

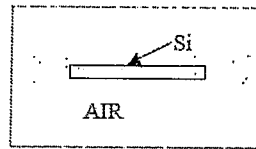
國立中山大學 105 學年度碩士暨碩士專班招生考試試題

科目名稱：基礎熱傳學【機電系碩士班甲組】

題號：438003

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（問答申論題） 共 2 頁第 1 頁

1. (20%) A silicon wafer is heated at a temperature T_H and now cooled in a closed air box initially at a temperature T_L and pressure P_0 . The box made by steel has the same initial temperature T_L . Assume that you know the mass of the wafer (m_w), the mass of the steel box (m_b) and the internal volume of the steel box (V_b). There is no heat transfer crossing the box. The specific heats for the silicon wafer, air and steel box are $c_{p,si}$, $c_{p,a}$ and $c_{p,st}$ at the average temperature between T_H and T_L . You are asked to derive the final temperature for the silicon wafer following the questions below:



(a) (4%) What is the mass of air?

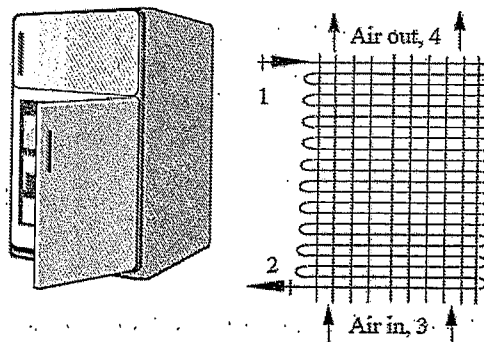
(b) (12%) The first law of thermodynamics for transient processes is listed below:

$$\dot{Q}_{1-2} - \dot{W}_{1-2} + \sum \dot{m}_i h_i - \sum \dot{m}_o h_o = \dot{m}_2 \left(u_2 + \frac{1}{2} V_2^2 + gZ_2 \right) - \dot{m}_1 \left(u_1 + \frac{1}{2} V_1^2 + gZ_1 \right) \quad (\text{Eq. 1.1})$$

\dot{Q}_{1-2} and \dot{W}_{1-2} are heat transfer into the system and work done by the system during the transient process from state 1 to 2. \dot{m} and h are the mass flow rate and enthalpy. The subscript i and o represent for inlet and outlet of the system. u , V , and Z represent the internal energy, velocity, and elevation. How do you simplify Equation 1.1 to analyze the problem?

(c) (4%) What is the final temperature for the silicon wafer?

2. (20%) A condenser in a refrigerator receives a flow of R-410a at $P_{1,Ref}$ and $T_{1,Ref}$ which is cooled by kitchen air coming in at $T_{in,air}$ so the R-410a leaves as saturated liquid at $T_{2,Ref}$ and air leaves at $T_{out,air}$. If the mass flow rate of R-410a is \dot{m}_R , you are asked to determine the air mass flow rate (\dot{m}_a)? Assume that you know the enthalpies at inlet 1 and outlet 2 are $h_{1,Ref}$ and $h_{2,Ref}$.



(a) (10%) How do you simplify Eq. 1.1 to analyze the problem?

(b) (10%) How much is \dot{m}_a required?

國立中山大學 105 學年度碩士暨碩士專班招生考試試題

科目名稱：基礎熱傳學【機電系碩士班甲組】

題號：438003

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（問答申論題） 共 2 頁第 2 頁

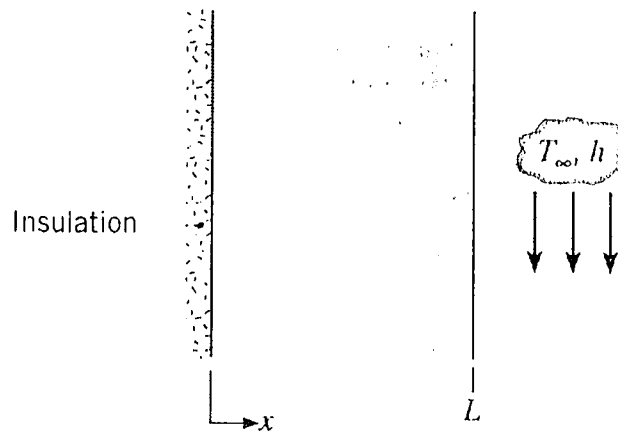
3.(20%) Consider a homogeneous solid medium within which there is no bulk motion and the temperature distribution $T(x,y,z,t)$ is expressed in Cartesian coordinates (x,y,z) and time t . Please draw a control volume to derive the heat equation, which is:

$$k\left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} + \frac{\partial^2 T}{\partial z^2}\right) = \rho c \frac{\partial T}{\partial t}$$

Please only consider the conduction and assume all the material properties are constant, such as the thermal conductivity k , density ρ , and heat capacity c .

