

# 國立中山大學 108 學年度 碩士暨碩士專班招生考試試題

科目名稱：熱力學【材料前瞻應材碩士班乙組】

## — 作答注意事項 —

考試時間：100 分鐘

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國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：熱力學【材料前瞻應材碩士班乙組】

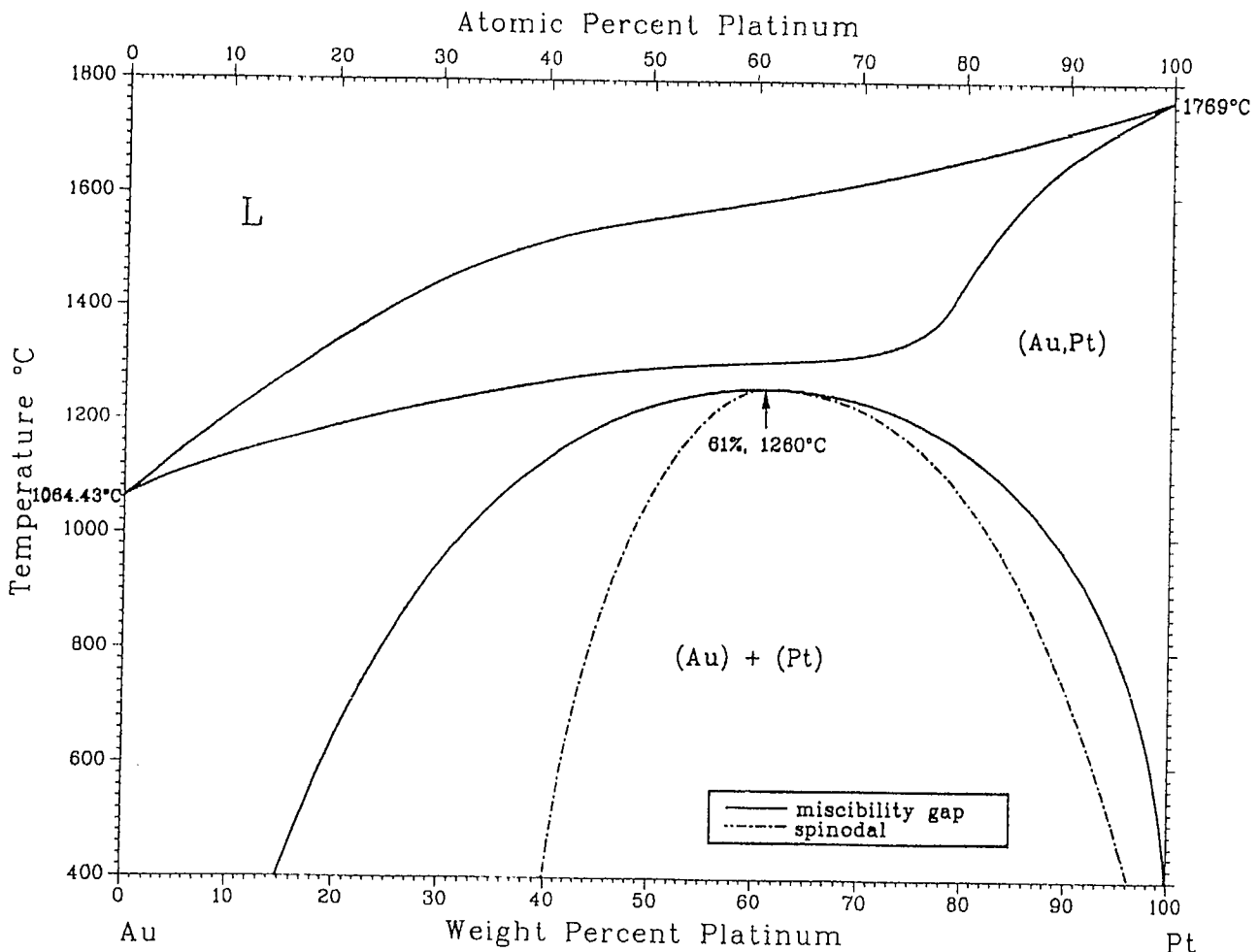
題號：487006

※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

- One mole of a monatomic ideal gas undergoes a reversible expansion at constant pressure during which the entropy of the gas increases by  $14.41 \text{ J/K}$  and the gas absorbs  $6236 \text{ joules}$  of heat. [1a, 10%] Calculate the initial and final temperatures of the gas. One mole of a second monatomic ideal gas undergoes a reversible isothermal expansion during which it doubles its volume, performs  $1729 \text{ joules}$  of work and increases its entropy by  $5.763 \text{ J/K}$ . [1b, 10%] Calculate the temperature at which the expansion was conducted. ( $C_v = 1.5R$  for ideal gas) (20%)
- Calculate the required pressure to distill mercury at  $80^\circ\text{C}$  and explain it. [15%]  
The vapor pressure of liquid mercury is,  
 $\ln P \text{ (atm)} = -7611/T - 0.795\ln(T) + 17.168$
- Measurements of the saturated vapor pressure of liquid A gives  $0.3045 \text{ atm}$  at  $205^\circ\text{C}$  and  $0.9310 \text{ atm}$  at  $247^\circ\text{C}$ . Calculate the normal boiling temperature of A. [15%]
- One mole of solid  $\text{Cr}_2\text{O}_3$  at  $2500 \text{ K}$  is dissolved in a large volume of a liquid Raoultian solution of  $\text{Al}_2\text{O}_3$  and  $\text{Cr}_2\text{O}_3$  in which  $X_{\text{Cr}_2\text{O}_3} = 0.2$  and which is also at  $2500 \text{ K}$ . Calculate the changes in enthalpy [4a, 10%] and entropy [4b, 10%] caused by the addition. The melting temperature of  $\text{Cr}_2\text{O}_3$  is  $2538 \text{ K}$ , and it can be assumed that the  $\Delta S_{m, \text{Cr}_2\text{O}_3} = \Delta S_{m, \text{Al}_2\text{O}_3}$ . ( $\Delta H_{\text{melting}}$  of  $\text{Al}_2\text{O}_3 = 107500 \text{ J}$  and  $T_{\text{melting}} = 2324 \text{ K}$ ) (20%)
- Plot the molar Gibbs free energy of mixing ( $\Delta G_{\text{mix}}$ ) of each phase and show their relationships with equilibrium phase compositions at temperature  $1400^\circ\text{C}$ [5a, 10%],  $800^\circ\text{C}$ [5b, 10%] and describe the meaning of dash line[5c, 10%], according to the following diagram. (30%)

**Au-Pt**



# 國立中山大學 108 學年度 碩士暨碩士專班招生考試試題

科目名稱：英文【材料前瞻應材碩士班甲組】

## — 作答注意事項 —

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# 國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：英文【材料前瞻應材碩士班甲組】

題號：487005

※本科目依簡章規定「不可以」使用計算機(選擇題)

共 3 頁第 1 頁

第一部份(單選題，每題 3 分)

1. In response to the forecast of the upcoming typhoon, the concert on the beach had to be \_\_\_\_\_ until next Saturday.  
(A) revoked (B) launched (C) abandoned (D) postponed
2. By 1990, production in the area is expected to double \_\_\_\_\_ of 1980.  
(A) that (B) it (C) one (D) what
3. The current economic recession is threatening the \_\_\_\_\_ of many people in the country.  
(A) substance (B) maturity (C) qualifications (D) livelihoods
4. Superconductors lose electrical resistance only \_\_\_\_\_ subjected to intense cold.  
(A) through (B) when (C) as (D) by
5. \_\_\_\_\_ exposure to dirty air can cause people suffer from some diseases.  
(A) Raised (B) Prolonged (C) Expanded (D) Enlarged
6. I think George would have been elected \_\_\_\_\_ so pompous.  
(A) if he has sounded (B) had he sounded (C) if he hadn't sounded (D) if he didn't sound
7. Understanding the cultural habits of another nation, especially \_\_\_\_\_ containing as many different subcultures as the United States, is a complex task.  
(A) one (B) the one (C) that (D) such
8. The ratio of the work done by the machine \_\_\_\_\_ the work done on it is called the efficiency of the machine.  
(A) against (B) with (C) to (D) for
9. In your first days at the school you'll be given a test to help the teachers to \_\_\_\_\_ you to a class at your level.  
(A) locate (B) place (C) deliver (D) assign
10. Resettling refugees is a global \_\_\_\_\_ obligation. Many of these countries, including the United States, have taken in refugees from that part of the world over the last several years.  
(A) hostile (B) humanitarian (C) antagonistic (D) oblivious (E) indifferent
11. Even though AIDS has already claimed millions of lives throughout the world, many people still don't \_\_\_\_\_ the need to take precautions against the disease.  
(A) appreciate (B) eventuate (C) overcome (D) confiscate
12. The government is taking steps to \_\_\_\_\_ the impact of inflation.  
(A) mitigate (B) vitalize (C) contradict (D) underline
13. Construction of the new highway system \_\_\_\_\_ completed on time if more workers had been hired.  
(A) needs to be (B) would have been (C) will be (D) should have
14. Professor Smith and Professor Brown will \_\_\_\_\_ in giving the class lectures.  
(A) alter (B) change (C) alternate (D) differ
15. A four-year \_\_\_\_\_ that sampled microbes from across the world's oceans is bringing the

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共 3 頁第 2 頁

mechanisms of climate change into focus.

