中國鋼鐵股份有限公司

110 年新進人員甄試試題

甄試類別：師級－材料

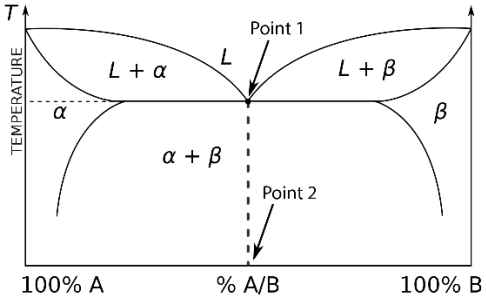
專業科目：1.物理冶金 2.熱力學

壹、選擇題—單選題 20 題(每題 1.5 分，答錯不倒扣；未作答者，不予計分)

1. A material is at an equilibrium condition at which its alpha and beta phases exist simultaneously. Which of the following must be true about this material?
   Ⓐ This material has only two phases; alpha and beta.
   Ⓑ Alpha and beta phases are equally thermodynamically favorable.
   Ⓒ Alpha phase is more thermodynamically favorable than the beta phase.
   Ⓓ The material is transitioning from alpha phase to beta phase.

2. What is the correct definition of "triple point" ?
   Ⓐ The temperature and pressure at which solid, liquid, and gas simultaneously exist.
   Ⓑ The most common experimental conditions of 1 atm, 298 K, and 1 mole of material.
   Ⓒ The reaction conditions of material at which the oxidated state and reduced state are equally likely to occur.
   Ⓓ The series of cyclical conditions at which a material can change from solid to liquid, liquid to gas, or gas to liquid.

3. Select the best pair of words to describe the two points on the following diagram.



   Point 1 is _____, and point 2 is _____.
   Ⓐ Converging point, convergence concentration.

Ⓑ Equality point, equilibrium composition.
Ⓒ Perfect point, best concentration.
Ⓓ Eutectic point, eutectic composition.

4. If a perfect crystalline material at its most stable form is cooled to absolute zero, the entropy of this material will approach zero.
   Ⓐ True.
   Ⓑ False.

5. Determine if the following statement is true or false. "A particular complex chemical reaction can be divided into several simple elementary reactions. The enthalpic change of the particular complex reaction is the sum of enthalpic change of the elementary reactions."
   Ⓐ True.
   Ⓑ False.

6. Determine if the following statement is true or false. "If a process has a positive change in Gibbs free energy, then this process is a spontaneous process."
   Ⓐ True.
   Ⓑ False.

7. Which of the following is the 1^{st} law of thermodynamics?
   Ⓐ The entropy of the a system undergoing a spontaneous process must decrease.
   Ⓑ The heat of an open system must remain constant throughout the entirety of the process.
   Ⓒ A process's change in Gibbs free energy can determine the process's spontaneity.
   Ⓓ The change in a system's internal energy is equal to the sum of heat added into the system and the work done by the system.

8. Which of the following is not a variable that is a part of the ideal gas law?
   Ⓐ Temperature.
   Ⓑ Number of molecules.
   Ⓒ Pressure.
   Ⓓ Electric field.

9. The transition between solid water (ice) and liquid water has a boundary with a negative slope on a pressure versus temperature plot. Which of the following is a <u>direct explanation</u> for this

phenomenon?

Ⓐ Solid water is lighter than liquid water.

Ⓑ Water has a high heat of fusion.

Ⓒ Liquid water is denser than solid water.

Ⓓ Solid water is crystalline, and liquid is amorphous.

10. What is the alloy of copper and tin called?

Ⓐ Bronze.

Ⓑ Brass.

Ⓒ Rolled gold.

Ⓓ Monel Metal.

