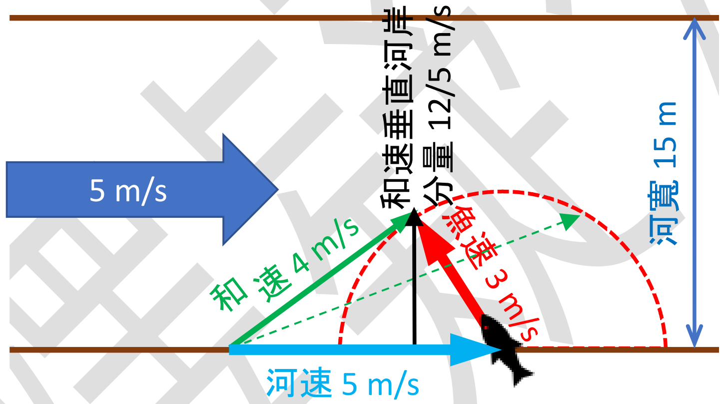
108 學年度校內轉系考試自然科學試題及標準答案疑義釋疑

108.7.18

題號	釋疑答覆	釋疑結果
1	此題討論二維空間向量相加的問題，詳見下圖。 魚以泳速 3 m/s 從岸邊一點出發之所有可能的速度向量，是以出發點為圓心，由圓心指向半徑為 3 m/s 圓弧上任一點為終點（如紅色虛線圓弧所示）的向量。 在流速 5 m/s 的河中，河流速向量（淺藍色實心箭號）與魚游速（出發點至紅虛線圓弧上的任一點）的向量和，為魚過河的可能速度向量（如綠色虛線所示）。將速度向量和延伸至兩岸間的直線，即為可能的過河路徑。 由圖示可知，所有可能過河路徑中的「最短路徑」，為向量和恰與紅虛線圓弧相切之路徑（沿實心綠箭頭之延伸線）；其他可能速度向量和所產生之路徑（以綠色虛線向量延伸線為例），均會產生較綠色實箭頭所示路徑為長的過河路徑。 於最短路徑時，垂直於河岸的和速度分量（黑實線向量所示）為 4 x 3/5 (m/s)= 12/5 (m/s) 沿此最短路徑的過河時間為 15 m / (12/5 m/s) = 25/4 s 故正確答案為 (A) 	維持原答案(A)
8	此題為電容器(C)與電阻(R)相接後，所形成的 RC 電路放電問題。 RC 電路放電的時間常數為 RC，若放電前電容電壓為 V_0，開始放電經時間 t 後，電容電壓隨時間的變化為 $V(t)= V_0 e^{-t/RC}$。 此題中 $V(2)/V(0)= 3.7\ V / 10\ V= e^{-2/RC}$ $\Rightarrow$ 2/RC = 1 $\Rightarrow$ RC= 2	維持原答案(C)

	由題目知 R= 20M Ω 可算得 $C= 0.1 \times 10^{-6}$ F = 0.1 μF 故正確答案為(C)	
12	波動在傳遞時，遇到不均勻介質，能量將無法順利傳遞，並於介面產生反射。 醫用超音波於造影時，主要經由體內的軟組織傳遞，當波動遇到體內的空氣間隙時，由於傳遞介質的差異過大，會造成能量被介面大量反射，無法順利穿透。 故答案(C)的敘述為錯誤的。 超音波為力學波，能量與振幅平方成正比，與電磁波的能量 E= hf 不同。 波的穿透能力，除本身波動的能量外，也與傳遞過程中的耗散有關。 低頻超音波於傳遞時不易被散射，能量可傳遞到較深的地方，有較高的穿透性。 故答案(E)的敘述是正確的。 此提問「敘述何者為非」，故答案為(C)。	**維持原答案(C)**
18	1. 題意已相當清楚，不應翻譯命名為主。 2. 科學記號: 括弧內先相加(13.7+0.027)，再取有效數字為 3 位(13.7)，再進行乘法(8.221)，所得數字為 112.6277，依下列原則第二點，取有效位數三位，答案為 113。維持原答案 C。	**維持原答案(C)**

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<td>A second set of rules specifies how to handle significant figures in calculations.

