

考試科目	微積分	系所別	科技管理與智慧財產研究所 科技管理組	考試時間	2月6日(星期五) 第二節
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以下各題，每大題 10 分，共 100 分。請寫明計算程序，無過程 0 分計算。

註：本卷中的「 e 」為尤拉數。

1.(1) 試求 $\lim_{x \rightarrow 2} \frac{1}{x-2} \int_2^x \frac{1}{\sqrt{t^2+2t+8}} dt = ?$

(2) 試求 $\lim_{n \rightarrow \infty} \left[\frac{n}{n^2} + \frac{n}{(n+2)^2} + \frac{n}{(n+4)^2} + \dots + \frac{n}{(3n-2)^2} \right] = ?$

2. 試求 $\int e^x \sin x dx = ?$

3. 試求下列級數的收斂區間為何？

$$\sum_{n=1}^{\infty} \frac{(x-3)^n}{n \cdot 4^n}$$

4. 試求 $\int \frac{x+3}{\sqrt{9-x^2}} dx = ?$

5. 星狀曲線 $x = \cos^3 t, y = \sin^3 t, 0 \leq t \leq \pi$ 的長度為何？

6. 已知隨機變數 X 的機率密度函數為 $f(x) = \begin{cases} kx^2 e^{-x}, & x \geq 0 \\ 0, & x < 0 \end{cases}$ ，試求：

(1) 常數 k 的值

(2) 累積分佈函數 $F(x) = P(X \leq x) = \int_0^x f(t) dt$

(3) 期望值 $E(X)$

7. 試求 $\iiint_E \frac{z^2}{\sqrt{x^2+y^2+z^2}} dV = ?$ 其中 $E = \{(x, y, z) | 4 \leq x^2 + y^2 + z^2 \leq 9, z \geq 0\}$ 。

8. 試解微分方程式 $6 \frac{dy}{dx} + y^4 e^{2x} = 0$

9. 試求 $\int_0^{\infty} x^3 e^{-x^2} dx = ?$

10. 設某產品的產量函數為 $f(x, y) = 240x^{\frac{3}{4}}y^{\frac{1}{4}}$ 。[x 表示勞力財(labor)的單位數， y 表示資本財(capital)的單位數]。若每一單位的勞力財為 200 元，且每一單位的資本財為 400 元，試求在總花費不超過 48000 元的最大產量為何？

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	經濟學	系 所 別	商學院共同科	考 試 時 間	2 月 6 日 (五) 第 二 節
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I. Multiple Choice (1 points each)

Identify the letter of the choice that best completes the statement or answers the question.

- Suppose the introduction of new tariffs on imported ovens not only raises the prices of imported ovens but also those of domestic ovens. We can conclude that imported and domestic ovens are
 - substitutes.
 - complements.
 - unrelated.
 - None of the above is correct.
- According to consumer theory, "if consumers do not buy less of a commodity when their incomes rise, they will
 - surely buy less when the price of the commodity rises."
 - surely buy more when the price of the commodity rises."
 - surely buy less when the price of the commodity falls."
 - either buy more or less when the price of the commodity rises."
- People with hidden health problems are more likely to buy health insurance than are other people. This is an example of
 - moral hazard and makes the cost of health insurance higher than otherwise.
 - moral hazard and makes the cost of health insurance lower than otherwise.
 - adverse selection and makes the cost of health insurance higher than otherwise.
 - adverse selection and makes the cost of health insurance lower than otherwise.
- Ben has a concave utility function $U(W) = W^{0.5}$, where W denotes his wealth. His only asset is shares in a start-up company. Tomorrow he will learn the stock's value. He believes that it is worth \$144 with probability $\frac{1}{2}$ and \$100 with probability $\frac{1}{2}$. What is the risk premium he would pay to avoid bearing this risk?
 - 1
 - 2
 - 10
 - 12
- Which of the following demonstrates the law of demand?
 - Ashlyn buys more apples at \$3 per pound than at \$5 per pound, other things equal.
 - Brian buys fewer croissants at \$1 per croissant than at \$2 per croissant, other things equal.
 - After Charles got a raise at work, he bought more pretzels at \$2 per pretzel than he did before his raise.

