

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(二) 第二節
以下各題, 每大題 10 分, 共 100 分。請以藍(黑)筆依序作答, 並寫明計算程序, 無過程 0 分計算					
1. (1) 試求 $\lim_{x \rightarrow 0} \frac{\sin 2x - 2x}{x^3} = ?$					
(2) 試求 $\int_{-\frac{\pi}{2}}^{\frac{3\pi}{2}}  \cos x  dx = ?$					
2. 試求 $\iiint_E \frac{z^2}{\sqrt{x^2 + y^2 + z^2}} dV = ?$ 其中 $E = \{(x, y, z)   1 \leq x^2 + y^2 + z^2 \leq 9, z \geq 0\}$ 。					
3. 試求 $\int_0^{\sqrt{3}} \int_{\sqrt{4-y^2}}^{\sqrt{16-y^2}} e^{x^2+y^2} dx dy + \int_{\sqrt{3}}^{2\sqrt{3}} \int_{\frac{y}{\sqrt{3}}}^{\sqrt{16-y^2}} e^{x^2+y^2} dx dy = ?$					
4. 設 $a, b$ 為實數, $f(x)$ 為 5 次實係數多項式且最高次項係數 $a$ , 若 $f(x)$ 滿足 $\int_b^x f(t) dt = 4(x^2 + 2x + 2)^3 - 4$ , 試求數對 $(a, b) = ?$					
5. 試解微分方程式 $\frac{dy}{dx} + \frac{y}{x} = e^{4x}$					
6. 設 $f(x) = \frac{1+x^2}{1+x^4}$ , $x > 0$ , 試求 $\int f(x) dx = ?$ (Hint: 令 $t = x - x^{-1}$ , $x > 0$ )					
7. 設某樂園的遊園車, 非假日時每 10 分鐘一班。設等車時間以 $X$ 表示, 則 $X$ 為一連續隨機變數。試回答下列問題:					
(1) 試寫出其機率密度函數, 並求出等遊園車不超過 4 分鐘的機率為何? (4 分)					
(2) 試求出等待遊園車的平均時間為何? (3 分)					
(3) 試求出等待遊園車的變異數為何? (3 分)					
8. 已知某產品的供給函數為 $p = S(x) = 0.06x^2 + 4$ , 試求當產品的單位價格為 58 元時的生產者剩餘的值為何?					
9. 某國家疫後的生產函數為 $z = f(x, y) = 60x^{\frac{1}{3}}y^{\frac{2}{3}}$ 。 [ $x$ 表示勞力財(labor), $y$ 表示資本財(capital)]。若勞力財增加 2%, 且資本財增加 1%, 則百分變化(percentage change) $\frac{\Delta z}{z} = ?$					
10. 設某一電信公司預估明年在 A 區的光纖網路新客戶數 $X$ (單位: 千戶) 與 B 區的新客戶數 $Y$ (單位: 千戶) 在 $D = \{(x, y)   0 \leq x \leq 5, 0 \leq y \leq 4\}$ 上的機率密度函數為					
$f(x, y) = \frac{9}{4000} xy\sqrt{25-x^2}(4-y)$ 。試求明年 A 區的新客戶數介於 3000 與 4000 戶, B 區的新客戶數介於 1000 與 2000 戶的機率為何?					
備註	一、作答於試題上者, 不予計分。 二、試題請隨卷繳交。				

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### Multiple Choice (1 point each)

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

- A consumer's utility function is  $U(x, y, z) = 5y + \min\{x, 2z\}$ . Now, at  $p_x = 1, p_y = 5$ , and  $p_z = 2$ , which of the following descriptions is correct as  $p_z$  marginally decreases.
  - The income effect increases the consumption of  $y$ .
  - There is no substitution effect.
  - There is no income effect.
  - The substitution effect increases the consumption of  $z$ .
- Suppose a consumer with a monotonic preference consumes only two goods. Then,
  - both goods need to be normal goods.
  - two goods are substitutes for each other.
  - if she has a downward sloping demand on one good, so as on another good.
  - None of the above is correct.
- Ann's preferences can be represented by the utility function  $U(x, y) = (x - 3)^2 + (y - 4)^2$ , then which of following is correct?
  - Her preference is convex.
  - Her preference is monotonic.
  - Commodity  $x$  is a "bad" for Ann.
  - If Ann has 10 dollars and  $p_x = p_y = 1$ , then Ann will consume  $x = y = 5$ .
- Consider a monopolistic competition market with a limited number of licenses that can be traded. In the long run, which of the following statements is incorrect?
  - All firms in the market earn zero profit.
  - Some firms have incentives to sell their licenses.
  - The potential entry firms will be indifferent between entering the market or not.
  - All firms produce at a quantity with decreasing average cost.
- Consider a market with demand,  $Q_D = 200 - 5P$  and supply,  $Q_S = 5P - 75$ . The production process causes pollution for the environment as a negative external cost per unit is represented as  $E_C = Q_S/5 + 10$ . If the government plans to levy a Pigouvian ad valorem tax, which of the following is the correct tax rate?
  - 45%
  - 66%
  - 75%
  - 100%