11. 以下有關二次再結晶 (secondary recrystallization) 之敘述何者錯誤？

Ⓐ 二次再結晶是晶粒成長的一種方式

Ⓑ 二次再結晶發生初期只有少數粗大晶粒形成

Ⓒ 一般鋼鐵材料不常發生二次再結晶

Ⓓ 二次再結晶反應驅動力是材料之變形儲存能

12. 通常為六方最密堆積之材料其延展性較差。其原因與下列哪個因素有關？

Ⓐ 熔點　　Ⓑ 差排密度　　Ⓒ 滑移系統　　Ⓓ 疊差能

13. 請問 Cottrell atmosphere 與下列何項最有關連？

Ⓐ 再結晶　　Ⓑ 差排運動　　Ⓒ 晶界移動　　Ⓓ 表面氧化

14. 為了能達到極大的過冷度，科學家在外太空做凝固實驗。請問其原理與下列哪個現象有關？

Ⓐ 高真空　　Ⓑ 低溫　　Ⓒ 無容器　　Ⓓ 以上皆是

15. 以下有關析出相變化何者為錯誤？

Ⓐ 過冷度愈大成核數目愈多

Ⓑ 過冷度愈大反應速率愈快

Ⓒ 過冷度愈小析出物成長速率愈快

Ⓓ 過冷度愈大析出物愈小

16. 下列有關 Polygonization 之陳述何者為錯誤？

Ⓐ Polygonization 過程中次晶界(subgrain boundary)會生成

Ⓑ Polygonization 過程中差排數量會下降

Ⓒ Polygonization 過程中晶粒會成長

Ⓓ Polygonization 過程中材料的電阻會下降

17. 下列有關 Kirkendall effect 之陳述何者為錯誤？

Ⓐ Kirkendall effect 證明原子擴散會在晶體內造成空孔

Ⓑ Kirkendall effect 證明原子在差排中的擴散高於晶格擴散

Ⓒ Kirkendall effect 證明擴散機構 ring mechanism 是錯誤的

Ⓓ Kirkendall effect 證明置換型原子擴散需藉助空孔

18. 下列那項陳述是錯誤的？

Ⓐ 鋼鐵材料之硬化能與差排無關

Ⓑ 鑄鐵中加入矽合金可使雪明碳鐵生成

Ⓒ 鋼鐵中 BCC 相可在高溫及低溫下生成

Ⓓ 不鏽鋼有沃斯田鐵相及肥粒鐵相兩種

19. 下列那些與擴散有關之陳述是正確的？

Ⓐ Fick's 第二定律告訴我們有關 non-steady state diffusion 之情形

Ⓑ 在相同溫度時，碳原子在沃斯田鐵相中的擴散係數常高於肥粒鐵相

Ⓒ 置換型與插入型合金原子之擴散均須借助晶體內之各種缺陷方能進行

Ⓓ 原子在雙晶界中的擴散速率高於在一般晶界中

20. 請問面心立方晶體其{110}結晶面之原子面密度(單位面積所含原子數)為何 ？(註：$\mathbf{a}_0$ 為晶格常數)

Ⓐ $\sqrt{2}/a_0^2$　　Ⓑ $1/(\sqrt{2}a_0^2)$　　Ⓒ $2/a_0^2$　　Ⓓ $0.5/(\sqrt{2}a_0^2)$

貳、選擇題—複選題 6 題(每題 2.5 分，全部答對才給分，答錯不倒扣；未作答者，不予計分)

21. 請問繞射原理 Bragg law 的公式內含那些參數 ？

Ⓐ 繞射角度　　Ⓑ 晶體結構　　Ⓒ 結晶面原子密度　Ⓓ入射光波長

22. 下列那些項陳述是錯誤的？

Ⓐ 一般而言材料強度愈高其延展性愈低

Ⓑ 經塑性變形的金屬材料只要在夠高的溫度下便會發生再結晶

Ⓒ 材料之相變化須藉由原子擴散方能進行

Ⓓ 無缺陷之晶體在大氣環境無法形成，但在高真空環境可以形成

23 下列那些項陳述是錯誤的？

Ⓐ 差排的能量與其 Burgers vector 之長度成正比

Ⓑ 刃差排的 Burgers vector 與差排線方向平行

Ⓒ 刃差排較螺旋差排容易產生 cross slip

Ⓓ 差排與差排相互作用可能造成差排的消失

24. Which of the following are causes for defects to form in a crystalline solid?

Ⓐ Deformation of material.

Ⓑ Rapid cooling from high temperature.

Ⓒ exposure to high energy radiations i.e. X-rays.

Ⓓ Exposure to harsh chemicals.

25. Which of the following can be done using an Ellingham diagram?

Ⓐ Determine the equilibrium temperature for a metal, the associated oxide, and oxygen.

Ⓑ Find the equilibrium concentrations for a metal allotrope.

Ⓒ Similar to oxygen, equilibrium temperature for a metal, its nitrides, and nitrogen.

Ⓓ Compare different metals based on their ease of being oxidized.

26. Which of the following description(s) is/are correct?

Ⓐ Allotropic states are always thermodynamically unstable.

Ⓑ A material with high energy of formation must be more stable than a material with a lower energy of formation.

Ⓒ Adding sufficient heat to a system can cause it to undergo a process with positive change in Gibbs Free energy.

Ⓓ Gibbs free energy does not describe the progression rate of a process.

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1.B	2.A	3.D	4.A	5.A
6.B	7.D	8.D	9.C	10.A
11.D	12.C	13.B	14.C	15.B
16.C	17.B	18.B	19.A	20.A

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21.AD	22.BCD	23.ABC	24.ABCD	25.ACD
26.CD				