

國立中山大學 106 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.(10%) As we know, the thermal energy transfers from higher to lower temperatures. Please describe how this physics law is fulfilled in the mathematical model for heat conduction and convection phenomenon (Hint: Fourier's Law and Newton's law of cooling).

2.(15%) Please use the first law of thermodynamics to determine the temperature change of a 128 m waterfall from one sufficient large body of water to another such that the bulk velocity can be neglected (The heat capacity c of water is $4200 \text{ J/kg}\cdot\text{K}$).

3.(25%) The energy transfer between human skin and surrounding atmosphere can be approximated as one-dimensional heat transfer problem. Consider a layer of human fatty tissue (脂肪組織) that is 3 mm thick with constant interior temperature of 36°C ($T_{s,1}$), which is the normal human body temperature. On a calm day, the convection heat transfer coefficient h between human skin and the surrounding atmosphere is $25 \text{ W/m}^2\cdot\text{K}$. Moreover, it reaches $65 \text{ W/m}^2\cdot\text{K}$ in a windy day. Assume the thermal conductivity of human fatty tissue k is $0.2 \text{ W/m}\cdot\text{K}$.

- (a) (10%) What is the ratio of the heat loss per unit area from the skin for the calm day to that for the windy day assuming that the ambient air temperature is maintained as -15°C (T_∞) for both cases?
- (b) (10%) What the new ambient temperature T_∞' would the air have to assume on the calm day ($h=25 \text{ W/m}^2\cdot\text{K}$) to produce the same heat loss occurring on the windy day ($T_\infty = -15^\circ\text{C}$, $h=65 \text{ W/m}^2\cdot\text{K}$)? T_∞' is exactly the so-called "wind chill temperature(風寒溫度)".
- (c) (5%) From the answers in (a) and (b), please explain why you will feel colder when you are riding a motorcycle with a faster speed.

Hint: Please assume one-dimensional conduction in a plane wall as shown in Figure 1, and solve this problem with equivalent thermal circuit.

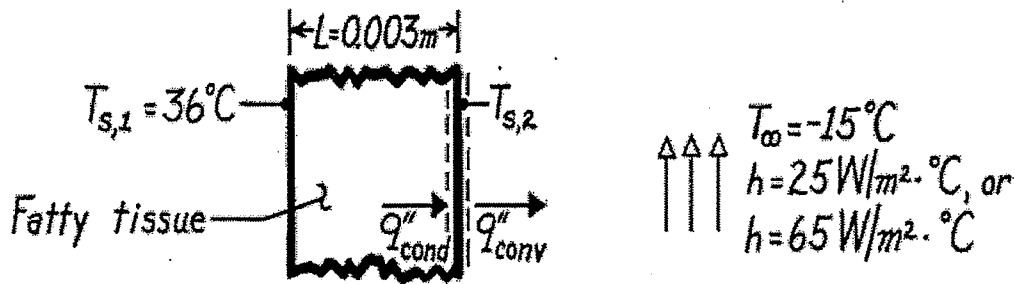


Figure 1

4.(20%) Consider a homogeneous solid medium with an internal heat generation \dot{q} (W/m^3), and its temperature distribution $T(x,y,z,t)$ is expressed under Cartesian coordinates (x,y,z) and time t . Please draw a control volume to derive the heat equation, which is:

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

背面有題

國立中山大學 106 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

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

5.(30%) As shown in Figure 2, the width w of a long copper bar of rectangular cross section is much greater than thickness L . Its lower surface is maintained as T_0 by a heat sink, and the initial temperature throughout the bar is also equal to T_0 . Suddenly, an electric current is passed through the bar to provide an internal heat generation $\dot{q} > 0$ (W/m^3), and an airstream of temperature T_∞ ($> T_0$) is passed over the top surface, while the bottom surface continues to be maintained as T_0 . Please assume all the material properties, such as the thermal conductivity k , density ρ , and heat capacity c , are constant.