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註

- 作答於試題上者，不予計分。
- 試題請隨卷繳交。

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6. What is the producer surplus of the monopoly when it conducts perfect price discrimination, given the demand function and marginal cost as  $Q = 10 - P$  and  $MC = 5$ , respectively?

- A. 3.125
- B. 6.25
- C. 12.5
- D. 25

7. Among the following total cost functions of firms in a perfectly competitive market, which one has a meaningful shutdown point ( $Q_{shutdown} > 0$ )?

- A.  $5Q^3 + 20Q^2 + 50Q + 100$
- B.  $5Q^3 - 20Q^2 + 50Q + 100$
- C.  $5Q^3 + 20Q^2 + 50Q - 400$
- D.  $5Q^3 + 2Q^2 - 100Q + 100$

8. The long-run total cost function of a firm in a monopolistic competitive market is  $TC(Q) = 7700Q - 100Q^2 + 1/3Q^3$ . Which of the following represents a possible long-run equilibrium price and output?

- A.  $(P, Q) = (100, 100)$
- B.  $(P, Q) = (200, 150)$
- C.  $(P, Q) = (500, 120)$
- D.  $(P, Q) = (500, 180)$

9.

		Player 2		
		A	B	C
Player 1	A	(1,2)	(2,1)	(1,0)
	B	(0,5)	(1,2)	(7,4)
	C	(-1,1)	(3,X)	(2,2)

Which of the following values of  $X$  yields the above game exactly two pure strategy Nash equilibria?

- A. 0
- B. 1
- C. 1.5
- D. 3

10. Suppose a market has the following well-defined market supply curve:  $Q = P + 3$ . The market structure of this market could be:

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- (i) Perfect competition.  
(ii) Monopolistic competition.  
(iii) Monopoly.  
(iv) Oligopoly.  
A. (i) only  
B. (ii) and (iii)  
C. (ii), (iii), and (iv)  
D. (i), (ii), (iii), and (iv)
11. Suppose Iran has a comparative advantage over other countries in producing pistachios, but other countries have an absolute advantage over Iran in producing pistachios. If trade in pistachios is allowed, Iran  
A. will import pistachios.  
B. will export pistachios.  
C. will have nothing to gain either from exporting or importing pistachios.  
D. will either import or export pistachios, but it is not clear from the given information.
12. In the United States, the CPI was 100 in 1983 and is 250 in 2018, then \$100 in 2018 purchases the same amount of goods and services as  
A. \$25 purchased in 1983.  
B. \$40 purchased in 1983.  
C. \$100 purchased in 1983.  
D. \$250 purchased in 1983.
13. Seeing a looming credit crunch, banks choose to hold more excess reserves relative to their deposits. This action  
A. does not change the money multiplier, but increase the money supply.  
B. does not change the money multiplier, but decrease the money supply.  
C. increases the money multiplier, and increase the money supply.  
D. decreases the money multiplier, and decrease the money supply.
14. Suppose the inflation rate is high, but unemployment is at its natural rate. If the central bank pursues a contractionary monetary policy, which of the following results would be expected in the short run?  
A. The short-run Phillips curve would shift to the left.  
B. The short-run Phillips curve would shift to the right.  
C. The economy would move up and to the left along a given short-run Phillips curve.  
D. The economy would move down and to the right along a given short-run Phillips curve.

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15. Which of the following would transfer wealth from old to young?
- Increases in the budget deficit
  - Increases in housing prices
  - More generous education subsidies
  - Indexation of Social Security benefits to inflation
16. Which of the following results in higher inflation and higher unemployment in the short run?
- The Fed institutes an interest rate cut.
  - The Fed raises interest rates.
  - The price of oil increases.
  - All of the above.
17. Other things being equal, as the price level of a country increases,
- its real value of money falls and its currency appreciates.
  - its real value of money rises and its currency appreciates.
  - its real value of money falls and its currency depreciates.
  - its real value of money rises and its currency depreciates.
18. Which of the following shifts both the long-run aggregate supply curve and the short-run aggregate supply curve?
- a change in the price level
  - a change in the money wage rate
  - an advance in technology
  - All of the above.
19. If the price level is constant and the slope of the aggregate expenditure curve in the Keynesian model is 0.75, a decrease in investment of \$100 leads to a(n) \_\_\_\_\_ in real GDP of \_\_\_\_\_.
- decrease; \$75.
  - increase; \$75.
  - increase; \$400.
  - decrease; \$400.
20. Suppose the economy is experiencing an unanticipated event. Real borrowing costs rise for debtors due to the occurrence of this event. What kind of event might it be and what kind of action could the Fed take to help the debtors?
- An unexpected fall in price; increase the money supply.
  - An unexpected fall in price; decrease the money supply.
  - An unexpected rise in price; decrease the money supply.
  - An unexpected rise in price; increase the money supply.