(A) exploitation (B) exemplification (C) exploding (D) expedition

16. A batch of sodium chloride manufactured by Y F Chemical Corp. was \_\_\_\_\_ with bacteria, resulting in fevers for eight patients after they were injected with the solution.

(A) purified (B) disinfected (C) obstructed (D) tainted

17. \_\_\_\_\_ a global nuclear war, life on earth as we know it would end forever.

(A) There should be (B) Should there be (C) If there had been (D) If there will be

18. Mr. Smith attends to the \_\_\_\_\_ of important business himself.

(A) transmission (B) transformation (C) transaction (D) transition

19. Society now requires the university to be a part of the community. \_\_\_\_\_, students themselves expect to play a role in the affairs of society.

(A) Hence (B) However (C) Moreover (D) Otherwise

20. The man you saw at the entrance is a veteran employee in the company. He \_\_\_\_\_ here twenty-seven years by the end of this year.

(A) has been working (B) has worked (C) would be working (D) will have been working

第二部份(單選題，每題 4 分)

It would be quite naive to expect a life without conflict, naive and boring. After all, as we struggle to find solutions, conflict leads to new ways of thinking. Nothing ever 21 in a world without conflicts. We see this in our lives; we see this in science. In fact, in science crises are essential: without them there is no 22. A life lived in harmony 23 a life without conflict. It must be a life where conflict leads to growth. Harmony is not the absence of conflict. It is the state in which conflict leads to positive change. Harmony is dynamic, not static. Innovation and growth challenge the status quo, shaking the very foundations where most base their values. Change only comes when we are ready to embrace it; change needs 24. It is much easier to plant our feet in the traditional, the convenient, in what does not force us to reexamine our views. No one likes to be wrong. This is why great innovation comes with 25, often bloody. The blood that is spilled is not always the one coursing through our veins: it is the blood of conviction, of prejudices, of deepseated ideas that are abandoned by the inexorable force of reason.

21. (A) forsakes (B) chooses (C) changes (D) reports

22. (A) innovation (B) place (C) time (D) relationship

23. (A) can't be (B) isn't that (C) is what (D) must do

24. (A) rhetorical questions (B) open minds (C) no evaluation (D) weak links

25. (A) revolution (B) information (C) tradition (D) conjunction

E-waste is being produced on a scale never seen before. Computers and other electronic devices 26 obsolete in just a few years, leaving consumers with few alternatives but to catch up by buying newer models. Tens of millions of tons of computers, TVs, VCRs, monitors, cell phones, and other gadgets 27 each year. Unfortunately, in most parts of the world, the bulk of all this e-waste 28 landfills, where it poisons the environment. This is because it contains a variety of toxic 29 such as lead, mercury, and arsenic that leak into the ground. In theory, recycling seems to be a good 30. However, the problem is that a large percentage of e-waste dropped off for recycling in rich countries is

背面有題

試題請隨卷繳回

國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：英文【材料前瞻應材碩士班甲組】

題號：487005

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共 3 頁第 3 頁

sold to the developing world, where its toxin may threaten the health of people living there.

26. (A) beget (B) begot (C) become (D) became
27. (A) is discarded (B) are discarded (C) is disputed (D) are disputed
28. (A) end at (B) ends up (C) end up to (D) ends up in
29. (A) subtitles (B) subsidies (C) substances (D) subordinates
30. (A) solution (B) pollution (C) salutation (D) population

# 國立中山大學 108 學年度 碩士暨碩士專班招生考試試題

科目名稱：材料科學【材料前瞻應材碩士班丙組】

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# 國立中山大學 108 學年度碩士暨碩士專班招生考試試題

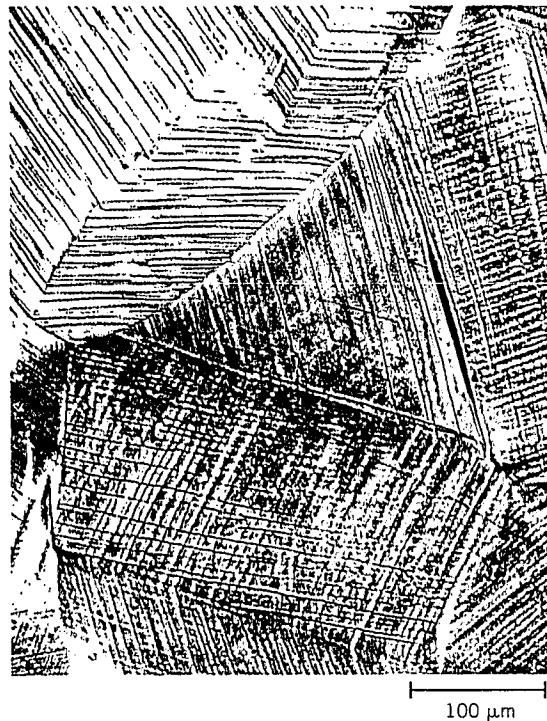
科目名稱：材料科學【材料前瞻應材碩士班丙組】

題號：487004

※本科目依簡章規定「不可以」使用計算機(問答申論題)

共 2 頁第 1 頁

- (1) For hexagonal crystals, Miller indices and Miller-Bravais indices can both be used to express directions and planes. Explain why two kinds of indices are used? 5 points
- (2) For diffusion in crystals to occur, an activation energy is required. (a) Explain the meaning of the activation energy of a diffusion process. (b) Explain why in most systems, the activation energy for interstitial diffusion is often lower than that for substitutional diffusion. 5 points each, 10 points
- (3) (a) Why the tensile fracture strain of a metal is always less than the compressive fracture strain? (b) Why the ultimate tensile strength of a material is defined as the stress at the maximum load during a tensile test? 4 points each, 8 points
- (4) Explain the following terms: (a) Anisotropy, (b) Schmid factor, (c) Fermi surface, (d) Ferromagnetism, (e) Semi-coherent interface boundary, (f) CCT diagram. 5 points each, 30 points
- (5) This figure showing the slip lines on the surface of a polycrystalline copper that was polished and subsequently deformed. Discuss this figure. 6 points



- (6) Give a schematic drawing of the solidification structure of a peritectic reaction under fast cooling rate. Equilibrium state is not obtained under the fast cooling rate. Explain your drawings. 6 points



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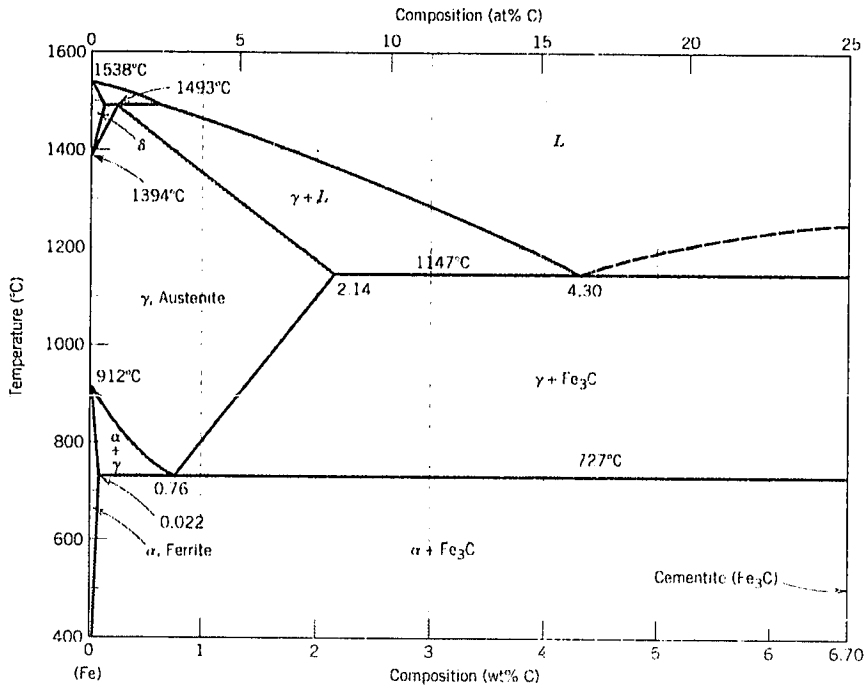
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共 2 頁第 2 頁

(7) Sketch the structures of (a) 0.4 wt% carbon steel, (b) 0.8 wt% carbon steel, and (c) 1.1 wt% carbon steel, that you would expect to see under an optical microscope. Label the phases and any other features of interest. These steels have been cooled slowly from 1000°C.