- (a) (6%) The one-dimensional simplification can be utilized in the direction parallel to that of width ($T(x,y,z,t) = T(x,t)$). Why?
- (b) (8%) List a partial differential equation with suitable boundary conditions that can solve temperature distribution $T(x,t)$.
- (c) (10%) Assume \dot{q} is a positive constant, and solve the partial differential equation in (b) under "steady state".
- (d) (6%) Please sketch the temperature distribution $T(x,t)$ as t goes by from $t=0$ to $t \rightarrow \infty$. Is this possible that the $T(x,t)$ is higher than T_∞ ?

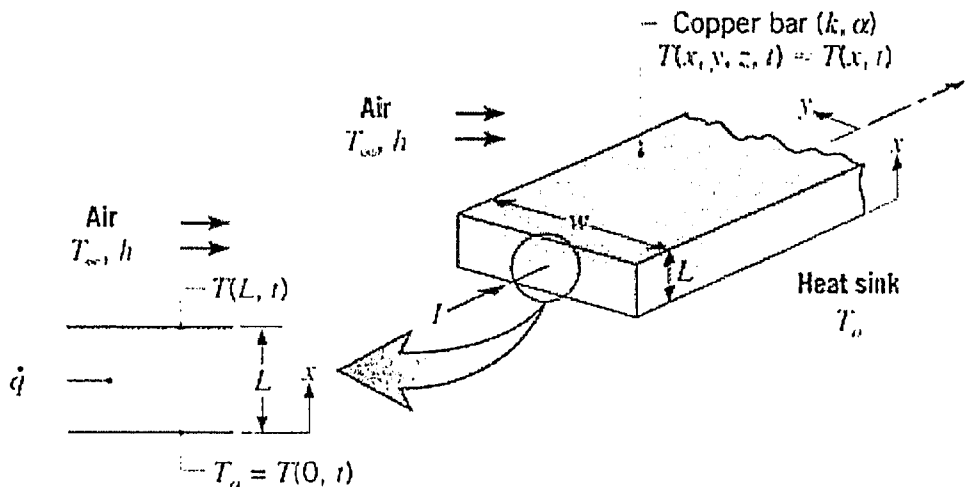


Figure 2

國立中山大學 106 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 1 頁第 1 頁

1. (20%) Solve the following ODEs.

(a) $y' = (-2x + y)^2 - 7, y(0) = 0.$ (10%)

(b) $y'' - 2y' + y = 35x^{3/2}e^x.$ (10%)

2. (15%) Solve $y'' + y = \begin{cases} 2t, & 0 < t < \pi/2 \\ 0, & t > \pi/2 \end{cases}$ with $\begin{cases} y(\pi/4) = \pi/2 \\ y'(\pi/4) = 2 - \sqrt{2} \end{cases}$ by using the Laplace transform.

3. (15%) Tank T_1 in Fig. 1 initially contains 300 gal of water in which 150 lb of salt are dissolved. Tank T_2 initially contains 200 gal of pure water. Liquid is pumped through the system as indicated, and the mixtures are kept uniform by stirring. Find the amounts of salt $y_1(t)$ and $y_2(t)$ in T_1 and T_2 , respectively.

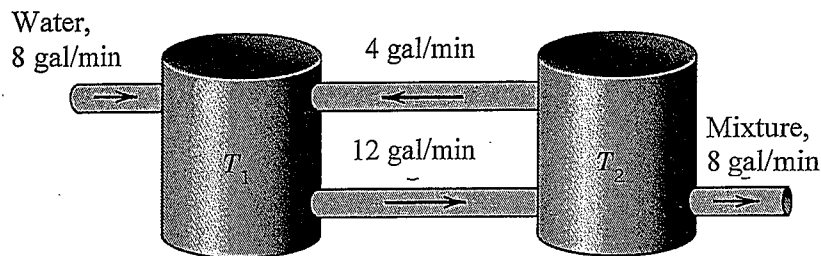


Fig. 1

4. (15%) Multiple choice problem. Suppose \mathbf{A} is a $n \times n$ matrix with rank n . In the following statements, which ones are true?