備

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### Problems and Short-essay Questions

1. David consumes two goods: pencils ( $x_1$ ) and erasers ( $x_2$ ). The price of a pencil is  $P_1$  while the price for an eraser is  $P_2$ . David has  $m$  dollars. David's utility function is

$$u(x_1, x_2) = \min\{6x_1 + x_2, x_1 + 2x_2\}.$$

- (7 points) Calculate the marginal rate of substitution ( $\frac{dx_2}{dx_1}$ ) for David.
- (7 points) What are David's demand functions in terms of  $P_1$ ,  $P_2$ , and  $m$ .
- (6 points) Suppose  $P_1 = 2$ ,  $P_2 = 4$ , and  $m = 40$ . Moreover, if one buys 10 pencils or more, he will get 5 erasers for free. What is David's optimal choice now?

2. A perfectly competitive market in a small country has 50 identical firms. Suppose the market demand function is  $P = 130 - Q$  and the supply curve of a firm is  $P = -50 + 50q$ , where  $P$  is the market price,  $Q$  is the market quantity supplied, and  $q$  is a firm's quantity supplied. Please answer the following questions in detail:

- (5 points) What is the market supply curve?
- (5 points) What is the market equilibrium under autarky?
- (10 points) Suppose the world price of the market product is 30, and the small country is currently under free trade. What level of import tariff should the government impose to make consumer surplus equal to 4512.5?

3. Below are some data from the land of milk and honey.

Year	Price of Milk	Quantity of Milk	Price of Honey	Quantity of Honey
2020	7	10	2	15
2021	5	17	5	3
2022	4	30	6	6

- (6 points) Compute the percentage change in nominal GDP between 2020 and 2022.
- (8 points) Suppose the government adopts the fixed-based approach to measure the real GDP by setting 2020 as the base year. What is the cumulative real GDP growth rate between 2020 and 2022?
- (6 points) Suppose the government adopts the chain-linked approach to measure the real GDP. What is the cumulative real GDP growth rate between 2020 and 2022?

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4. Suppose the nominal exchange rate between the dollar and the euro is 2 euros per dollar. Answer the following questions.

a. (5 points) The price of a book in Europe is 20 euros. If the purchasing power parity holds, how much will the same book cost in the United States?

b. (10 points) If the price level in the U.S. is 120 and the price level in Europe is 150, what is the real exchange rate in terms of European goods per U.S. good? By how much is the Euro undervalued or overvalued than predicted by the purchasing-power parity?

c. (5 points) If the nominal exchange rate between the dollar and the euro becomes 1.5 euros per dollar, what will happen to U.S. net capital outflow?



備註

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考試科目	管理個案分析	系所別	科智所	考試時間	2月6日(二)第2節
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● 個案：讓蘋果手錶停售、飛利浦敗訴！神秘醫療廠憑什麼撼動大鯨魚？

就在2023年末銷售旺季，年銷售量逾5,300萬支的蘋果手錶（Apple Watch）卻因侵權疑慮，遭到美國國際貿易委員會勒令停售 Series 9 與 Ultra 2 兩款產品。雖然禁售令一時喊停，但該禁令一旦落實，分析師估計，將會使蘋果營收損失從3億美元（約合新台幣92億元）起跳。但膽敢向蘋果提出此侵權申訴的，不過是一家名不見經傳的醫療公司瑪西莫

（Masimo）。市值約60億美元的它，憑什麼讓市值3兆美元的蘋果重摔一跤？

今年60歲的瑪西莫執行長基亞尼（Joe Kiani），9歲從伊朗移民美國，取得聖地牙哥州立大學電子工程碩士後，首份工作就和血氧監測儀有關。當年他在技術顯現的堅持和硬底子，讓這位蘋果高層口中「醫療界的賈伯斯」，屢屢打贏侵權官司，更為瑪西莫帶進龐大收入。早在1970年代以前，要測量血氧濃度，須用針頭抽血。直到任職醫療設備商日本光電的青柳卓雄發現，只要偵測心臟跳動，就能準確測量血氧濃度。根據此概念，日本另一家企業美能達（Minolta）推出了全球第一款指尖型血氧儀。但直到史丹佛大學麻醉醫師紐爾（William New）創立了尼爾寇（Nellcor）之後，指尖型血氧儀才真正為臨床所用，該公司更一度拿下美國9成市占，躋身血氧儀全球第一大廠。

