科學研究之基礎

(1) 記錄
(2) 生活規畫與時間管理
(3) 念研究所做什麼
(4) 研究之程序
(5) 實驗之記錄

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(1974 年 7 月，初稿於中研院；2000，2001，2004，2006，2008 年增修)
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第一章 記　錄

(初稿，1974 年於中研院)
(2000 年 7 月 18 日版)

1. 學會“記錄”
   靠“記錄”，不靠“記憶”。

2. 準備好的筆記本
   (1) 一般事務
   (2) 實驗記錄
   (3) 其他：
      a. 行程表 (週記)
      b. 電話簿 (或電腦)

3. 報告 (記錄) 要件：
   (1) 即時記錄，即時交 (不是作文)。
   (2) 寫出日期，2004, 7. 5。姓名。
   (3) 實驗筆記要編號：
      MS04-01，MS04-02……
   (4) 統一 (A4 紙，橫排)。

第二章　生活規畫與時間管理

（2002 年 7 月 19 日）

大　綱

一、 前　言
   1. 每人都有 24 小時
   2. 用合理、平衡的方法管理時間
   3. 愉快的工作，不是拼命的工作

二、 將「人生目標」與「時間管理」合併規畫
   1. 合理的人生
   2. 生活規畫與時間管理
   3. 如何更精明的工作

三、 做重要的事 (人生規畫)
   1. 寫出目標
   2. 排出優先順序
   3. 寫出達成目標的方法
   4. 把可工作的時間優先用在目標上

四、 如何更有效率
   1. 知道自己時間的流向
   2. 可工作的時間
   3. 80、20 定律
   4. 將任務分成小部份
   5. 同性質的一起做

五、 減少浪費

六、 平　衡

一、前　言

1. 每人每天都有 24 小時 (世界是公平的)
   但是：
   (1) 某些人很特殊：一天只睡了 3 小時，吃飯很快，過目不忘...
   (要學習嗎?)
   (2) 很多 ”勵志” 的書，建議我們：
   ○ 不要以家庭為念,不做家庭雜事,才有機會成為大企業...(對嗎?)
   ○ 先生事業成功，是妻子的光榮...(對嗎?)
   (3) 某些講求“效率”的書，建議我們：
   ○ 如何省 30 秒，..... (要這樣做嗎?)
   ○ 做那個動作，可以更快 (扣子由下往上扣，或由上往下扣....)....(要這樣做嗎?)
   (4) 某些人：
   ○ 用很多時間看電視、逛街、只看影劇版新聞.....(不對嗎?)

2. 用合理，平衡的方法管理時間：
   本文希望提供一些方法，你我皆可做到的方法，來管理時間。

3. 愉快的工作，不是拼命的工作 (work smarter, not work harder)：
   時間管理需與生活規畫配合。

二、將人生目標與時間管理合併規畫
   (時間規理＝生活規畫)

1. 合理的人生：
   (1) 維持生命
   (2) 做人之樂趣　} 互相影響
   (3) 工作’

2. 生活規畫與時間管理：
   (1) 先扣除“為維持生命所需要的時間 (睡覺、吃飯、梳洗、運動...)，再扣除“做人樂趣所需要的時間 (家庭生活，興趣，...)
   ＝可工作時間
   (2) 可工作時間＝可預測的事+難預測的事
   努力做到　　＞80%　　＜20%

3. 如何“更精明的工作”
   (1) 找出重要的事，排出先後順序。　→即是生活規畫
   (2) 工作的更有效率，用最好的方式處理。 →開 源
   (3) 減少浪費，不做 ”不必做” 的事。　→節 流

4. 不是“更努力的工作”

加長工作時間，減少必要睡眠，不吃早餐，不參與家人活動.....

(不好吧！！)

三、做重要的事 (人生規畫)

1. 寫出目標

在 2 分鐘內寫出，2 分鐘修改

(1) 長程目標 (一生之目標)

發財？家庭幸福？服務人群？快樂....

(2) 中程目標 (五年內要達成的)

就業？拿到博士？.....

(3) 短程目標 (六個月內要達成的)

要債？修房子？.....

