

Name: _____

Intermediate Macroeconomics (ECO 3203) – Fall 2025 – Exam 2

Multiple choice questions (60 points). Circle all correct answers. There are 3 questions with more than one or no correct answers—the other 12 have only one correct answer. **4 points** for each; no partial credit for some, but not all, correct answers.

1. In an open economy, _____ may not equal _____.
 a. exports, imports
 b. spending, output
 c. $Y, C + I + G + NX$
 d. saving, investment

2. A country with a trade surplus is a _____.
 a. net capital outflow
 b. net lender
 c. net borrower
 d. closed economy

3. In a small open economy, _____.
 a. the world interest rate is endogenous
 b. domestic and foreign bonds are perfect complements
 c. international trade of assets is impossible
 d. the domestic real interest rate equals the world real interest rate.

4. Alex and Tess are discussing a recent increase in investment demand in their home country of Mozea, a nation with a small open economy. Alex claims that they should expect the real interest rate to increase. Tess argues that the real interest rate will surely decrease. Who is correct?
 a. Alex is correct.
 b. Tess is correct.
 c. Neither is correct: there will be no change in the real interest rate.
 d. Both are correct: the world real interest rate will increase and the domestic real interest rate will decrease.

5. 1 US dollar equals 0.8 Swiss francs. The price of a basket of goods that is representative of consumption is 1,000 dollars in the US and 800 francs in Switzerland. What is the real exchange rate between Switzerland and the US?
 - a. $64/100 = 0.64$
 - b.** 1
 - c. $100/64 = 1.5625$
 - d. We cannot tell based on this information.
6. If purchasing power parity holds, the real exchange rate is _____.
 - a. equal to 0
 - b.** equal to 1
 - c. equal to the nominal exchange rate
 - d. undetermined
7. Import tariffs _____.
 - a.** increase consumer prices
 - b.** address trade imbalance
 - c. are good for the economy
 - d. are bad for the economy
8. Break-even investment is _____.
 - a. the depreciation rate
 - b. constant over time
 - c.** the amount of investment necessary to keep capital per effective worker constant
 - d. not enough to keep the economy growing
9. Consider the Solow model with population growth (at rate n) and technological progress (at rate g). In the steady state, output per worker _____.
 - a. does not grow
 - b.** grows at rate g
 - c. grows at rate n
 - d. grows at rate $g+n$
10. Under balanced growth, _____.
 - a. the economy does not grow
 - b.** the economy grows in the steady state
 - c. the economy is not in a steady state
 - d. the economy shrinks and grows irregularly

11. In 2019, the high-income Country A has an output growth rate of 3% while the low-income Country B has an output growth rate of 10%. In the far-off year of 2080, Country A's output growth rate has remained at a steady 3% while Country B's output growth rate has decreased to 3.5%. Which of the following statements are true?

- a. Country B's economy is failing while Country A's economy is thriving.
- b. They are demonstrating beta-convergence.
- c. They are demonstrating sigma-convergence.
- d. Neither country demonstrates exponential growth.

12. _____ is an example of creative destruction.

- a. The automobile displacing carriages
- b. Bank tellers getting laid off with the arrival of the ATM
- c. Online retail taking over brick-and-mortar stores
- d. Supermarket cashiers being replaced with self-checkout counters

13. Productivity slowdown is the puzzling empirical fact that _____.

- a. capital is becoming less productive over time
- b. labor is becoming less productive over time
- c. production is decreasing over time
- d. total factor productivity is decreasing over time

Question was worded incorrectly.
d. accepted as correct answer
+8 points if none chosen

14. Which of the following statements are true?

- a. Industrial policy always takes a short-term view.
- b. Research activities have negative externalities that investors do not internalize.
- c. The government is unable to allocate capital across sectors.
- d. Politics may influence which sectors are invested in, which limits the effectiveness of industrial policy.

