

# 中央警察大學 102 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 4 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、請說明如何生產出具有胰島素（insulin）基因之基因轉殖細菌（transgenic bacteria）？並請說明如何選殖出可製造胰島素之品系（clone）？

二、請分別寫出 alkane、alkyne、cyclo-alkene、cyclo-alkane 及 naphthalene 之通式？

三、請解釋下列專有名詞：

- (1) Avogadro's number
- (2) Hybrid orbitals
- (3) Equilibrium constant
- (4) dissociation
- (5) Pauli's exclusion principle

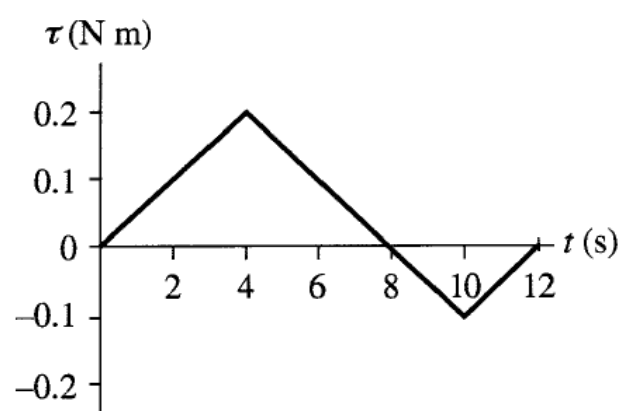
四、請說明下列數種醣類分子的構造：

- (1) cellulose
- (2) glycogen
- (3) amylose
- (4) chitin
- (5) lactose

五、一電子在電視機內之陰極射線管加速區內進行等加速度運動，在 3 公分的距離內，其速度由  $2 \times 10^4$  公尺/秒增加至  $1 \times 10^7$  公尺/秒，則電子在此加速距離需多少時間？此區域內電子之加速度為何？

六、A U-shaped tube is open to the air at both ends and is partially filled with Mercury (density= $13,600\text{kg/m}^3$ ). Water (density= $1000\text{kg/m}^3$ ) is poured into the left arm until the water is 10.0cm deep. How far upward from its initial position does the mercury rise on the right side?

七、A 12-cm-diameter, 2.0 kg uniform circular disk, which is initially at rest, experiences the net torque shown in the figure below. What is the disk's angular velocity at  $t=12\text{s}$ ? The disk rotates about an axis perpendicular to the plane of the disk and through its center. ( $I_{\text{Disk}}=MR^2/2$ )



八、Complete the following table.

|   |   |
|---|---|
| <b>Chemical Formula: <math>\text{SiF}_4</math></b>  | <b>Chemical Formula: <math>\text{NO}_2^+</math></b>   |
| <b>Lewis Structure:</b>   | <b>Lewis Structure:</b><br><i>(nitrogen is the central atom)</i>  |
| <b>Molecular Geometry:</b><br><i>(words only, you do not have to draw the molecule in three dimensions)</i> | <b>Molecular Geometry:</b><br><i>(words only, you do not have to draw the molecule in three dimensions)</i> |
| <b>Molecular Polarity: (yes/no)</b>   | <b>Molecular Polarity: (yes/no)</b>   |
| <b>Bond Angle for F–Si–F</b>  | <b>Bond Angle for O–N–O</b>   |

九、Write the balance equation and the total ionic equation for the neutralization of phosphoric acid by calcium hydroxide.

十、請回答下列問題：

(一) Mongolism (Down's syndrome) is caused an extra chromosome #21 resulting from abnormal cell division in

- (a) asiatic people
- (b) black people
- (c) white people
- (d) any group

because it is not confined to any one group.

(二) Which is the correct sequence of steps in mitosis?

- (a) anaphase, metaphase, interphase, telophase, prophase
- (b) prophase, metaphase, telophase, interphase, anaphase
- (c) interphase, prophase, telophase, anaphase, metaphase
- (d) prophase, metaphase, anaphase, telophase, interphase

(三) A cross between a red rose and a white rose results in 100% pink. When two of these pink roses are crossed, assuming large numbers of offspring, the ratio of offspring produced most probably will be

- (a) 100% pink
- (b) 75% pink ; 25% red
- (c) 25% red ; 50% pink ; 25% white
- (d) 50% red ; 50% white

## Equations and Constants

$$\begin{aligned}
 N_A &= 6.022 \times 10^{23} \text{ mol}^{-1} & h &= 6.626 \times 10^{-34} \text{ J s} & c &= 2.998 \times 10^8 \text{ m s}^{-1} \\
 e &= 1.60 \times 10^{-19} \text{ C} & m_e &= 9.11 \times 10^{-31} \text{ kg} & 1 \text{ \AA} &= 1 \times 10^{-10} \text{ m} \\
 E_K &= \frac{1}{2} m v^2 & \Delta E &= h\nu & v\lambda &= c \\
 V &= \frac{\kappa Q_1 Q_2}{d} & \kappa &= 8.99 \times 10^9 \text{ J m C}^{-2} & E &= h\nu = \frac{1}{2} m v^2 + \Phi \\
 \mu &= Qr & 1 \text{ D} &= 3.34 \times 10^{-30} \text{ C m} & \tilde{\nu} &= \frac{1}{\lambda} \\
 \Delta E &= \frac{hc}{\lambda} = hc\tilde{\nu} & p &= \frac{h}{\lambda} & \lambda &= \frac{h}{mv} & \Delta x \Delta p &\geq \frac{h}{4\pi} \\
 \frac{1}{\lambda} &= R_H \left( \frac{1}{n_1} - \frac{1}{n_2} \right) & E &= 2.178 \times 10^{-18} \text{ J} \left( \frac{1}{n_1} - \frac{1}{n_2} \right) & \Delta E &= -2.178 \times 10^{-18} \text{ J} \left( \frac{1}{n_f} - \frac{1}{n_i} \right)
 \end{aligned}$$