3 points each, 9 points



(8) For some substitutional solid solutions, an ordered phase (superlattice) is formed below a certain temperature ( $T_0$ ), and a disordered phase is formed above  $T_0$ . Explain the reason for this?

6 points

(9) Under what condition(s) dynamic strain aging can occur in metals.

5 points

(10) The solidification process of a material can occur at a temperature well below its melting point, what is the reason for this?

5 points

(11) Viscosity is used to measure the resistance to deformation of a noncrystalline material. How viscosity is defined? And what is the unit of viscosity?

5 points.

(12) Draw a typical creep curve of strain versus time at constant load and constant elevated temperature. Explain your drawing.

5 points

# 國立中山大學 108 學年度 碩士暨碩士專班招生考試試題

科目名稱：工程數學【材料前瞻應材碩士班乙組】

## —作答注意事項—

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國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：工程數學【材料前瞻應材碩士班乙組】

題號：487001

※本科目依簡章規定「不可以」使用計算機(問答申論題)

共 1 頁 第 1 頁

1. Find the general solution of  $2y' - \frac{x^3 + xy^2}{x^2y} = 0$  (15%)
2. Use Frobenius method to solve the following equation:  
 $5x^2y'' - xy' + 1.8y = 0$  (20%)
3. Use Laplace transform to solve the following equation:  
 $y'' + 5y' + 6y = 1 - u(t-1)$ ,  $y(0) = 0$ ,  $y'(0) = 0$  (15%)
4. Find a basis of eigenvectors of the following matrix and diagonalize it:  
 $A = \begin{bmatrix} 3 & 4 \\ 1 & 3 \end{bmatrix}$  (15%)
5. A violin string is fastened at the ends  $x=0$  and  $x=1$ . Assuming the vibrations of the violin string can be modeled by the one dimensional wave equation:  $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$   
Find the deflection  $u(x,t)$  for the string when the initial velocity is zero and the initial deflection satisfies  $u(x,0) = \begin{cases} x & \text{if } 0 < x < 0.5 \\ 1-x & \text{if } 0.5 < x < 1 \end{cases}$  (20%)
6. Calculate the work done by the force  $\vec{F} = [x^2, y^2, z^2]$  in the displacement along curve  $C$ :  
 $\vec{r} = [\sin t, \cos t, e^t]$  from  $(0,1,1)$  to  $(0,-1,e^\pi)$ . (15%)

# 國立中山大學 108 學年度 碩士暨碩士專班招生考試試題

科目名稱：普通物理【材料前瞻應材碩士班丙組】

## —作答注意事項—

考試時間：100 分鐘

- 考試開始響前不得翻閱試題，並不得書寫、劃記、作答。請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
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- 試題採雙面列印，考生應注意試題頁數確實作答。
- 違規者依本校招生考試試場規則及違規處理辦法處理。

**Problem 1. [Mechanics: 40 points]**

Materials are made of atoms linked by the electrostatic force. Around the equilibrium positions, the electrostatic force can be modeled as a spring with elastic constant  $k$ .

(a) [5 points] If the potential between two atoms is:

$$V(r) = e^{-\frac{r}{a}} - \frac{C}{r},$$

where  $r$  is the distance between the two atoms,  $a$  and  $C$  are constants. If this potential function has a minimum at  $r = r_0$ , do Taylor's expansion of  $V(r)$  around  $r = r_0$ :

$$V(r) \approx V_0 + \frac{1}{2} k (r - r_0)^2 + \dots$$

to obtain  $V_0$  and  $k$  (express your answers with  $r_0$ ,  $a$ , and  $C$ ).

(b) [5 points] Use the result of (a), what is the force between the two atoms?

(c) [10 points] Consider 2 non-identical atoms with mass  $m_1$  and  $m_2$ , connected by a force modeled as a spring with elastic constant  $k$ . The center of mass is stationary (not moving). Assume the 2 atoms only move in  $x$ -direction, solve the angular frequency of the vibration motion of the 2 atoms (express your answer with  $m_1$ ,  $m_2$ , and  $k$ . How many vibration modes?

(d) [20 points] Now consider 3 identical atoms with mass  $m$ , connected by a force modeled as a spring with elastic constant  $k$ . The center of mass is stationary (not moving). Assume the 3 atoms only move in  $x$ -direction, solve the angular frequencies of the vibration motion of the 3 atoms (express your answer with  $m$  and  $k$ . How many vibration modes?

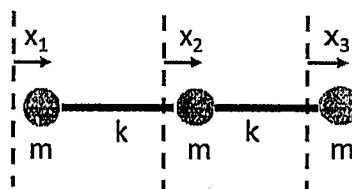


Figure 1

**Problem 2. [Electromagnetism: 30 points]**

Electromagnetic fields are the dominant forces in materials science. They are also directly related to optoelectronic applications. The electric field at a distance  $r$  from a point charge  $Q$  is:

$$\mathbf{E} = \frac{1}{4\pi\epsilon_0} \frac{Q}{r^2} \hat{\mathbf{z}},$$

# 國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：普通物理【材料前瞻應材碩士班丙組】

題號：487002

※本科目依簡章規定「不可以」使用計算機(問答申論題)

共 2 頁 第 2 頁

where  $\hat{z}$  is the unit vector along the vector  $\mathbf{z}$ . Consider the following questions in the vacuum, and use the units in the above formula.

(a) [5 points] Find the electric field (magnitude and direction) a distance  $s$  away from the midpoint between two charges:  $q$  at  $z = -d/2$  and  $q$  at  $z = +d/2$ .

(b) [5 points] Write down the electric potential  $V$  of the configuration in (a). Calculate the electric field from the potential  $V$ .

(c) [5 points] Find the capacitance of two parallel infinite plates, with opposite uniform charge density  $\sigma$  and  $-\sigma$ . The distance between the two plates is  $d$ .

(d) [5 points] Calculate the electric field and potential difference between the two plates for the configuration of (c).

(e) [5 points] Calculate the energy per unit area stored in the configuration of (c).

(f) [5 points] Consider a particle with mass  $m$  and charge  $q$  moving with velocity  $v$  in a uniform magnetic field  $B$ . Since magnetic force is perpendicular to the velocity, its effect is to change the direction of the velocity without changing its magnitude, resulting in a circular motion. Solve the radius and angular frequency of the circular motion.

### Problem 3. [Thermodynamics: 20 points]

(a) [10 points] Considering an ideal gas, the probability of the particles with velocity  $v$  to  $v + dv$  follows the Maxwell-Boltzmann distribution:

$$f(v)d^3v = \left(\frac{m}{2\pi kT}\right)^{3/2} e^{-\frac{mv^2}{2kT}} d^3v,$$

where  $m$  is the mass of the particle,  $k$  is the Boltzmann's constant, and  $T$  is the temperature. Calculate the square root of the mean square speed  $v_{rms} \equiv \sqrt{\langle v^2 \rangle}$  (the symbol  $\langle \dots \rangle$  is the expectation value).

[ You might need the integration:  $\int_0^\infty x^2 e^{-x^2} dx = \frac{\sqrt{\pi}}{2}$ ,  $\int_0^\infty x^3 e^{-x^2} dx = \frac{1}{2}$ ,  $\int_0^\infty x^4 e^{-x^2} dx = \frac{3}{8}\sqrt{\pi}$  ]

(b) [5 points] Based on the result in (a), calculate the average kinetic energy .

(c) [5 points] Based on the result in (b), calculate the specific heat per particle of the ideal gas.

### Problem 4. [Waves/Optics/Modern physics: 10 points]

(a) [5 points] In a stretched string, the wave  $e^{ik(x-\omega t)}$  can be reflected from the end of the string in two ways:  $+e^{-i(kx+\omega t)}$  and  $-e^{-i(kx+\omega t)}$ . The reflected wave would interfere with the incoming wave. Calculate the standing waves obtained from such interference.

(b) [5 points] A wave has an angular frequency  $\omega$  and a wavelength  $\lambda$ . Calculate the speed of the wave.

# 國立中山大學 108 學年度 碩士暨碩士專班招生考試試題

科目名稱：綜合化學【材料前瞻應材碩士班甲組】

## — 作答注意事項 —

考試時間：100 分鐘

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國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：綜合化學【材光系前瞻應用材料碩士班甲組】

題號：487003

※本科目依簡章規定「不可以」使用計算機(選擇題)

共 4 頁第 1 頁

單選題，每題 5 分，總分 100 分。

1. For *trans*  $[\text{RuX}_2(\text{CO})_2\text{L}_2]$  complex, what are the irreducible representation for experimentally observed IR stretching bands?