1. In addition and subtraction, the answer cannot have more digits to the right of the decimal point than either of the original numbers. Consider these examples:

$$\begin{array}{r} 89.332 \\ +\ 1.1 \\ \hline 90.432 \end{array}$$ 1.1 ⟵ one digit after the decimal point; 90.432 ⟵ round off to 90.4

$$\begin{array}{r} 2.097 \\ -0.12 \\ \hline 1.977 \end{array}$$ −0.12 ⟵ two digits after the decimal point; 1.977 ⟵ round off to 1.98

The rounding-off procedure is as follows. To round off a number at a certain point we simply drop the digits that follow if the first of them is less than 5. Thus, 8.724 rounds off to 8.72 if we want only two digits after the decimal point. If the first digit following the point of rounding off is equal to or greater than 5, we add 1 to the preceding digit. Thus, 8.727 rounds off to 8.73, and 0.425 rounds off to 0.43.

2. In multiplication and division, the number of significant figures in the final product or quotient is determined by the original number that has the *smallest* number of significant figures. The following examples illustrate this rule:

$2.8 \times 4.5039 = 12.61092$ ⟵ round off to 13
$\frac{6.85}{112.04} = 0.0611388789$ ⟵ round off to 0.0611

3. Keep in mind that *exact numbers* obtained from definitions (such as 1 ft = 12 in, where 12 is an exact number) or by counting numbers of objects can be considered to have an infinite number of significant figures.

佐證資料：
書名：General chemistry　　出版年或版次：7th　　頁次：　16
作者：　Raymond Chang　　出版公司：　McGraw-Hill</td>
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<td>25</td>
<td>題目為:以下哪個原子的基態和其所有激態都屬於順磁性。題目並非詢問分子或離子之基態或激發態，維持原答案 B。
N 原子基態**電子組態** $1s^2\ 2s^2\ 2p^3$ 屬於順磁性，其所有激態皆屬於順磁性。
Ti 原子基態**電子組態**[Ar] $3d^2\ 4s^2$ 的基態屬於順磁性，但其激發態有可能屬於逆磁性。</td>
<td>**維持原答案(B)**</td>
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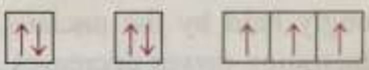
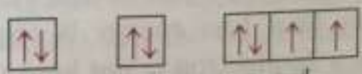
Qualitatively, we can understand why (c) is preferred to (a). In (a), the two electrons are in the same $2p_x$ orbital, and their proximity results in a greater mutual repulsion than when they occupy two separate orbitals, say $2p_x$ and $2p_y$. The choice of (c) over (b) is more subtle but can be justified on theoretical grounds. The fact that carbon atoms contain two unpaired electrons is in accord with Hund's rule.
The electron configuration of nitrogen ($Z = 7$) is $1s^22s^22p^3$:


Again, Hund's rule dictates that all three $2p$ electrons have spins parallel to one another; the nitrogen atom contains three unpaired electrons.
The electron configuration of oxygen ($Z = 8$) is $1s^22s^22p^4$. An oxygen atom has two unpaired electrons:


佐證資料：書名：General chemistry　　出版年或版次：7th　　頁次：　238
作者：　Raymond Chang　　出版公司：　McGraw-Hill
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<td>26</td>
<td>
本題目最基本概念是典型原子半徑約在 100pm (1 pm = 1 x × 10^{-12} m)，雖未提供 Pd 的原子量 106.4g/mol，但依基礎觀念應可選擇(A) 138 pm 與(D) 154 pm，答案 C (1.95 × 10^{-8} cm = 195 pm) ，已接近 200pm。因此不予考慮，本題建議本題(A)或(D)皆給分。
occupies only about $1/10^{13}$ of the volume of the atom. We express atomic (or molecular) dimensions in terms of the SI unit called the picometer (pm), and
$$1 \text{ pm} = 1 \times 10^{-12} \text{ m}$$
A typical atomic radius is about 100 pm, whereas the radius of an atomic nucleu[s is] only about 5×10^{-3} pm. You can appreciate the relative sizes of an atom anc[d] nucleus by imagining that if an atom were the size of a sports stadium, the volu[me] of its nucleus would be comparable to that of a small marble. Although the prot[ons] are confined to the nucleus of the atom, the electrons are conceived of as being spr[ead] out about the nucleus at some distance from it.
The Neutron
Rutherford's model of atomic structure left one major problem unsolved. It was kno[wn] that hydrogen, the simplest atom, contains only one proton and that the helium a[tom] contains two protons. Therefore, the ratio of the mass of a helium atom to that o[f a] hydrogen atom should be 2:1. (Because electrons are much lighter than protons, t[heir] contribution can be ignored.) In reality, however, the ratio is 4:1.
佐證資料：書名：General chemistry　　出版年或版次：7th　　頁次：　35
作者：　Raymond Chang　　出版公司：　McGraw-Hill
</td>
<td>答案更正為(A)或(D)皆給分</td>
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28

Raoult's law 和 Henry's law皆源至於理想氣體the kinetic molecular theory，及其中的Dalton's law of partial pressures理論。因此，Raoult's law其系統(system)中vapor-pressure亦須遵守理想氣體Dalton's law of partial pressures理論。答案B與D皆為正確敘述，答案**A**之敘述有誤。因此，**維持原答案A。**

12.5 The Effect of Pressure on the Solubility of Gases

For all practical purposes, external pressure has no influence on the solubilities of liquids and solids, but it does greatly affect the solubility of gases. The quantitative relationship between gas solubility and pressure is given by ***Henry's[†] law***, which states that *the solubility of a gas in a liquid is proportional to the pressure of the gas over the solution:*

$$c \propto P$$

$$c = kP \qquad (12.3)$$

Here c is the molar concentration (mol/L) of the dissolved gas; P is the pressure (in atm) of the gas over the solution at equilibrium; and, for a given gas, k is a constant that depends only on temperature. The constant k has the units mol/L · atm. You can see that when the pressure of the gas is 1 atm, c is *numerically* equal to k. If several gases are present, P is the partial pressure.

Each gas has a different k value at a given temperature.

Henry's law can be understood qualitatively in terms of the kinetic molecular theory. The amount of gas that will dissolve in a solvent depends on how frequently the gas molecules collide with the liquid surface and become trapped by the condensed phase. Suppose we have a gas in dynamic equilibrium with a solution [Figure 12.6(a)]. At every instant, the number of gas molecules entering the solution is equal to the number of dissolved molecules moving into the gas phase. If the partial pressure of the gas is increased [Figure 12.6(b)], more molecules dissolve in the liquid because

[†] William Henry (1775–1836). English chemist. Henry's major contribution to science was his discovery of the law describing the solubility of gases, which now bears his name.