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18  
 IA IIA IIIB IVB VB VIB VIIB --- VIII --- IB IIB IIIA IVA VA VIA VIIA VIIIA  
 1A 2A 3B 4B 5B 6B 7B --- 8 --- 1B 2B 3A 4A 5A 6A 7A 8A

|           |           |            |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |
|-----------|-----------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1         |           |            |           |           |           |           |           |           |           |           |           |           |           |           |           |           | 2         |
| <u>H</u>  |           |            |           |           |           |           |           |           |           |           |           |           |           |           |           |           | <u>He</u> |
| 1.008     |           |            |           |           |           |           |           |           |           |           |           |           |           |           |           |           | 4.003     |
| 3         | 4         |            |           |           |           |           |           |           |           |           |           | 5         | 6         | 7         | 8         | 9         | 10        |
| <u>Li</u> | <u>Be</u> |            |           |           |           |           |           |           |           |           |           | <u>B</u>  | <u>C</u>  | <u>N</u>  | <u>O</u>  | <u>F</u>  | <u>Ne</u> |
| 6.941     | 9.012     |            |           |           |           |           |           |           |           |           |           | 10.81     | 12.01     | 14.01     | 16.00     | 19.00     | 20.18     |
| 11        | 12        |            |           |           |           |           |           |           |           |           |           | 13        | 14        | 15        | 16        | 17        | 18        |
| <u>Na</u> | <u>Mg</u> |            |           |           |           |           |           |           |           |           |           | <u>Al</u> | <u>Si</u> | <u>P</u>  | <u>S</u>  | <u>Cl</u> | <u>Ar</u> |
| 22.99     | 24.31     |            |           |           |           |           |           |           |           |           |           | 26.98     | 28.09     | 30.97     | 32.07     | 35.45     | 39.95     |
| 19        | 20        | 21         | 22        | 23        | 24        | 25        | 26        | 27        | 28        | 29        | 30        | 31        | 32        | 33        | 34        | 35        | 36        |
| <u>K</u>  | <u>Ca</u> | <u>Sc</u>  | <u>Ti</u> | <u>V</u>  | <u>Cr</u> | <u>Mn</u> | <u>Fe</u> | <u>Co</u> | <u>Ni</u> | <u>Cu</u> | <u>Zn</u> | <u>Ga</u> | <u>Ge</u> | <u>As</u> | <u>Se</u> | <u>Br</u> | <u>Kr</u> |
| 39.10     | 40.08     | 44.96      | 47.88     | 50.94     | 52.00     | 54.94     | 55.85     | 58.47     | 58.69     | 63.55     | 65.39     | 69.72     | 72.59     | 74.92     | 78.96     | 79.90     | 83.80     |
| 37        | 38        | 39         | 40        | 41        | 42        | 43        | 44        | 45        | 46        | 47        | 48        | 49        | 50        | 51        | 52        | 53        | 54        |
| <u>Rb</u> | <u>Sr</u> | <u>Y</u>   | <u>Zr</u> | <u>Nb</u> | <u>Mo</u> | <u>Tc</u> | <u>Ru</u> | <u>Rh</u> | <u>Pd</u> | <u>Ag</u> | <u>Cd</u> | <u>In</u> | <u>Sn</u> | <u>Sb</u> | <u>Te</u> | <u>I</u>  | <u>Xe</u> |
| 85.47     | 87.62     | 88.91      | 91.22     | 92.91     | 95.94     | (98)      | 101.1     | 102.9     | 106.4     | 107.9     | 112.4     | 114.8     | 118.7     | 121.8     | 127.6     | 126.9     | 131.3     |
| 55        | 56        | 57         | 72        | 73        | 74        | 75        | 76        | 77        | 78        | 79        | 80        | 81        | 82        | 83        | 84        | 85        | 86        |
| <u>Cs</u> | <u>Ba</u> | <u>La*</u> | <u>Hf</u> | <u>Ta</u> | <u>W</u>  | <u>Re</u> | <u>Os</u> | <u>Ir</u> | <u>Pt</u> | <u>Au</u> | <u>Hg</u> | <u>Tl</u> | <u>Pb</u> | <u>Bi</u> | <u>Po</u> | <u>At</u> | <u>Rn</u> |
| 132.9     | 137.3     | 138.9      | 178.5     | 180.9     | 183.9     | 186.2     | 190.2     | 190.2     | 195.1     | 197.0     | 200.5     | 204.4     | 207.2     | 209.0     | (210)     | (210)     | (222)     |