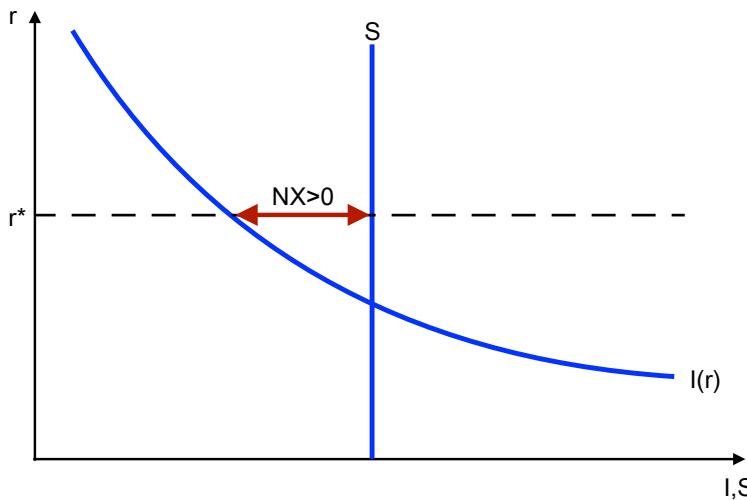
15. _____ increases the growth rate of the economy.

- a. Increasing the government's budget deficit
- b. Raising college tuition fees
- c. Providing tax incentives for research and development
- d. Restricting international knowledge flow

Written response questions. Show your work: if you give the right answer without showing how you arrived at it, you will only get partial credit. If you need more space, use the last page and clearly indicate which question you are answering.

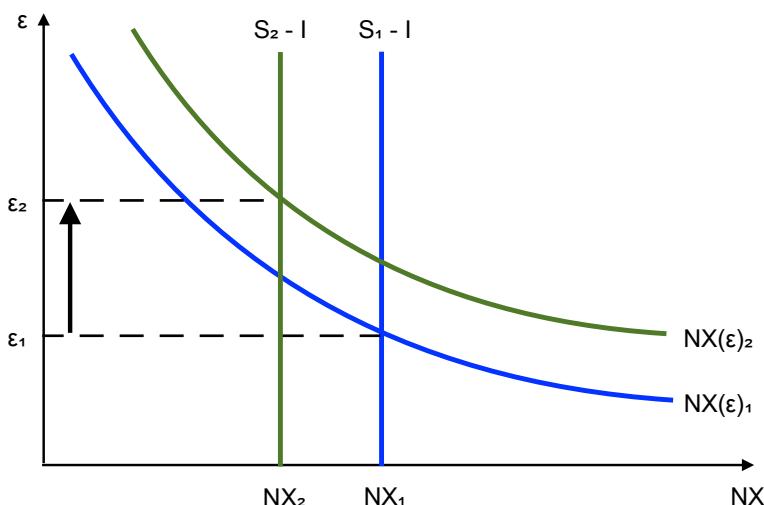
1. (10 points) Genovia, the wealthy gemstone of a country in the mountains, has long been engaged in trade. Their main export is the famous Genovian pears, and thanks to a few good harvests, the country currently exports more than it imports. But while its economy is strong, Genovia is too small to impact the rest of the world, specifically the world interest rate.

- a. **(5 points)** Show the amount of trade on a diagram with investment and savings on the horizontal axis and the real interest rate on the vertical axis.



2 points for correct curves
1 point for correct NX
1 point for labeling all curves
1 point for axis titles and labels

- b. **(5 points)** Genovian elections will be held next year. The opposition's policy program is built around fiscal expansion. To finance increased government spending, they propose to introduce import tariffs. Show the impact of this program on a diagram with net exports on the horizontal axis and the real exchange rate on the vertical axis.



2 points for correct curves
1 point for correct shift in curves
1 point for labeling all curves
1 point for axis titles and labels

-1 point if showing the impact on two diagrams which are otherwise correct
-2 points if showing the impact of only one program point which is otherwise correct

2. (10 points) The cosmetics of macro models in per-effective-worker units.

- a. **(5 points)** Suppose a country produces output according to the following aggregate production function:

$$Y = AK^\alpha L^{1-\alpha}, \quad 0 < \alpha < 1.$$

Derive the per-worker production function and its marginal product of per-worker capital.

1.
$$\frac{Y}{L} = \frac{AK^\alpha L^{1-\alpha}}{L} = \frac{AK^\alpha}{L^\alpha} = A \left(\frac{K}{L}\right)^\alpha$$

Denoting $y \doteq Y/L$ and $k \doteq K/L$:

$$y = Ak^\alpha$$

2 points for correct per-worker math
1 point for correct notation
2 points for correct MPK (still 2 points if the per-worker production function is wrong but the derivative is correct)

2. $MPK = A\alpha k^{\alpha-1}$

- b. **(5 points)** Suppose a country produces output according to the following aggregate production function:

$$Y = AK^\alpha[(1-u)EL]^{1-\alpha}, \quad 0 < \alpha < 1$$

where u is the fraction of labor engaged in research and E is labor efficiency. Derive the per-effective-worker production function and its marginal product of per-effective-worker capital.

