考試科目	經濟學	系所別	經濟學系 二年級	考試時間	7 月 8 日(三) 第二節

1. （每小題 5 分，共計 30 分）

請解釋並舉例說明下列名詞的經濟概念，同時指出其在經濟理論分析上的重要性。未說明重要性者，該小題不予計分。

(a) law of diminishing marginal returns

(b) market mechanism

(c) production function

(d) competitive advantage

(e) Nash equilibrium

(f) natural monopoly

2. （每小題 10 分，共計 20 分）

(a) 請使用圖形和文字說明勞動市場供給曲線和需求曲線的推導過程。

(b) 請嘗試利用勞動市場的供給和需求模型架構，分析我國近年薪資成長停滯的現象。

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3. The following data are derived from country A in 2019 (in billions):

Personal Consumption expenditures	24000
Gross private domestic Investment	12000
Government expenditures on goods and services	3000
Exports	8000
Imports	7000
Depreciation	5000
Taxes	2500
Net interest income from abroad	500
Net transfers from abroad	-1000
Foreign investment in the country A	3500
Country A's investment in foreign countries	2000

Assume that there is no any statistical discrepancy and other transactions. Answer the following questions:
[**Your answers will not be counted if no calculation process and/or explanation are provided.**]

(a) What is the amount of the country A's domestic demand for domestic goods? (3%) What is the amount of country's GDP? (3%) What is the amount of country A's private saving? (3%)

(b) What is the amount of the country A's currency account balance? (3%) What is the amount of country A's capital and financial account balance? (3%)

(c) What is the balance of country A's official settlements account? (4%)

(d) The following statement is true, false, or uncertain? Explain.
"For individual country, its total saving may not be equal to its gross private domestic investment. For the whole world, total saving must be equal to gross private investment." (6%)

4. The following data are related to country A's population distribution (in millions) in a year.

Total population:	25
Young (age below 16) population:	3
Institutionalized population:	2
Labor force:	16
Frictional unemployment:	1
Structural unemployment:	2

[Continued in the next page.]

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Assume that country A has no cyclical unemployment. Moreover, country A's output is equal to 30 billion (in real terms), its price level is equal 110, and the nominal wage is equal to W_0 in the year. Answer the following questions: [**Your answers will not be counted if no calculation process and/or explanation are provided.**]

(a) What is the labor participation rate of country A? (3%) What is the unemployment rate of country A? (3%) What is the natural unemployment rate of country A? (3%)

(b) Why is the aggregate demand (AD) curve negatively sloped? Provide and explain at least two reasons. (4%) Draw the the short-run and long-run aggregate supply (AS) curves for country A. In particular, explain why the short-run AS curve differs from the long-run. (2%)

(c) Draw AD/AS curves for country A according to the data given above. In particular, lable the short-run and long-run equilibria of country A in the diagram. (2%)

(d) (continued from (c)) Now, the congress of country A passes a law that increases the nominal wage rate by 10%. Comparing with the original equilibrium in (c), what will happen to country A's price level, nominal wage rate, real wage rate, and output in the short-run equilibrium as well as in the long-run equilibrium? Draw AD/AS curves to explain. (8%)

備註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。

考試科目	微積分	系所別	經濟系/國貿系/金融所 統計系/企管系/資管系 二年級	考試時間	7月8日(三) 第四節

Part I Problems (Multiple choice problems; 50 points; 5 points for each problem)

選擇題請在答案卡上作答，否則不予計分。

1. Which of the following statement is false?

   (a) $\frac{d}{dx}\ln(2x) = \frac{d}{dx}\ln(x)$ for $x > 0$.

   (b) $\frac{d}{dx}\csc(x) = \cot(x)\csc(x)$ for $x \in (0, \pi)$.

   (c) $\frac{d}{dx}\frac{\sin(x)}{\cos(x)} = 1 + \tan^2(x)$ for $x \in (-\pi/2, \pi/2)$.

   (d) $\frac{d}{dx}2^x = \ln(2) \cdot 2^x$ for $x \in (-\infty, \infty)$.

   (e) $\frac{d}{dx}(x^3 + 2x + 1) = 3x^2 + 2$ for $x \in (-\infty, \infty)$.

2. Let $f(x) = 1 + x^2$ for $x \in (-\infty, \infty)$ and let $g(x) = \tan(x)$ for $x \in (-\pi/2, \pi/2)$. Which of the following statement is true?

   (a) $\frac{d}{dx}\frac{g(x)}{f(x)} = \frac{2x\tan(x)}{(1+x^2)^2}$ for $x \in (-\pi/2, \pi/2)$.

   (b) $\frac{d}{dx}(f(x) + g(x)) = 2x + \sec(x)$ for $x \in (-\pi/2, \pi/2)$.

   (c) $\frac{d}{dx}(f(x)g(x)) = \sec^2(x)(1 + x^2) + 2x\tan(x)$ for $x \in (-\pi/2, \pi/2)$.

   (d) $\frac{d}{dx}f(g(x)) = 2g(x)$ for $x \in (-\pi/2, \pi/2)$.

   (e) None of the above statements is true.

3. Suppose that f is a differentiable function such that $f'(x) = -f(x)$ and $f(x) > 0$ for all $x \in (-\infty, \infty)$. Which of the followig statement is false?

   (a) $f(x) = f(0)e^{-x}$ for $x \in (-\infty, \infty)$.

   (b) $f''(x) = f(x)$ for $x \in (-\infty, \infty)$.

   (c) f is strictly increasing on $(-\infty, \infty)$.

   (d) Let $g(x) = \frac{d}{dx}\ln(f(x))$ for $x \in (-\infty, \infty)$. Then g is a constant function on $(-\infty, \infty)$.

