I.　單選題 (40%，每題 2.5 分)
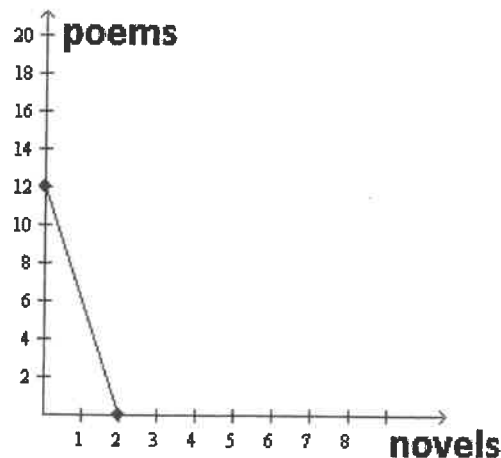
1. Suppose the income of buyers decreases in a market for an inferior good, and technological progress occurs also. What would we expect to happen in the market?
   A. Equilibrium price would decrease, but the impact on equilibrium quantity would be ambiguous.
   B. Equilibrium quantity would increase, but the impact on equilibrium price would be ambiguous.
   C. Equilibrium quantity would decrease, but the impact on equilibrium price would be ambiguous.
   D. None of the above is correct.

Figure 1

Production Possibilities Frontier

2. **Refer to Figure 1.** The opportunity cost of producing 1 novel is
   A. 1/6 poem.　　B. 2 poems.　　C. 6 poems.　　D. 12 poems.

3. If average variable cost is decreasing as output increases, then marginal cost is definitely
   A. increasing as output increases.
   B. decreasing as output increases.
   C. greater than average variable cost.
   D. less than average variable cost.

4. Suppose universities are considering an increase in tuition to enhance revenue. If they feel that raising tuition would enhance revenue, it is
   A. ignoring the law of demand.
   B. assuming that the demand for university education is elastic.
   C. assuming that the demand for university education is inelastic.
   D. assuming that the supply of university education is elastic.
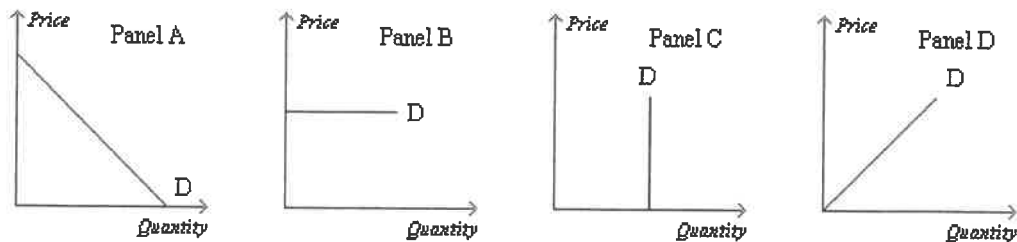
※ 注意：1.考生須在「彌封答案卷」上作答。
　　　　 2.本試題紙空白部份可當稿紙使用，試題須隨答案卷繳回。
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Figure 2

5. **Refer to Figure 2.** Which of the following statements is correct?

   A. Panel C represents the typical demand curve for a perfectly competitive firm, and Panel B represents the typical demand curve for a monopoly.

   B. Panel B represents the typical demand curve for a perfectly competitive firm, and Panel A represents the typical demand curve for a monopoly.

   C. Panel A represents the typical demand curve for a perfectly competitive firm, and Panel C represents the typical demand curve for a monopoly.

   D. Panel C represents the typical demand curve for a perfectly competitive firm, and Panel D represents the typical demand curve for a monopoly.

6. A profit-maximizing firm in a perfectly competitive market can sell its product for $7. At its current level of output, the firm's average total cost is $10. The firm's marginal cost curve crosses its marginal revenue curve at an output level of 9 units. The firm experiences a

   A. profit of more than $27.

   B. profit of exactly $27.

   C. loss of more than $27.

   D. loss of exactly $27.

7. In the short run, for a particular market, there are 5,000 firms. Each firm has a marginal cost of $7 when it produces 200 units of output. One point on the market supply curve is

   A. quantity = 5,000; price = $7.

   B. quantity = 35,000 price = $35,000.

   C. quantity = 1,000,000, price = $7.

   D. quantity = 1,000,000, price = $35,000.

8. Which of the following is true about a monopolistically competitive firm?

   A. It can earn an economic profit in the short run, but not the long run.

   B. It can earn an economic profit in the short run and the long run.

   C. It can earn an economic profit in the long run, but not the short run.

   D. It cannot earn an economic profit in either the short run or long run.

科目：經濟學　　　　　系組：經濟學系　　　　年級：二

9.　If a Taiwanese citizen buys a television made in China by a China firm, then
　　A.　Taiwan's net exports decrease and Taiwan's GDP decreases.
　　B.　Taiwan's net exports are unaffected and Taiwan's GDP decreases.
　　C.　Taiwan's net exports are unaffected and Taiwan's GDP is unaffected.
　　D.　Taiwan's net exports decrease and Taiwan's GDP is unaffected.