$D_{2h}$ ( <i>mmm</i> )	$E$	$C_2(z)$	$C_2(y)$	$C_2(x)$	$i$	$\sigma(xy)$	$\sigma(xz)$	$\sigma(yz)$	
$A_g$	1	1	1	1	1	1	1	1	$x^2, y^2, z^2$
$B_{1g}$	1	1	-1	-1	1	1	-1	-1	$R_z, xy$
$B_{2g}$	1	-1	1	-1	1	-1	1	-1	$R_y, xz$
$B_{3g}$	1	-1	-1	1	1	-1	-1	1	$R_x, yz$
$A_u$	1	1	1	1	-1	-1	-1	-1	
$B_{1u}$	1	1	-1	-1	-1	-1	1	1	$z$
$B_{2u}$	1	-1	1	-1	-1	1	-1	1	$y$
$B_{3u}$	1	-1	-1	1	-1	1	1	-1	$x$

- (A)  $A_g$                       (B)  $B_{1u}$                       (C)  $B_{2u}$                       (D)  $B_{3u}$                       (E)  $B_{3g}$
2. What are the bond orders of  $[\text{Mo}_2(\text{SO}_4)_4]^{4-}$ ?  
 (A) 2.5                      (B) 3                      (C) 3.5                      (D) 4                      (E) 4.5
3. How many microstates dose O atom has in  $(1s)^2(2s)^2(2p)^4$  configuration?  
 (A) 9                      (B) 12                      (C) 15                      (D) 18                      (E) 21
4. What is the ligand-field stabilization energy of  $[\text{Fe}(\text{CN})_6]^{4-}$ ?  
 (A)  $-12/5 \Delta_o$                       (B)  $-9/5 \Delta_o$                       (C)  $-6/5 \Delta_o$                       (D)  $-3/5 \Delta_o$                       (E)  $-1/5 \Delta_o$
5. Which of the following step is included in the Fischer-Tropsch process?  
 (A) Insertion via metallocyclobutane  
 (B) Splitting of the C - O bond  
 (C) C - N bond formation  
 (D) 1, 2-insertion  
 (E) Reductive elimination
6. Which of the following statements concerning systematic errors, random errors, and gross errors is INCORRECT?  
 (A) Systematic errors can be detected by Student t-test for two independent samples  
 (B) Random errors can be minimized by averaging over a large number of observations  
 (C) Random errors can be detected by F-test for two independent samples  
 (D) Absorption of  $\text{CO}_2$  by a standardized solution of KOH leads to a carbonate error that is identified to one type of systematic errors.  
 (E) Examples of typical gross errors in an EDTA titration include notation mistakes and calculation errors
7. Which of the following statements concerning titration is INCORRECT?  
 (A) The reaction between acid and alkali is called as a neutralization titration, which can be used to determine the  $\text{pK}_a$  value of weak acid.  
 (B) The redox reaction between the analyte and titrant is called as a redox titration, which can be used to determine the standard reduction potential of the analyte.  
 (C) Titration of metal ions with EDTA in an  $\text{NH}_3/\text{NH}_4\text{Cl}$  buffer solution can prevent metal hydroxide from precipitating.  
 (D) Argentometric titration is a type of titration involving the use of  $\text{AgNO}_3$  as a titrant.



# 國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：綜合化學【材光系前瞻應用材料碩士班甲組】

題號：487003

※本科目依簡章規定「不可以」使用計算機(選擇題)

共 4 頁第 2 頁

- (E) In a back titration, a known excess of an analyte is added to the titrant.
8. Which of the following statements concerning buffer solutions is INCORRECT?
- (A) The pH of a buffer rarely varies when a limited amount of strong acid or base is added.  
 (B) A buffer owns the maximum capacity to resist changes of pH when the prepared pH of a buffer is equal to its  $pK_a$  value.  
 (C) Diluting a buffer solution enhances its buffer capacity.  
 (D) The pH of an acetate buffer that is a mixture with 0.10 M acetic acid ( $K_a = 1.8 \times 10^{-5}$ ) and 0.10 M sodium acetate is 4.74.  
 (E) After 1.0 mL of 0.10 M NaOH is added to 100 mL of an acetate buffer, the pH of this buffer is 4.75.
9. Which of the following statements is INCORRECT?
- (A)  $200 \text{ ppb Hg(II)} = 1 \text{ }\mu\text{M Hg}^{2+} = 1000 \text{ nM Hg(II)}$  (Atomic mass of Hg is 200 amu).  
 (B) The number 0.0001 has four significant figures.  
 (C)  $1.51 (\pm 0.02) + 1.51 (\pm 0.02) = 3.02 (\pm 0.028)$ .  
 (D) The concentration of Pb(II) in samples of human urine was determined to be  $1.3 \pm 0.2 \text{ ppm}$ . The relative standard deviation of all measurements is 15%.  
 (E) An unknown was determined to contain 20.0  $\mu\text{g}$  of Cd(II) per liter. A spike of 4.0  $\mu\text{g/L}$  Cd (II) was added to replicate a portion of unknown. Analysis of the spiked sample gave a concentration of 23.6  $\mu\text{g/L}$ . Thus, the percent recovery of the spike is 90%.
10. Kidney stones form from sparingly soluble calcium salts. Calcium oxalate monohydrate [ $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ ; molecular weight = 146.1 g/mol] and calcium carbonate [ $\text{CaCO}_3$ ; molecular weight = 100.1 g/mol] are the major components of kidney stones. The solubilities of  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  and  $\text{CaCO}_3$  in water are  $7.36 \times 10^{-3} \text{ g/L}$  and 0.67 mg/100 mL, respectively, at 25°C. The values of  $K_{sp}$  of  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$  and  $\text{CaCO}_3$  are separately
- (A)  $2.54 \times 10^{-9}$  and  $4.5 \times 10^{-9}$ .  
 (B)  $2.54 \times 10^{-10}$  and  $4.5 \times 10^{-10}$ .  
 (C)  $3.54 \times 10^{-10}$  and  $5.5 \times 10^{-10}$ .  
 (D)  $1.54 \times 10^{-9}$  and  $3.5 \times 10^{-9}$ .  
 (E) None of the above
11. Which of the following is true for a system at equilibrium?
- (A)  $\Delta S^\circ_{\text{sys}} = \Delta S^\circ_{\text{surr}}$   
 (B)  $\Delta S^\circ_{\text{sys}} = -\Delta S^\circ_{\text{surr}}$   
 (C)  $\Delta S^\circ_{\text{sys}} = \Delta S^\circ_{\text{surr}} = 0$   
 (D)  $\Delta S^\circ_{\text{univ}} > 0$   
 (E) None of these choices are correct.
12. Ammonium cyanate ( $\text{NH}_4\text{CNO}$ ) reacts to form urea ( $\text{NH}_2\text{CONH}_2$ ). At 65°C the rate constant,  $k$ , is  $3.60 \text{ L mol}^{-1}\text{s}^{-1}$ . What is the rate law for this reaction?
- (A)  $\text{Rate} = 3.60 \text{ L mol}^{-1}\text{s}^{-1} [\text{NH}_4\text{CNO}]$   
 (B)  $\text{Rate} = 3.60 \text{ L mol}^{-1}\text{s}^{-1} [\text{NH}_4\text{CNO}]^2$   
 (C)  $\text{Rate} = 0.28 \text{ mol L}^{-1}\text{s}^{-1} [\text{NH}_4\text{CNO}]$   
 (D)  $\text{Rate} = 0.28 \text{ mol L}^{-1}\text{s}^{-1} [\text{NH}_4\text{CNO}]^2$   
 (E)  $\text{Rate} = 3.60 \text{ L mol}^{-1}\text{s}^{-1} [\text{NH}_2\text{CONH}_2]^{-1}$

背面有題

試題請隨卷繳回

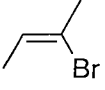
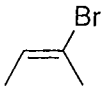
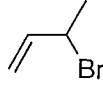
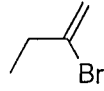
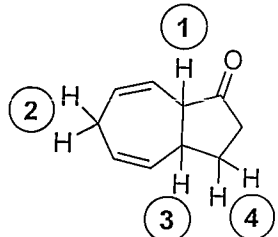
國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：綜合化學【材光系前瞻應用材料碩士班甲組】