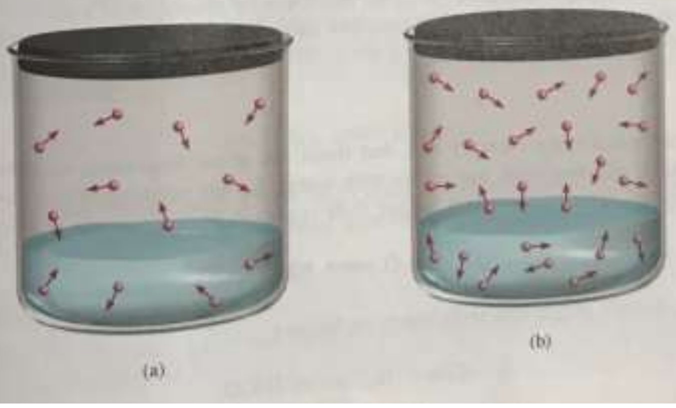
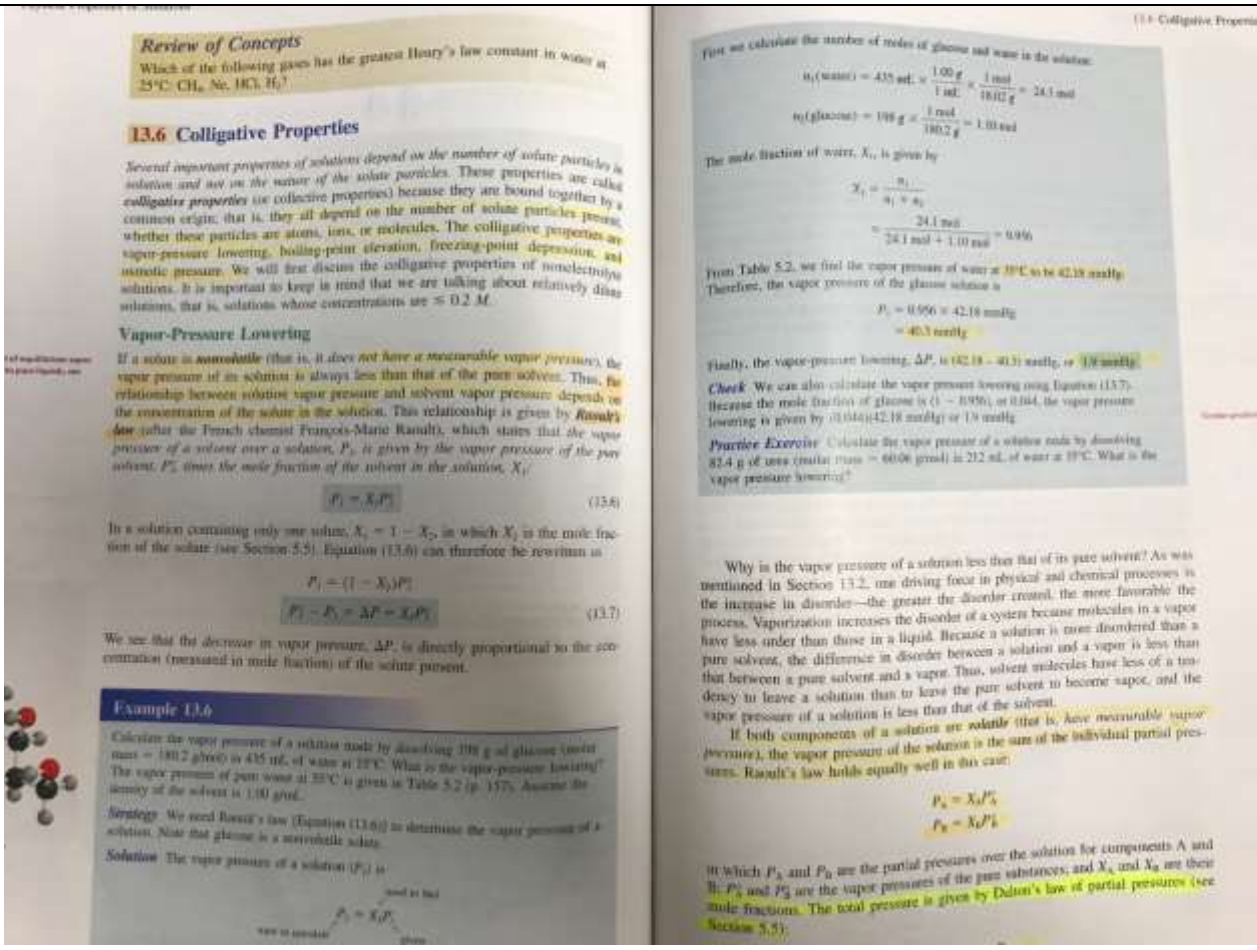