   (e) $\lim_{x\to\infty} f(x) = 0$.

4. Suppose that f is a differentiable function on $(-\infty, \infty)$ such that $f(x) = ax^2 + bx + c$ for $x \in (-1, 0)$ for some constants a, b and c and $f(x) = -0.5$ for $x < -1$. Which of the following statements is false?

   (a) $c = a - 0.5$.

   (b) If $f(0) = 0$, then $f'(0) = 2$.

   (c) If $f'(0) = 2$, then $a = 1$.

   (d) If $f(0) = 0$, then $f(x) + f(-x) = 0$ for $x \in (-1, 1)$.

   (e) f is continuous at 0.

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5. For $k > 0$, let $D_k = \{(x, y) : 0 \le x \le k\pi \text{ and } x\sin(x) \le y \le x\}$ and let A_k be the area of D_k. Which of the following statement is true?

   (a) $A_1 = 2\pi + \pi^2/2$.

   (b) $A_2 = 4\pi + 2\pi^2$.

   (c) $A_3 = 3\pi + 9\pi^2/2$.

   (d) $A_4 = 4\pi + 8\pi^2$.

   (e) None of the above statement is true.

6. Let $f(x, y) = x\sin(x^2 + y) + x + y$ for $x, y \in (-\infty, \infty)$. Which of the following statement is true?

   (a) $\lim_{(x,y)\to(0,0)} \dfrac{f(x,y)}{x(x^2+y)} = 1$.

   (b) $\displaystyle\int_0^a f(x, y)dy = -x\cos(x^2 + a) + x\cos(x^2) + ax + \frac{a^2}{2}$ for $a > 0$.

   (c) $\dfrac{\partial}{\partial y} f(x, y) = 2x^2\cos(x^2 + y) + \sin(x^2 + y) + 1$.

   (d) The tagent plane to the surface $z = f(x, y)$ at the point $(0, 0, 0)$ is $z = 2x + y$.

   (e) None of the above statements is true.

7. Suppose that f is a differentiable function on $(0, 1)$ and f is continuous on $[0, 1]$. Which of the following statement is false?

   (a) If $f(0)f(1) < 0$, then there exists a number $c \in (0, 1)$ such that $f(c) = 0$.

   (b) If $f'(0.1)f'(0.9) < 0$, then there exists a number $c \in (0.1, 0.9)$ such that $f'(c) = 0$.

   (c) If $f(0) = 0$ and $f(1) = 1$, then there exists a number $c \in (0, 1)$ such that $f'(c) = 1$.

   (d) If $f'' > 0$ on $(0, 1)$ and $f'(c) = 0$ for some $c \in (0, 1)$, then $f(x) \ge f(c)$ for $x \in [0, 1]$.

   (e) If $f(x) = f(1 - x)$ for $x \in [0, 1]$, $f(0) > 0$ and $f(0.5) = 0$, then $f''(0.5) > 0$.

8. Define a sequence $\{a_n\}_{n=1}^{\infty}$ as follows. Let $a_1 = 1$ and $a_{n+1} = 0.5a_n + 1/n$ for $n \ge 2$. Which of the following statement is true?

   (a) $\lim_{n\to\infty} a_n = 1$.

   (b) $\lim_{n\to\infty} a_n = \infty$.

   (c) $\lim_{n\to\infty} a_n/n = 0$.

   (d) $\sum_{n=1}^{\infty} na_n < \infty$.

   (e) None of the above statements is true.

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9. Let $S = \{r : r$ is a positive number such that $\sum_{k=0}^{\infty} x^k/k!$ converges absolutely for $|x| < r\}$. Which of the following statement is true?

   (a) S is empty.

   (b) S is nonempty and $r \leq 1$ for all $r \in S$.

   (c) S is nonempty and if for some $r \in S$, a function f is defined as

   $$f(x) = \sum_{k=0}^{\infty} \frac{x^k}{k!}$$

   for $x \in (-r, r)$, then $f'(x) > f(x)$ for $x \in (0, r)$.

   (d) $S = (0, \infty)$.

   (e) None of the above statements is true.

10. Let $f(x, y) = 1/(1 + x^2 + y^2)$ for $x, y \in (-\infty, \infty)$ and let $D_a = \{(x, y) : x^2 + y^2 \leq a^2\}$ for $a > 0$. Which of the following statement is true?

    (a) $\int_{D_1} f(x, y)d(x, y) = \pi \ln(2)$.

    (b) $\int_{D_2} f(x, y)d(x, y) = \pi \ln(4)$.

    (c) $\int_{D_3} f(x, y)d(x, y) = \pi \ln(6)$.

    (d) $\int_{D_4} f(x, y)d(x, y) = \pi \ln(8)$.

    (e) None of the above statements is true.

Part II Problems (50 points)

Note: For Part II Problems, SHOW YOUR WORK TO GET THE POINTS

11. (20 points) Use Newton's method to find the zero of $f(x) = x^2 - 3$ with $x_0 = 2$. (Perform four iterations.)

12. (30 points) Let $f(x)$, $F(x)$ and $h(x)$ be defined as the following:

$$\begin{aligned} f(x) &= \frac{2}{\sqrt{\pi}\lambda} e^{-(x/\lambda)^2}, \\ F(x) &= \int_0^x f(t)dt, \\ h(x) &= \frac{f(x)}{1 - F(x)}. \end{aligned}$$

    (a) (15 points) Find $\lim_{x \to 0^+} h(x)$.

    (b) (15 points) Find $\lim_{x \to \infty} h(x)$.

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