10.　Suppose that in a closed economy GDP is equal to 11,000, taxes are equal to 1,000, consumption equals 7,500, and government purchases equal 2,000. What is national saving?
　　A. −1,000　　B. 500　　C. 1,500　　D. 2,500

11.　Tina borrowed $1,000 from David for a year and agreed to repay her $1,050 at the end of the year. If the inflation rate was 3 percent, what is the real interest rate David received?
　　A.　10 percent
　　B.　5 percent
　　C.　3 percent
　　D.　2 percent

12.　The long-run effect of reducing the government budget deficit would be
　　A.　a lower price level with unchanged output
　　B.　a lower price level and a lower level of output
　　C.　a higher price level and a higher level of output
　　D.　a higher price level with unchanged output

13.　Suppose there were a large decline in net exports. If a central bank wanted to stabilize output, it could
　　A.　buy bonds to raise interest rates.
　　B.　buy bonds to lower interest rates.
　　C.　sell bonds to raise interest rates.
　　D.　sell bonds to lower interest rates.

14.　Use AD-AS model to analyze the following events. Which one would raise the equilibrium output in the short run but not in the long run?
　　A.　A recession overseas causes foreigners to buy fewer domestic goods.
　　B.　The stock market turns to recession, which changes consumers' wealth temporarily.
　　C.　The government increases its defense expenditure.
　　D.　A technological improvement raises productivity.

※ 注意：1. 考生須在「彌封答案卷」上作答。
　　　　　2. 本試題紙空白部份可當稿紙使用，試題須隨答案卷繳回。
　　　　　3. 考生於作答時可否使用計算機、法典、字典或其他資料或工具，以簡章之規定為準。

科目：經濟學　　　　　　系組：經濟學系　　　　年級：二

15. Refer to the following table to find the marginal propensity to consume (MPC).

Income	Taxes	Consumption
$1,000	$600	$ 400
2,000	600	1,000
3,000	600	1,600

   A. 0.4

   B. 0.5

   C. 0.6

   D. 0.8

16. Refer to the following table:

Bank of Citi

Assets		Liabilities	
Reserves	$130,000	Deposits	$600,000
Loans	$470,000		

If the required reserve ratio is 10 percent, then what quantity of excess reserves does Bank of Citi now hold?

   A. $13,000

   B. $47,000

   C. $60,000

   D. $70,000

II. 問答題 (60%)

1. (15%) Assume that Japan and China can switch between producing coolers and producing radios at a constant rate. The following table shows the number of coolers or number of radios each country can produce in one day. (須說明每題的理由，無說明者不予計分)

