

國立中山大學 111 學年度學士後醫學系招生考試試題答案疑義釋疑公告

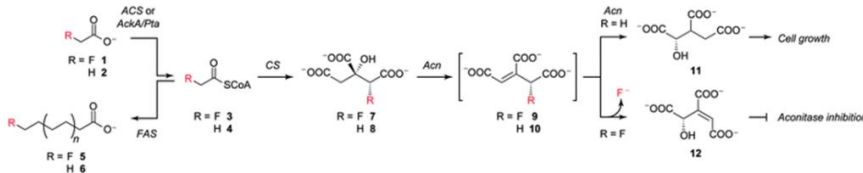
科目	題號	釋疑答覆	釋疑結果
普通生物及生化概論	2	<p>固氮作用為部分原核生物將環境中的氮氣經生化過程轉化為含氮化合物之過程。植物雖可經由與此些原核生物共生之方式，由原核生物代謝產物取得植物所需之含氮化合物，但植物本身並無此固氮能力。相關資料多見于各相關教科書中，以下僅附二例以為參考。因此，本題之答案確為(A)。</p> <p>See “Nitrogen Fixation Nitrogen fixation is the process by which nitrogen is taken from its molecular form (N<sub>2</sub>) in the atmosphere and converted into nitrogen compounds useful for other biochemical processes. Fixation can occur through atmospheric (lightning), industrial, or biological processes. Biological nitrogen fixation can be represented by the following reaction, in which the enzyme-catalyzed reduction of N<sub>2</sub> to NH<sub>3</sub>, NH<sub>4</sub><sup>+</sup>, or organic nitrogen occurs:  <math display="block">\text{N}_2 + 16\text{ATP} + 8\text{e}^- + 8\text{H}^+ \rightarrow 2\text{NH}_3 + 16\text{ADP} + 16\text{P}_i + \text{H}_2</math> This process is performed by a variety of prokaryotes, both symbiotic and free living, using an enzyme complex termed nitrogenase that is composed of two separate protein components (dinitrogenase reductase and dinitrogenase). Dinitrogenase reductase donates two high potential electrons at a time to dinitrogenase and contains an Fe-S center that holds the electrons before donation. Dinitrogenase then catalyzes the reduction of N<sub>2</sub>. Once nitrogen has been fixed, it can be oxidized to NO<sub>2</sub><sup>-</sup>/NO<sub>3</sub><sup>-</sup> or assimilated by organisms.”  Extracted from:  G. Hanrahan, G. Chan,  Encyclopedia of Analytical Science (Second Edition),  NITROGEN,  Editor(s): Paul Worsfold, Alan Townshend, Colin Poole,  Elsevier,  2005,  Pages 191-196,  ISBN 9780123693976,  <a href="https://doi.org/10.1016/B0-12-369397-7/00401-5">https://doi.org/10.1016/B0-12-369397-7/00401-5</a>.</p> <p>See “Nitrogen fixation takes place in a wide variety of bacteria, the best known of which is rhizobium which is found in nodules on the roots of leguminous plants such as peas, beans, soya and clover.”  Extracted from:  Chemistry of the Elements (Second Edition),  Chapter 23 - Chromium, Molybdenum and Tungsten,  Editor(s): N.N. GREENWOOD, A. EARNSHAW,  Butterworth-Heinemann,  1997,  Pages 1002-1039,  ISBN 9780750633659,  <a href="https://doi.org/10.1016/B978-0-7506-3365-9.50029-8">https://doi.org/10.1016/B978-0-7506-3365-9.50029-8</a>.</p>	維持答案不變 (A)