2. 排出優先順序

(1) 對自己重要 (無正確答案)：

適合自己特性，適合自己條件 (龜兔賽跑)

(2) 排出 3 個最重要的：

只能列 3 個，因為不可能什麼都做。

(3) 充實自己：

◯ 讀書，聽演講 → 學習他人

◯ 自己改進 (從自己記錄，經驗中學習) →自我學習

3. 寫出達成目標的“方法”

目 標	方 法
身體健康	每天運動，定期檢體，營養均衡，睡眠充足...
家庭幸福	用心的與家人相處。
事業成功	自己具備的條件：學歷、技能、考試資格....
就 業	寫履歷表，求職信，看報紙，找熟人，請教別人...

4. 把“可工作的時間”優先用在：

長程目標－A1, A2, A3

中程目標－B1, B2, B3

短程目標－C1, C2, C3

(1) 把為達成“長程目標”的事，變成習慣：

例如:為了達到家庭幸福，儘量每天回家吃晚飯，陪父母、太太及小孩，把這些作息變成一種習慣.....。長程目標，需要 ”持續性”。

(2) 儘量只做“優先的事”。

(3) 不做“以前”的事

做“校長”的事，不做“主任的事”.....。

(4) 不做“以後”的事
聯考考不上，要怎麼辦?
(5) 做“現在”的事。
(6) 可以調整順序。

四、如何更有效率

1. 知道自己時間的流向 (記錄時間)
(1) 必用的時間：吃飯，睡覺，運動，休閒等。
(2) 可整體使用的時間：早晨起床後？上班後 1 小時？中午或晚上？
(3) 自己的韻律：早晨？晚上？其他？

2. 可工作的時間：每天先做 ”長程目標” 的事。

3. 80%，20% 定律。
將 80% 的時間用在 “重要的事”，20% 用在 “其他的事”

4. 將任務分成小部份 (蠶食)，最容易的部份先做：
例如：警衛換班制，筆記本

5. 同性質的工作一起做：
例如：洗衣，寫賀卡，處理電話，購物

6. 留下彈性時間 (因為不可能都計算得到)。

五、減少浪費
(儘量不做事，現在做什麼最好？)

1. 授權、分工：在一定的時間裡，要完成 10 件工作時，若無法達成工作時，應尋求別人幫忙，挑最重要的 3-4 件做，其他由別人負責。

2. 利用閒暇時間，一心二用：約人碰面時，可約在書店，等候時可看書；錯開交通時間....。

3. 學會拒絕，不要高估自己。

4. 不要求十全十美。80% 的事，求 80 分；20%的事，做 90 分以上。

5. 準時開會，準時結束。

六、平衡

1. 與小孩相處的時間： a. 零。 (不夠親近，小孩可能會排斥你)
   b. 4 小時以上 (無法做自己的事情)
   c. 1-2 小時 (平衡)
2. 打電話回家：每天打，一次打 10 分鐘；比每週打，一次打 1 小時好。
3. 讀英文：每天讀 30 分鐘，比每週一次 3 小時有效率。
4. 事業，家庭，健康兼顧。無法解決的事，先回家，明天再講。
5. ……

第三章 念研究所做什麼？

COMMON MISCONCEPTIONS CONCERNING GRADUATE SCHOOL

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Chemical engineering education
Fall, 1984, pp. 156-158

Twenty-five years ago, I stared graduate school at the University of Delaware. Looking back on that time, I can see that I was a typical graduate student in that I was both excited and terrified, confident and anxious, sure of success one day and afraid of failure the next. I did, however, harbor certain basic misconceptions about the experiences which lay ahead of me. In talking to our graduate students here at Penn State, I found that those same misconceptions are still common, and this insight prompted me to give the following introductory address to our incoming graduate students.

……..

LIKE YOU TODAY, I was also entering graduate school twenty-five years ago. My mind was also filled with questions and concerns. It was also cluttered with certain misconceptions, which are still popular today. I would like to look back on that time with you and try to tell you how my views on graduate school have changed.

The first misconception I had was that graduate school would be a continuation of my experience as an undergraduate.

