

管理中英庚款董事會  
第五屆留英公費生考試

試  
題

(二十六年度)

# 普通科目試題

## 黨義

- (一)從科學發展的經驗上舉例說明「知難行易」之理論
- (二)建國方略中所列各項建設事業以何者為樞紐而當先辦試說明之

## 國文

有科學之原理，斯有科學之實用，故一種科學理論之發見，每為衆多科學應用事項發生之基礎。然有時應用科學或實際知識之發展反在其相關理論科學之前。兩者之影響是否為相互的，試各就所知之學科中舉例論之。

注意：(一)題中「科學」一名詞，從其廣義，包含一切有組織之知識，不專以自然科學為限。作者可各就所習或所知之科目中舉例。

(二)文言白話均可，至多不得過七百字。作者不必刻意為文，但求思想清晰，文理通順，即可。

## ENGLISH

- I. Write an essay on one of the following topics:
  - 1. "A Little Learning is a Dangerous Thing."
  - 2. Reminiscences of My Childhood.
- II. Translate the following passage into Chinese:

In the present state of the world men suffer many evils, and this shows that their characters are not yet adjusted to the social state. Now the qualification requisite for the social state is that each individual shall have such desires only as may fully be satisfied without trenching upon the ability of others to obtain similar satisfaction. This qualification is not yet fulfilled, because civilised man retains some of the characteristics which were suitable for the conditions of his earlier predatory life. He needed one moral constitution for his primitive state, he needs quite another for his present state. The resultant is a process of adaptation which has been going on for a long time, and will go on for a long time to come.

Civilisation represents the adaptations which have already been accomplished. Progress means the successive steps of the process. That by this process man will eventually become suited to his mode of life,

Spencer has no doubts. All excess and deficiency of suitable faculties must disappear; in other words, all imperfection. "The ultimate development of the ideal man is logically certain—as certain as any conclusion in which we place the most implicit faith; for instance, that all men will die." Here is the theory of perfectibility asserted, on new grounds, with a confidence not less assured than that of Condorcet or Godwin. Progress then is not an accident, but a necessity. Civilisation is a part of nature, being a development of man's latent capabilities under the action of favourable circumstances which were certain at some time or other to occur.

III. Translate the following passage into English:

### 革命之勇氣

革命之勇氣，由仁心而生者也，仁心一日不滅，則勇氣一日不息，故能毅然以身爲犧牲而不亂。

欲犧牲其身者，其所由之道有二焉：一曰恆，二曰烈。恆乎，烈乎，斯二者欲校其難易，權其輕重，非可以一言盡也。設譬以明之：譬之治飯，盛米以鑊，束薪燒之。鑊之爲用，能任重，能持久，水不能蝕，火不能鎔，飽受煎熬，久而不渝，此恆之德也；猶革命黨人之負擔責任，集勞怨於一躬，百折不撓以行其志者也。薪之爲用，炬火熊熊，頃刻而盡，顧體質雖燬，而熱力漲發，飯以是熟，此烈之德也；猶革命黨人之猛向前進，一往不返，流血既同種者也。

IV. Auditory Comprehension Test.

### INSTRUCTIONS

Ladies and gentlemen, I shall try, by means of this examination, to test your comprehension of spoken English. But do not worry, for the questions will be, on the whole, easy ones. I shall endeavor to speak slowly and distinctly, and you will be given ample time in which to answer. However, you must listen carefully both to the directions and to the questions asked that you may avoid foolish mistakes and do yourselves justice. The examination consists of two parts, the directions for which will be given separately. I shall now turn to Part I.

## PART I

In this part, I shall make, one after the other, a series of statements, some of which are obviously true and some of which are obviously false. You must listen to these statements and decide whether each one is a correct statement—that is, true and according to fact—or an incorrect statement—that is, false and contrary to fact. You will then indicate your decision on the paper you have before you, by placing a check mark (✓) or a cross (✗) in the space following the number of the statement. If you think the statement is true, place a check in the space, the sign that looks like the letter v; if you think it is false, place a cross there, the sign that looks like the letter x. Remember that a check mark (✓) means that you consider the statement true; a cross (✗) means that you consider the statement false. Let me give you an example; by making two statements, the answers to which are given on your paper. Statement A is “My clothes are made of cloth”. As that is a true statement, a check (✓) has been placed in the space after the letter A. Statement B is “Coal is white”. As that is a false statement, a cross (✗) has been placed in the space after the letter B. Of course, if you do not understand the question, or do not know the answer, it is safest not to guess but to leave the space blank. I shall now begin.