19	<p>答案中，只有 (C) cholesterol and other sterols 未發現與蛋白質形成共價鍵。釋疑提出之參考資料中，亦未提到 cholesterol and other sterols。而在選項 ABCD 中，僅有膽固醇未發現與蛋白質形成共價鍵。本題維持原答案 C。</p>	維持答案不變(C)
41	<p>釋疑提出答案(C)亦為 false。然而，答案(C)所描述之結構與內容正確，故非答案，本題維持原答案 D。</p> <p>See “Figure 4. Longitudinal section of a lateral line canal. Each fluid-filled canal is open to the outside via a pore (P). A canal neuromast (SE) with its overlying cupula (C) sits on the floor of the canal, with one neuromast between each pore. The canal neuromasts are innervated by a cranial nerve. From Grassé PP (1958) L’oreille et ses annexes. In: Grassé PP (ed.) <i>Traité de Zoologie</i>, vol. 13, pp. 1063–1098. Paris: Masson.”</p> <p>Extracted from:  Fish: Hearing, Lateral Lines (Mechanisms, Role in Behavior, Adaptations to Life Underwater)  Editor(s): John H. Steele,  Authors: A.N. Popper, D.M. Higgs,  <i>Encyclopedia of Ocean Sciences (Second Edition)</i>,  Academic Press,  2009,  Pages 476-482,  ISBN 9780123744739,  <a href="https://doi.org/10.1016/B978-012374473-9.00680-9">https://doi.org/10.1016/B978-012374473-9.00680-9</a>.</p>	維持答案不變(D)
51	<p>釋疑提出答案(E)亦為 false。多篇研究顯示(如下面二例)，coronavirus 應為 positive-sense single-stranded RNA viruses。因此，本題答案應為 (C) (E)。</p> <p>See “Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) was first detected in late December 2019 and has spread worldwide. Coronaviruses are enveloped, positive sense, single-stranded RNA viruses and employ a complicated pattern of virus genome length RNA replication as well as transcription of genome length and leader containing subgenomic RNAs. Although not fully understood, both replication and transcription are thought to take place in so-called double-membrane vesicles in the cytoplasm of infected cells. Here we show detection of SARS-CoV-2 subgenomic RNAs in diagnostic samples up to 17 days after initial detection of infection and provide evidence for their nuclease resistance and protection by cellular membranes suggesting that detection of subgenomic RNAs in such samples may not be a suitable indicator of active coronavirus replication/infection.”</p> <p>Extracted from:  Alexandersen, S., Chamings, A. and Bhatta, T.R., 2020. SARS-CoV-2 genomic and subgenomic RNAs in diagnostic samples are not an indicator of active replication. <i>Nature communications</i>, 11(1), pp.1-13.</p> <p>See “Coronaviruses (CoVs) are a highly diverse family of enveloped positive-sense single-stranded RNA viruses. They infect humans, other mammals and avian species, including livestock and companion animals, and are therefore not only a challenge for public health but also a veterinary and economic concern. Within the order of Nidovirales and the suborder of Coronavirineae lies the family Coronaviridae. The latter is further specified into the subfamily of Orthocoronavirinae, which consists of four genera: alphacoronavirus, betacoronavirus, gammacoronavirus and</p>	原答案(C)維持，增加答案(E)，答(C)或(E)皆可。

	<p>deltacoronavirus. Whereas alphacoronaviruses and betacoronaviruses exclusively infect mammalian species, gammacoronaviruses and deltacoronaviruses have a wider host range that includes avian species. Human and animal coronavirus infections mainly result in respiratory and enteric diseases<sup>1,2</sup>.”</p> <p>Extracted from: V'kovski, P., Kratzel, A., Steiner, S., Stalder, H. and Thiel, V., 2021. Coronavirus biology and replication: implications for SARS-CoV-2. Nature Reviews Microbiology, 19(3), pp.155-170.</p>	
71	<p>此題指”脫氨後”氨基酸的 <math>\alpha</math>-keto acid，而非對氨基酸的直接修飾。而 Creatine 的形成過程中 glycine 並未經過脫氨，相關資料多見于各文獻中，以下僅附一例以為參考。因此，本題答案確為 (D)。</p> <p>參考資料如下：</p> <p>摘取自： Brosnan, J.T., Wijekoon, E.P., Warford-Woolgar, L., Trottier, N.L., Brosnan, M.E., Brunton, J.A. and Bertolo, R.F., 2009. Creatine synthesis is a major metabolic process in neonatal piglets and has important implications for amino acid metabolism and methyl balance. The Journal of nutrition, 139(7), pp.1292-1297.</p>	維持答案不變(D)
82	<p>Glutamine, or glutamate, aspartate 會互相轉換，皆可當作 arginine 的 precursors。相關資料多見于各文獻中，以下僅附一例以為參考。因此，本題答案確為 (E)。</p> <p>參考資料原文如下： “In most bacteria ammonium assimilation takes place through the very efficient and ATP-consuming glutamine synthetase-glutamate synthase pathway, which produces two amino acids that are general distributors of nitrogen in cellular metabolism, glutamine and glutamate (1). A very direct use of these amino acids takes place in arginine biosynthesis, which starts with glutamate as precursor and in which another glutamate molecule, aspartate, and carbamoyl phosphate provide the three nitrogen atoms included in the guanidine group; carbamoyl phosphate is synthesized from glutamine, bicarbonate, and ATP (2). Given its high energetic demand, this pathway is usually subjected to feedback inhibition by arginine of one of its first enzymatic steps. In cyanobacteria, N-acetylglutamate kinase (NAGK) is inhibited by arginine, but under sufficient nitrogen, the C/N balance and energy status indicator PII protein (glnB gene product) binds to NAGK, relieving its inhibition by arginine, with the effect of increasing the production of arginine by the biosynthetic pathway (3). Bolay et al. (4) now</p>	維持答案不變(E)