4.(20%) Consider a hot metal that is initially at a uniform temperature T_i and is placed into a liquid of a lower uniform and constant temperature T_∞ . The thermal transient effect begin at time $t=0$, the temperature of the solid will decrease for time $t>0$, until it eventually reaches T_∞ . This reduction is due to the convection heat transfer at the solid-liquid interface. Assume the temperature T of the metal only depends on time t such that T can be simplified as $T(t)$ instead of $T(x,y,z,t)$. Please derive $T(t)$ of the metal in terms of the convection heat transfer coefficient h , metal density ρ , metal heat capacity c , volume of metal V , and surface area of metal A .

5.(20%) The plane wall with constant properties without heat generation shown in the figure is initially at a uniform temperature T_i . Suddenly the surface at $x=L$ is heated by a fluid at T_∞ having a convection heat transfer coefficient h . The boundary at $x=0$ is perfectly insulated. Please sketch the temperature distribution $T(x,t)$ as t goes by from $t=0$ to $t \rightarrow \infty$.



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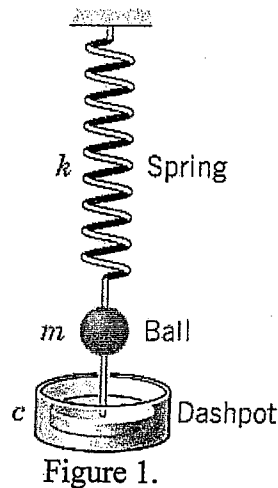
科目名稱：工程數學【機電系碩士班乙組、丙組】

題號：438002

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（問答申論題）

共 2 頁 第 1 頁

1. (20%) The ODE of the damped mass-spring system (Figure 1) is $my'' + cy' + ky = 0$. Assume that this damping force is proportional to the velocity $y' = dy/dt$. The constant c is called the damping constant.
- The damping force $F_2 = -cy'$ acts against the motion. Show that c is positive. (2%)
 - Show the characteristic equation. (3%)
 - The characteristic equation in (b) may have three kinds of roots corresponding to three types of motions (Overdamping, Critical Damping, and Underdamping). Write down the discriminant equation for each case, and find the general solution. (15%)



2. (10%) Solve the IVP. Show the details of your work.
 $y''' + 5y'' + 24y' + 20y = x$, $y(0) = 1.94$, $y'(0) = -3.95$, $y''(0) = -24$.
3. (10%) Find a basis of solutions by using power series method or FROBENIUS method. Try to identify the series as expansions of known functions. Show the details of your work.
 $x^2y'' + 4x^3y' + (x^2 - 2)y = 0$
4. (10%) Solve the equation by the Laplace transform. Show the details of your work.
 $y'' - 5y' + 6y = 6u(t-1)$, $y(0) = 0$, $y'(0) = 0$. (u is the unit step function.)
5. (15%) A surface $S: 2x^2 + y^2 + z = 5$ is given. Find:
- The tangent plane at $(1, -1, 2)$. (5%)
 - The (shortest) distance between point $(0, -2, 1)$ and the tangent plane in (a). (5%)
 - The plane orthogonal to the tangent plane in (a) includes points $(0, 0, 1)$ and $(1, 2, -1)$. (5%)
6. (20%) A vector $\vec{F} = [y, z, x^2z]$ and a paraboloid surface $S: z = f(x, y) = 5 - (x^2 + y^2)$, $z \geq 1$ are given. Evaluate the following surface integrals: (\vec{n} is a unit normal vector of S)
- $\iint_S (\nabla \times \vec{F}) \cdot \vec{n} dA$ (10%)
 - $\iint_S \vec{F} \cdot \vec{n} dA$ (10%)

國立中山大學 105 學年度碩士暨碩士專班招生考試試題

科目名稱：工程數學【機電系碩士班乙組、丙組】

題號：438002

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（問答申論題） 共 2 頁第 2 頁

7. (15%) Solve the Laplace's equation: $\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = 0$ with the boundary conditions, as shown in Figure 2.

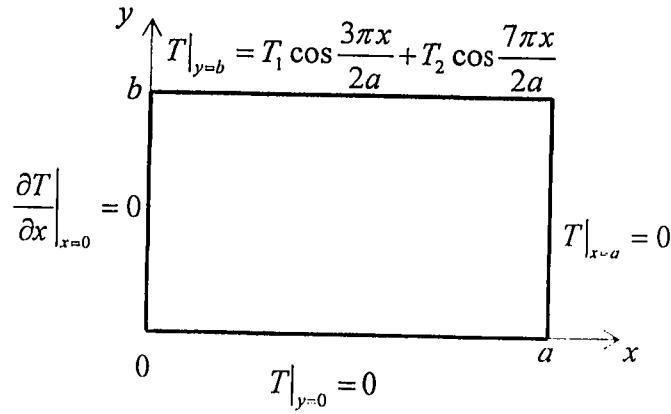


Figure 2.