1. There are more letters in the word SICK than in the word THICK.
2. The word FIRE is spelt F-I-R-E.
3. The word BAT means the opposite of GOOD.
4. H-I-T is pronounced HEAT.
5. That part of the day in which one sleeps is called the LIGHT.
6. The word VINE begins with a V.
7. Neither PICK nor PECK is spelt with a G.
8. RUN is the past participle of the verb to ring.
9. We speak of a woman as “he”.
10. Children are sent to school to study.
11. Of the two numbers four and seven, the first is the smaller.
12. Birds very often grow on tall trees.
13. You are now writing on a blank sheet of paper.
14. Students usually learn easy lessons much more quickly than difficult ones.

15. The instrument which tells us the time of day is called an hour.
16. Most people eat breakfast early in the morning, not in the afternoon at all.
17. The proper answer to the question, "Are all men of the same height"? is "No".
18. The proper answer to the question, "Have not floods killed many people in China"? is "Yes".
19. If you had received a prize of a hundred dollars, you would be feeling very sorry and low in your spirits.
20. A man who makes a business of lending money to others is called a beggar.
21. When you have washed your face, you then dry it with water.
22. A system of government in which the people elect their own ruler is called a president.
23. It is not possible to travel from China to England in as short a time as it takes one to go from Shanghai to Peiping.
24. I would describe a man who always shares with his friends everything that he has, as unselfish.
25. Summer vacation begins in June and ends in August. Therefore, January is a part of it.
26. It is always difficult to secure ice when the temperature is below zero fahrenheit.
27. Whenever there is too little food, and people can find no way of supporting themselves, we say that a country is prosperous.
28. We want something very much, but we do not have enough money to pay for it. Therefore, we can easily afford it.
29. That study which deals with the processes, activities, and phenomena incidental to and characteristic of living organisms is called history.
30. She is willing to come to my house, but she would rather go to yours. The logical conclusion is that she prefers you to me.
31. A certain book was written in the sixteenth century. Smith lived in the sixteenth century. Therefore that book might have been written by Smith.
32. Mr. Brown has never been outside of England and has not even been fifty miles from London. It is therefore safe to say that Mr. Brown has traveled widely.

33. In a certain country there are many institutions of learning, and commerce and industry are well developed. But sanitation is neglected and mortality is high. Every year, epidemics take off large numbers of the people. What that country needs is factories.

		SCORE		
		I	II	T
EXAMPLES:	A. <u>✓</u> B. <u>×</u>			
1. _____	7. _____	13. _____	19. _____	25. _____
2. _____	8. _____	14. _____	20. _____	26. _____
3. _____	9. _____	15. _____	21. _____	27. _____
4. _____	10. _____	16. _____	22. _____	28. _____
5. _____	11. _____	17. _____	23. _____	29. _____
6. _____	12. _____	18. _____	24. _____	30. _____
* * *				

## PART II

In this part, I shall read to you several short paragraphs. After I have read each paragraph, I shall ask you several questions on the contents or meaning of that paragraph. You have, on the paper before you, four possible or impossible answers for each question. As soon as you hear the question, decide which answer you think is the right one. Then place in the space in the right-hand margin the letter (A,B,C, or D) which comes before that answer. If you think the first answer correct, place the letter A in the space; if the second answer, the letter B; and so on. In each case, answer the question by placing a letter (A,B,C, or D) in the space in the right-hand margin, and do nothing more. Of course, if you are uncertain or do not know, it will be safest not to guess but to leave the space blank. I shall now begin Part II.

PARAGRAPH A: Men were once engaged in driving a railway tunnel under a large river, not far from London. While they were working, an accident

occurred. All escaped except one man who stumbled and fell while running away from the confusion. Before he could regain his feet, the muddy water rushed over him. The accident was due to carelessness on the part of one man who did not do his duty.

Question 1. Where was the tunnel being made?

Question 2. How many men failed to escape?

Question 3. What was the cause of the accident?