This was probably my greatest misconception. First of all, graduate courses and undergraduate courses are, in general, somewhat different. You are an elite group since we only accept on out of every fifteen applicants to our graduate program. Consequently, there is no doubt in our minds that you can perform well in graduate courses since your ability in chemical engineering courses has been demonstrated by your undergraduate record. Therefore, graduate courses tend to be more relaxed, with less emphasis on evaluation and certainly no hint of being a weeding-out process. We feel that you are in these courses because you want to learn, and therefore our main emphasis is on enhancing your technical expertise. You are now engineers, not just high school graduates.

The main difference between undergraduate and graduate education is related to the research aspect of graduate studies. Very few of our graduate students fail to receive their graduate degree because of their performance in courses. The main hurdle is the ability to do independent research. Up to now, in my opinion, you educational experiences have been somewhat artificial. You have studied in order to pass exams which cover very specific and limited areas. In the past, you worked certain problems on examinations. You knew there was an answer. You also knew you had enough data to reach that answer. Conducting research in graduate school, on the other hand, does not involve an artificial environment. You will be working on problems where no one knows the answer, and the problem itself might not even be clear. Graduate research is similar to an apprenticeship. You will be working directly with an expert and will learn by doing and observing how this expert approaches problems. The key to graduate research is

problem solving, not the acquisition of specific information. You will learn how to solve problems by actually performing this task under the direction of an expert, not by studying the philosophy or idealized approach to problem solving.

What happened to me may also happen to some of you. I slowly began to realize that research was unlike anything that I had been exposed to previously. There is a natural tendency to exaggerate the difference and come to the counter-mis-conception that research has nothing to do with your undergraduate work. This is not true either. Research is a natural extension of your learning career to date, but it is also more than that. You have been learning and obtaining information from teachers, textbooks, and independent study in libraries. But what do you do when the knowledge you desire is not available in any book or article, or when no individual exists who knows the answer? Research in the physical sciences and engineering is the process of learning by asking nature questions. In a sense, nature becomes your ultimate teacher. When you design experiments, you are really formulation your questions for nature. Unlike your previous teachers, nature does not anticipate your question. You will get a direct and honest answer to your question as it was formulate. If you are misled or have difficulties, it will not be because nature failed to answer your question. It will be due to your failure in formulating the question or in interpreting the results. The best researchers are the ones who ask what appear to be very simple questions and receive earthshaking replies.

At this point, one might ask how theory fits into all this if the basis of research is asking nature questions through experimentation. As J. Willard Gibbs said, “The purpose of theory is to find that viewpoint from which experimental observations appear to fit the simplest pattern.” You want to determine this pattern so that you can generalize your

experimental observations and minimize the number of experiments that have to be conducted.

My second misconception concerning graduate school was that the choice of a research topic was one of the most important decisions of my life since it would determine what area I would work in for the rest of my career.

New graduate students continually forget that the main purpose of research at the graduate level is to learn how to do research and to solve problems. The acquisition of knowledge in a particular area is of secondary importance. If you have learned how to do research in area A, it is a relatively minor step to acquire the facts and background needed to conduct research in area B. Consequently, when choosing a research topic, your main concern should not be whether you like the research area, but whether this particular research project and the director of this research have the best chance of teaching you how to conduct research.

My third misconception was that my research work would follow the idealized method of scientific inquiry which involves a literature search, development of a theory, design of the experiments, and interpretation of results that tested the theory.

One quickly learns that research is often more like a random walk than an idealized textbook approach. The young researcher is often quite upset when discovering this fact. At first it is difficult to accept this basic truth. It is much easier to arrive at one of the following conclusions:

◎ My thesis advisor is incompetent.

◎ My research topic is a real lemon; I don’t know how anyone talked me into doing this.

◎ My research has nothing to do with what I have learned in the classroom.

◎ No one else has problems like me; my project is unique in its difficulty.

What the young researcher fails to realize is that the way research results are presented in a paper or a seminar has nothing to do with the process that was followed in obtaining those results. Research cannot be planned like many other human endeavors. It is, in fact, a form of art. If you knew beforehand what your results were going to be and the path you would have to take to obtain them, it simply would not be research. One frustration which all faculty members face is that many funding organizations also do not realize this. As a graduate student, you must be careful not to confuse the formal presentation of results in papers or seminars with the actual process. A related misconception is that the results you obtain in research should be in proportion to the time and effort you have spent. The most difficult aspect of research is that you do not usually see a steady progression of results. Instead, results come in bursts or surges. It takes tremendous tenacity to hand in there and keep plugging away when you are not aware of any progress.

