MIDTERM – Version 2

No calculators permitted. A total of 140 points are possible.

Last Name: _____________________________ First Name: ________________________

Your Student ID Number: __ __ __ - __ __ - __ __ __ __

** Part A: Multiple Choice Questions **
(20 questions, each of which is worth 5 points)

Instructions: Answer these multiple choice questions on your Scantron. Write on the Scantron your name (last name first), student ID number, and exam version number in the “name,” “subject,” “test no.” boxes respectively. For example,

<table>
<thead>
<tr>
<th>NAME</th>
<th>McComb, Madeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBJECT</td>
<td>530-66-6271</td>
</tr>
<tr>
<td>DATE</td>
<td></td>
</tr>
</tbody>
</table>

** Warning **

If you first fill in an answer and then erase it to fill in a different one, and the first answer is not fully erased, the Scantron reader may detect two answers and not accept either one. Do not fill in an answer till you are sure this is the one you want to give, or you may not receive credit for the question.
1. Which of the following is not a formula for productivity growth estimated from prices

A. \[ g_A = \alpha g_r + \beta g_w + \gamma g_s - g_p \]
B. \[ g_A = \alpha g_r + \beta g_w + \gamma g_s - (\alpha + \beta + \gamma) g_p \]
C. \[ g_A = \alpha g_r + \beta g_w + \gamma g_s \]
D. \[ g_A = \alpha g_r/p + \beta g_w/p + \gamma g_s/p \]
E. \[ g_A = \alpha (g_r - g_p) + \beta (g_w - g_p) + \gamma (g_s - g_p) \]

2. Suppose that the share of national income paid to capital owners is .30. If there is an additional social return to capital of $3 for every private $1 of return, then in doing growth accounting a 1% growth of the capital stock will cause what percentage growth in output.

A. .30%
B. .90%
C. 1.00%
D. 1.20%
E. Not sufficient information to tell.

3. When we do growth accounting in competitive economies since the Industrial Revolution the **SHARE** of the growth of output per worker seemingly explained by increases in the capital stock per worker is typically.

A. 0.25
B. **0.33**
C. 0.67
D. 1.00
E. None

4. How much greater (roughly) is material output per person now in the USA than in Uganda?

A. 8x
B. 10x
C. 15x
D. **33x**
E. 100x
5. French fertility levels were kept relatively high in the 18th century because

A. The Catholic church was very influential.
B. Widespread drunkenness made people careless about birth control.
C. Most men had mistresses as well as wives.
D. **Middle class women used wet nurses for their children.**
E. France was under populated compared to most of Europe.

6. “**Engel’s Law**” implies which of the following:

A. As income increases food expenditure declines.
B. As people get wealthier they eat more calories.
C. **In richer societies a larger percentage of the population lives in cities.**
D. Food is a luxury good.
E. Food expenditure increases proportionately with income.

7. Suppose that in an economy the labor supply is growing at 4%, the capital stock is growing at 6%. What is the rate of growth of **capital per worker**?

A. 10%
B. 6%
C. 4%
D. **2%**
E. -2%

8. Suppose in an economy output is growing at 5%, and all the inputs are growing at 1%. What is the rate of efficiency growth?

A. 5%
B. **4%**
C. 3%
D. 2%
E. 0%
9. Malthus wrote his “Essay on a Principle of Population” in
   A. 1812
   B. 1798
   C. 1789
   D. 1776
   E. 1688

10. Malthus assumed that living standards were much lower in China than in England at the time he wrote. Which of the following pieces of evidence suggests that he was wrong.
   A. The population density in China was much greater than in England.
   B. Chinese women married young, and almost all of them married.
   C. English women typically delayed marriage until age 25.
   D. English men typically delayed marriage until age 27.
   E. Chinese fertility rates were about the same as English.

11. We believe the Chinese economy in 1800 was still Malthusian. This was because:
   A. The technology of the society was improving only slowly.
   B. Marriage was nearly universal for women.
   C. Birth rates were above 30 per thousand.
   D. The technology of the society was not improving.
   E. Agriculture was still the major occupation.

12. The most likely cause of the material prosperity of the people of Tahiti in the late 18th century when the Europeans arrived was.
   A. The absence of syphilis.
   B. Widespread infanticide.
   C. The absence of mosquitos.
   D. The isolation of the islands from other cultures, which stopped immigration.
   E. Widespread death in the Shiva wars of the 1760s which left the islands depopulated.
Use these facts for questions 13-16. Suppose the death rate per thousand of the population in a Malthusian economy is given by \( D(w) = 100-10w \) where \( w \) is the real wage. Suppose the birth rate is 40 per thousand of the population independent of the level of wages.

13. What is the long run real wage?

A. 3  
B. 4  
C. 5  
D. 6  
E. 10

14. What is the long run life expectancy at birth?

A. 40  
B. 35  
C. 30  
D. 25  
E. 20

15. Suppose that at a given wage the number of deaths per thousand drops by 10 as a result of improvements in medicine. What is the new long run life expectancy at birth?