國立中山大學 105 學年度碩士暨碩士專班招生考試試題

科目名稱：自動控制【機電系碩士班丙組】

題號：438004

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（問答申論題） 共 2 頁第 1 頁

1. (10%) In Fig. 1, let $G(s) = \frac{K(s-3)(s+5)}{(s+2)(s+10)(s^2+2s+15)}$.

(a) (5%) Plot the root loci for the system.

(b) (5%) Determine the range of K for stability.

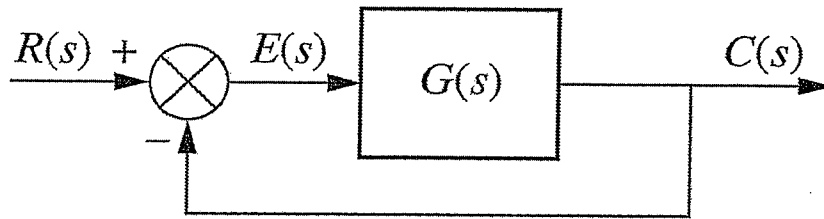


Fig. 1

2. (10%) In Fig. 2, let $J = 0.0001 \text{ kg-m}^2$, $K = 1 \text{ N-m/rad}$, and $D = 0.01 \text{ N-m-s/rad}$.

(a) (5%) Determine $\theta(t)$ for a unit step input of torque $T(t)$.

(b) (5%) Determine the percent overshoot and peak time from (a).

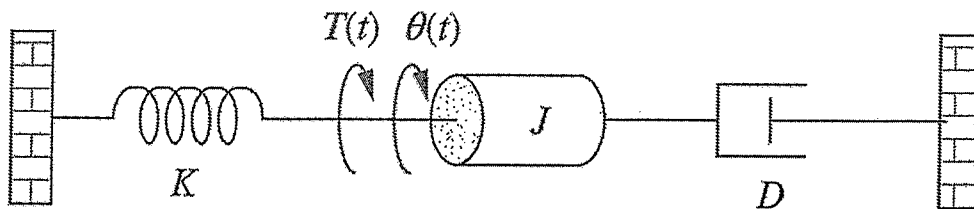


Fig. 2

3. (10%) In Fig. 1, let $G(s) = \frac{K(s+z)}{s(s+p)}$. Find the values of K, z, p to meet the specifications: The closed-loop poles are at $-2 \pm j2$ and the steady-state error for a unit ramp input is 0.2.

4. (20%) In Fig. 1, let $G(s) = \frac{K}{(s+0.5)(s+5.5)}$. Please design a PID controller to fulfill the specifications: damping ratio is 0.8; settling time is 1 sec; zero steady state error for a unit step input.

5. (20%) The impulse response of a given system is known to be $e^{-t} - 3e^{-2t} + 3e^{-4t}$. What is the transfer function of this system?

國立中山大學 105 學年度碩士暨碩士專班招生考試試題

科目名稱：自動控制【機電系碩士班丙組】

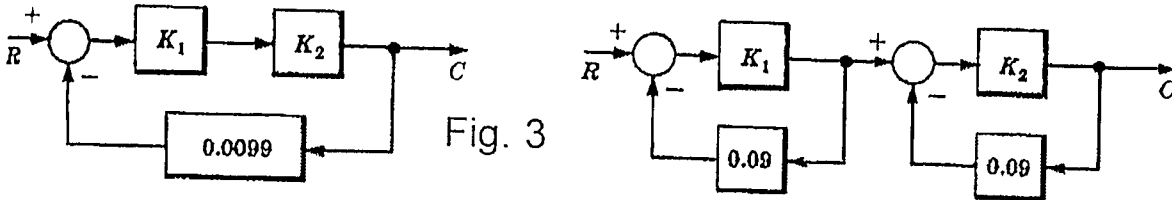
題號：438004

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（問答申論題） 共 2 頁第 2 頁

6. (30%) This problem considers a class of systems whose transfer function has the form: $T = (A_1 + k A_2) / (A_3 + k A_4)$. Note that k is a parameter and A_1, A_2, A_3 and A_4 are polynomials of s . For such systems, the sensitivity of T with respect to the parameter k is known to be:

$$S_k^T = \frac{dT}{dk} \frac{k}{T} = \frac{k(A_2 A_3 - A_1 A_4)}{(A_3 + k A_4)(A_1 + k A_2)}$$

- (a) Show that the two systems in Fig. 3 have the same transfer function when $K_1 = K_2 = 100$.
- (b) Compare the sensitivities of these two systems with respect to parameter K_1 for nominal values $K_1 = K_2 = 100$.
- (c) Based on the results of part (b), tell us which system is better and explain why.



