

中央警察大學 113 學年度碩士班入學考試試題

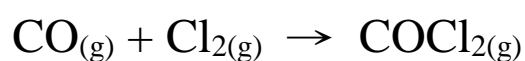
所 別：鑑識科學研究所

科 目：自然科學

作答注意事項：

1. 本試題共 10 題，每題各占 10 分；共 3 頁。
2. 不用抄題，可不按題目次序作答，但應書寫題號。
3. 禁用鉛筆作答，違者不予計分。

一、The following reaction will form phosgene from carbon monoxide and chlorine:



Consider the following thermodynamic data:

Compound	ΔH_f° (kJ/mol)	ΔG_f° (kJ/mol)	S° (J/mol · K)
$\text{CO}_{(g)}$	-110	-137	198
$\text{Cl}_{2(g)}$	0	0	223
$\text{COCl}_{2(g)}$	-223	-210	290

What is the entropy change for the formation of 1 mole of phosgene?

What can we learn from the Gibbs free energy of phosgene?

二、Cytochromes are a biologically important group of iron-containing molecules. They are important in redox processes. Part of the electron transfer process in the human body involves a transfer of an electron from cytochrome to cytochrome to cytochrome. The following are the standard reduction potentials for several cytochromes:

	E°
$\text{Cytochrome b-Fe}^{3+} + e^- \rightleftharpoons \text{Cytochrome b-Fe}^{2+}$	+0.08V
$\text{Cytochrome c-Fe}^{3+} + e^- \rightleftharpoons \text{Cytochrome c-Fe}^{2+}$	+0.22V
$\text{Cytochrome a-Fe}^{3+} + e^- \rightleftharpoons \text{Cytochrome a-Fe}^{2+}$	+0.29V
$\text{Cytochrome a}_3\text{-Fe}^{3+} + e^- \rightleftharpoons \text{Cytochrome a}_3\text{-Fe}^{2+}$	+0.38V

Assuming that every electron transfer occurs spontaneously, could you determine the order of electron transfer for the cytochromes listed in the table?

三、Two harmonic waves are traveling in the same medium and are described by the following equations:

$$y_1 = 12\sin(3\pi x - 0.5\pi t)$$

$$y_2 = 12\sin(3\pi x - 0.5\pi t - 4)$$

where x and y are in meters and t is in seconds. What is the displacement of the resultant wave at $x = 1.0$ m and $t = 1.0$ s?

四、A man strikes a long steel rod at one end. Another man, at the other end with his ear close to the rod, hears the sound of the blow twice (once through air and once through the rod), with a 0.1 seconds interval between them. How can you determine the length of the rod? [For the steel, the bulk modulus = 2.1×10^{11} Pa, and the density = 7.0×10^3 kg/m³. Speed of sound in air = 340 m/s.]

五、The unknown substance is being tested using four different test solutions (A, B, C, and D), each with a concentration of 1 M. The test solutions are identified as follows: A = NaCl, B = NaNO₃, C = NaI, and D = Na₂S. Upon mixing each of these test solutions with the unknown substance, the following observations were made: A resulted in a white precipitate, B showed no reaction, C resulted in a yellow precipitate, and D resulted in a black precipitate. Based on these observations, the unknown substance could potentially be identified.

六、請說明人類 5 種免疫球蛋白在結構上具有哪些共通特性？並說明其在分類上的主要差異？

七、根據含水 DNA 纖維之 X 射線繞射圖譜(X-ray diffraction photograph)，請說明 1953 年由 James Watson 和 Francis Crick 所推導之 DNA 結構模型之特徵為何？

八、假設不同氣體在相同溫度下有相同的動能，請分別計算以下兩種氣體組合之運動速率比值各為何？

(一) 氦氣與氮氣分子之運動速率比值

(二) 氧氣與硫化氫分子之運動速率比值

九、假設有一種溫度計，測定水之冰點為 -50° ，沸點為 200° ，若以此溫度計測得某一溶液顯示之溫度為 80° ，請問分別相當於攝氏、華氏及絕對溫度多少度？(請詳列其計算流程)

十、請說明真核生物(eukaryotes)其細胞中之胞器於演化過程中可能是如何形成的？