- (a) \mathbf{A} is a singular matrix.
- (b) $\det(\mathbf{A}) = 0.$
- (c) The nullity of \mathbf{A} is $n.$
- (d) The column rank of \mathbf{A} is $n.$
- (e) $\mathbf{Ax} = \mathbf{0}$ has only a trivial solution $\mathbf{x} = \mathbf{0}.$
- (f) $\mathbf{Ax} = \mathbf{b}$ has an unique solution $\mathbf{x} = \mathbf{A}^{-1}\mathbf{b}.$
- (g) The column vectors are linearly dependent.
- (h) The row vectors of \mathbf{A} span $R^n.$
- (i) \mathbf{A} is diagonalizable.

5. (15%) Compute the flux of a liquid through the surface $S: x^2 + y^2 = 4, |z| \leq 2,$ where the velocity field is $\mathbf{F} = [\sin(x), \cos(x), \cos(z)].$ (Hint: Divergence theorem of Gauss)

6. (20%) The vibrating string can be modeled by one-dimensional wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}.$ Consider a plastic string of length $L = \pi$ with fixed ends and $c^2 = 1.$ It initially has zero displacement and the following velocity:

$$u_t(x, 0) = \begin{cases} 0.01x, & \text{if } 0 \leq x \leq \frac{1}{2}\pi \\ 0.01(\pi - x), & \text{if } \frac{1}{2}\pi \leq x \leq \pi \end{cases}$$

Find the displacement $u(x, t)$ of the string.

國立中山大學 106 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 $G_c(s) = 1$, $G(s) = \frac{K(s^2 + 4s + 6)}{(s+3)(s+5)(s^2 + 2s + 5)}$.

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

(b) (5%) Find K to yield a steady-state error of 0.1 for a unit step input.

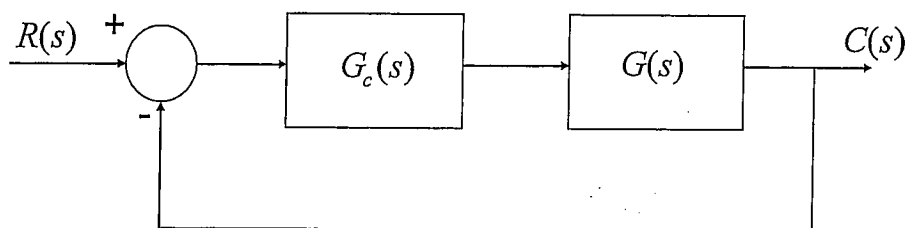


Fig. 1

2. (10%) The control system is shown in Fig. 2.

(a) (5%) Plot the Bode magnitude and phase plots.

(b) (5%) Determine the gain margin and phase margin from (a).

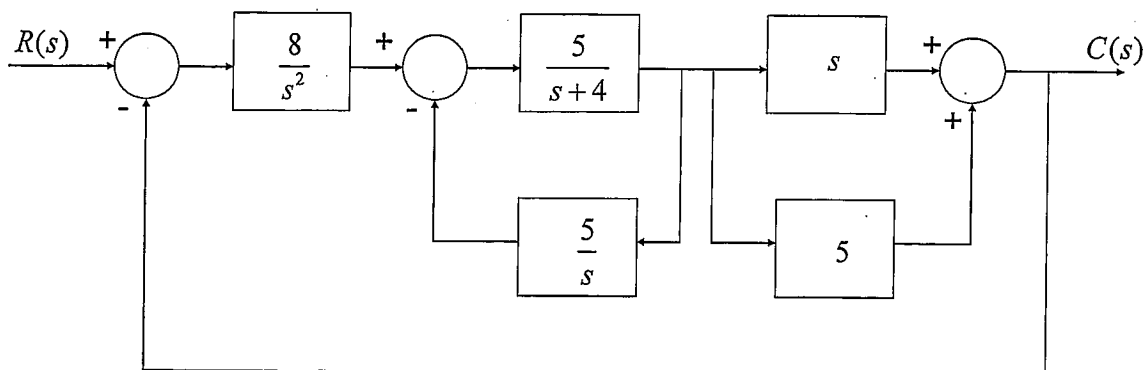


Fig. 2

3. (10%) In Fig. 1, let $G_c(s) = K$, $G(s) = \frac{60}{(s^2 + 10s + 60)(s+10)^3}$.