國立中山大學 105 學年度碩士暨碩士專班招生考試試題

科目名稱：工程英文【機電系碩士班丁組】

題號：438001

※本科目依簡章規定「不可以」使用計算機(混合題)

共 3 頁 第 1 頁

I. 選擇題 You are to choose the word, phrase or selection that best completes the sentence or meets the meaning of the condition. Then, on your answer sheet, find the number of the question and mark your answer. (20% in total, 2% each, 單選, 共 20 分, 每題 2 分, 請劃記於答案卡上)

1. The fabrication procedure of linear motors was as (). Choose the correct word between (). (a) subjects, (b) performances, (c) results, (d) follows.
2. In this investigation we () two different computer simulations. (a) classified, (b) ran, (c) processed, (d) carried out.

3. What is the symbol (Fig. 1) in engineering graphics? (a) First-angle projection. (b) Second-angle projection. (c) Third-angle projection. (d) Forth-angle projection.

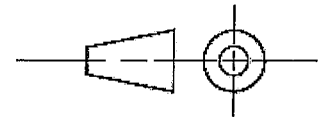


Fig. 1

4. Follow the below arrow in Fig. 2, what kind of drawing can we have? (a) Half-section view. (b) Quarter-section view. (c) Section view. (d) Broken-out-section view.



Fig. 2

5. Our data () 80 abstracts was taken from academic journal articles on life science. (a) presented of, (b) made from, (c) consisted of, (d) consists of.
6. What kind of failure theories are adequate for brittle materials? (a) Maximum shear stress, (b) Maximum normal stress, (c) Distortion energy, (d) Ductile Coulomb-Mohr.
7. What is not considered in journal bearing design? (a) Rotation speed, (b) Size of spherical roller, (c) Load, (d) Lubricant viscosity.
8. What is not considered in allowable bending stress number for spur gears in Mechanical Engineering design? (a) Size factor, (b) Rim-thickness factor, (c) Surface condition factor, (d) Stress-cycle factor.
9. How many degree-of-freedom does a sailing boat has? (a) Three, (b) Four, (c) Five, (d) Six.
10. The device in Fig. 3 rotates about the x axis with a non-constant angular velocity. Which of the following is true (choose one)? (a) Newton's second law can not be used to derive it's equations of motion, (b) The only non-zero moment will be about the x axis, (c) At the instant shown, there will be a non-zero y-axis bearing force, (d) The mass moment of inertia I_{xx} is zero.

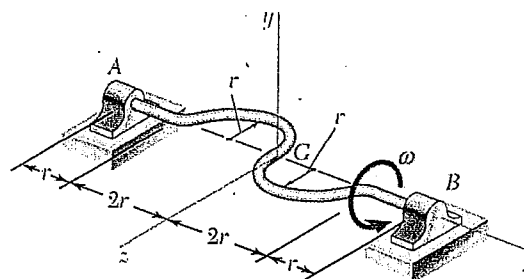


Fig. 3

國立中山大學 105 學年度碩士暨碩士專班招生考試試題

科目名稱：工程英文【機電系碩士班丁組】

題號：438001

※本科目依簡章規定「不可以」使用計算機(混合題)

共 3 頁第 2 頁

II. 中翻英 Chinese-English Translation. 參考以下中文內容，將中文內容翻譯成英文，寫於答案紙上 Translate the following Chinese passages into English passages. Write your answer on the answer sheet. (兩題共 25 分)

1. 脫膜(demolding)時間是由射出零件(injection part)在模穴(mold cavity)內的移動速度所支配。在 MDIS 驅動方式中，滑動零件(sliding part)是藉由在前進與反轉行程(stroke)之間的慣性力差異所驅動。圖一呈現射出零件的自由體圖。前進行程的方向為模穴上表面向外的方向，如圖一所示向右方向為正 X 方向。射出零件與模穴表面之間的摩擦力為 $\mu_k \cdot N$ ， μ_k 為藉由實驗所得到的動摩擦係數。射出零件的質量與重量分別以 m 與 W 來表示。模穴表面的反作用力是由射出零件冷卻至固化時的殘餘保壓 P_b (packing pressure) 所導致，且 $N = P_b \cdot A$ ， A 為模穴平行於射出方向的接觸面積。(20%)
2. 本研究設計為兩階段，以探討學習策略的辨識、分類和應用。實驗結果對於應用和科學研究皆有極大利益(great interest)。(5%)