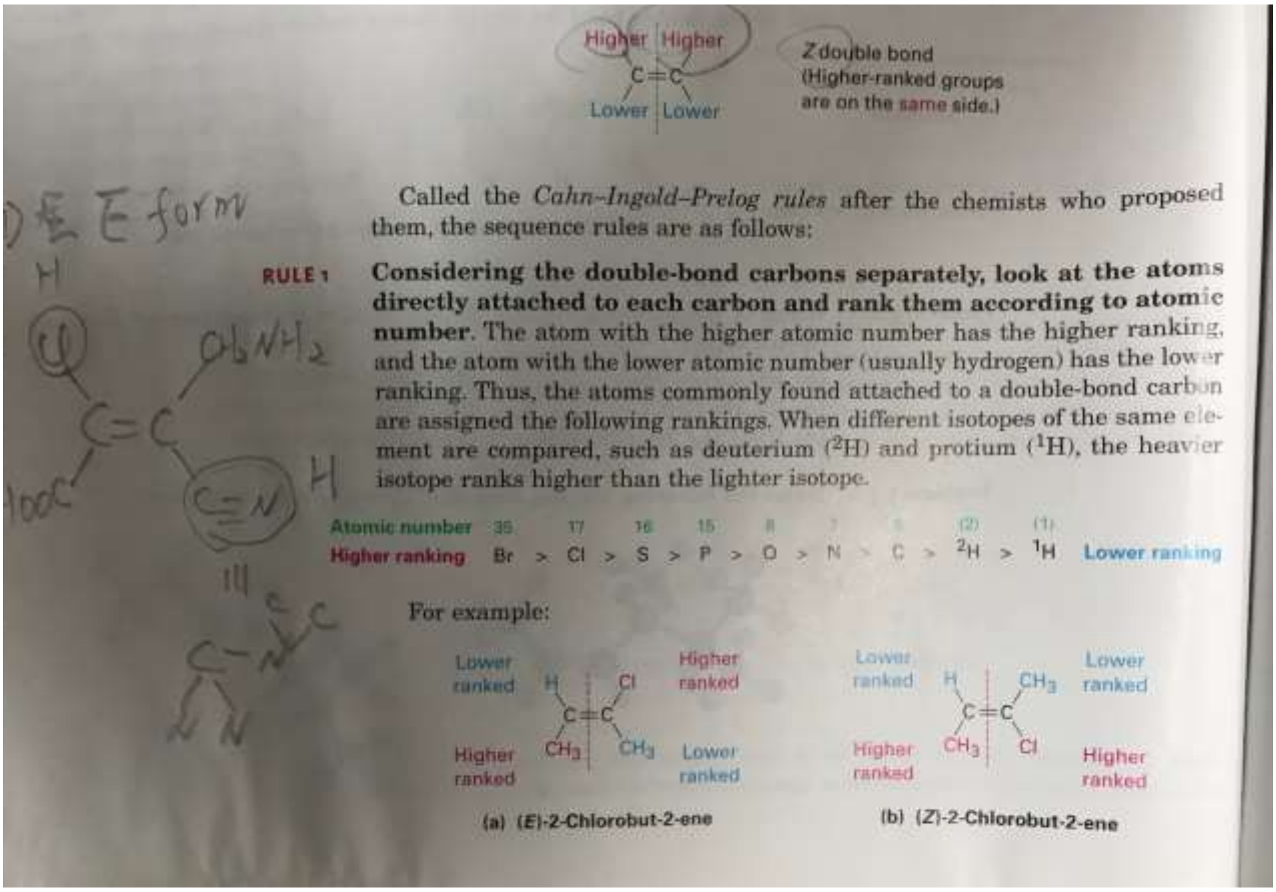