1.
$$\frac{Y}{EL} = \frac{AK^\alpha[(1-u)EL]^{1-\alpha}}{EL} = \frac{AK^\alpha(1-u)^{1-\alpha}}{(EL)^\alpha} = A(1-u)^{1-\alpha} \left(\frac{K}{EL}\right)^\alpha$$

Denoting $y = Y/(EL)$ and $k = K/(EL)$:

$$y = A(1-u)^{1-\alpha}k^\alpha$$

2 points for correct per-effective-worker math
1 point for correct notation
2 points for correct MPK (still 2 points if the per-effective-worker production function is wrong but the derivative is correct)

2. $MPK = A(1-u)^{1-\alpha}\alpha k^{\alpha-1}$

3. (20 points) The Kingdom of Wakanda is the most technologically advanced nation on Earth. Producing output needs very little labor, thus the per-effective-worker production function is $f(k) = k^{2/3}$. Technological progress increases labor efficiency by a whopping 7 percent per year while the depreciation rate is very low, only 3 percent per year. Wakandans want to keep this incredible technology to themselves, so they hide from the world and their population doesn't grow. Furthermore, Wakandans save 20 percent of their income. (*The parts of this question build on each other.*)

- a. **(2 points)** Capital per effective worker is 1 this year. What will it be next year?

$$\Delta k = 0.2 \times 1^{\frac{2}{3}} - (0.03 + 0.07) \times 1 = 0.2 - 0.1 = 0.1$$

$$\Rightarrow k' = k + \Delta k = 1 + 0.1 = 1.1$$

1 point for correct change in capital
1 point for correct next-period capital

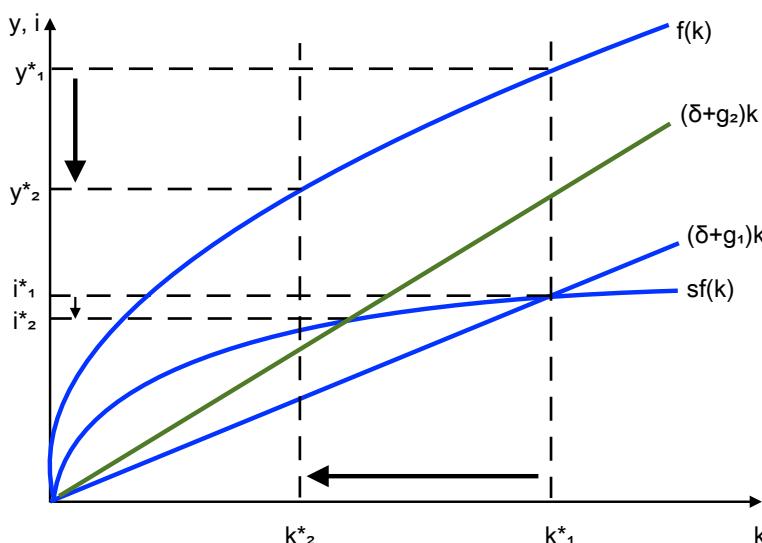
- b. **(2 points)** Is 1 the steady-state level of capital per effective worker? If not, what is it? No, because $\Delta k \neq 0$. Steady state:

1 point for correct math
1 point for correct conclusion

$$0 = 0.2(k^*)^{\frac{2}{3}} - (0.03 + 0.07)k^* = 0.2(k^*)^{\frac{2}{3}} - 0.1k^*$$

$$(k^*)^{-\frac{1}{3}} = \frac{0.1}{0.2} = \frac{1}{2} \Rightarrow k^* = \left(\frac{1}{2}\right)^{-\frac{1}{3}} = \left(\frac{1}{2}\right)^{-3} = 2^3 = 8$$

- c. **(4 points)** Wakandan material scientists have long been on a quest to find a replacement for vibranium, a metal from outer space that fuels their technological progress. One fateful day they finally crack the code and create adamantium, a worthy substitute. Since Wakanda now has both vibranium and adamantium, the rate of technological progress increases by 6 percentage points, to 13 percent per year. Show the impact of this innovation using the diagram of the Solow model.