(a) (5%) Find the value of K that will yield oscillations.

(b) (5%) Find the frequency of oscillations.

4. (20%) In Fig. 1, let $G(s) = \frac{K}{s(s+5)(s^2 + 10s + 50)}$.

(a) (10%) Please design a lead controller $G_c(s)$ to fulfill a 10% overshoot and a peak time of 0.86 second for a unit step input (assume a compensator zero at -5 on the real axis).

(b) (10%) Derive the unit step response from (a).

國立中山大學 106 學年度碩士暨碩士專班招生考試試題

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共 2 頁第 2 頁

5. (10%) This problem considers the following three systems whose transfer functions are

$$G_1(s) = \frac{1}{(s+2)(s+3)} \quad G_2(s) = \frac{s+1}{(s+2)(s+3)} \quad G_3(s) = \frac{1}{(s+2)(s+3)(s+1)}$$

Which system has the largest bandwidth? Which system has the smallest bandwidth? Why?

6. (20%) With a unit step input, this problem considers following three systems whose transfer functions are

$$G_1(s) = \frac{25}{s^2 + 6s + 25} \quad G_2(s) = \frac{25}{s^2 + 8s + 25} \quad G_3(s) = \frac{25(s+1)}{s^2 + 6s + 25}$$

- (a) (10%) Assuming the desired output for a unit step input is 1, which of the above three systems has the largest steady-state error? Why?

- (b) (10%) Among these three systems, who has the largest overshoot? Who has the smallest overshoot? Why?

7. (20%) With a unit step input, this problem considers following three systems whose transfer functions are

$$G_1(s) = \frac{s+1}{s^2 + 6s + 25} \quad G_2(s) = \frac{s+2}{s^2 + 6s + 25} \quad G_3(s) = \frac{s+3}{s^2 + 6s + 25}$$

- (a) (10%) Which of these three systems has the largest overshoot? Why?

- (b) (10%) Which of these three systems has the smallest peak time? Why?

國立中山大學 106 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 2 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 worm lead angle plus the worm helix angle is 90° . The worm lead angle is the () the worm helix angle. (a) basic to, (b) term with, (c) result in, (d) complement of.
 2. () is the error between a number of successive attempts to move the machine to the same position. (a) Precision, (b) Accuracy, (c) Resolution, (d) Reliability.
 3. Optical fibers transmit light using the property of total internal (). (a) reflection, (b) transmission, (c) refraction, (d) projection.
 4. To () the results, the product of crank angular velocity and crank length may be assigned a value of unity. (a) design, (b) normalize, (c) normal, (d) view.
 5. A () is a machine tool used for producing surfaces of revolution. (a) boring machine, (b) tapping machine, (c) lathe, (d) milling machine.
 6. What kind of failure theories are adequate for brittle materials? (a) Maximum normal stress, (b) Maximum shear stress, (c) Ductile Coulomb-Mohr, (d) Distortion energy.
 7. () is used to define the plastic deformation of metals at elevated temperatures into predetermined shapes using compressive forces. (a) Casting, (b) Forging, (c) Injection molding, (d) Welding.
 8. For a planar four-bar linkage, if the coupler is shortest, the inversion of the crank-rocker mechanism is called a (). (a) double-crank mechanism, (b) rocker-crank mechanism, (c) drag-link mechanism, (d) double-rocker mechanism.
 9. How many degree-of-freedom does a flying object have? (a) Three, (b) Four, (c) Five, (d) Six.
 10. () is the study of motion in mechanisms without reference to the forces that act on the mechanism. (a) Newton's second law, (b) Kinetics, (c) Kinematics, (d) Dynamics.