III. 英翻中 English-Chinese Translation. (共 30 分) 請寫於答案紙上

1. Any two of these unknowns can be expressed in terms of the remaining one. (3%)
2. A system is said to be conservative if no energy is lost due to friction or energy-dissipating nonelastic members. (3%)
3. Since the segments AB and BC of the frame can be considered as beams, the beam force-deflection formulas can be used to generate the stiffness matrix of the frame. (3%)
4. We are glad to be able to inform you that this paper should be acceptable after condensation to no more than 60% of its present total length. (3%)
5. The relationship, while significant, is moderate in strength and in line with previous studies. (3%)
6. The simulation results indicated that the nocompensation method and the two-phase arrangement without magnetic coupling appear to be a better technical solution for the multiphase system, which led to a higher system efficiency and better acceleration profile. (5%)
7. These preliminary evaluations, even though based on a rather simplified model of the generator, have produced some important insights on system dynamics and on the range of values to be assigned to several significant parameters. (5%)
8. As another application of the new fundamental solutions, we superpose several Hertzian loads within a square and solve the contact problem for a rigid indenter of the shape given due to the nonlinear equation. (5%)

國立中山大學 105 學年度碩士暨碩士專班招生考試試題

科目名稱：工程英文【機電系碩士班丁組】

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※本科目依簡章規定「不可以」使用計算機(混合題)

共 3 頁第 3 頁

IV. Questions 問答題 (共 25 分)。Answer the below questions only “in English” on your answer sheet. 回答下列問題，並寫在答案紙上，僅能以“英文”回答。

1. What is the meaning of the term “number of degrees of freedom”? (3%)
2. What is the meaning of the term “accuracy and repeatability” of a machine? You can make a drawing to assist in explaining it. (3%)
3. What is the meaning of the term “resonance”? You can make a drawing to assist in explaining it. (3%)
4. What is the meaning of the term “metal forming”? (3%)
5. What is the meaning of the term “tolerance”? (3%)
6. In manufacturing processes, what are net shape processes and near net shape processes? (3%)
7. What is the meaning of the term “anneal”? (3%)
8. Use some sentences and drawings to explain the difference between Oblique projection and Isometric projection. (4%)

國立中山大學 105 學年度碩士暨碩士專班招生考試試題

科目名稱：科技英文【機電系碩士班乙組、戊組】

題號：438005

※本科目依簡章規定「不可以」使用計算機(混合題)

共 6 頁第 1 頁

A. 說明：請依文意在文章後所提供的(A)到(F)選項中分別選出最適當者，填入空格中，使篇章結構清晰有條理。各題答對者，得1分；答錯、未作答或畫記多於一個選項者，該題以零分計算。

Since the early 1990s, the lithium-ion battery has been the most suitable battery for portable electronic equipment. Today, they're commonly used for cellphones, computers, tablets, digital cameras, and other devices.

Lithium-ion batteries have nearly twice the energy density of traditional nickel cadmium batteries. 1 This feature has important implications for cellphones and computers, because it makes these items more portable for consumers. It also makes power tools easier to use and allows workers to use them for longer periods of time.

2 Lithium-ion batteries retain no "memory" of their power capacity from previous charging cycles. Thus they require no scheduled cycling and can be fully re-fueled to their maximum capacity during each charging cycle. Other rechargeable battery types, in contrast, retain information from previous charging cycles, which wastes valuable storage space. Over time, this makes these rechargeable batteries hold less of a charge.

3 It is fragile and requires a protection circuit to maintain safe operation. A high load could overheat the pack and safety might be jeopardized. 4 After 2-3 years of use, the pack often becomes unserviceable due to a large voltage drop caused by high internal resistance.

It should be noted, however, that manufacturers are constantly making improvements on lithium-ion batteries. 5 With such rapid progress, the use of lithium-ion batteries will certainly expand further.

- (A) The lithium-ion battery is also a low maintenance battery.
- (B) Despite its overall advantages, the lithium-ion battery has its drawbacks.
- (C) New and enhanced chemical combinations are introduced every six months or so.
- (D) Attempts to develop rechargeable lithium-ion batteries failed due to memory problems.
- (E) That is, they carry more power in a smaller unit, helping to reduce overall weight and size.
- (F) Another downside is the increase of the internal resistance that occurs with cycling and aging.

B. 說明：請依文意在文章後所提供的(A)到(F)選項中分別選出最適當者，填入空格中，使篇章結構清晰有條理。各題答對者，得1分；答錯、未作答或畫記多於一個選項者，該題以零分計算。

Eccentrics are people who have an unusual or odd personality, set of beliefs, or behaviour pattern. They may or may not comprehend the standards for normal behaviour in their culture. They simply don't care about the society's disapproval of their habits or beliefs.

Once considered socially unacceptable, eccentric people have been found to possess some positive characteristics. 6 They often have more curiosity about the world and, in many cases, are contentedly obsessed by hobbies and interests. 7 They live in a world of their own and do not worry about what others think of them. So they are usually less restricted and therefore more carefree in forming new ideas.