	Output Produced in One Day	
	Coolers	Radios
Japan	12	6
China	24	3

   (1) (5%) Japan's opportunity cost of one cooler is _____

   (2) (5%) Japan has an absolute advantage in the production of _____

   (3) (5%) Japan has a comparative advantage in the production of _____
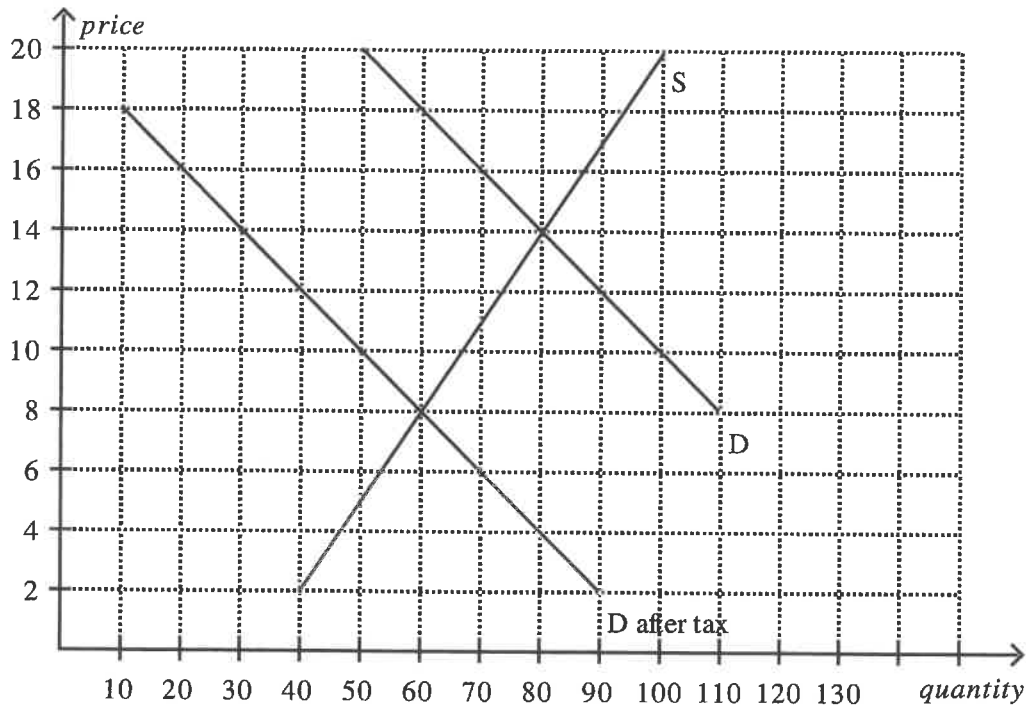
※ 注意：1.考生須在「彌封答案卷」上作答。

    2.本試題紙空白部份可當稿紙使用，試題須隨答案卷繳回。

    3.考生於作答時可否使用計算機、法典、字典或其他資料或工具，以簡章之規定為準。

2. (15%) Using the figure shown below, answer the following questions.

(1) (3%) What is the amount of the tax per unit?

(2) (3%) How much of the tax per unit do sellers pay?

(3) (3%) How much of the price buyers actually pay after tax?

(4) (3%) Compute the **change** of consumer surplus (CS) after tax. [Hint: CS(after tax)−CS(before tax)]

(5) (3%) Compute the deadweight loss after tax.

3. (15%) 假設某國的邊際消費傾向等於 0.8。該國政府正考慮兩種政策：增加 $5 億的政府支出或減 $5 億的稅。試在同一張凱因斯交叉圖上比較這兩種政策，並指出及計算下列問題：

(1) (7%) 兩個政策在第一期對所得的影響分別為多少？

(2) (8%) 哪個政策會產生較高的均衡所得？ (須詳細說明理由)

4. (15%) 近期美國 Fed 採取何種貨幣政策？並說明 Fed 採取此種貨幣政策的原因。試分析此政策對美國的利率、物價以及 GDP 的可能影響。

科目：微積分　　　　　　　　　　系組：經濟系　　　年級：二年級

1. (30 pts) Let $f(x) = \frac{2x}{1+x^2}$.　Please answer the following questions:

(a) Where is f increasing and where is f decreasing?

(b) Where is f concave-up and where is f concave-down?

(c) Find all local maxima and local minima of f.

(d) Find all inflection points of f.

(e) Find all asymptotes of f.

(f) Sketch the graph of f.

2. (20 pts) Use Lagrange's method to find the solution of the following problem:

$$\max_{x,y} (\ln x^k y) + 10$$

s.t. $2x + y = 20$, where k is a positive constant.

3. (50 pts) Compute the following problems:

A.　For $f(x) = \sqrt[3]{x^2 + 2x - 10}$, find $f'(x)$.

B.　For $f(x) = \frac{(1+2x)^{10}(3-x^2)^5(1+x+x^2)^3}{(1+e^x)^2}$, find $f'(x)$.

C.　Compute $\int \frac{x}{1-x^2} dx$.

D.　Compute $\int \ln \sqrt{x}\, dx$.

E.　Compute $\lim_{x\to\infty}(1 - \frac{2}{x})^x$.

F.　Compute $\lim_{x\to\infty} \frac{e^{2x}}{\ln x^{100}}$.

G.　For $f(x,y) = x^2 y + y^{10} + x^2 e^{2y}$, find ∇f.

H.　Compute $\int_{-2}^{\infty} \frac{1}{x^2} dx$.

I.　For $x^2 + xy - 2y = 5$, find $\frac{dy}{dx}$.

J.　Compute $\int_0^2 \int_y^1 xy\, dxdy$.

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　　　　　3. 考生於作答時可否使用計算機、法典、字典或其他資料或工具，以簡章之規定為準。