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- D. Danny buys fewer Snickers at \$1.5 per bar after the price of Skittles falls to \$1 per bag.
6. In the long run, the toothpaste market is monopolistically competitive, and WhiteMan is one of the firms. WhiteMan's long-run cost function is $c(q) = q^3 - xq^2 + 14q$. The firm faces demand $q = 5 - \frac{1}{2}p$. What is x ?
- A. 3
 B. 4
 C. 5
 D. 6
7. There are four residents $i = 1, 2, 3,$ and 4 in a small village. If resident i donates d_i dollars, total public funding is $D = \sum_{i=1}^4 d_i$. Resident i 's utility is $U_i = m_i - d_i + i \cdot \ln(D)$, where m_i is the money resident i has and $m_i > 6$ for all i . What is the socially optimal level of D ?
- A. 8
 B. 10
 C. 12
 D. 14
8. Demand for bubble tea is $q_d = 42 - 2p$, and supply is $q_s = 0.5p - 2$. Consumption causes an obesity external cost $c_s = 3q^2$. Which policy achieves the social optimum?
- A. Close the bubble tea market.
 B. For every bubble tea consumed, the customer pays the bubble store 12 dollars more.
 C. For every bubble tea produced, the bubble store pays 12 dollars to the government.
 D. Set a quota equal to $q = 3$.
9. Consider the game in the payoff matrix.

		Player 2	
		B	T
Player 1	B	(2, 1)	(0, 0)
	T	(0, 0)	(1, 2)

- Which the following description is wrong?
- A. There are 3 Nash equilibria.
 B. In the mixed-strategy Nash equilibrium, all players get less than 1.
 C. If player 1 moves first, (2, 1) can be the Nash equilibrium payoff.
 D. If player 2 moves first, (2, 1) cannot be a Nash equilibrium payoff.

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10. Regarding the “tragedy of the commons,” which statement is incorrect?
- Rivalry in the use of the resource is the main cause of the problem.
 - It is an example of the prisoner’s dilemma.
 - Limiting access to the common resource can alleviate the problem.
 - The government may use a cap-and-trade policy to address the problem.
11. In the base year, consumers buy mostly beef. In the current year, beef prices rise sharply, so consumers switch to chicken (which did not rise in price). Assume the CPI is calculated using a fixed basket, while GDP deflator uses current quantities. Which statement is MOST likely true?
- CPI and GDP deflator both overstate inflation equally.
 - CPI overstates inflation more than GDP deflator.
 - GDP deflator overstates inflation more than CPI.
 - Both CPI and GDP deflator correctly measure inflation.
12. A country imports most of its consumer electronics. Due to a global chip shortage, import prices of electronics rise by 30%, while domestically produced goods barely change in price. No major change occurs in quantities produced. What happens?
- CPI rises significantly; GDP deflator rises little.
 - GDP deflator rises significantly; CPI rises little.
 - Both rise significantly.
 - Neither rises significantly.
13. In the simple Keynesian cross model with exogenous investment, the government requires households to deposit part of their income into restricted mutual-fund accounts for their children, and these funds are not used to finance any current domestic physical investment (they are held purely as financial assets for future use). What happens to current output?
- Current output rises because higher saving leads to higher investment.
 - Current output falls because consumption decreases and investment is exogenous.
 - Current output does not change because only government spending matters.
 - Current output rises because mutual-fund purchases count as investment in GDP.
14. U.S. inflation this year is 5%, and Taiwan’s inflation is 2%. Assume relative PPP holds, so the real exchange rate remains constant. What should happen to the nominal exchange rate? Let the exchange rate be quoted as NT dollars per U.S. dollar (NTD/USD).
- NTD/USD should rise by about 3%.
 - NTD/USD should fall by about 3%.
 - NTD/USD should not change.
 - The direction cannot be determined.

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15. Consider a small open economy with free capital mobility and a floating exchange rate. If the government increases its budget deficit (holding everything else constant), what is the most likely effect on the interest rate, net capital flows, and the real exchange rate?

- A. Domestic interest rate rises; capital inflow increases; domestic currency appreciates.
- B. Domestic interest rate rises; capital outflow increases; domestic currency depreciates.
- C. Domestic interest rate remains unchanged; capital inflow increases; domestic currency appreciates.
- D. Domestic interest rate remains unchanged; capital outflow increases; domestic currency depreciates.

