中央警察大學 111 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、請依據孟德爾（G. J. Mendel）提出之獨立分配律（Law of independent assortment），說明不同人之間 DNA 多樣性的產生；依此說明並請計算一對夫妻可能生下幾種 DNA 不同的孩子。

二、穩定同位素具有鑑別相關檢體產地來源之潛力，因此，在刑事鑑識上亦有其應用之價值。請說明何謂同位素（Isotopes）？並請以質量數為 24、25 及 26 之鎂原子為例，分別說明其質子數與中子數。

三、某鑑識實驗室發展了一個血液鑑定系統，為了解此系統在進行偵測時需要的血液量，故進行下列的實驗：取 10 μL 的血液進行一連串的十倍稀釋，並從 10 倍、100 倍及 1,000 倍稀釋液中，分別取 10 μL 去進行測試。請說明如何由 10 μL 的血液進行一連串的十倍稀釋至 1,000 倍；並請計算 10 μL 之 10 倍、100 倍及 1,000 倍稀釋液中分別含多少量之血液。

四、臺鐵的某一火車由 A 站從靜止狀態出發，然後以等加速度直線往 B 站行駛，10 秒後之速率達 40 公尺／秒，請計算加速度；此時距離 A 站有多少公尺？再繼續往前開 88 公尺後，其速率為多少？（需列出計算過程）

五、某案件之檢體裂解嚴重，使得細胞核 DNA 之鑑定失敗，鑑識人員遂改以鑑定粒線體 DNA，請說明其原因。

六、The spring constant between the atoms in HBr is around 412 N/m. Determine the energy difference between the n = 0 and n = 1 states for this molecule in joules. What photon wavelength, in units of microns, and wave number, would be associated with absorption from n = 0 to n = 1? Where in the electromagnetic spectrum is this absorption?

$$\omega_{oscillator} = \sqrt{\frac{k}{\mu}} = \sqrt{\frac{\frac{k}{m_1 m_2}}{m_1 + m_2}}$$

$$\nu_{oscillator} = \frac{\omega_{oscillator}}{2\pi}$$

七、Snells law : $n_1 \sin\theta_1 = n_2 \sin\theta_2$

A broadband light source is composed of wavelengths from 400 nm to 800 nm. The beam is incident on a block of BK7 glass at an angle of 30.0 degrees from the normal. What happens to the beam as it refracts through the glass? Answer this quantitatively by describing the refraction of the 400 nm and 800 nm extremes in wavelength.

八、Write a Lewis structure and identify the octet-rule exception for

(a) XeF_4;

(b) H_3PO_4 (draw two resonance structures and select the more important; all O atoms are bonded to P and three O atoms have H bonded to them);

(c) $BFCl_2$

九、At 1000°C, cyclobutane (C_4H_8) decomposes in a first-order reaction, with the very high rate constant of 87 s^{-1}, to two molecules of ethylene (C_2H_4).

(a) The initial C_4H_8 concentration is 2.00 M. What is the concentration after 0.010 s?

(b) How long will it take for 70.0% of the C_4H_8 to decompose?

十、Which type of polymer is formed from each of the following monomers: (a) amino acids; (b) alkenes; (c) simple sugars; (d) mononucleotides?