Many young researchers also feel that their problem is so complex that it really cannot be explained to anyone else in a reasonable period of time. No matter how badly things are going, or how tortuous your route, you should always maintain a clear idea of you objective. If you cannot give a clear overview of your research project in a few short sentences, you have a good indication that part of your problem is your inability to keep things clearly defined in your own mind.

My fourth misconception was that the study of chemical engineering had

nothing to do with human values, ethics, morals, etc.

When I started my graduate studies, I considered science to be ethically or morally neutral. However, as Bronowski has pointed out, this is confusing the results or findings of science with the activity of conduction science. There is no question that the results of your research will be ethically neutral; however, at the center of scientific inquiry is the standard that facts or truth, not dogma, must dominate your research. By conducting research, you will be training yourself to avoid and resist every form of persuasion but the facts. The most difficult part will be to avoid deceiving yourself. In everyone's career, there comes a time when experimental observations are inconsistent with a pet theory. It will be a test of your maturity as a researcher to unbiasedly look at the facts and to determine if the experimental observations are consistent or inconsistent with the theory, independent of your personal feelings. As T. H. Huxley said, "The great tragedy of science is the slaying of a beautiful theory by an ugly fact." There is a natural tendency to formulate vague theories which cannot be proven wrong, but all good theories will eventually lead to their own demise since they will finally predict something which is inconsistent with experimental observation.

Science does not have a Hippocratic oath or any other professionally induced ethical rule. However, you can be untruthful and still be a successful doctor or lawyer. This is not a viable possibility for the scientific researcher. As you develop into a good researcher, you will develop the capability of making judgments based solely on the facts. I feel this training can have a very significant positive influence on the moral and ethical aspect of your life since it tends to minimize self-deception and rationalization.

My fifth and final misconception was that graduate study was all hard work and the rewards would come later when I had an interesting job and

was making a lot of money.

After I received my advance degrees, I realized that some of the best years of my life were those I spent in graduate school. I found that the pleasure and sense of accomplishment that came with learning and creating far outweighed the other pleasures in life. As graduate students, you are among the fortunate few who will not have to spend all of your time for the next few years working to meet the material needs of your life. Until this century, the great majority of people had to spend 100% of their time just to feed their bodies. A few privileged individuals, such as the Brahmins, Mandarins, Aristocrats, etc. had the opportunity to simultaneously feed their bodies and their minds. We have made great advances, but today most people still spend a major part of their lives working to fill their material needs, I am confident that you will look back on these years and be grateful that you had this opportunity to devote all of your effort to learning and creating.

If you are very lucky, you might, after much hard work, devotion, and frustration, be fortunate enough to be the first person to see one of those patterns to which Gibbs referred. That will be the most rewarding time of your graduate studies, not the moment you receive a piece of paper which declares that you have now earned a specific degree or that first pay check.

第四章 研究之程序

(初稿，1974 年於中研院)
(2000 年 7 月 18 日版)

大　綱

1. 書、專書、綜論與研究報告

2. 科學研究的過程

3. 科學論文的寫法與內容

4. 研究經驗:

   (1) 台灣西南沿海養殖貝類大量死亡之研究

   (2) 民房與民地之收購一國立台灣海洋學院之經驗

   (3) 鯉魚高濃度鋅之研究

1. 書，專書(monograph)，綜論 (review)，與研究報告 (original paper)

(1) 書 (book)

書 (book)是提供基本知識，給不具專門知識者的大眾。例如書名叫做「水質污染」的，它提供給一般大眾一些有關水質,水污染的情況，防治等的普通知識。

書如何寫成的呢?乃是由具有某一領域專門知識的學者,先以他人在此領域所寫的書做為參考,甚至以他最熟悉,影響其最深的一本書做為範本,再收集有關的綜論(review,或 article)以及參考許多的研究報告(original paper)濃縮成簡單的普通知識,而寫成一本書。