PARAGRAPH B: Forest fires, which cause such enormous damage every year, are due to a variety of causes. One very common cause is the falling of sparks from a passing train upon dry leaves and brush. A more common source of fires is the camp-fire left incompletely extinguished by hunters and picnickers. The most common cause of all is the half-burned cigarette stub carelessly thrown by motorists into the ditch, where it sets fire to dry grass. The only natural cause of forest fires, and the least common one, is lightning, which when it blasts a tree will sometimes set brush burning. If steps are taken to eliminate these causes, such fires can be very largely controlled.

Question 1. What is said to be the most common cause of forest fires?

Question 2. What people are said to be most responsible for fires?

Question 3. What implication in regard to forest fires does the paragraph carry?

PARAGRAPH C: Certain weak points in Black Hawk's character made him an easy prey to his enemies. He was easily flattered, and his enemies boasted loudly of his leadership while they subtly encouraged him into hopeless wars. He was very gullible, seeming unable to tell his friends from his foes. But Black Hawk also possessed strong points of character. He showed throughout his entire relations with the white people a manliness of character that forces us to think well of him and his race. Furthermore, he was honest in all his dealings. In addition, he showed a military genius that ranks him as one of the most intelligent Indians in history. Above all, he was loyal to his people and thought first of their comfort and safety.

Question 1. What phrase best describes the subject of this portrait?

Question 2. Why was Black Hawk easily deceived by his enemies?

Question 3. What is the attitude of the author as expressed in this paragraph?



PARAGRAPH D: Perhaps the most striking instances of adaptation to varying conditions determined purely by congenital endowment, independent of prior existence, are to be found in the behavior of ants. All the activities characteristic of ants, as well as of bees and wasps, are in their main outlines instinctive. They are displayed by ants which have been taken from their nests immediately after their being hatched, and set apart to form a new nest. Independently of prior experience, the processes of nest-building, the rearing of the young, the capture of the so-called slaves, the maintenance of domestic animals, and the like, vary in adaptation to varying circumstances.

- Question 1. Of what does this paragraph describe the activities?
- Question 2. What kind of activity is described in this paragraph?
- Question 3. What is it, according to the writer, that determines adaptation to environment?
- Question 4. Which of the following activities is not mentioned in this paragraph?

PARAGRAPH E: It would seem, on a hasty view, that the attainment of as much as possible was the one goal of man's contentious life. And yet, as regards the spirit, this is but a semblance. We live in an ascending scale when we live happily, one thing leading to another in an endless series. There is always a new horizon for onward-looking men, and although we dwell on a small planet, immersed in petty business and not enduring beyond a brief period of years, we are so constituted that our hopes are inaccessible, like stars, and the term of hoping is prolonged until the term of life. To be truly happy is a question of how we begin and not of how we end, of what we want and not of what we have. An aspiration is a joy forever, a possession as solid as a landed estate, a fortune which we can never exhaust and which gives us year by year a revenue of pleasurable activity. To have many of these is to be spiritually rich.

- Question 1. What does the writer consider to be the most important thing in life?
- Question 2. How does the writer describe life?
- Question 3. What does the writer compare with stars?
- Question 4. Which word or phrase best describes the author's attitude toward life?



A. 1. A) under a railway, B) beneath a river, C) through the water, D) in London \_\_\_\_\_

2. A) one of the men, B) all of the men, C) none of the men, D) all but one of the men \_\_\_\_\_

3. A) the fact that some men fell, B) the muddy water of the river, C) carelessness, D) the confusion \_\_\_\_\_

B. 1. A) lightning, B) sparks from trains, C) half-burned cigarettes, D) incompletely extinguished campfires \_\_\_\_\_

2. A) people in cars, B) hunters, C) passengers on trains, D) men who fell trees \_\_\_\_\_

3. A) that they are increasing, B) that they are caused intentionally, C) that they are not controllable, D) that they are largely caused by man \_\_\_\_\_

C. 1. A) an evil character, B) a perfect leader, C) difficult to understand, D) a mixture of good and bad \_\_\_\_\_

2. A) He was a military genius, B) He was dishonest, C) He was easily flattered, D) He had insight into character \_\_\_\_\_

3. A) He worships Black Hawk, B) He hates Black Hawk, C) He has no feelings about Black Hawk, D) He is trying to give a fair picture of Black Hawk \_\_\_\_\_