1 point for correct curves
1 point for correct shift in curves
1 point for labeling all curves
1 point for axis titles and labels

no point deduction if only showing impact on investment but not output

- d. (4 points) What is the new steady-state level of capital per effective worker?
Express it either as a fraction or a number with 3 decimal points precision.

$$0 = 0.2(k^*)^{\frac{2}{3}} - (0.03 + 0.13)k^* = 0.2(k^*)^{\frac{2}{3}} - 0.16k^*$$

$$(k^*)^{-\frac{1}{3}} = \frac{0.16}{0.2} = \frac{4}{5}$$

$$k^* = \left(\frac{4}{5}\right)^{-\frac{1}{3}} = \left(\frac{4}{5}\right)^{-3} = \left(\frac{5}{4}\right)^3 = \frac{125}{64} \approx 1.953$$

All 4 points for correct math
(partial credit if one step is incorrect but the following ones are correct conditional on the wrong answer)

- e. (4 points) Is this the Golden Rule level of capital per effective worker? If not, would that be higher or lower?

Answer 1 (easier):

$$MPK = \frac{2}{3}k^{-\frac{1}{3}}$$

If k^* from part d. was the Golden Rule level of capital per effective worker, MPK would be

$$MPK = \frac{2}{3} \left[\left(\frac{5}{4}\right)^3 \right]^{-\frac{1}{3}} = \frac{2}{3} \left(\frac{5}{4}\right)^{-1} = \frac{2}{3} \times \frac{4}{5} = \frac{8}{15}$$

Since $MPK = \frac{8}{15} > \delta + g = 0.16 = \frac{8}{50}$, this is not the Golden Rule level of capital. k_G^* would be higher.

Answer 2 (harder):

$$MPK = \frac{2}{3}(k_G^*)^{-\frac{1}{3}} = 0.03 + 0.13 = 0.16$$

$$(k_G^*)^{-\frac{1}{3}} = 0.16 \times \frac{3}{2} = \frac{16}{100} \times \frac{3}{2} = \frac{24}{100} = \frac{6}{25}$$

$$k_G^* = \left(\frac{6}{25}\right)^{-\frac{1}{3}} = \left(\frac{6}{25}\right)^{-3} = \left(\frac{25}{6}\right)^3 = \left(\frac{5}{6/5}\right)^3 > \left(\frac{5}{4}\right)^3$$

k^* from part d. is not the Golden Rule level of capital. k_G^* would be higher.

1 point for correctly identifying k^* from part d. is not k^*_G
1 point for correctly identifying k^*_G would be higher
2 points for correct math (partial credit if one step is incorrect but the following ones are correct conditional on the wrong answer)

- f. **(4 points)** Wakanda decides to open its borders, and foreigners flock to the country. The population starts growing at a rate of 4 percent per year. What would the Golden Rule savings rate be?

$$MPK = \frac{2}{3}(k_G^*)^{-\frac{1}{3}} = 0.03 + 0.13 + 0.04 = 0.2$$

$$(k_G^*)^{-\frac{1}{3}} = 0.2 \times \frac{3}{2} = \frac{1}{5} \times \frac{3}{2} = \frac{3}{10}$$

$$k_G^* = \left(\frac{3}{10}\right)^{-\frac{1}{3}} = \left(\frac{3}{10}\right)^{-3} = \left(\frac{10}{3}\right)^3$$

$$y_G^* = \left[\left(\frac{10}{3}\right)^3\right]^{\frac{2}{3}} = \left(\frac{10}{3}\right)^2$$

$$i_G^* = 0.2 \times \left(\frac{10}{3}\right)^3 = \frac{2}{10} \times \left(\frac{10}{3}\right)^3$$

$$s_G^* = \frac{\frac{2}{10} \times \left(\frac{10}{3}\right)^3}{\left(\frac{10}{3}\right)^2} = \frac{2}{10} \times \frac{10}{3} = \frac{2}{3}$$

All 4 points for correct math
 (partial credit if one step is incorrect but the following ones are correct conditional on the wrong answer)