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. (共 25 分)

1. 現今製造業面臨了很多挑戰, 例如: 全球性競爭與快速變化的客戶需求。這些挑戰促成同步工程(Concurrent engineering)的採用。同步工程是一種涉及在最短時間內上市最高品質且最具價格競爭力產品的開發過程管理哲學。一個瞭解這種新觀念的好方法就是與應用於產品開發過程的傳統工程方法來比較。(15%)

2. 機械工程是一門應用工程學、物理學與材料科學原理於機械系統設計、分析、製造與維護的學科。機械工程範疇(field)需要瞭解力學、製造學、熱力學、材料科學與電學的核心領域(area)。(10%)

背面有題

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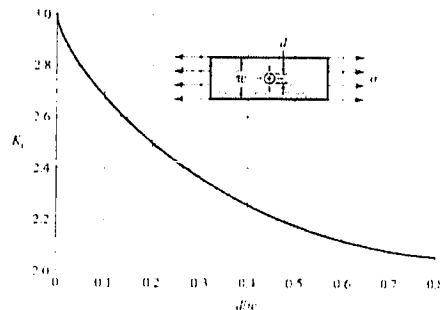
共 2 頁 第 2 頁

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

1. Geometric errors are defined here as errors in form of individual machine components (e.g. straightness of motion of a linear bearing). Geometric errors are concerned with the quasi-static accuracy of surfaces which move relative to each other, such as components of linear and rotary axes. (5%)
2. There were 19 participants in total, 18 males and 1 female, accepting the new creativity test. All of them were under undergraduate students. Both pre-course and post-course tests were conducted. (5%)
3. The Taguchi method is applied to minimize experimental numbers and to collect experimental data representing the quality performances of a system. A process parameters design for a titanium dioxide thin film in the vacuum spraying process is studied in this application study. (5%)
4. Parameter studies are an aid in selecting optimum linkage dimensions and speeds. We might examine velocities in a particular class of linkages, without specifying actual dimensions or speeds. To be as general as possible, a family of curves of velocity versus crank angle can be plotted. (5%)
5. Industry 4.0 is the current trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the Internet of things and cloud computing. These principles support companies in identifying and implementing Industry 4.0 scenarios. (5%)
6. Suppose the link lengths, configuration, and crank speed are specified and we have already solved the position and velocity equations. Let the drive crank angular velocity and acceleration be given. (5%)

IV. Questions 問答題 (共 25 分)。Answer the below questions in English or Chinese on your answer sheet. 回答下列問題，並寫在答案紙上，可以中文或英文回答。

1. What is the meaning of the term “metal forming”? (3%)
2. What is the meaning of the term “tolerance”? (3%)
3. What is the meaning of the term “anneal”? (3%)
4. What is the meaning of the term “fatigue failure” and how to prevent fatigue failure occurring? (6%)
5. What is the meaning of the term “stress concentration” and how to use the below figure? (6%)



6. What is the meaning of the term “work hardening (strain hardening)”? (4%)

國立中山大學 106 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：第1題至第4題，每題請分別根據文章之文意選出最適當的一個選項，請畫記在答案卡之「選擇題答案區」。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。(8%)

In Japan, a person's blood type is popularly believed to decide his/her temperament and personality. Type-A people are generally considered sensitive perfectionists and good team players, but over-anxious. Type Os are curious and generous but stubborn. Type ABs are artistic but mysterious and unpredictable, and type Bs are cheerful but eccentric, individualistic, and selfish. Though lacking scientific evidence, this belief is widely seen in books, magazines, and television shows.

The blood-type belief has been used in unusual ways. The women's softball team that won gold for Japan at the Beijing Olympics is reported to have used blood-type theories to customize training for each player. Some kindergartens have adopted teaching methods along blood group lines, and even major companies reportedly make decisions about assignments based on an employee's blood type. In 1990, Mitsubishi Electronics was reported to have announced the formation of a team composed entirely of AB workers, thanks to "their ability to make plans."

The belief even affects politics. One former prime minister considered it important enough to reveal in his official profile that he was a type A, while his opposition rival was type B. In 2011, a minister, Ryu Matsumoto, was forced to resign after only a week in office, when a bad-tempered encounter with local officials was televised. In his resignation speech, he blamed his failings on the fact that he was blood type B.

The blood-type craze, considered simply harmless fun by some Japanese, may manifest itself as prejudice and discrimination. In fact, this seems so common that the Japanese now have a term for it: bura-hara, meaning blood-type harassment. There are reports of discrimination leading to children being bullied, ending of happy relationships, and loss of job opportunities due to blood type.