D. 1. A) human beings, B) insects, C) beasts, D) slaves \_\_\_\_\_

2. A) independent, B) acquired, C) instinctive, D) undetermined \_\_\_\_\_

3. A) nest-building, B) prior existence, C) adaptation to circumstance, D) congenital endowment \_\_\_\_\_

4. A) warfare, B) home-making, C) commerce, D) animal husbandry \_\_\_\_\_

- E. 1. A) attainment of as much as possible, B) aspirations, C) business, D) prolonging the term of life \_\_\_\_\_
2. A) not to be measured, B) filled with struggle, C) very exhausting, D) a pleasurable activity \_\_\_\_\_
3. A) the earth, B) a small planet, C) hopes, D) a landed estate \_\_\_\_\_
4. A) idealism, B) pessimism, C) cynicism, D) scepticism \_\_\_\_\_

# 專門科目試題

## 天文門

### (1) GENERAL ASTRONOMY

(Answer any 6 questions.)

- I. (1) Describe the different systems of coördinates used in astronomy and their transformations.
- (2) On March 21, one hour after sunset, what would be the approximate position of a star having a right ascension of seven hours and a declination equal to the latitude of the observer?
- II. (1) If  $H$  is the hour angle of a star at rising, show that
- $$\tan^2 \frac{H}{2} = \frac{\cos (\varphi - \delta)}{\cos (\varphi + \delta)}$$
- $\varphi$  being the latitude of the observer,  $\delta$  the declination of the star.
- (2) How many hours and minutes is the sun above the horizon at Nanking ( $\varphi = 32^\circ 4'$ ) on the day of summer solstice? The obliquity of the ecliptic is  $23^\circ 27'$ .
- III. (1) Define (a) Sidereal Time (b) Apparent Solar Time (c) Mean Solar Time (d) Standard Time (e) Equation of Time.
- (2) Show that the relation between Sidereal Time  $T$  and Mean Solar Time  $t$  at any instant is
- $$T = \alpha_m + 12^h + t$$
- where  $\alpha_m$  is the right ascension of the Mean Sun at the instant considered.
- IV. (1) State Kepler's laws concerning the planetary motion and show that the 3rd or harmonic law is only an approximation.
- (2) Halley's Comet has a period of about 76 years. At perihelion its distance from the sun is 0.58 of an astronomical unit. Find its distance at aphelion and the eccentricity of its orbit.
- V. Describe several methods for the determination of stellar parallax.
- VI. (1) Define the (a) visual (b) photographic (c) Photo-visual (d) Bolometric and (e) absolute magnitude of a star.

- (2) Suppose  $m$  be the apparent and  $M$  the absolute magnitude of a star, show that its distance  $r$  is related to  $m$  and  $M$  by the formula:

$$\log_{10} r = \frac{m - M + 5}{5}.$$

- VII. (1) Describe the equatorial mounting of a telescope.  
 (2) Describe the Newtonian and the Cassegrainian form of a reflecting telescope.  
 (3) Compare the relative advantages of reflecting and refracting telescopes.

## (2) GENERAL MATHEMATICS

1. Find the equation of the ellipse determined by the five points:

$$P_1(1,1), P_2(\sqrt{3}, 0), P_3(-\sqrt{3}, 0), P_4(0, \sqrt{3}), P_5(0, -\sqrt{3}).$$

Find also its semiaxes, foci and eccentricity.

2. (a) Two vectors are determined by the point pairs:

$$P_1(0,3,4), Q_1(-2,2,2); P_2(6,1,0), Q_2(2,1,-3).$$

What is the angle they make with each other?

- (b) On the upper half of the unit sphere

$$x^2 + y^2 + z^2 = 1$$

two points are given whose  $xy$ -coordinates are  $x_1 = 0, y_1 = \frac{1}{\sqrt{2}}$  and

$x_2 = \frac{1}{2}\sqrt{3}, y_2 = \frac{1}{4}\sqrt{2}$  respectively. How long is the smaller arc of the great circle passing through the given points?

3. If  $P$  is the perpendicular from one of the base angles of a spherical isosceles triangle to the opposite side, show that

$$\sin P = 2 \sin \frac{a}{2} \cos \frac{A}{2}$$

where  $a$  is the base and  $A$  the angle at the vertex.