8 Statistics show they visit their doctors less—about once in eight to nine years, which is 20 times less than the average person. This could be partly due to their innate traits such as humour and happiness. 9 This may explain why eccentrics are, on the whole, healthier.

Psychologists therefore suggest that we pay attention to those who do not conform. It could be our aunt who has been raising pet lizards. 10 Their crazy hobby or strange sense of humour is what keeps them going. Eccentric people may seem odd, but they will likely live a happier and healthier life because they enjoy what they are doing. In fact, many of history's most brilliant minds have displayed some unusual behaviours and habits.

國立中山大學 105 學年度碩士暨碩士專班招生考試試題

科目名稱：科技英文【機電系碩士班乙組、戊組】

題號：438005

※本科目依簡章規定「不可以」使用計算機(混合題)

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- (A) Eccentrics are also found to be healthier.
- (B) According to a recent study in England, eccentrics are more creative.
- (C) Or it could be our best friend's brother who wears shorts to a formal dance.
- (D) People may have eccentric taste in clothes, or have eccentric hobbies.
- (E) Psychologists also find that eccentric people do not follow conventions.
- (F) Such personal traits are found to play an important role in boosting the body's immune system.

C. 說明：每題請分別根據各篇文章之文意選出最適當的一個選項。各題答對者，得2分；答錯、未作答或畫記多於一個選項者，該題以零分計算。

Six Sigma is a highly disciplined process that helps companies focus on developing and delivering near-perfect products and services. The word "sigma" is a statistical term that measures how far a given process falls short of perfection. The central idea behind Six Sigma is that if a company can measure how many "defects" they have in a commercial production process, they can systematically figure out how to eliminate the problems and get as close to "zero defects" as possible.

Training and teamwork are essential elements of the Six Sigma methodology. In other words, companies need to have their team leaders and team members trained to implement the Six Sigma processes. They must learn to use the measurement and improvement tools. They also need to learn communication skills necessary for them to involve customers and suppliers and to serve their needs.

Six Sigma was developed in 1986 by Motorola, an American telecommunications company. Engineers in Motorola used it as an informal name for a plan to reduce faults in production processes. A few years later, Motorola extended the name "Six Sigma" to mean a general performance improvement method, beyond purely "defect reduction" in the production process. In 1995, Jack Welch, CEO of General Electrics (GE), decided to implement Six Sigma in GE; and by 1998 GE claimed that Six Sigma had generated over three-quarters of a billion dollars of cost savings.

By 2000, Six Sigma was effectively established as an industry in its own right, involving the training, consultancy and implementation of Six Sigma methodology in all sorts of organizations around the world. Organizations as diverse as local governments, prisons, hospitals, the armed forces, banks, and multi-national corporations have been adopting Six Sigma for quality and process improvement.

11. According to the passage, what is "Six Sigma"?
- (A) A digital device to speed up production processes.
 - (B) A near-perfect process in business communication.
 - (C) A statistical term that measures a company's budgets and profits.
 - (D) A quality measure that detects problems to improve products and services.
12. For Six Sigma to be applied successfully, which of the following are the most crucial factors?
- (A) Customers and suppliers' needs.
 - (B) Tools in statistics and marketing.
 - (C) Strong teamwork and proper training.
 - (D) Good leadership and sufficient budget.
13. How are the author's ideas developed in the last two paragraphs?
- (A) By definition.
 - (B) By comparison.
 - (C) In time order.
 - (D) In space order.
14. According to the passage, which of the following is true regarding Six Sigma?
- (A) It helped Motorola and General Motors to promote sales.
 - (B) It requires multi-national efforts to generate satisfactory results.
 - (C) It has gained popularity mostly among large telecommunications companies.
 - (D) It has become a business model which provides services to organizations worldwide.

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D. 說明：每題請分別根據各篇文章之文意選出最適當的一個選項。各題答對者，得2分；答錯、未作答或畫記多於一個選項者，該題以零分計算。

Scientists are trying to genetically modify the world in which we live. They are even trying to wipe out diseases via genetic modification. For example, researchers have tried to engineer mosquitoes to kill malaria parasites. The malaria parasite is carried by the female *Anopheles* mosquito. When transmitted to a human, the parasite travels first to the liver and then on to the bloodstream, where it reproduces and destroys red blood cells. An estimated 250 million people suffer from malaria each year, and about one million die—many of them children. There are currently no effective or approved malaria vaccines.

To “kill” malaria, scientists are genetically modifying a bacterium in mosquitoes so that it releases toxic compounds. These compounds are not harmful to humans or the mosquito itself, but they do kill off the malaria parasite, making the mosquito incapable of infecting humans with malaria.