16. Which of the following definitions is correct?

- A. Labor force = number of employed.
- B. Labor force = population - number of unemployed.
- C. Unemployment Rate = (number of unemployed ÷ adult population) × 100.
- D. Unemployment Rate = (number of unemployed ÷ [number of employed + number of unemployed]) × 100.

17. People will want to hold more money if the price level

- A. or the interest rate increases.
- B. or the interest rate decreases.
- C. increases or the interest rate decreases.
- D. decreases or the interest rate increases.

18. The Fisher equation states the long-run relationship between nominal interest rate, real interest rate, and the inflation rate. Suppose that the Fisher equation holds and that monetary policy is neutral in the sense that it has no impact on the real interest rate in the long run. Then given that the real interest rate is fixed over time, if the central bank increases the nominal interest rate target, how will the inflation rate respond in the long run?

- A. Increase
- B. Decrease
- C. Unchanged
- D. Uncertain

19. An increase in expected inflation shifts

- A. the long-run Phillips curve right.
- B. the short-run Phillips curve right.
- C. neither the short-run nor long-run Phillips curve right.
- D. both the short-run and long-run Phillips curve right.

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20. If the Fed conducts open-market operations and sells short-term government bonds, the money supply

- A. increases and aggregate demand shifts right.
- B. increases and aggregate demand shifts left.
- C. decreases and aggregate demand shifts right.
- D. decreases and aggregate demand shifts left.

II. Problems and Short-essay Questions

1. Suppose that the inverse demand function is $p = 10 - Q$ and the inverse supply function is $p = 1 + 2Q$.

- a. (8 points) Calculate the incidence of a specific tax of \$1 per unit falling on consumers.
- b. (8 points) What are the corresponding price elasticities of demand and supply in the pre-tax equilibrium?
- c. (4 points) Now suppose that the inverse demand function is given by $p = 10 - bQ$ and the inverse supply function is $p = 1 + dQ$. Calculate the incidence of a specific tax of \$1 per unit falling on consumers as a function of b and d .

2. A monopolist firm has two identical factories, 1 and 2. Each factory has cost q_i^2 , where q_i stands for factory i 's output, $i = 1, 2$. If a factory produces any positive output, the firm must pay a fixed tax of \$2 for that factory. Let total output be $Q = q_1 + q_2$.

- a. (10 points) What is the cost function of the firm?
- b. (10 points) Suppose the firm can identify two isolated markets, A and B , with demand functions

$$P_A = 5 - Q_A,$$

$$P_B = 5 - \frac{1}{2}Q_B.$$

Please calculate the equilibrium price and quantity in each market.

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3. Consider an open economy described by the following equations:

$$Y = C + I + G + NX$$

$$C = 180 + 0.65(Y - T)$$

$$I = 350 - 40r$$

$$G = 200$$

$$T = 150$$

$$NX = 120 - 0.1Y + 15q$$

where Y is GDP, C is consumption, I is investment, G is government purchases, T is taxes, r is the interest rate, NX is net exports, and q is the real exchange rate (an increase in q means a depreciation). Suppose the full-employment level of GDP is $Y^* = 2000$.

a. (10 points) Suppose the central bank keeps the interest rate fixed at $r = 4$ and the real exchange rate is $q = 1$. Solve for equilibrium GDP. Is the economy above or below full employment? Please show your calculation.

b. (5 points) Assuming no change in monetary or exchange-rate policy, by how much would GDP have to change to restore full employment? Please show your calculation.

c. (5 points) Instead, suppose fiscal policy does not change. What change in the real exchange rate q would be required to restore full employment (interpret your result as appreciation or depreciation)? Please show your calculation.

