \).

\[
\begin{align*}
y &= k^{1/2} \\
\Delta k &= 0 \quad \Rightarrow \quad s \cdot y &= \delta k \\
\frac{s}{\delta} k^{1/2} &= \delta k \quad \Rightarrow \quad k = \left(\frac{s}{\delta}\right)^{2}
\end{align*}
\]
II. MULTIPLE CHOICE (2 points each)

1. The production function feature called “constant returns to scale” (CRS) means that if we:
   (a) multiply capital by z₁ and labor by z₂, we multiply output by z₃.
   (b) increase capital and labor by 10 percent each, we increase output by 10 percent.
   (c) increase capital and labor by 5 percent each, we increase output by 10 percent.
   (d) increase capital by 10 percent and increase labor by 5 percent, we increase output by 7.5 percent.

2. The property of diminishing marginal product means that, after a point, when additional quantities of:
   (a) a factor are added, output diminishes.
   (b) both labor and capital are added, output diminishes.
   (c) both capital and labor are added, the marginal product of labor diminishes.
   (d) a factor are added when another remains fixed, the marginal product of that factor diminishes.

3. If the consumption function is given by the equation \( C = 500 + 0.5Y \), the production function is \( Y = 50 \, K^{0.5} \, L^{0.5} \), where \( K = 100 \) and \( L = 100 \), then \( C \) equals:
   (a) 1,000.
   (b) 2,500.
   (c) 3,000.
   (d) 5,000.

4. If disposable income is 4,000, consumption is 3,500, government spending is 1,000, and tax revenues are 800, national saving is equal to:
   (a) 300.
   (b) 500.
   (c) 700.
   (d) 1,000.

5. In a closed economy with fixed output, when government spending increases:
   (a) private saving decreases.
   (b) private saving increases.
   (c) public saving decreases.
   (d) public saving increases.
6. If output is described by the production function \( Y = A K^{0.2} L^{0.7} \), then the production function has:
(a) constant returns to scale (CRS).
(b) decreasing returns to scale (DRS).
(c) increasing returns to scale (IRS).
(d) cannot be determined.

7. The national income accounts identity, for an open economy, is:
(a) \( Y = C + I + G - NX \).
(b) \( Y = C + I + G + NX \).
(c) \( Y = C + I + G \).
(d) \( Y = C + I - G \).

8. If GDP (measured in billions of current dollars) is $5,465, consumption is $3,657, investment is $741, and government purchases are $1,098, then net exports are:
(a) $131.
(b) -$131.
(c) $31.
(d) -$31.

9. The GDP deflator is equal to:
(a) the ratio of nominal to real GDP.
(b) the ratio of real to nominal GDP.
(c) real GDP minus nominal GDP.
(d) nominal GDP minus real GDP.

10. Real GDP means the value of goods and services is measured in _______ prices:
(a) current.
(b) real.
(c) constant.
(d) average.
Use graph below to answer questions 11-13:

11. Starting from $k_1$, the capital-labor ration will:
   (a) decrease.
   (b) remain constant.
   (c) increase.
   (d) first increase and then remain constant.

12. Starting from $k_2$, the capital-labor ration will:
   (a) decrease.
   (b) remain constant.
   (c) increase.
   (d) first increase and then remain constant.

13. Starting from $k_3$, the capital-labor ration will:
   (a) decrease.
   (b) remain constant.
   (c) increase.
   (d) first increase and then remain constant.

14. When the real wage is above the level that equilibrates supply and demand:
the quantity of labor supplied exceeds the quantity demanded.
(b) the quantity of labor demanded exceeds the quantity supplied.
(c) there is no unemployment.
(d) the labor market clears.

15. If the per-worker production function is given by \( y = k^{0.5} \), the saving rate, \( s \), is 0.3, and the depreciation rate, \( \delta \), is 0.1, then the steady-state ratio of capital to labor is:

(a) 1.
(b) 2.
(c) 4.
(d) 9.