1. 一個經濟體系存在 50 個相同的(identical)消費者與 20 家相同的廠商，消費者的效用函數與預算限制式分別為 $u(x,m) = 16x - x^2 + 2m$ 與 $Px + m = 100$，x 與 m 分別為個人商品需求量與貨幣數量，P 為商品價格。廠商的成本數為 $c(x) = x + 0.5x^2$，x 為個別廠商的商品供給量，市場的數量為 X，

   (1)求算個人的需求函數、市場的需求函數；(5%)
   (2)求算個別廠商的供給函數、市場的供給函數；(5%)
   (3)求算市場均衡價格、市場均衡的需求彈性。(5%)

2. 獨占廠商於 A、B 兩市場的需求函數分別為 $P_A = 60 - q_A$ 及 $P_B = 30 - 2q_B$，成本函數為 $C(q) = 10q$，$q = q_A + q_B$，
   (1)採單一訂價，利潤極大下的價格、兩市場的銷售量、廠商的利潤各為多少？(12%)
   (2)採差別訂價，利潤極大下兩市場的價格、銷售量各為多少？(8%)

3. (1)廠商的生產函數 $Q = L^2 \times \sqrt{K}$，Q 為產量，L 為勞動，其價格 $w = 4$，K 為資本，其價格 $r = 1$，求算廠商的長期成本 LTC；(9%)
   (2)承(1)題，產量 $Q = 32$ 時，廠商最適的 L、K 與 LTC 各為多少？(6%)

4. (1)請說明何謂「節儉的矛盾」？並以經濟邏輯說明該現象發生的原因；(10%)
   (2)所得稅與定額稅，何種稅制比較「不易」發生節儉的矛盾？為什麼？(5%)

5. 引進預期的 Phillips 曲線 $\pi = \lambda(0.08 - u) + \pi^e$，政府的效用函數 $\Omega = -u - \theta\pi^2$，式中 π 為通貨膨脹率，π^e 為預期通貨膨脹率，u 為失業率，$\lambda > 0$，$\theta > 0$，央行宣告維持 $\pi = 0$，
   (1)求算權衡均衡最適的 π，並說明此時任命保守的央行官員可降低 π；(6%)
   (2)$\lambda = 1$、$\theta = 25$，法則均衡、權衡均衡、時序不一致的 Ω 分別為多少？(9%)

6. (1)生產函數 $Y = 3\sqrt{KN}$，Y 為產出，K 為資本，N 為勞動，人口成長率 $= \dot{N}/N = 1\%$，折舊率 $= 5\%$，儲蓄率 $= 40\%$，根據以上模型寫出 Solow 成長模型的基本累積方程式，並求解靜止均衡的每人資本 $k = K/N$、黃金律的每人資本、黃金律的儲蓄率各為多少？(16%)
   (2)承(1)題，靜止均衡的每人產出成長率與經濟成長率分別為多少？為什麼？(4%)

請計算到小數點第 3 位, 由第 4 位四捨五入

(1) (24%) 新冠疫情帶動宅經濟發燒, 許多民眾改用外送服務購買餐點。美食外送平台業者公布外送訂單量年增達 4 倍, 顯見疫情正逐漸改變人們生活與消費的方式。若想進一步知道疫情下外送員收入的情形, 比較 F 外送平台與 U 外送平台的外送員每月薪資(單位: 萬元) 的差異, 抽查的結果如下

F 外送平台	$n_1 = 81$	$\bar{X}_1 = 8.8$	$S_1 = 1.5$
U 外送平台	$n_2 = 91$	$\bar{X}_2 = 9.5$	$S_2 = 3.25$

(a) (8%) 檢定兩外送平台外送員每月薪資的變異數是否相同 $(\alpha = 0.1)$?

(b) (8%) 給定 $\alpha = 0.04$, 檢定兩外送平台外送員平均月薪資有無差異?

(c) (8%) 假設在 $\alpha = 0.05$ 與對立假設兩外送平台外送員平均月薪資差為 0.5 萬元, 請計算「檢定力」(power).