Despite this achievement, scientists are faced with the challenge of giving the modified mosquitoes a competitive advantage so that they can eventually replace the wild population. Complete blockage of the malaria parasite is very important. If some of the parasites slip through the mechanism, then the next generation will likely become resistant to it. And if that happens, the scientists are back where they started.

Another challenge for scientists is to gain public approval for this genetic modification regarding mosquitoes and malaria control. Environmental activists have raised concerns about the release of genetically engineered organisms without any clear knowledge of their long-term effect on ecosystems and human health. There is still a long way to go before genetic modification techniques are put to use in disease control.

15. What is the main idea of this passage?

- (A) Researchers have found an effective way to halt the spread of insect-borne diseases around the world.
- (B) Many people are worried about the effects of genetically modified organisms on the environment.
- (C) It takes time to gain public support for the application of genetic modification to disease control.
- (D) Genetic engineering looks promising in reducing malaria, though there may be unknown consequences.

16. Which of the following best shows the organization of this passage?

- (A) Introduction → Comparison → Contrast
- (B) Problem → Solution → Potential difficulties
- (C) Proposal → Arguments → Counter-arguments
- (D) Definition → Examples → Tentative conclusions

17. According to the passage, which of the following is true about malaria parasites?

- (A) They are resistant to genetic modification and vaccines.
- (B) They reproduce in the human liver and grow stronger there.
- (C) They can be found in only one gender of a class of mosquitoes.
- (D) They are transmitted to around one million children each year.

18. What does “that” in the third paragraph refer to?

- (A) Some malaria parasites escaping from the ecosystems.
- (B) Malaria parasites becoming immune to the engineered bacterium.
- (C) Modified mosquitoes becoming more competitive than the wild ones.
- (D) Transmission of malaria being blocked from mosquitoes to humans.

E. 說明：每題請分別根據各篇文章之文意選出最適當的一個選項。各題答對者，得3分；答錯、未作答或畫記多於一個選項者，該題以零分計算。

In the last decade a revolution has occurred in the way that scientists think about the brain. We now know that the decisions humans make can be traced to the firing patterns of neurons in specific parts of the brain. These discoveries have led to the field known as neuroeconomics, which studies the brain's secrets to success in an economic environment that demands innovation and being able to do things differently from

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competitors. A brain that can do this is an iconoclastic one. Briefly, an iconoclast is a person who does something that others say can't be done.

This definition implies that iconoclasts are different from other people, but more precisely, it is their brains that are different in three distinct ways: perception, fear response, and social intelligence. Each of these three functions utilizes a different circuit in the brain. Naysayers might suggest that the brain is irrelevant, that thinking in an original, even revolutionary, way is more a matter of personality than brain function. But the field of neuroeconomics was born out of the realization that the physical workings of the brain place limitations on the way we make decisions. By understanding these constraints, we begin to understand why some people march to a different drumbeat.

The first thing to realize is that the brain suffers from limited resources. It has a fixed energy budget, about the same as a 40 watt light bulb, so it has evolved to work as efficiently as possible. This is where most people are impeded from being an iconoclast. For example, when confronted with information streaming from the eyes, the brain will interpret this information in the quickest way possible. Thus it will draw on both past experience and any other source of information, such as what other people say, to make sense of what it is seeing. This happens all the time. The brain takes shortcuts that work so well we are hardly ever aware of them. We think our perceptions of the world are real, but they are only biological and electrical rumblings. Perception is not simply a product of what your eyes or ears transmit to your brain. More than the physical reality of photons or sound waves, perception is a product of the brain.

Perception is central to iconoclasm. Iconoclasts see things differently to other people. Their brains do not fall into efficiency pitfalls as much as the average person's brain. Iconoclasts, either because they were born that way or through learning, have found ways to work around the perceptual shortcuts that plague most people. Perception is not something that is hardwired into the brain. It is a learned process, which is both a curse and an opportunity for change. The brain faces the fundamental problem of interpreting physical stimuli from the senses. Everything the brain sees, hears, or touches has multiple interpretations. The one that is ultimately chosen is simply the brain's best theory. In technical terms, these conjectures have their basis in the statistical likelihood of one interpretation over another and are heavily influenced by past experience and, importantly for potential iconoclasts, what other people say.

The best way to see things differently to other people is to bombard the brain with things it has never encountered before. Novelty releases the perceptual process from the chains of past experience and forces the brain to make new judgments. Successful iconoclasts have an extraordinary willingness to be exposed to what is fresh and different. Observation of iconoclasts shows that they embrace novelty while most people avoid things that are different.

The problem with novelty, however, is that it tends to trigger the brain's fear system. Fear is a major impediment to thinking like an iconoclast and stops the average person in his tracks. There are many types of fear, but the two that inhibit iconoclastic thinking and people generally find difficult to deal with are fear of uncertainty and fear of public ridicule. These may seem like trivial phobias. But fear of public speaking, which everyone must do from time to time, afflicts one-third of the population. This makes it too common to be considered a mental disorder. It is simply a common variant of human nature, one which iconoclasts do not let inhibit their reactions.