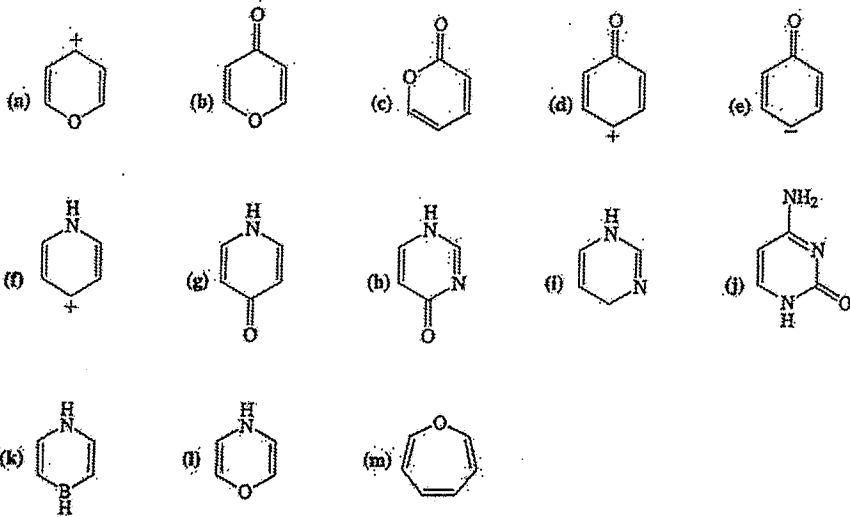
題號：487003

※本科目依簡章規定「不可以」使用計算機(選擇題)

共 4 頁第 3 頁

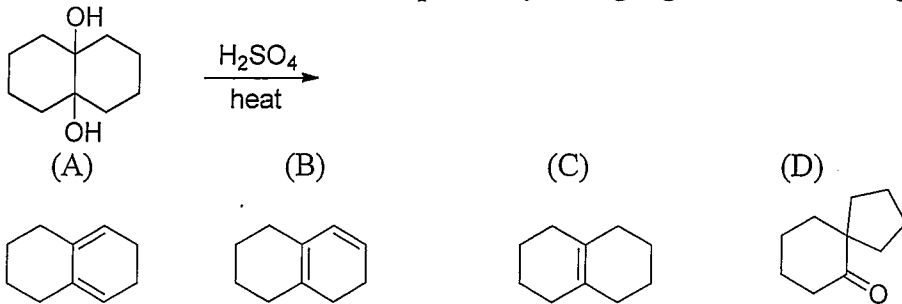
13. The dissolution of barium hydroxide in water is an exothermic process. Which of the following statements is correct?
- (A) The enthalpy of solid barium hydroxide plus pure water is less than that of the solution, at the same temperature.
- (B) The enthalpy of solid barium hydroxide plus pure water is greater than that of the solution, at the same temperature.
- (C) The enthalpy of solid barium hydroxide plus pure water is the same as that of the solution, at the same temperature.
- (D) The temperature of the solution is lower than of the barium hydroxide and water before mixing.
- (E) When barium hydroxide dissolves in water, the system does work on the surroundings.
14. When metal A is placed in a solution of metal ions  $B^{2+}$ , a reaction occurs between A and  $B^{2+}$ , and metal ions  $A^{2+}$  appear in the solution. When metal B is placed in acid solution, gas bubbles form on its surface. When metal A is placed in a solution of metal ions  $C^{2+}$ , no reaction occurs. Which of the following reactions would not occur spontaneously?
- (A)  $C(s) + 2H^+(aq) \rightarrow H_2(g) + C^{2+}(aq)$
- (B)  $C(s) + A^{2+}(aq) \rightarrow A(s) + C^{2+}(aq)$
- (C)  $B(s) + C^{2+}(aq) \rightarrow C(s) + B^{2+}(aq)$
- (D)  $A(s) + 2H^+(aq) \rightarrow H_2(g) + A^{2+}(aq)$
- (E)  $B(s) + 2H^+(aq) \rightarrow H_2(g) + B^{2+}(aq)$
15. Which of the following statements is FALSE?
- (A) According to valence bond theory, overlap of bonding orbitals of atoms will weaken a bond, due to electron-electron repulsion.
- (B) Valence bond theory explains the bonding in diatomic molecules such as HCl without resorting to the use of hybrid orbitals.
- (C) In the valence bond treatment, overlap of an s orbital on one atom with an  $sp^3$  orbital on another atom can give rise to a  $\sigma$  bond.
- (D) A carbon-carbon double bond in a molecule may give rise to the existence of *cis* and *trans* isomers.
- (E) In the valence bond treatment, a  $\pi$  bond is formed when two 2p orbitals overlap side to side.
16. When ( $\pm$ )-2,3-dibromobutane reacts with potassium hydroxide, the products are (2*S*,3*R*)-3-bromobutan-2-ol and its enantiomer and an alkene product. Please indicate the correct alkene molecule obtained in this reaction.
- (A)  (B)  (C)  (D) 
17. Please correctly ranks the indicated protons of the following molecule in order of increasing acidity.
- 
- (A)  $2 > 1 > 3 > 4$  (B)  $2 > 3 > 1 > 4$  (C)  $1 > 3 > 2 > 4$  (D)  $1 > 2 > 3 > 4$

18. Please predict which of the following compounds are NOT aromatic.

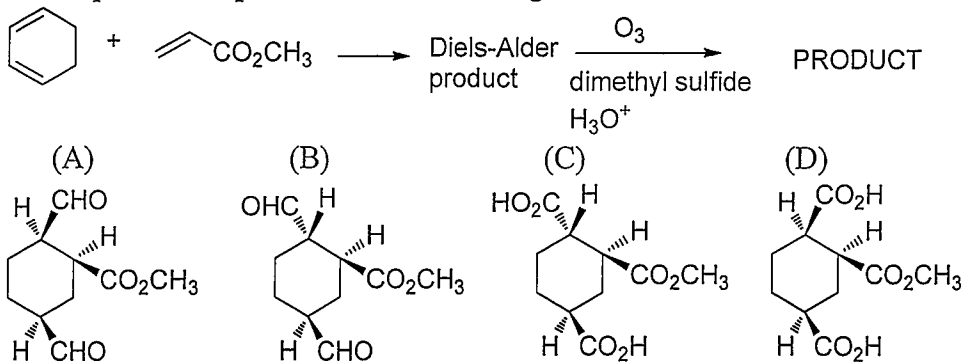


- (A) a,g,k,m    (B) d,i,l,m    (C) d,g,i,l    (D) h,i,k,l

19. Please indicate what is NOT the product you might get in the following reaction.



20. Please predict the product of the following reaction.



# 國立中山大學 108 學年度 碩士暨碩士專班招生考試試題

科目名稱：熱力學【材光系碩士班乙組】

## — 作答注意事項 —

考試時間：100 分鐘

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- 答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，不得另攜帶紙張，請衡酌作答。
- 答案卡請以 2B 鉛筆劃記，不可使用修正液（帶）塗改，未使用 2B 鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，其後果由考生自行負擔。
- 答案卷（卡）應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。
- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶具有通訊、記憶或收發等功能或其他有礙試場安寧、考試公平之各類器材、物品（如鬧鈴、行動電話、電子字典等）入場。
- 試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。
- 試題採雙面列印，考生應注意試題頁數確實作答。
- 違規者依本校招生考試試場規則及違規處理辦法處理。