Figure 12.6 *A molecular interpretation of Henry's law. When the partial pressure of the gas over the solution increases from (a) to (b), the concentration of the dissolved gas also increases according to Equation (12.3).*

佐證資料：書名：General chemistry　　出版年或版次：11th　　頁次：　238
作者：　Raymond Chang　　出版公司：　McGraw-Hill

維持原答案(A)

	 **Review of Concepts** Which of the following gases has the greatest Henry's law constant in water at 25°C: CH_4, Ne, HCl, H_2? **13.6 Colligative Properties** *Several important properties of solutions depend on the number of solute particles in solution and not on the nature of the solute particles.* These properties are called **colligative properties** (or collective properties) because they are bound together by a common origin; that is, they all depend on the number of solute particles present, whether these particles are atoms, ions, or molecules. The colligative properties are vapor-pressure lowering, boiling-point elevation, freezing-point depression, and osmotic pressure. We will first discuss the colligative properties of nonelectrolyte solutions. It is important to keep in mind that we are talking about relatively dilute solutions, that is, solutions whose concentrations are ≤ 0.2 *M*. **Vapor-Pressure Lowering** If a solute is **nonvolatile** (that is, it does *not have a measurable vapor pressure*), the vapor pressure of its solution is always less than that of the pure solvent. Thus, the relationship between solution vapor pressure and solvent vapor pressure depends on the concentration of the solute in the solution. This relationship is given by ***Raoult's law*** (after the French chemist François-Marie Raoult), which states that *the vapor pressure of a solvent over a solution, P_1, is given by the vapor pressure of the pure solvent, P_1°, times the mole fraction of the solvent in the solution, X_1:* $P_1 = X_1P_1^\circ$ (13.6) In a solution containing only one solute, $X_1 = 1 - X_2$, in which X_2 is the mole fraction of the solute (see Section 5.5). Equation (13.6) can therefore be rewritten as $P_1 = (1 - X_2)P_1^\circ$ $P_1^\circ - P_1 = \Delta P = X_2P_1^\circ$ (13.7) We see that the decrease in vapor pressure, ΔP, is directly proportional to the concentration (measured in mole fraction) of the solute present. **Example 13.6** Calculate the vapor pressure of a solution made by dissolving 198 g of glucose (molar mass = 180.2 g/mol) in 435 mL of water at 35°C. What is the vapor-pressure lowering? The vapor pressure of pure water at 35°C is given in Table 5.2 (p. 157). Assume the density of the solvent is 1.00 g/mL. **Strategy** We need Raoult's law (Equation (13.6)) to determine the vapor pressure of a solution. Note that glucose is a nonvolatile solute. **Solution** The vapor pressure of a solution (P_1) is $P_1 = X_1P_1^\circ$ First we calculate the number of moles of glucose and water in the solution: $n_1(\text{water}) = 435\ \text{mL} \times \frac{1.00\ \text{g}}{1\ \text{mL}} \times \frac{1\ \text{mol}}{18.02\ \text{g}} = 24.1\ \text{mol}$ $n_2(\text{glucose}) = 198\ \text{g} \times \frac{1\ \text{mol}}{180.2\ \text{g}} = 1.10\ \text{mol}$ The mole fraction of water, X_1, is given by $X_1 = \frac{n_1}{n_1 + n_2} = \frac{24.1\ \text{mol}}{24.1\ \text{mol} + 1.10\ \text{mol}} = 0.956$ From Table 5.2, we find the vapor pressure of water at 35°C to be 42.18 mmHg. Therefore, the vapor pressure of the glucose solution is $P_1 = 0.956 \times 42.18\ \text{mmHg} = 40.3\ \text{mmHg}$ Finally, the vapor-pressure lowering, ΔP, is (42.18 − 40.3) mmHg, or 1.9 mmHg. **Check** We can also calculate the vapor pressure lowering using Equation (13.7). Because the mole fraction of glucose is (1 − 0.956), or 0.044, the vapor pressure lowering is given by (0.044)(42.18 mmHg) or 1.9 mmHg. **Practice Exercise** Calculate the vapor pressure of a solution made by dissolving 82.4 g of urea (molar mass = 60.06 g/mol) in 212 mL of water at 35°C. What is the vapor pressure lowering? Why is the vapor pressure of a solution less than that of its pure solvent? As was mentioned in Section 13.2, one driving force in physical and chemical processes is the increase in disorder—the greater the disorder created, the more favorable the process. Vaporization increases the disorder of a system because molecules in a vapor have less order than those in a liquid. Because a solution is more disordered than a pure solvent, the difference in disorder between a solution and a vapor is less than that between a pure solvent and a vapor. Thus, solvent molecules have less of a tendency to leave a solution than to leave the pure solvent to become vapor, and the vapor pressure of a solution is less than that of the solvent. If both components of a solution are **volatile** (that is, *have measurable vapor pressure*), the vapor pressure of the solution is the sum of the individual partial pressures. Raoult's law holds equally well in this case: $P_A = X_AP_A^\circ$ $P_B = X_BP_B^\circ$ in which P_A and P_B are the partial pressures over the solution for components A and B; P_A° and P_B° are the vapor pressures of the pure substances; and X_A and X_B are their mole fractions. The total pressure is given by Dalton's law of partial pressures (see Section 5.5): 佐證資料：書名：General chemistry　出版年或版次：7th　頁次： 450 作者： Raymond Chang　出版公司： McGraw-Hill	
31	依據 the Cahn-Ingold-Prelog rules，唯有答案(B)之取代基組合可形成 Z 異構物之化合物。**維持原答案 B。**	**維持原答案**(B)