參考資料原文如下：



“Fig. 1 Metabolic pathways of characterized biogenic organofluorines. Fluoroacetate (1) is activated through the same routes as acetate (2), which produces fluoroacetyl-CoA (3) and acetyl-CoA (4), respectively. Fluoroacetyl-CoA can be used by fatty acid synthases (FAS) as a starter unit to initiate formation of  $\omega$ -fluoro-fatty acids (5), which account for the majority of characterized organofluorines, in an analogous manner to canonical fatty acids (6). It can also be converted to fluorocitrate (7) while the normal cellular metabolite, acetyl-CoA, yields citrate (8) as an intermediate of the tricarboxylic acid (TCA) cycle. When the aconitase (Acn) acts on fluorocitrate and citrate, it produces fluoroaconitate (9) and aconitate (10), respectively. With the physiological substrate, the aconitate is rehydrated to generate isocitrate (11), which is an intermediate of the TCA cycle and used for cell growth. However, elimination of fluoride occurs from fluoroaconitate to yield 4-hydroxy-transaconitate (12), a potent inhibitor of the aconitase. Since the inhibitor is already bound to the active site and has an extremely slow off-rate, fluorocitrate is an effectively irreversible inhibitor that leads to disruption of the TCA cycle. (ACS, acetyl-CoA synthetase; AckA, acetate kinase; Pta, Phosphotransacetylase; CS, citrate synthase; Acn, aconitase.)”

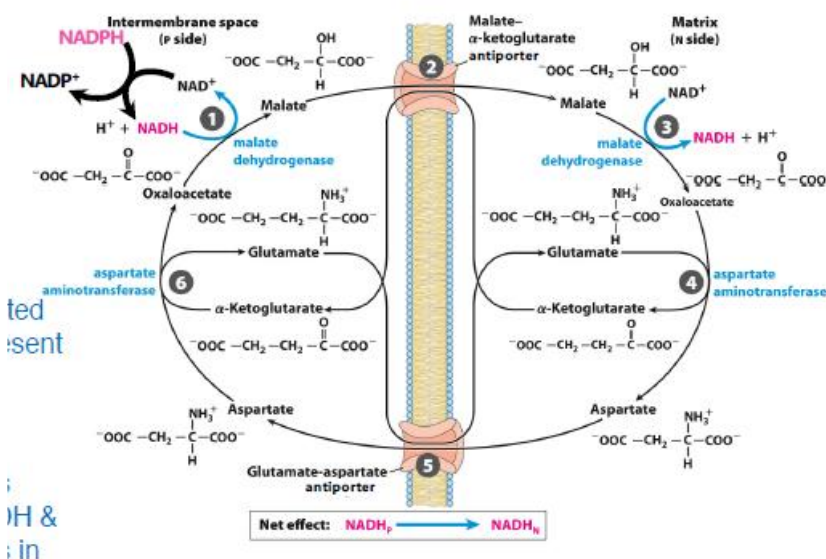
摘取自：

Walker, M.C. and Chang, M.C., 2014. Natural and engineered biosynthesis of fluorinated natural products. *Chemical Society Reviews*, 43(18), pp.6527-6536.

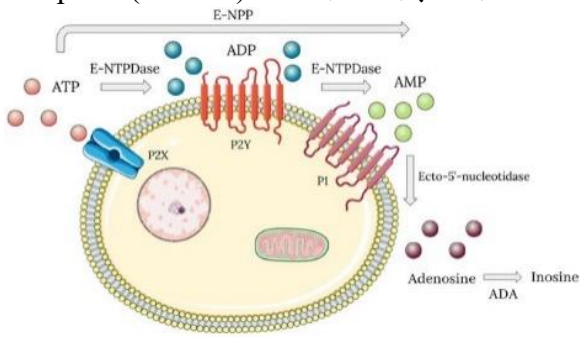
84

Dihydroxyacetone phosphate/glycerol-3-phosphate shuttle 才是使用 NADH。

依循 Lehninger Principle of Biochemistry 6<sup>th</sup> edition 的第 758 頁 Figure 19-31 在 Intermembrane space 為以  $NADPH + NAD^+ \rightarrow NADP^+ + NADH$  為主，而在 Matrix 則為  $NAD^+$  接受 Malate 之 proton 而形成  $NADH + H^+$ ，因此未使用 malate/aspartate shuttle，D 選項錯誤。本題維持原始答案為 B