# 國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：熱力學【材光系碩士班乙組】

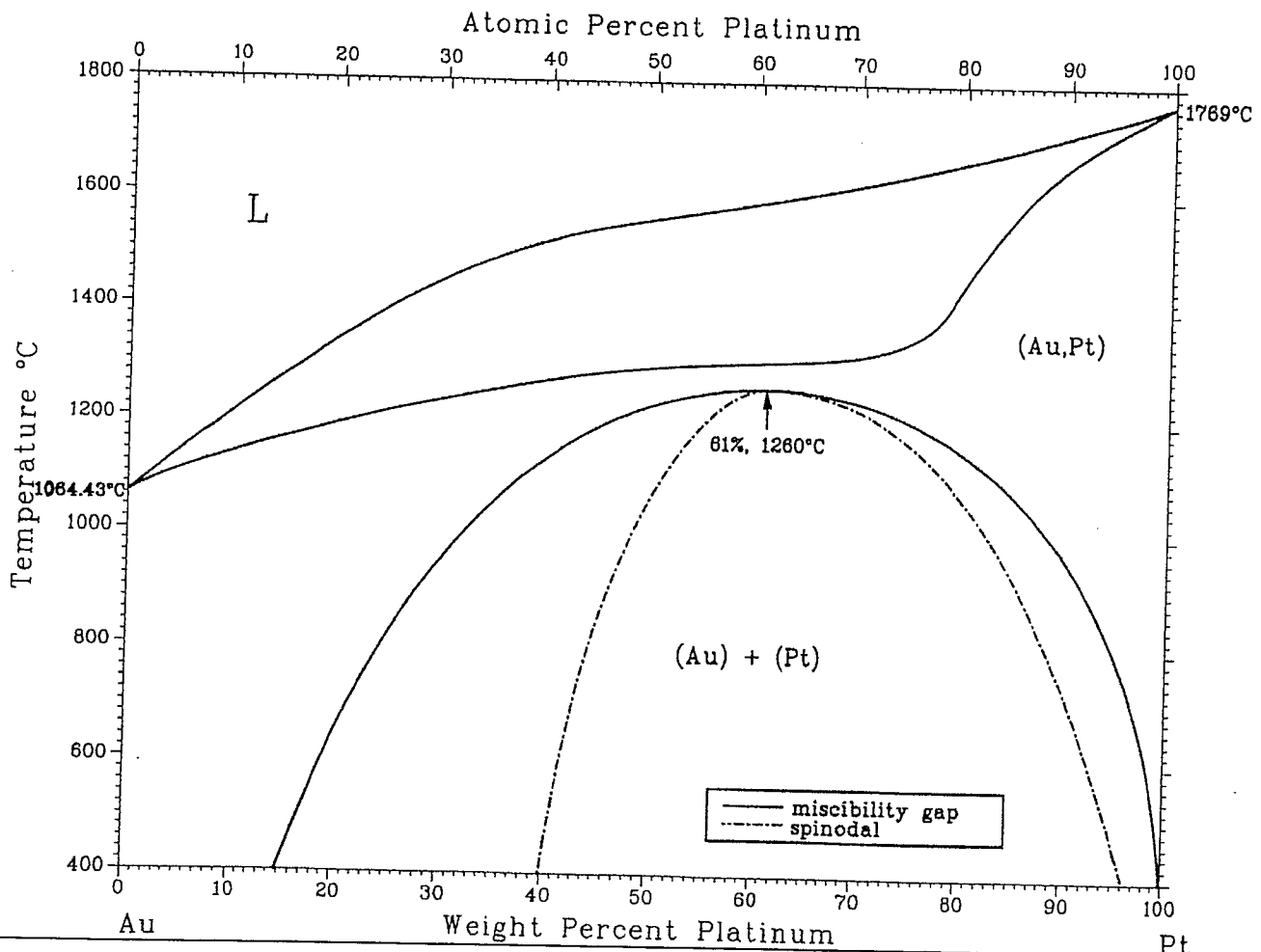
題號：439005

※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. One mole of a monatomic ideal gas undergoes a reversible expansion at constant pressure during which the entropy of the gas increases by 14.41 J/K and the gas absorbs 6236 joules of heat. [1a, 10%] Calculate the initial and final temperatures of the gas. One mole of a second monatomic ideal gas undergoes a reversible isothermal expansion during which it doubles its volume, performs 1729 joules of work and increases its entropy by 5.763 J/K. [1b, 10%] Calculate the temperature at which the expansion was conducted. ( $C_v = 1.5R$  for ideal gas) (20%)
2. Calculate the required pressure to distill mercury at 80 °C and explain it. [15%]  
The vapor pressure of liquid mercury is,  
 $\ln P \text{ (atm)} = -7611/T - 0.795 \ln(T) + 17.168$
3. Measurements of the saturated vapor pressure of liquid A gives 0.3045 atm at 205 °C and 0.9310 atm at 247 °C. Calculate the normal boiling temperature of A. [15%]
4. One mole of solid  $\text{Cr}_2\text{O}_3$  at 2500 K is dissolved in a large volume of a liquid Raoultian solution of  $\text{Al}_2\text{O}_3$  and  $\text{Cr}_2\text{O}_3$  in which  $X_{\text{Cr}_2\text{O}_3} = 0.2$  and which is also at 2500 K. Calculate the changes in enthalpy [4a, 10%] and entropy [4b, 10%] caused by the addition. The melting temperature of  $\text{Cr}_2\text{O}_3$  is 2538 K, and it can be assumed that the  $\Delta S_{m, \text{Cr}_2\text{O}_3} = \Delta S_{m, \text{Al}_2\text{O}_3}$ . ( $\Delta H_{\text{melting}}$  of  $\text{Al}_2\text{O}_3 = 107500 \text{ J}$  and  $T_{\text{melting}} = 2324 \text{ K}$ ) (20%)
5. Plot the molar Gibbs free energy of mixing ( $\Delta G_{\text{mix}}$ ) of each phase and show their relationships with equilibrium phase compositions at temperature 1400 °C [5a, 10%], 800 °C [5b, 10%] and describe the meaning of dash line [5c, 10%], according to the following diagram. (30%)

## Au-Pt



# 國立中山大學 108 學年度 碩士暨碩士專班招生考試試題

科目名稱：科技英文【材光系碩士班甲組】

## —作答注意事項—

考試時間：100 分鐘

- 考試開始響前不得翻閱試題，並不得書寫、劃記、作答。請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- 答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，不得另攜帶紙張，請衡酌作答。
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- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶具有通訊、記憶或收發等功能或其他有礙試場安寧、考試公平之各類器材、物品（如鬧鈴、行動電話、電子字典等）入場。
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- 試題採雙面列印，考生應注意試題頁數確實作答。
- 違規者依本校招生考試試場規則及違規處理辦法處理。

# 國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：科技英文【材光系碩士班甲組】

題號：439004

※本科目依簡章規定「不可以」使用計算機(混合題)

共 11 頁第 1 頁

## A. Multiple Choice Questions. (60 %)

Write your answers in boxes 1-40 on your answer sheet. There is a guessing penalty, and you are deducted a point for the wrong answer rather than just not giving the credit. Questions 1-40, 1.5 points for each question.

### ● Reading test article 1 (source: Wikipedia)

Vibranium is a fictional metal appearing in American comic books published by Marvel Comics. This fictional metal is noted for its uncanny ability to leverage thermodynamics in absorbing, storing, and releasing kinetic energy in a controlled manner. In the Marvel Universe, vibranium was first deposited on Earth by a meteorite 10,000 years ago. In the comics, the first documented discovery of vibranium was during a human expedition to Antarctica. This particular isotope of vibranium was called "Anti-Metal" due to its property of dissolving other metals.

- (1) In physics, the kinetic energy of an object is the energy that it possesses due to its motion. It is defined as the work needed to accelerate a body of a given mass from rest to its stated velocity. Having gained this energy during its acceleration, the body maintains this kinetic energy unless its speed changes. The same amount of work is done by the body when decelerating from its current speed to a state of rest. Which of the following is correct?
- A. In classical mechanics, the kinetic energy of a non-rotating object of mass  $m$  traveling at a speed  $v$  is  $= \frac{1}{2}mv^2$ .
  - B. In relativistic mechanics, this is a good approximation only when  $v$  is much less than the speed of light.
  - C. The standard unit of kinetic energy is the joule.
  - D. None of above
  - E. All of above
- (2) The first law of thermodynamics is a version of the law of conservation of energy, adapted for thermodynamic systems. The law of conservation of energy states that the total energy of an isolated system is constant; energy can be transformed from one form to another, but can be neither created nor destroyed. The primitive notion of heat was taken as empirically established, especially through calorimetry regarded as a subject in its own right, prior to thermodynamics. Jointly primitive with this notion of heat were the notions of empirical temperature and thermal equilibrium. This framework also took as primitive the notion of transfer of energy as work. This framework did not presume a concept of energy in general, but regarded it as derived or synthesized from the prior notions of heat and work. By one author, this framework has been called the "thermodynamic" approach. Which of the following is correct?
- A. all cases in which work is produced by the agency of heat, a quantity of heat is consumed which is proportional to the work done

國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：科技英文【材光系碩士班甲組】

題號：439004

※本科目依簡章規定「不可以」使用計算機(混合題)

共 11 頁第 2 頁

- B. all cases in which work by the expenditure of an equal quantity of work an equal quantity of heat is produced
- C. None of above
- D. All of above
- Isotopes of a given element have the same number of (3) but different numbers of (4) in each atom.
- (3) Which of the following is correct?
- A. Electrons
- B. Neutron
- C. Protons
- D. None of above
- E. All of above
- (4) Which of the following is correct?
- A. Electrons
- B. Neutron
- C. Protons
- D. None of above
- E. All of above
- Antarctica is Earth's (5) continent. The long-imagined (but undiscovered) south polar continent was originally called *Terra Australis*, sometimes shortened to 'Australia' as seen in a woodcut illustration titled *Sphere of the winds*, contained in an astrological textbook published in Frankfurt in 1545. During that period, geographers had to make do with clumsy phrases such as "the Antarctic Continent". They searched for a more poetic replacement, suggesting various names such as Ultima and Antipodea. Eventually Antarctica was adopted in the 1890s. It contains the geographic (6) Pole and is situated in the Antarctic region of the Hemisphere, almost entirely south of the Antarctic Circle, and is surrounded by the Ocean. At 14,000,000 square kilometres, it is the (7)-largest continent. For comparison, Antarctica is nearly twice the size of Australia.
- (5) Which of the following is correct?
- A. westernmost
- B. easternmost
- C. southernmost
- D. northernmost
- E. None of above

背面有題

試題請隨卷繳回



國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：科技英文【材光系碩士班甲組】

題號：439004

※本科目依簡章規定「不可以」使用計算機(混合題)

共 11 頁第 3 頁

(6) Which of the following is correct?