原本，基亞尼只須將研發的技術，出售給尼爾寇就好，「當時這筆錢就足以讓他退休，」基亞尼的律師詹森（Steve Jensen）向《華爾街日報》透露。但尼爾寇不願立刻將技術導入產品，讓基亞尼下定決心，要自行生產獨家血氧儀。如今，瑪西莫在美國血氧儀市占已超越尼爾寇，形成兩強獨大局面。而瑪西莫的第1場專利戰發生在1999年，提告對象就是尼爾寇。尼爾寇的專家證人無法解釋產品如何運作，也排除不了侵權疑慮，最終在2005年9月敗訴，隔年開始支付損害賠償和特許權使用費，最終金額接近8億美元。

瑪西莫在2009年的第2場專利戰，就升級槓上荷蘭巨擘飛利浦（Philips），焦點仍是指尖測量血氧、脈搏的專利技術。飛利浦在法庭上強調，發明必須是出乎意料的進步或創新，不然應該受到挑戰。然而，法院認為瑪西莫的發明符合條件，使飛利浦在2014年敗訴，支付3億美元損害賠償，並同意把瑪西莫技術納入產品，最終為瑪西莫帶來共10億美元營收。

第3場專利糾紛，就是此次蘋果之戰。曾任瑪西莫子公司瑟拉寇（Ceracor）技術長的拉米戈（Marcelo Lamego），協同二十多位同事，在2013年帶槍投靠蘋果。當時他寫給蘋果執行長庫克（Tim Cook）的一封電子郵件，引發了蘋果透過人才剽竊瑪西莫技術的疑慮。但彭博揭露，2020年挨告的蘋果對美國法院提出兩大主張：首款Apple Watch在2014年9月宣布推出時，並無血氧偵測功能。且招聘、雇用另一家公司員工，並不構成不正當手段，使陪審團以6比1支持蘋果。

備

註

- 一、作答於試題上者，不予計分。
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不死心的基亞尼，後來在 2021 年改向美國國際貿易委員會投訴，指稱 Apple Watch 功能侵犯其專利，並取得勝利。但蘋果卻輸不起這場仗，雖然 Apple Watch 僅占營收 1 成，卻有毛利、市占雙高優勢。

取自《商業周刊》

● 問題：每題佔(20%)

1 「基亞尼只須將研發的技術，出售給尼爾蔻就好....但尼爾蔻不願立刻將技術導入產品，讓基亞尼下定決心，要自行生產獨家血氧儀。」。科技創新者將技術賣給市場上的大廠，獲利了結，這似乎是對雙方最無風險的一種解決方案。但是尼爾蔻不願「立刻」將技術導入產品，讓基亞尼決定要自行生產獨家血氧儀。請問尼爾蔻在買下這項技術之後，有「哪些合理的理由」不將新技術立刻導入產品呢？

2 如今，瑪西莫在美國血氧儀市占已超越尼爾蔻，還分別對尼爾蔻及飛利浦發起專利侵權訴訟，並贏得賠償及授權使用費。可見，創新者除了努力研發出新科技，也要懂得進行專利的佈局。請問你若是瑪西莫的科技管理者，你會如何去瞭解既有的大廠如尼爾蔻及飛利浦是如何在發展他們現有的科技產品？基於這些瞭解，你會如何研發科技？申請專利？

3 瑪西莫和蘋果的第一個訴訟是關於人才轉移所可能帶來的「營業秘密」洩漏的問題。主管帶領團隊員工集體跳槽的事件在台灣也時有所聞。請問你若是招聘該團隊的公司主管，你要如何避免偷取營業秘密的指控？

4 瑪西莫和蘋果的第二個訴訟是專利訴訟，蘋果雖然有許多專利、有資金有人才，但是面對專精一項產品的瑪西莫似乎無法將其壓服。反而因為蘋果手錶的市佔率與獲利可期，很可能會接受瑪西莫的授權和解條件。請以此例伸論「小蝦米／大鯨魚」「新創小公司／主流大公司」在專利訴訟上的相對優勢與劣勢。

5 政治大學商學院有哪些科技？商學院產生過哪些智慧財產權呢？  
你為何要來這裡學習科技管理與智慧財產權呢？

備註

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