

考試科目：科學教育

答題說明：1.本試題共三頁。

2.答案寫在答案紙上，一律由左至右，橫式書寫；不必抄題，但須註明題號。試題請隨同答案卷一併繳回。

3.本科試題有簡答題 5 題，每題 10 分；問答題 5 題，每題 20 分，共 150 分。

壹、簡答題（共 5 題，每題 10 分，小計 50 分）

- 1.What is the meaning of “ Pedagogical Content Knowledge” ? Why is it important in science teaching? (10 分)
- 2.請簡單的使用一種學習理論「描述」並「解釋」以下的現象 :(10 分)
A class of sixth graders attended a hands-on activities with enthusiasm in accordance with a copy of checklist the teacher gave to them step by step.
- 3.何謂認知心理學中所稱的二元編碼理論(dual coding theory)? (10 分)
- 4.兩位著名的科教學者 Barry J . Frase和 Kenneth G. Tobin合編的 International Handbook of Science Education 由 Kluwer Academic Publishers 公司於 1998 年在英國(UK)London出版，是目前科學教育研究的重要文獻之一。其中在第 27 頁至第 38 頁，收錄了 Clive Sutton 所撰的 New perspective on language in science 一文。假設你的論文引用了該篇文獻的論述，請你將它依 APA 格式寫成參考文獻。(10 分)
- 5.如何建構一個適合國小或國中學生的科學學習環境？請闡述您的構想與設計。(10 分)

貳、問答題（共 5 題，每題 20 分，小計 100 分）

1. 請閱讀下列論文摘要後回答下列問題。（20 分）

This interview-based study probed 48 grade 8-10 students' mental models of atom and molecules and found that many of these students preferred models that are both discrete and concrete. Modeling is a powerful skill that defines much of the scientific method; however, most younger science students have difficulty separating models and reality. Language that is common to both biology and chemistry (e.g., nucleus and shells) is a major source of confusion for some students. Several students concluded that atoms can reproduce and grow and that atomic nuclei divide. Electron shells were visualized as shells that enclosed and protected atoms, while electron clouds were structure in which electrons were embedded. These, and other alternative conceptions may be generated during discussion as a result of semantic differences between teacher and student language. Students expressed a strong preference for space-filling molecular models and their conceptions of models used in chemistry reveal much about the difficulties that students face as they try to assimilate and accommodate scientific ideas, and terminology. It is recommended that teachers develop student modeling skills and that they discuss analogical models, including shared and unshared attributes, with their students.

- (1) 該研究的主要發現是什麼？在科學教學上有何應用價值？
- (2) 就你所閱讀過的文獻，說明該文獻評量學生的 mental models 之方法。

2. 請閱讀以下從 Journal of Research in Science Teaching 期刊摘錄出來的英文描述，並依據最後之中文題目用「中文」作答（20 分）

A large number of American elementary school students are now studying science using the hands-on inquiry curricula developed in the 1990s.... A goal of these programs, echoed in the National Science Education Standards, is that children should gain ‘ ‘ abilities to do scientific inquiry’ ’ and ‘ ‘ understanding about scientific inquiry.’ ’ We have studied the degree to which students can do inquiries by using four hands-on performance assessments, which required one or three class periods. To be fair, the assessments avoided content that is studied in depth in the hands-on programs. For a sample of about 1000 fifth grade students, we compared the performance of students in hands-on curricula with an equal number of students with textbook curricula. The students were from 41 classrooms in nine school districts. The results show little or no curricular effect. There was a strong dependence on students' cognitive ability, as measured with a standard multiple-choice

instrument. There was no significant difference between boys and girls. Also, there was no difference on a multiple-choice test, which used items released from the Trends in International Mathematics and Science Study (TIMSS). It is not completely clear whether the lack of difference on the performance assessments was a consequence of the assessments, the curricula, and/or the teaching.

- (1) 請簡單的描述這個研究的研究方法。(5分)
- (2) 請問你相信這個研究結果嗎？請先陳述信或不信，然後陳述理由。(5分)
- (3) 最後請根據本篇文章之情境針對以下之英文句子：

「It is not completely clear whether the lack of difference on the performance assessments was a consequence of the assessments, the curricula, and/or the teaching.」提出您個人對 hands-on 教學的見解。(10分)

3. 科學教學上，瞭解學生的學習準備度(readiness)是很重要的，現在你想做某一個科學概念的教學，因此想先瞭解學生的學習起點(或者是認知結構...等)，請您從科學教育研究的立場說明如何進行這樣的研究，如果需要的話，你可以用某一個科學概念為例來協助你的說明。(20分)
4. 「講述式教學」固然常被教育改革者所詬病，但它本身並非一無是處，而且仍是目前學校教育的主流教法之一，過去數十年來這種教法也曾教導出許多傑出的學生，原因在於講述的外表下，仍可找到符合當代科學教育思潮或理論的內涵。請你指出講述式教學有哪些地方，可以符合當代科學教育的思潮或理論？(20分)
5. 提升全民的科學素養是當今科學教育的重點目標之一，請說明目前大眾科學教育活動的內容有哪些？有什麼優缺點？有什麼問題與困難？要如何帶動全面普及大眾科學推廣活動？(20分)