A. 40  
B. 35  
C. 30  
D. 25  
E. 20

16. Suppose the death rate is again given by \( D(w) = 100-10w \) where \( w \) is the real wage. Suppose the birth rate is still 40 per thousand. Output \( Q \) is produced according to the formula

\[
Q = AK^\alpha N^\beta T^\gamma
\]

where \( A \) is the level of technology, \( K \) is capital, and \( T \) is the land area. If there is a one-time improvement in the technology level \( A \) of 2%, what is the new long run real wage?

A. 3  
B. 4  
C. 5  
D. 6  
E. 10
17. What does skeletal evidence suggest about material prosperity in the Americas in the years before Columbus arrived (1492) compared to the years 1492-1800.

A. On balance there was little change from 5,000 BC to 1800 AD.
B. It declined markedly after Columbus because of the oppression of the Spanish.
C. It improved after Columbus because of the arrival of better European technology.
D. It improved with the arrival of settled agriculture because of more secure food supplies.
E. It declined with the onset of settled agriculture because elite groups were able to seize more output.

18. Which of the following was NOT a feature of the European Marriage Pattern?

A. Little fertility outside marriage.
B. Late age of first marriage by women.
C. No sign of fertility control within marriage.
D. Large percentage of women remain unmarried.
E. Fewer female infants survive than do male infants.

19. The Black Death struck first in England in

A. 800
B. 1066
C. 1287
D. 1349
E. 1688

20. Expectation of future years of life for girls in Europe in the eighteenth century reached a maximum at what age?

A. 20
B. 12
C. 6
D. 1
E. 0
Part B: LONG ANSWER (40 points)

1. (a) Starting from the expression \( pQ = rK + wL + sT \) show how the rate of growth of efficiency in an economy can be calculated from output and input price growth rates (30)

Assume constant returns to scale and competitive markets:

- Constant returns to scale: \( rK + wL + sT = pQ \) if we let \( p = 1 \),
  \( (rK/Q) + (wL/Q) + (sT/Q) = \alpha + \beta + \gamma = 1 \)
- Competitive markets: \( mpL = w, mpK = r, mpT = s \)

Starting from our constant returns to scale (CRS) condition:

\[
(p + \Delta p)(Q + \Delta Q) = (r + \Delta r)(K + \Delta K) + (w + \Delta w)(L + \Delta L) + (s + \Delta s)(T + \Delta T)
\]

\[
pQ + p\Delta Q + Q\Delta p + \Delta p\Delta Q = rK + r\Delta K + K\Delta r + \Delta rK
\]

\[
+ wL + w\Delta L + L\Delta w + \Delta wL
\]

\[
+ sT + s\Delta T + T\Delta s + \Delta sT
\]

- Since we are interested in \( \Delta (pQ) \), we need to subtract (\( pQ = rK + wL + sT \)) from (\( p + \Delta p)(Q + \Delta Q) \). We will also ignore terms with two deltas as they will most likely be very small.

\[
\rightarrow p\Delta Q + Q\Delta P = r\Delta K + K\Delta r + w\Delta L + L\Delta w + s\Delta T + T\Delta s
\]

- Next separate all terms involving changes in quantities and those involving changes in prices.

\[
\rightarrow p\Delta Q - r\Delta K - w\Delta L - s\Delta T = K\Delta r + L\Delta w + T\Delta s - Q\Delta p
\]

- Divide by \( pQ \).

\[
\rightarrow \frac{p\Delta Q}{pQ} - \frac{r\Delta K}{pQ} - \frac{w\Delta L}{pQ} - \frac{s\Delta T}{pQ} = \frac{K\Delta r}{pQ} + \frac{L\Delta w}{pQ} + \frac{T\Delta s}{pQ} - \frac{Q\Delta p}{pQ}
\]

- Multiply by \( 1 = \frac{K}{K} = \frac{L}{L} = \frac{T}{T} = \frac{r}{r} = \frac{w}{w} = \frac{s}{s} \).

\[
\rightarrow \frac{\Delta Q}{Q} - \frac{rK}{pQ} \frac{\Delta K}{K} - \frac{wL}{pQ} \frac{\Delta L}{L} - \frac{sT}{pQ} \frac{\Delta T}{T} = \frac{rK}{pQ} \frac{\Delta r}{r} + \frac{wL}{pQ} \frac{\Delta w}{w} + \frac{sT}{pQ} \frac{\Delta s}{s} - \frac{\Delta p}{p}
\]

- Now, where \( \frac{\Delta x}{x} = G_x \) and \( \frac{rK}{pQ} = \alpha, \frac{wL}{pQ} = \beta, \frac{sT}{pQ} = \gamma \)

\[
\rightarrow G_Q - \alpha G_K - \beta G_L - \gamma G_T = \alpha G_R + \beta G_W + \gamma G_S - G_P = G_A
\]
(b) What three conditions will cause the formula you have derived above to incorrectly calculate efficiency growth? (10)

- Non-constant returns to scale (i.e. increasing or decreasing returns to scale)
- Imperfectly competitive markets for goods and factors
- Externalities in capital/investment