1. What is the speaker's attitude toward the blood-type belief in Japan?
(A) Negative. (B) Defensive. (C) Objective. (D) Encouraging.
2. According to the examples mentioned in the passage, which blood type can we infer is the **LEAST** favored in Japan?
(A) Type A. (B) Type B. (C) Type O. (D) Type AB.
3. Why did Prime Minister Ryu Matsumoto resign from office?
(A) He revealed his rival's blood type.
(B) He was seen behaving rudely on TV.
(C) He blamed his failings on local officials.
(D) He was discriminated against because of blood type.
4. Which field is **NOT** mentioned in the passage as being affected by blood-type beliefs?
(A) Education. (B) Sports. (C) Business. (D) Medicine.

B. 說明：第5題至第8題，每題請分別根據文章之文意選出最適當的一個選項，請畫記在答案卡之「選擇題答案區」。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。(12%)

Many marine animals, including penguins and marine iguanas, have evolved ways to get rid of excess salt by using special salt-expelling glands around their tongue. However, the sea snake's salt glands cannot handle the massive amounts of salt that would enter their bodies if they actually drank seawater. This poses a serious problem when it comes to getting enough water to drink. If seawater is not an option, how does this animal survive in the ocean?

背面有題

國立中山大學 106 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 2 頁

An international team of researchers focused on a population of yellow-bellied sea snakes living near Costa Rica, where rain often does not fall for up to seven months out of the year. Because yellow-bellied sea snakes usually spend all of their time far from land, rain is the animals' only source of fresh water. When it rains, a thin layer of fresh water forms on top of the ocean, providing the snakes with a fleeting opportunity to lap up that precious resource. But during the dry season when there is no rain, snakes presumably have nothing to drink. Thus, the team became interested in testing whether sea snakes became dehydrated at sea.

The researchers collected more than 500 yellow-bellied sea snakes and weighed them. They found that during the dry season about half of the snakes accepted fresh water offered to them, while nearly none did during the wet season. A snake's likelihood to drink also correlated with its body condition, with more withered snakes being more likely to drink, and to drink more. Finally, as predicted, snakes captured during the dry season contained significantly less body water than those scooped up in the rainy season. Thus, it seems the snake is able to endure certain degrees of dehydration in between rains. Scientists believe that dehydration at sea may explain the declining populations of sea snakes in some parts of the world.

5. What is the purpose of the study described in this passage?
 - (A) To test if sea snakes lose body water at sea.
 - (B) To see whether sea snakes drink water offered to them.
 - (C) To find out if sea snakes are greatly reduced in population.
 - (D) To prove that sea snakes drink only water coming from rivers.
6. Which of the following is true about sea snakes?
 - (A) Their salt glands can remove the salt in the seawater.
 - (B) They can drink seawater when it mixes with rainwater.
 - (C) The ocean is like a desert to them since they don't drink seawater.
 - (D) They usually live near the coastal area where there is more fresh water.
7. Which of the following is one of the findings of the study?
 - (A) If a sea snake was dried and weak, it drank more fresh water.
 - (B) If captured in the wet season, sea snakes drank a lot of fresh water.
 - (C) Most of the sea snakes had lost a lot of body water when captured.
 - (D) Dehydration is not a problem among sea snakes since they live at sea.
8. What can be inferred from the study?
 - (A) Sea snakes can easily survive long years of drought.
 - (B) Evolution will very likely enable sea snakes to drink seawater.
 - (C) Sea snakes will be the last creature affected by global warming.
 - (D) The sea snakes' population distribution is closely related to rainfall.

C.說明：各題答對者，得4分；答錯、未作答或畫記多於一個選項者，該題以零分計(24%)

The text has seven paragraphs, A-G. Choose the correct heading for paragraphs A, B and D-G from the list of headings below. Write the correct number, 1-9, in boxes Q9-Q14 on your answer sheet.

國立中山大學 106 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 3 頁

List of Headings	
1.	Robots working together
2.	Preparing LGVs for takeover
3.	Looking ahead
4.	The LGVs' main functions
5.	Split location for newspaper production
6.	Newspapers superseded by technology
7.	Getting the newspaper to the printing center
8.	Controlling the robots
9.	Beware of robots!