- A. west
- B. east
- C. south
- D. north
- E. None of above

(7) Which of the following is correct?

- A. 1st
- B. 2nd
- C. 3rd
- D. 4th
- E. 5th

The main differences between the various forms of primary bonding are:

- (8) --there is electrostatic attraction between oppositely charged ions.
- (9) --there is electron sharing between two adjacent atoms such that each atom assumes a stable electron configuration.
- (10) --the positively charged ion cores are shielded from one another, and also "glued" together by the sea of valence electrons.
- (11) --that each electron state can hold no more than two electrons, which must have opposite spins.

(8) Which of the following is correct?

- A. Ionic
- B. Covalent
- C. Metallic
- D. Pauli exclusion principle states
- E. None of above

(9) Which of the following is correct?

- A. Ionic
- B. Covalent
- C. Metallic
- D. Pauli exclusion principle states
- E. None of above

(10) Which of the following is correct?

- A. Ionic
- B. Covalent
- C. Metallic
- D. Pauli exclusion principle states
- E. None of above

國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：科技英文【材光系碩士班甲組】

題號：439004

※本科目依簡章規定「不可以」使用計算機(混合題)

共 11 頁第 4 頁

(11) Which of the following is correct?

- A. Ionic
- B. Covalent
- C. Metallic
- D. Pauli exclusion principle states
- E. None of above

Types of Materials Let us classify materials according to the way the atoms are bound together

- (12) : are bound by covalent forces and also by weak van der Waals forces, and usually based on C and H. They decompose at moderate temperatures (100 – 400 C), and are lightweight. Examples: plastics rubber.
- (13) : atoms behave like either positive or negative ions, and are bound by Coulomb forces. They are usually combinations of metals or semiconductors with oxygen, nitrogen or carbon (oxides, nitrides, and carbides). Hard, brittle, insulators. Examples: glass, porcelain.
- (14) : the bonding is covalent (electrons are shared between atoms). Their electrical properties depend strongly on minute proportions of contaminants. Examples: Si, Ge, GaAs.
- (15) : valence electrons are detached from atoms, and spread in an 'electron sea' that "glues" the ions together. Strong, ductile, conduct electricity and heat well, are shiny if polished.

(12) Which of the following is correct?

- A. Polymers Covalent
- B. Ceramics
- C. Semiconductors
- D. Metals
- E. None of above

(13) Which of the following is correct?

- A. Polymers Covalent
- B. Ceramics
- C. Semiconductors
- D. Metals
- E. None of above

(14) Which of the following is correct?

- A. Polymers Covalent
- B. Ceramics
- C. Semiconductors
- D. Metals
- E. None of above

背面有題

試題請隨卷繳回

國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：科技英文【材光系碩士班甲組】

題號：439004

※本科目依簡章規定「不可以」使用計算機(混合題)

共 11 頁第 5 頁

(15) Which of the following is correct?

- A. Polymers Covalent
- B. Ceramics
- C. Semiconductors
- D. Metals
- E. None of above

● Reading test article 2

This article has five sentences missing. Please fill in the correct ones.

Title: Global Oil Production (source: FLPT TEST)

In 1956, a renowned scientist named Marion King Hubbert forecasted future oil production based on his own analysis. He estimated that U.S. oil production would peak within twenty years. Most oil experts rejected his assessment. (16) To everyone's surprise, however, Hubbert was finally vindicated when, in 1970, U.S. oil production surged and then gradually declined. Afterwards, the public quickly believed Hubbert when he predicted worldwide oil production would collapse within a generation. The following years, however, showed that this pessimistic forecast was flawed. (17) In Hubbert's opinion, the price of oil would not matter. In fact, it has had a profound impact on the oil supply. Rising oil prices have motivated oil companies to find new oil sources. (18) The rising oil price has also made it feasible for oil companies to adopt new and more expensive extraction processes. In Canada, billions of barrels of oil are locked in deposits of oily sand.

(19) But now that a single barrel is worth US\$100, companies can afford to tap this vast reserve. Similarly, oil fields in the U.S. state of North Dakota were hardly touched for years because the oil was trapped in solid rock. Today it is financially worthwhile for companies to use a costly procedure called "fracking" to extract the oil from the rock. World oil production presently stands at about ninety million barrels per day, and within two decades this figure could increase. (20) But as new extraction technology is developed, that day will continue to retreat further and further into the future.

- A. The reason for such an error was that it did not take economics or technological change into account.
- B. Some day, the world will face an inevitable oil shortage.
- C. In the past, it was uneconomical to recover such oil.
- D. This has led to breakthrough discoveries in countries like Ghana and French Guiana.
- E. After all, similar predictions had been made before and had been proven wrong each time.

國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：科技英文【材光系碩士班甲組】

題號：439004

※本科目依簡章規定「不可以」使用計算機(混合題)

共 11 頁第 6 頁

● Reading test article 3

A new way has been found to reduce the damage fruit flies cause to starfruit grown in Malaysia. A chemical has been developed that attracts fruit flies. This chemical is mixed with insecticide and then put on some of the leaves of the starfruit plants. The flies, when they smell the chemical, go to the leaves and are then killed by the insecticide. As a result, there are fewer fruit flies and less damage is caused to the starfruit crop.

(21) Why do farmers in Malaysia need this new chemical?

- A. Fruit flies are harming their starfruit.
- B. The starfruit is a danger to the fruit flies.
- C. They cannot use the old insecticides.
- D. They need the chemical to protect the leaves.

(22) How does the chemical help to protect the starfruit?

- A. It is a kind of poison that causes less damage to fruit flies.
- B. It keeps the flies away from the starfruit plants.
- C. It helps the starfruit to grow faster.
- D. It attracts the flies to the insecticide, which kills them.

● Reading test article 4

Dancers and athletes are not the only ones to suffer injuries caused by the repeated use of particular muscles. In fact, a muscle injury is as likely to end the career of a pianist (23) it is that of a football player. In the same way that sports can put excess (24) on large muscles, playing a musical instrument can overwork small ones. (25), holding a violin firmly in place necessitates tensing muscles in the neck and jaw. Few musicians can maintain ideal posture while they practice (26) the size, weight, or inconvenient shape of their instruments. Doctors recommend frequent breaks during practice sessions for stretching, (27) musicians are generally unwilling to interrupt their music for the sake of their health.

(23) Which of the following is correct?

- A. as
- B. neither
- C. than
- D. nor
- E. None of above

(24) Which of the following is correct?

- A. anxiety
- B. stress
- C. attention
- D. effect
- E. None of above

背面有題

試題請隨卷繳回

國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：科技英文【材光系碩士班甲組】

題號：439004

※本科目依簡章規定「不可以」使用計算機(混合題)

共 11 頁第 7 頁

- (25) Which of the following is correct?  
A. At first  
B. On the contrary  
C. In the long run  
D. For instance  
E. None of above
- (26) Which of the following is correct?  
A. together with  
B. aside from  
C. due to  
D. except for  
E. None of above
- (27) Which of the following is correct?  
A. but  
B. or  
C. so  
D. and  
E. None of above
- (28) The \_\_\_\_\_ is likely to have serious repercussions in future negotiations.  
A. incident  
B. incidence  
C. incidental  
D. incidentally  
E. None of above
- (29) To enter information on the spreadsheet you will \_\_\_\_\_ a cell by clicking on it and then type your data.  
A. select  
B. selecting  
C. to select  
D. selection  
E. None of above
- (30) Adam is generally considered to be one the most \_\_\_\_\_ designer in the fashion industry today.  
A. impression  
B. impressively  
C. impressive  
D. impressing  
E. None of above

國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：科技英文【材光系碩士班甲組】

題號：439004

※本科目依簡章規定「不可以」使用計算機(混合題)

共 11 頁第 8 頁

- (31) Please don't hesitate to contact us if there is \_\_\_\_\_ else I can do to assist.
- A. anything
  - B. anybody
  - C. anywhere
  - D. anyway
  - E. None of above
- (32) Unfortunately we cannot include \_\_\_\_\_ in the list of presenters.
- A. they
  - B. their
  - C. them
  - D. themselves
  - E. None of above
- (33) Ms. Julie has agreed to let us use the report \_\_\_\_\_ prepared.
- A. her
  - B. she
  - C. hers
  - D. herself
  - E. None of above
- (34) How long have you \_\_\_\_\_ by your present company?
- A. been employed
  - B. being employed
  - C. employed
  - D. be employed
  - E. None of above
- (35) Bill has been \_\_\_\_\_ in Holland since 1995.
- A. working
  - B. worked
  - C. to be working
  - D. to work
  - E. None of above
- (36) The interview had already been \_\_\_\_\_ for an hour when she arrived.
- A. to be waited
  - B. to be waiting
  - C. waited
  - D. waiting
  - E. None of above

