

中央警察大學 107 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 2 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、 Calculate the terminal velocity for a fine blood droplet, of diameter 0.2 mm and mass 4.44 ng, falling through air using the following equation.

$$x = \frac{-A \pm \sqrt{A^2 + 4mg}}{2}$$

[Hint]: Here m is the droplet mass and $g = 9.81 \text{ ms}^{-2}$ is the acceleration due to gravity. $A = 6\pi\eta = 3.4 \times 10^{-4} \text{ Pa}$. $x = rv_t$, r is the radius and v_t is the terminal velocity.

二、 A body was discovered on November 12 at 1:00 PM and was found to have larvae of the blow fly species *Phormia regina* present. In a laboratory it was determined that this species requires 16 hours at 27°C to develop from the egg stage to the larva stage. Given that the average temperature on November 12 was 15°C and on November 11 was 17°C, when did the blow fly first arrive at the scene?

三、 The precipitation of $\text{AgCl}(s)$ calls for the addition of $\text{AgNO}_3(aq)$ to $\text{CaCl}_2(aq)$. Write the overall balanced equation, the total ionic equation, and the net ionic equation. If $\text{CaCl}_2(aq)$ is not available, suggest another alternative chloride salt that could be used.

- 四、What will happen to the pH of blood if a person is exposed to elevated carbon dioxide levels based on all of the equilibrium processes involved in normal respiration ?
- 五、The enhancement of fingerprints on porous surfaces is often carried out by ninhydrin solution. A concentrated solution of ninhydrin is prepared using 25 g of solid dissolved in 260 cm³ of solvent (ethanol, ethyl acetate and acetic acid). The working solution is then prepared by taking 50 cm³ of the concentrated solution and adding further solvent up to a total volume of 1000 cm³. Calculate the molarity of both the concentrated and working solutions of ninhydrin. The molecular formula for ninhydrin is C₉H₆O₄.
- 六、請說明界面活性劑作用之原理及其分類。
- 七、為偵辦某槍擊案件，警察人員進行槍身質量為 2 公斤的來福槍的試射，其射出的彈頭質量為 0.01 公斤，彈頭離開槍口的速度為 500 公尺/秒，如果槍身並非被緊緊地靠在肩上，請計算槍身在反衝於肩膀前的速度。
- 八、請比較人類細胞核和粒線體中之 DNA，其結構、套數和複製等方面的差異。
- 九、請回答下列二個問題：
- (一) 為何誤飲摻有甲醇的假酒，易造成視力神經障礙甚至失明？
 - (二) 為何福馬林 (Formalin) 可作為消毒劑或防腐劑？
- 十、請回答下列二個問題：
- (一) 一顆質量為 0.2 公斤的球，被台灣之光陳偉殷以每小時 144 公里之球速投出，請計算其動能。
 - (二) 有一質量為 1 公斤的球以每秒 20 公尺之速度向右行進，並與質量為 3 公斤速度為每秒 4 公尺向左行進的另一顆球正面碰撞，若此二球碰撞後黏在一起行進，請計算其速度。