4. Describe Newton's method for approximating to a real root of the equation  $f(x) = 0$ , and explain geometrically with the aid of a figure.

Apply the method to obtain the root near  $x = 2$  of the equation

$$x^4 - 5x - 5 = 0.$$

5. A variable sphere of radius  $r$  is described with its center on the surface of a fixed sphere of radius  $a$ . Prove that the area of its surface intercepted inside the fixed sphere is a maximum when  $r = 4a/3$ .

6. Compute the area enclosed by the curve

$$x = 3 \cos t - \cos^3 t, y = \sin^3 t.$$

Compare this area with that of the ellipse having the same vertices. Show that except for the vertices the given curve is always interior to the ellipse.

7. A straight line  $OP$  revolves about the fixed point  $O$  with a constant velocity, while the other point  $P$  moves along the line with a velocity proportional to the distance  $\overline{OP}$ . Find the equation of the curve described by  $P$ . Show that the tangent to the curve always makes one and the same angle with the revolving line,
8. Solve the differential equation;

$$\frac{d^2 y}{dx^2} - 2m \frac{dy}{dx} + m^2 y = \sin nx.$$

### (3a) MATHEMATICAL ANALYSIS

1. (a) State the first and the second laws of the mean for integrals.  
(b) Define the finite and the infinite discontinuities of a function  $f(x)$  at  $x = a$ . Give examples.  
(c) State the necessary and sufficient condition for the uniform convergence of a series of functions.
2. (a) State and prove the Taylor's series for function of one variable with integral remainder.  
(b) Study the convergence of the integral

$$\int_0^{\infty} x e^{-x^6} \sin 2x \, dx.$$

3. Integrate

(a)  $\int \frac{x^{n-1} \, dx}{\sqrt{R}},$

(b)  $\int \frac{dx}{x(nx-n-1)\sqrt{R}},$

where

$$R = nx^{n-1} + (n-1)x^{n-2} + \dots + 3x^2 + 2x + 1.$$

4. If  $y = \sin (m \sin^{-1} x)$ , prove that

$$(1-x^2) \frac{d^{n+2}y}{dx^{n+2}} = (2n+1)x \frac{d^{n+1}y}{dx^{n+1}} + (n^2-m^2) \frac{d^ny}{dx^n}.$$

Expand  $y$  in the powers of  $x$ .

5. If  $b^2 - ac = 0$ , prove that the integral

$$\int \frac{b-x}{b+x} \frac{dx}{\sqrt{x(x+a)(x+c)}}$$

may be integrated by means of elementary functions.

### (3b) MODERN PHYSICS

(In solving the following problems, the values of the fundamental constants are taken to be: Electronic charge,  $e = 4.77 \times 10^{-10}$  e.s.u.; Mass of electron,  $m = 9.035 \times 10^{-28}$  g.; Planck's constant,  $h = 6.55 \times 10^{-27}$  erg. sec.; Avogadro's number,  $N = 6.064 \times 10^{23}$  per mol; Velocity of light,  $c = 3 \times 10^{10}$  cm. per sec.; Rydberg constant,  $R_{\infty} = 1.097 \times 10^5$  cm.<sup>-1</sup>)

- Electrons are projected with velocity  $v$  from a point in a uniform magnetic field  $H$ . The electrons all start off in nearly the same direction, which is perpendicular to the field. Show that they will all pass through a line parallel to the field, and find the position of this line.
- Give the principle of J. J. Thomson's positive ray parabola apparatus.
  - If hydrogen positive rays continue to radiate light 4 cm. beyond the cathode and the  $H\beta$  line ( $\lambda = 4861 \text{ \AA}$ ) has a Doppler shift to the blue end of 5 angstroms, estimate the time duration of light emission from hydrogen ions.
- X-rays from a Coolidge tube fall upon a thin piece of silver (atomic number = 47), and the secondary K-radiations of silver are observed. What is the minimum potential difference in volts across the Coolidge tube? Do you expect to observe from the silver radiator other secondary emissions besides the K-radiations? If so, discuss briefly their characteristics.