Finally, to be successful iconoclasts, individuals must sell their ideas to other people. This is where social intelligence comes in. Social intelligence is the ability to understand and manage people in a business setting. In the last decade there has been an explosion of knowledge about the social brain and how the brain works when groups coordinate decision making. Neuroscience has revealed which brain circuits are responsible for functions like understanding what other people think, empathy, fairness, and social identity. These brain

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regions play key roles in whether people convince others of their ideas. Perception is important in social cognition too. The perception of someone's enthusiasm, or reputation, can make or break a deal. Understanding how perception becomes intertwined with social decision making shows why successful iconoclasts are so rare.

Iconoclasts create new opportunities in every area from artistic expression to technology to business. They supply creativity and innovation not easily accomplished by committees. Rules aren't important to them. Iconoclasts face alienation and failure, but can also be a major asset to any organization. It is crucial for success in any field to understand how the iconoclastic mind works.

Questions 19-22, Choose the correct letter, A, B, C or D.

19. Neuroeconomics is a field of study which seeks to

- (A) cause a change in how scientists understand brain chemistry.
- (B) understand how good decisions are made in the brain.
- (C) understand how the brain is linked to achievement in competitive fields.
- (D) trace the specific firing patterns of neurons in different areas of the brain.

20. According to the writer, iconoclasts are distinctive because

- (A) they create unusual brain circuits.
- (B) their brains function differently.
- (C) their personalities are distinctive.
- (D) they make decisions easily.

21. According to the writer, the brain works efficiently because

- (A) it uses the eyes quickly.
- (B) it interprets data logically.
- (C) it generates its own energy.
- (D) it relies on previous events.

22. The writer says that perception is

- (A) a combination of photons and sound waves.
- (B) a reliable product of what your senses transmit.
- (C) a result of brain processes.
- (D) a process we are usually conscious of.

Questions 23-26, Do the following statements agree with the claims of the writer in reading passage?

- (A) YES (if the statement agrees with the claims of the writer)
- (B) NO (if the statement contradicts the claims of the writer)
- (C) NOT GIVEN (if it is impossible to say what the writer thinks about this)

23. Exposure to different events forces the brain to think differently.

24. Iconoclasts are unusually receptive to new experiences.

25. Most people are too shy to try different things.

26. When concern about embarrassment matters less, other fears become irrelevant.

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F. 解釋下列名詞有關的人物及事務(英文作答後再以中文翻譯自己的答案，只有中文或英文只算得一半)。每題六分，共 30 分。

27. What is Brownian motion, describe it's behavior

28. Kepler's three laws

29. inertia

30. conservation of momentum

31. WLAN

G. 簡答下列文章中相關之問題。每題五分，共 20 分。

Classical versus quantum mechanics

Historically, classical mechanics came first, while quantum mechanics is a comparatively recent invention. Classical mechanics originated with Isaac Newton's laws of motion in *Principia Mathematica*; Quantum Mechanics was discovered in the early 20th century. Both are commonly held to constitute the most certain knowledge that exists about physical nature. Classical mechanics has especially often been viewed as a model for other so-called exact sciences. Essential in this respect is the relentless use of mathematics in theories, as well as the decisive role played by experiment in generating and testing them.

According to the correspondence principle, there is no contradiction or conflict between the two subjects, each simply pertains to specific situations. The correspondence principle states that the behavior of systems described by quantum theories reproduces classical physics in the limit of large quantum numbers. Quantum mechanics has superseded classical mechanics at the foundational level and is indispensable for the explanation and prediction of processes at molecular and (sub)atomic level. However, for macroscopic processes classical mechanics is able to solve problems which are unmanageably difficult in quantum mechanics and hence remains useful and well used.

Relativistic versus Newtonian mechanics

In analogy to the distinction between quantum and classical mechanics, Einstein's general and special theories of relativity have expanded the scope of Newton and Galileo's formulation of mechanics. The differences between relativistic and Newtonian mechanics become significant and even dominant as the velocity of a massive body approaches the speed of light. For instance, in Newtonian mechanics, Newton's laws of motion specify that $F = ma$, whereas in Relativistic mechanics and Lorentz transformations, which were first discovered by Hendrik Lorentz, $F = \gamma m a$ (γ is the Lorentz factor, which is almost equal to 1 for low speeds).

32. What had Newton written? And what is the Newtonian mechanics?

33. Why is the classical mechanics so-called exact sciences ?

34. Why is classical mechanics for macroscopic processes remaining useful and well used?

35. What is the differences between relativistic and Newtonian mechanics?