4. Suppose that an economy has the Phillips curve

$$\pi_t = \pi_{t-1} - 0.5(u_t - 0.04)$$

where π_t is the inflation rate at time t and u_t is the unemployment rate at time t .

a. (3 points) What is the natural rate of unemployment? Briefly explain your answer.

b. (7 points) Graph the short-run and long-run relationships between inflation and unemployment implied by this Phillips curve. Clearly label: (i) the horizontal axis, (ii) the vertical axis, and (iii) the point at which the short-run Phillips curve intersects the long-run Phillips curve.

c. (5 points) Compute the sacrifice ratio in this economy. Clearly explain your calculations.

d. (5 points) Suppose the current inflation rate is 10 percent. The central bank aims to reduce inflation to 5 percent. How much cyclical unemployment is necessary to achieve this reduction in inflation? Clearly explain your calculations.

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● 個案：路易莎的特色與困境

走進路易莎咖啡門市總是客滿狀態，人人安靜使用自己的筆電、看書或輕聲細語進行讀書會，因此不少人戲稱路易莎為「K書中心」，忍不住好奇店家的獲利模式。路易莎創辦人黃銘賢董事長突破「翻桌率」思維巢臼，認為外帶及外送才是業績主力，而且店內客重複消費也能拉高消費總價，甚至樂觀認為「K書中心」形象反而墊高了路易莎的品牌價值，讓這裡成為「文青集散地」……其實路易莎一開始也是常見的外帶咖啡店、規模小、座位少，直到當初將原為「起家厝」的烘豆廠房改為輔大烘豆概念店時，偌大的營業空間卻一整天等不到客人，只好想出設置插座的服務，吸引輔大學生走入路易莎消費，想不到從此為路易莎帶來差異化服務……。誠如眾人好奇，餐飲店講求的不就是翻桌率，學生來一整天只點一杯飲料，路易莎怎麼賺錢？黃銘賢說明他的「插座理論」：定價太高的咖啡店會造成一整桌客人只點1杯咖啡，而平價速食店常被單人霸占4人座，座位的效益都不高，反觀路易莎設計了插座之後，消費者自然「一個蘿蔔一個坑」，點了一杯飲料後，彼此會有默契地把插座座位坐好坐滿，尤其遇到期中、期末考週，路易莎店內更是一位難求。

創辦人黃明賢觀察到，路易莎消費者有時段性，早餐有早餐的客群，若打算坐一整天也會因為價格合理而點上2杯飲料，中午懶得外出用餐會直接點輕食，下午再來一份甜點，累計下來的消費額也很可觀。他指出，限時或低消制對單店經營的咖啡店業者來說，確實有助提高營收，但不適用於連鎖店，因為主打外帶外送的路易莎，平時接一張訂單就直接超越現場座位的營業額，所以座位對路易莎來說其實是附加價值，不需要追求翻桌率，主打平價親民的形象。……

然而，疫情期間大舉展店的路易莎，門市數量已經突破600家，超越第二名星巴克的550家，但是2023年的年營收：星巴克台灣事業體營收逾150億元，而路易莎只有約24億元。「如何維持平價親民的特色，同時又能增加營收以突破困境？」成為路易莎難以迴避的管理挑戰。

取自《ET Today 財經雲》ET專訪／全台最賺錢的門市竟在校園內！路易莎意外成「護國神山」神隊友

備

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● 問題：每題佔(20%)

- 1 路易莎要如何利用已經建立的「K 書中心」形象來作為企業的資產，以創新的商業模式（事業經營範圍＋獲利模式）來增加營收呢？
- 2 承上題，為了要落實您所建議的創新商業模式，路易莎需要研發出什麼新科技嗎？還是需要取得什麼新的資源（不動產、無形資產、合作契約、專業人才.....）？還是需要跟那些廠商或組織合作？
- 3 承上題，為了要落實您所建議的創新商業模式，路易莎需要取得的新資源中有哪些可以申請專利？商標？著作權？或營業秘密？
- 4 如果路易莎想要打破「K 書中心」的形象、拓展出新的定位，您會建議路易莎推出哪些創新的產品與服務呢？其他競爭者是否能夠快速地模仿而推出類似的產品與服務呢？或，為什麼這些創新的產品與服務是路易莎可以做得比其他競爭者更好的呢？
- 5 您為何要來政治大學商學院學習科技管理與智慧財產權呢？
您預期在這裡學哪些知識與能力？
這些知識與能力跟您在大學所習得的能力可以如何整合？
您在具備這種整合的能力之後，期待未來能從事什麼樣的工作？

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