4. The radioactive constant for radium is  $1.30 \times 10^{-11}$  per second and its atomic weight is 226. The atomic weight of uranium I is 238. There are  $3.44 \times 10^{-7}$  grams of radium in equilibrium with each gram of uranium I. Find the half-value period of uranium I in years.
5. Assuming that "heavy" hydrogen has an atomic mass twice that of ordinary hydrogen, find the approximate distance in angstroms between the respective  $H_{\infty}$ 's of these isotopes.
6. What evidences are there that the atomic number is equal to the number of electrons (extra-nuclear) in the atom? Why is the atomic number considered to be of more fundamental significance than the atomic weight?

#### (4a) THEORETICAL MECHANICS AND CELESTIAL MECHANICS

Work out either (a) or (b) in each set of problems.

- I. (a) Write the equations of motion of a projectile in the air, whose resistance  $mg\varphi(v)$  is taken into account. Express the rectangular coordinates of the projectile in terms of  $\theta$  (the angle between the tangent to the path and the horizontal) by means of a quadrature. If

$$\varphi(v) = \frac{1}{n}(a + bv^n),$$

show that the limiting velocity of the projectile as time increases indefinitely is

$$\left(\frac{n-a}{b}\right)^{\frac{1}{n}}.$$

- (b) Derive the differential equation of the orbit of a particle under the action of a central force. If the force be attractive and varies directly as the distance, show that the orbit is an ellipse with the center of force at its geometrical center.
- II. (a) What is Gauss' law and what is Gauss' theorem in the potential theory? Give a proof for each.
- (b) Derive Hamilton's canonical equations from Lagrange's equations of motion.



- III. (a) Derive the Kepler's equation for the motion of a planet. Show how an approximate solution may be obtained by the graphical method and how to obtain the more exact value by successive approximation.
- (b) Derive Euler's equation involving two radii and their chord in a parabolic motion.

- IV. (a) If a homogeneous sphere of radius  $a$  contracts under the mutual attraction of its constituent particles to one of radius  $b$ , show that the work done by the gravitational force is equal to

$$\frac{3}{5} M^2 k^2 \left( \frac{1}{b} - \frac{1}{a} \right),$$

where  $M$  is the total mass of the sphere.

- (b) Liouville showed that all dynamical problems for which the kinetic and potential energies can respectively be put in the forms

$$T = \frac{1}{2} \psi \left[ \varphi_1(q_1) \dot{q}_1^2 + \dots + \varphi_n(q_n) \dot{q}_n^2 \right], \quad V = \frac{1}{\psi} \left[ \omega_1(q_1) + \dots + \omega_n(q_n) \right]$$

where  $\psi = \psi_1(q_1) + \dots + \psi_n(q_n)$ ,

may be solved by quadrature. Can you prove this theorem for the particular case  $\psi = 1$ ? Show that the motion of a particle about two fixed centers of force may be transformed into a system of Liouville's type by introducing elliptic coördinates.

- V. (a) Show that, according to the equilibrium theory of the tides, the elevation of the water above the mean sea level at any point is given by

$$S = \frac{1}{2} \frac{M}{E} \left( \frac{a}{R} \right)^3 a (3 \cos^2 \Theta - 1)$$

where  $M$  and  $E$  are masses of the moon and the earth;  $a$ , radius of the earth;  $R$ , distance of the moon; and  $\Theta$ , the angle between the point under consideration and the moon as viewed from the center of the earth.

- (b) If  $a$ ,  $p$ ,  $i$ , denote respectively the semi-major-axis, semiparameter, and inclination of a cometary orbit, show that the quantity

$$\frac{1}{a} + \frac{2\sqrt{p} \cos i}{a^{3/2}}$$

remains constant before and after a close approach to a planet, whose orbit is supposed to be a circle of radius  $a'$ . This is Tisserand's criterion for the identity of comets.

#### (4b) ASTROPHYSICS

(Answer any 4 questions.)

1. (a) Name several methods by which the surface temperature of stars is determined.  
(b) Describe one method in detail.  
(c) State briefly the chief technical difficulties encountered in the method of Photographic Spectrophotometry.
2. What are the Fraunhofer Lines? Explain the mechanism of the formation of these Lines.
3. Discuss the Theory of Thermal Ionization in the stellar atmosphere, and trace its relation to Stellar Evolution.
4. Discuss, (a) the nature and (b) the modern theory of Sun-spots.
5. Describe fully the theory and construction of the Hale Spectroheliometer.