背面有題

試題請隨卷繳回

國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：科技英文【材光系碩士班甲組】

題號：439004

※本科目依簡章規定「不可以」使用計算機(混合題)

共 11 頁第 9 頁

- (37) We had not \_\_\_\_\_ a chance to meet the new doctor before the meeting
- A. to be had
  - B. have
  - C. haved
  - D. had
  - E. None of above
- (38) The dress \_\_\_\_\_ me \$100.
- A. cost
  - B. is cost
  - C. spent
  - D. is spent
  - E. None of above
- (39) It's really a \_\_\_\_\_ that you have to leave so soon.
- A. poor
  - B. pity
  - C. sorry
  - D. kind
  - E. None of above
- (40) Nanotechnology is manipulation of matter on an atomic, molecular, and supramolecular scale. The earliest, widespread description of nanotechnology referred to the particular technological goal of precisely manipulating atoms and molecules for fabrication of macroscale products, also now referred to as molecular nanotechnology. NANO is made up of components between \_\_\_ in size? Which of the following is correct?
- A. 1 and 100  $\mu\text{m}$
  - B. 1 and 100mm
  - C. 1 and 100 m
  - D. 0.0001 and 0.1 mm
  - E. None of above

# 國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：科技英文【材光系碩士班甲組】

題號：439004

※本科目依簡章規定「不可以」使用計算機(混合題)

共 11 頁第 10 頁

B. Please translate the instructions (1)-(2) below to Chinese. (10 points for each question)

## (1) TSMC's Chang Upbeat About Long-Term Prospects for IC Industry

Taiwan Semiconductor Manufacturing founder Morris Chang says he's optimistic towards the long-term prospects for the integrated circuit industry in the wake of emerging technologies. In an interview with the Chinese-language Economic Daily News, Chang says he remains upbeat about the semiconductor industry, due to the continued need for computing, and I-C demand is expected to remain solid in the long term. Chang is known as the "father of semiconductors" in the global integrated circuit industry and for founding and building T-S-M-C into the world's largest semiconductor foundry operator. The company now enjoys a more-than 50-per cent share of the global pure-play foundry market. Chang retired from the company in June 2018.

## (2) 2019 New Year Celebration in Taipei, Taiwan

A massive crowd of people flocked to Taipei City Hall Square on Monday night awaiting the fireworks display at Taipei 101. The revelers were treated to a six-minute pyrotechnic show - the longest ever at the skyscraper and accompanied by music and animations on an LED lighting system that covered the 35th to 90th floors on the tower's northern facade. The Taipei 101 fireworks extravaganza, now in its 15th year, is one of the world's most popular New Year's countdown parties. It attracts visitors from all over the world, especially from neighboring countries. This year's fireworks display was also broadcast to the world via satellite, with live coverage of the show becoming available for television channels and internet media outlets to download starting at 11:55 p.m. local time.

背面有題

試題請隨卷繳回



# 國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：科技英文【材光系碩士班甲組】

題號：439004

※本科目依簡章規定「不可以」使用計算機(混合題)

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C. Please follow the instructions below to write an English essay with a length of about 150 to 180 words. (10 points for each question)

Nowadays, millions of Taiwanese are learning English as a prioritized foreign language. More and more schools in Taiwan have made English an elective or even a compulsory subject. Why has English become so popular these days? In your composition, you should

- (1) give reasons to explain this trend of learning English, and
- (2) offer some suggestions on what can be done to attract domestic students to learn English in Taiwan.

# 國立中山大學 108 學年度 碩士暨碩士專班招生考試試題

科目名稱：材料科學【材光系碩士班丙組】

## — 作答注意事項 —

考試時間：100 分鐘

- 考試開始響前不得翻閱試題，並不得書寫、劃記、作答。請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- 答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，不得另攜帶紙張，請衡酌作答。
- 答案卡請以 2B 鉛筆劃記，不可使用修正液（帶）塗改，未使用 2B 鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，其後果由考生自行負擔。
- 答案卷（卡）應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。
- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶具有通訊、記憶或收發等功能或其他有礙試場安寧、考試公平之各類器材、物品（如鬧鈴、行動電話、電子字典等）入場。
- 試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。
- 試題採雙面列印，考生應注意試題頁數確實作答。
- 違規者依本校招生考試試場規則及違規處理辦法處理。

# 國立中山大學 108 學年度碩士暨碩士專班招生考試試題

科目名稱：材料科學【材光系碩士班丙組】

題號：439003

※本科目依簡章規定「不可以」使用計算機(問答申論題)

共 2 頁第 1 頁

- (1) For hexagonal crystals, Miller indices and Miller-Bravais indices can both be used to express directions and planes. Explain why two kinds of indices are used? 5 points
- (2) For diffusion in crystals to occur, an activation energy is required. (a) Explain the meaning of the activation energy of a diffusion process. (b) Explain why in most systems, the activation energy for interstitial diffusion is often lower than that for substitutional diffusion. 5 points each, 10 points
- (3) (a) Why the tensile fracture strain of a metal is always less than the compressive fracture strain? (b) Why the ultimate tensile strength of a material is defined as the stress at the maximum load during a tensile test? 4 points each, 8 points
- (4) Explain the following terms: (a) Anisotropy, (b) Schmid factor, (c) Fermi surface, (d) Ferromagnetism, (e) Semi-coherent interface boundary, (f) CCT diagram. 5 points each, 30 points
- (5) This figure showing the slip lines on the surface of a polycrystalline copper that was polished and subsequently deformed. Discuss this figure. 6 points



- (6) Give a schematic drawing of the solidification structure of a peritectic reaction under fast cooling rate. Equilibrium state is not obtained under the fast cooling rate. Explain your drawings. 6 points

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科目名稱：材料科學【材光系碩士班丙組】

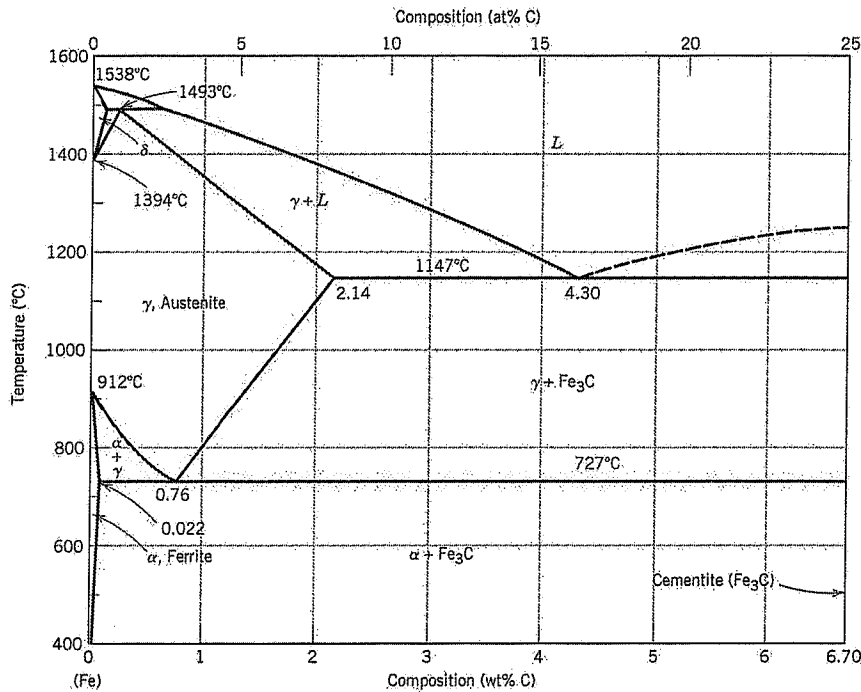
題號：439003

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- (7) Sketch the structures of (a) 0.4 wt% carbon steel, (b) 0.8 wt% carbon steel, and (c) 1.1 wt% carbon steel, that you would expect to see under an optical microscope. Label the phases and any other features of interest. These steels have been cooled slowly from 1000°C.

3 points each, 9 points



- (8) For some substitutional solid solutions, an ordered phase (superlattice) is formed below a certain temperature ( $T_0$ ), and a disordered phase is formed above  $T_0$ . Explain the reason for this? 6 points
- (9) Under what condition(s) dynamic strain aging can occur in metals. 5 points
- (10) The solidification process of a material can occur at a temperature well below its melting point, what is the reason for this? 5 points
- (11) Viscosity is used to measure the resistance to deformation of a noncrystalline material. How viscosity is defined? And what is the unit of viscosity? 5 points.
- (12) Draw a typical creep curve of strain versus time at constant load and constant elevated temperature. Explain your drawing. 5 points