$F(0.05, 79, 89) = 1.432$, $F(0.95, 79, 89) = 0.695$, $F(0.1, 79, 89) = 1.323$,
$F(0.9, 79, 89) = 0.753$ $F(0.05, 80, 90) = 1.429$, $F(0.95, 80, 90) = 0.697$,
$F(0.1, 80, 90) = 1.321$, $F(0.9, 80, 90) = 0.755$ $F(0.05, 81, 91) = 1.426$,
$F(0.95, 81, 91) = 0.698$, $F(0.1, 81, 91) = 1.318$, $F(0.9, 81, 91) = 0.756$

(2) (21%) 續(1), F 外送平台想要研究會員每月在不同餐飲類型 (米其林餐點, 傳統小吃, 速食) 與會員月收入 (3 萬元以下, 3 萬元 - 7萬元, 7 萬元以上) 的購買金額狀況(單位: 萬元), 進行變異數分析得結果如下:

ANOVA	SS	df	MS	F	P-value
餐飲類型	110.889	B	C	11.695	0.001
會員收入	A	D	114.333	E	0.001
交互	F	G	H	1.043	0.413
隨機	85.333	18	4.741		
總和	I	26			

(a) (9%) 請完成 $A - I$.

(b) (4%) 請問會員收入對購買金額有無顯著差異$(\alpha = 0.05)$?

(c) (4%) 請問餐飲類型對購買金額有無顯著差異$(\alpha = 0.05)$?

(d) (4%) 請問會員收入與餐飲類型對購買金額有無顯著交互效果$(\alpha = 0.05)$?

(3) (28%) 續(1)，F 外送平台想要研究每週營業額(萬元) 與折扣運費次數的關係. 令 x 為折扣運費次數，y 為每週營業額.

$$\sum_{i=1}^{20} y_i = 675, \sum_{i=1}^{20} x_i = 88, \sum_{i=1}^{20} (y_i - \bar{y})^2 = 1387.75,$$

$$\sum_{i=1}^{20} y_i^2 = 24169, \sum_{i=1}^{20} x_i^2 = 426, \sum_{i=1}^{20} (y_i - \hat{y}_i)^2 = 59.683,$$

$$\sum_{i=1}^{20} (x_i - \bar{x})(y_i - \bar{y}) = 227.$$

,

	coefficient	standard error	t-statistic	P-value
intercept	A	1.349	C	1.287E-05
slope	B	0.292	D	9.521E-14

(a) (8%) Use OLS method to estimate the unknown parameters (calculate A and B).

(b) (8%) Test the significance of coefficients (calculate C and D)($\alpha = 0.01$).

(c) (6%) Explain the estimated coefficients.

(d) (6%) Calculate the determination of coefficient and explain the value.

(4) (27%) 輔仁醫院於 2017 年 9 月完工啟用，校方對醫院作了規劃並委託同學做實地訪查，欲調查輔醫櫃台現場掛號的情況。同學隨機觀察每 5 分鐘到輔醫櫃台掛號的人數，觀察了 10 次，人數分別是 18、22、25、17、27、15、22、24、24、14。

(a) (8%) 請用最大概似法 MLE(maximum likelihood estimation) 求一段時間到輔醫櫃台掛號人數機率分配之期望值的估計式。

(b) (8%) 請用動差法 (method of moment) 求一段時間到輔醫櫃台掛號人數機率分配之期望值的估計式。

(c) (6%) 續(b)，動差估計式是否具不偏性及一致性？

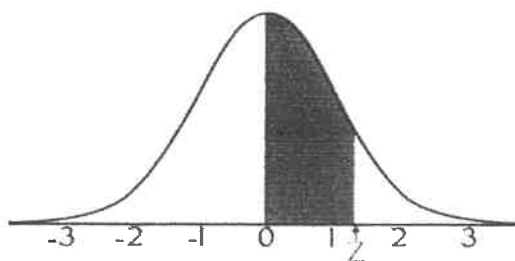(d) (5%) 求 30 分鐘內有 100 人到輔醫櫃台掛號的機率。

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STANDARD NORMAL TABLE (Z)

Entries in the table give the area under the curve between the mean and z standard deviations above the mean. For example, for $z = 1.25$ the area under the curve between the mean (0) and z is 0.3944.

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0190	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2969	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3513	0.3554	0.3577	0.3529	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998

※ 注意：1. 考生須在「彌封答案卷」上作答。

　　　　2. 本試題紙空白部份可當稿紙使用，試題須隨答案卷繳回。

　　　　3. 考生於作答時可否使用計算機、法典、字典或其他資料或工具，以簡章之規定為準。