Q9.	Paragraph A
Q10.	Paragraph B
Example 9	Paragraph C
Q11.	Paragraph D
Q12.	Paragraph E
Q13.	Paragraph F
Q14.	Paragraph G

ROBOTS AT WORK

Paragraph A

The newspaper production process has come a long way from the old days when the paper was written, edited, typeset and ultimately printed in one building with the journalists working on the upper floors and the printing presses going on the ground floor. These days the editor, subeditors and journalists who put the paper together are likely to find themselves in a totally different building or maybe even in a different city. This is the situation which now prevails in Sydney. The daily paper is compiled at the editorial headquarters, known as the prepress centre, in the heart of the city, but printed far away in the suburbs at the printing centre. Here human beings are in the minority as much of the work is done by automated machines controlled by computers.

Paragraph B

Once the finished newspaper has been created for the next morning's edition, all the pages are transmitted electronically from the prepress centre to the printing centre. The system of transmission is an update on the sophisticated page facsimile system already in use on many other newspapers. An imagesetter at the printing centre delivers the pages as film. Each page takes less than a minute to produce, although for colour pages four versions, once each for black, cyan, magenta and yellow are sent. The pages are then processed into photographic negatives and the film is used to produce aluminium printing plates ready for the presses.

背面有題

國立中山大學 106 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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Paragraph C (9. Beware of robots!)

A procession of automated vehicles is busy at the new printing centre where the Sydney Morning Herald is printed each day. With lights flashing and warning horns honking, the robots (to give them their correct name, the LGVs or laser guided vehicles) look for all the world like enthusiastic machines from a science fiction movie, as they follow their own random paths around the plant busily getting on with their jobs. Automation of this kind is now standard in all modern newspaper plants. The robots can detect unauthorised personnel and alert security staff immediately if they find an “intruder” ; not surprisingly, tall tales are already being told about the machines starting to take on personalities of their own.

Paragraph D

The robots' principal job, however, is to shift the newsprint (the printing paper) that arrives at the plant in huge reels and emerges at the other end some time later as newspapers. Once the size of the day' s paper and the publishing order are determined at head office, the information is punched into the computer and the LGVs are programmed to go about their work. The LGVs collect the appropriate size paper reels and take them where they have to go. When the press needs another reel its computer alerts the LGV system. The Sydney LGVs move busily around the press room fulfilling their two key functions to collect reels of newsprint either from the reel stripping stations, or from the racked supplies in the newsprint storage area. At the stripping station the tough wrapping that helps to protect a reel of paper from rough handling is removed. Any damaged paper is peeled off and the reel is then weighed.

Paragraph E

Then one of the four paster robots moves in. Specifically designed for the job, it trims the paper neatly and prepares the reel for the press. If required the reel can be loaded directly onto the press; if not needed immediately, an LGV takes it to the storage area. When the press computer calls for a reel, an LGV takes it to the reel loading area of the presses. It lifts the reel into the loading position and places it in the correct spot with complete accuracy. As each reel is used up, the press drops the heavy cardboard core into a waste bin. When the bin is full, another LGV collects it and deposits the cores into a shredder for recycling.

Paragraph F

The LGVs move at walking speed. Should anyone step in front of one or get too close, sensors stop the vehicle until the path is clear. The company has chosen a laserguide function system for the vehicles because, as the project development manager says “The beauty of it is that if you want to change the routes, you can work out a new route on your computer and lay it down for them to follow” . When an LGV' s batteries run low, it will take itself off line and go to the nearest battery maintenance point for replacement batteries. And all this is achieved with absolute minimum human input and a much reduced risk of injury to people working in the printing centres.

Paragraph G

The question newspaper workers must now ask, however is, “how long will it be before the robots are writing the newspapers as well as running the printing centre, churning out the latest edition every morning?”