維持答案不變(B)

87	<p>Reverse transcriptases 是屬於以 RNA 為模板進行 DNA 合成，而 RNA replicases 是以 RNA 為模板直接進行 RNA 合成，兩種雖然是不同的酵素，但是其 error rates 相似。</p> <p>此二種酵素皆是以 RNA 為模板，但是分別合成 DNA 和 RNA，且是在類似的病毒中，皆具有完全一樣的催化機轉和正常的活性，因此可以在生物技術中應用，例如現階段 COVID-19 檢測，為使用 Reverse transcriptases 進行 qPCR 定量，選項 C 不是正確答案。</p> <p>本題維持原始答案為 D</p>	維持答案不變(D)
90	<p>此題針對藥物和抑制劑(drugs and inhibitors)的敘述，而大多數的藥物(化合物)在生物體內有多種 target，Caffeine 有自己的 adenosine A2A receptors (A2ARs)，也可以競爭結合 adenine receptor。</p>  <p>而 Viagra 作用機轉為能在海綿體內誘導產生 NO 而活化 guanylate cyclase 導致 cGMP 上升，cGMP 作用使海綿體平滑肌鬆弛，其內動脈擴張→大量血液注入海綿體，陰莖勃起，為連續作用而非單一作用。</p> <p>本題維持原始答案為 A</p>	維持答案不變(A)
38	<p>此題為 CRISPR-Cas9 技術的相關內容，CRISPR-Cas9 技術是由細菌用作免疫防禦的自然發生的基因組編輯系統所發展而來的生物技術。依循 Campbell Biology 12th Edition 第 410 頁說明 Cas9 為一種核酸切割酶，可以切割任何的雙股 DNA，作用機制為以 Cas9 蛋白以及嚮導 RNA (gRNA) 為核心的組成，而此技術則是使用互補嚮導 RNA (gRNA) 進行引導，因此此題 E 選項為最佳答案，故維持原答案 E</p>	維持答案不變(E)
31	<p>依循 Campbell Biology 12<sup>th</sup> Edition 第 712 頁清楚說明 dikaryotic 的定義，”As a dikaryotic mycelium grows, the two nuclei in each cell divide in tandem without fusing. Because these cell retain two separate haploid nuclei, they differ from diploid cells, which have pairs of homologous chromosomes with in a single nucleus.“，即雙核期是一個細胞中具有二個單倍體的細胞核，隨著此雙核菌絲體的生長，每個細胞中的兩個細胞核在沒有融合的情況下進行分裂。因為這些細胞保留了兩個獨立的單倍體細胞核，它們與二倍體細胞不同，與二倍體細胞在單個細胞核中具有成對的同源染色體是不同的，此 dikaryotic stage 是 Basidiomycetes 生活史中的特徵，Zygomycetes 的 young zygosporangium 是多核而非雙核，因此 E 選項不正確，本題維持原始答案為 B</p>	維持答案不變(B)
33	<p>依循 Campbell Biology 12th Edition 第 269 至 270 頁資料，在光合作用之光反應中，來自太陽的能量以光子的形式轉化為化學能，以 ATP 和 NADPH 的形式儲存起來。光合作用過程中，依賴光的反應經過光系統 II 和光系統 I 將由 Photon 激發的電子經由電子傳遞鏈轉移，因此植物是以 Photon 的形式接收來自太陽的光。而光系統 II 和光系統 I 各獲得 4 個 Photon 時，可產生一分子的氧氣。本題維持原始答案為 C</p>	維持答案不變(C)

39	<p>題幹為針對氯離子通道功能性缺失，此主要為針對 cystic fibrosis 的遺傳性疾病所導致的現象，依循 Campbell Biology 12th Edition 第 336 頁資料，此為位於人類第 7 對染色體上的 cystic fibrosis transmembrane conductance regulator (CFTR) 基因缺陷導致失去功能，此通道存在於外分泌上皮細胞的頂端質膜上，功能障礙會降低細胞分泌活性，從而導致導管系統阻塞並最終導致整個腺體纖維化。因此 C 選項是因為此現象造成胰管的堵塞，阻止胰液排出而非增加胰液分泌量。在肺臟則是增加肺泡和氣管分泌物。本題維持原始答案為 B。</p>	維持答案不變(B)
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