	 Higher Higher C=C Lower Lower *Z* double bond (Higher-ranked groups are on the same side.) Called the *Cahn–Ingold–Prelog rules* after the chemists who proposed them, the sequence rules are as follows: RULE 1 **Considering the double-bond carbons separately, look at the atoms directly attached to each carbon and rank them according to atomic number.** The atom with the higher atomic number has the higher ranking, and the atom with the lower atomic number (usually hydrogen) has the lower ranking. Thus, the atoms commonly found attached to a double-bond carbon are assigned the following rankings. When different isotopes of the same element are compared, such as deuterium (^2H) and protium (^1H), the heavier isotope ranks higher than the lighter isotope. Atomic number 35 17 16 15 8 7 6 (2) (1) Higher ranking Br > Cl > S > P > O > N > C > ^2H > ^1H Lower ranking For example: (a) (*E*)-2-Chlorobut-2-ene (b) (*Z*)-2-Chlorobut-2-ene 佐證資料：書名：fundamentals of organic chemistry 出版年或版次：7th 頁次： 86 作者： John McMurry 出版公司 Brooks/cole	
32	本題答案有誤，應更改為 (D)	答案更正為(D)
37	FtsZ 收縮環受到 Min system 的調控，才能在正確位置上將細胞準確的分成對等的兩邊，也就是大腸桿菌利用 Min system 探知細胞的中間位置，再以 Z ring 將細胞分成兩半。題目為「大腸桿菌如何知道它的中間位置?」，因此本題維持原答案。	維持原答案(E)
38	只要沒有突變的產生，抑制物 (Repressor) 不會因為操縱子移至別處而改變相互間的親和力，因此抑制物本身仍會與移置 *lacA* 後的操縱子結合。但因為有乳糖的存在，所以會降低抑制物與操縱子的結合機會，但抑制物仍不會完全不再與操縱子結合。本題維持原答案。	維持原答案(C)

42	僅有感染過相同血清型的登革熱患者才能終身對該血清型的登革熱免疫，所以概括地描述受過登革熱感染均有終身免疫力的現象是個錯誤的敘述。本題維持原答案。	**維持原答案**(D)
43	投予廣效性抗生素改變腸道微生物菌相後，最直接受到影響的，就是這些腸道微生物原來支援人體的功能，合成維生素和營養素就是腸道微生物支援人體的功能之一。而抗藥菌株的產生並非為投予廣效性抗生素的必然後果。本題維持原答案。	**維持原答案**(D)
49	當天擇發生時，其子代為了適應環境會產生外型或特性上的改變，也就是需要觀察到後代的基因組成有所改變。石虎受目前環境的壓力，僅觀察到族群變小的事實，但是並沒有看到石虎在外型或特性上發生改變，所以無法證實天擇的發生。本題維持原答案。	**維持原答案**(E)
50	進行作物的掩埋或焚毀，使用農藥或生物防治的方式均為可行的防治秋行軍蟲的方式，所以選項 D 與 E 均為敘述正確的選項。而秋行軍蟲的幼蟲食性廣泛，是主要造成農損的原因。本題維持原答案。	**維持原答案**(A)

總結：

共計 15 題申請釋疑，13 題維持原答案，2 題更改答案。

- 第 26 題答案更正為(A)或(D)皆給分。
- 第 32 題答案更正為 (D)。