D.說明：Please completely fill out the following questions.(6%)

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15. [____] is defined as the rate of change of velocity. (2%)
16. Without other force, an object that is thrown in the air falls because it is under the [____] of the Earth. (2%)
17. What is Newton's 3rd law? (2%)

E. 說明：請分別根據各篇文章之文意由題後之字匯中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。(10%)

Important breakthroughs in the foundations of mechanical engineering occurred in England during the 17th century when Sir Isaac Newton both formulated the three Newton's Laws of (18) and developed (19), the (20) basis of physics. Newton was reluctant to publish his methods and laws for years, but he was finally persuaded to do so by his colleagues, such as Sir Edmund Halley, much to the benefit of all mankind.

Mechanical engineers are also expected to understand and be able to apply basic concepts from c (21), physics, chemical engineering, civil engineering, and electrical engineering. All mechanical engineering programs include multiple semesters of mathematical classes including calculus, and advanced mathematical concepts including differential equations, partial (22) equations, linear algebra, abstract algebra, and differential geometry, among others.

Answers Keywords of according above text:

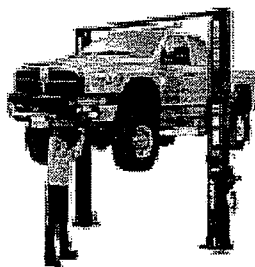
Abbreviation, basis, calculus, chemistry, force, electrical, equations, differential, motion, formula, mathematical, mechanical

F. 選擇下圖正確之名稱。每題 2 分，共 10 分。

A. Choice the Correct Answer from pictures: (10%)



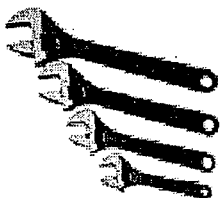
(23) _____



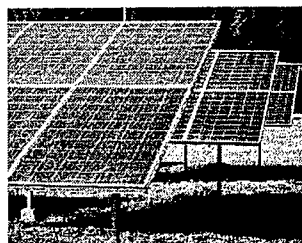
(24) _____

Ref. answers:

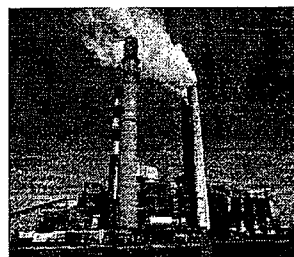
Robotor, tank,
Wheels,
Air pollution,
solar farm, carpets,
automotive, tracks,
smooth flour,
screwdriver,
wrenches, antenna,
sun batteries



(25)



(26)



(27)

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G. 翻譯下文中 underlined sentence 成中文:(每題 5 分, 共 15 分)

The distinction between science, engineering and technology is not always clear. Science is the reasoned investigation or study of phenomena, aimed at discovering enduring principles among elements of the phenomenal world by employing formal techniques such as the scientific method. Technologies are not usually exclusively products of science, because they have to satisfy requirements such as utility, usability and safety. Engineering is the goal-oriented process of designing and making tools and systems to exploit natural phenomena for practical human means, often (but not always) using results and techniques from science. The development of technology may draw upon many fields of knowledge, including scientific, engineering, mathematical, linguistic, and historical knowledge, to achieve some practical result. Technology is often a consequence of science and engineering — although technology as a human activity precedes the two fields. For example, science might study the flow of electrons in electrical conductors, by using already-existing tools and knowledge. This new-found knowledge may then be used by engineers to create new tools and machines, such as semiconductors, computers, and other forms of advanced technology. In this sense, scientists and engineers may both be considered technologists; the three fields are often considered as one for the purposes of research and reference.

翻譯：

28. Technologies are not usually exclusively products of science, because they have to satisfy requirements such as utility, usability and safety.
29. Engineering is the goal-oriented process of designing and making tools and systems to exploit natural phenomena for practical human means, often (but not always) using results and techniques from science.
30. Scientists and engineers may both be considered technologists; the three fields are often considered as one for the purposes of research and reference.

H. 簡答下列文章中相關之問題。每題五分, 共 15 分。

Classical mechanics 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.

31. What had Newton written? Why is the classical mechanics so-called exact sciences?
32. Why is classical mechanics for macroscopic processes remaining useful and well used?
33. What is Newtonian mechanics not able to explain but quantum mechanics can predict?