(2)專書(monograph)

monograph(專書,專題著作((論文)),專題),a serious article or book on one particular subject that the author has studied deeply。狹義的說,它是由 review 或 original paper 二者之間集成,對某一專題做一整理;廣義而言,它是一本書,通常它量多於 review。

(3)綜論(review)

綜論(review,或 article;論說,討論,書評)乃是由具有某行專門知識,並且對此行有很深入研究的專家，將已經發表的研究報告加以整理濃縮而成。換言之,即將最近某一特定題目，世界之研究情況做一綜合介紹。所以著者要相當廣泛閱讀,且需為此行之專家。將過去之研究及將來之展望綜合整理,對於新進者很有用。

(4)研究報告(original paper)

研究論文(original paper; research paper)是科學研究最終目的。研究論文乃是將創新或前人沒有提過的知識,將其成果公諸於世。碩士及博士論文皆為 original paper。

(5)報告(report)

報告,讀書心得報告,部份實驗結果,醫院裡的特殊病例或個案,都可能是報告,報告有時可稱為論文,有時不可以。

(6)摘錄(abstract)

abstract 即 original paper 的簡短報告,或將同行的 original paper 加以整理,使人易於了解其最近的發展趨勢。

(7)preliminary report, short paper

因事實需要，或希望將研究成果儘快發表者。

(8) criticism (letter to editor)

寫信給雜誌編者,對別人在此雜誌上發表的 original paper 表示不同的觀點。

2.科學研究的過程

(1)從問題之發現,到寫成論文

問題

↓(基本知識+經驗+天才)

擬定假設

↓(基本知識+相關知識+圖書館)

收集參考資料與文獻

研究計劃之設計

↓(基本知識+經驗,以舊的方法找出新的事實,

↓或以新的方法找出新的事實)

實驗之進行

↓(實驗只是研究最簡易的步驟而已。

↓別人已作過,我們重新再作。技術性之工作一手高)

結果的解析

↓(如果與原假設相符就得到結論,

↓如果與原假設不符,再循環回原假設;

↓學識和經驗相當重要)

結論

↓(將結論寫成論文,論文的寫作→

↓專門的學悶,基本知識+經驗)

論文

(2)進行研究之一般準則

◯研究的態度..持久之毅力與恆心最重要

◯不可操之過急一作實驗要有韻律

◯查文獻,立計劃

◯成功與失敗一失敗不一定就是放棄,至少減低再失敗的機率

3.科學論文之寫法與內容

(1)論文之本質(論文之必須條件):

a.正確性 accuracy, b.客觀 objectivity, c.不偏 impartiality, d.追證 verifiability e.平易 readability, f.獨創 originality

(2)科學論文之內容

① 論文題目(title)

另有 running title 常附於 title 旁邊,是 title 的縮短

a. 題目要能明確表示論文的內容

b. 簡潔:有些雜誌規定必須在幾個字內

例如:關於昆蟲器官畸形之研究(不簡潔)

關於昆蟲畸形之研究(不明確)

昆蟲器官畸形之研究(可)

c.引起讀者的注意,但不能過份誇張

② Author's name

a.避免賣人情

b.誰對論文出力最大者,列名於前

③ Introduction

介紹論文的性質(nature),範圍(scope),意義(bearing),重要性(importance)以及動機(motive); introduction 不要太長,有時引用別人文獻,但文獻須與自己論文相繭,毫不相關的文獻不可引用,避免贅長。

④ Material and methods

一般實驗應皆有其再現性,故 material and methods 必須書寫清楚。materials:來源必須交代清楚,材料特性皆須書寫。

Methods：(a)實驗：自然科學上常用，(b)觀察：醫學上常用，(c)調查：有直接調查,和第二手資料(如報紙等)，(d)問答法：行為科學之研究用的較多。

⑤ Results：

是實驗最忠實的紀錄,是論文最長及最重要的部份; 需要十分精確。

⑥ Discussion:

把實驗結果與他人實驗結果分析討論；必須保持公正,就事論事,即使與假設不符,亦應明白報告出來。

⑦ Summary: 把 discussion 的結果 generalization。

⑧ Acknowledgement (謝辭)。

⑨ 文獻。

4.研究經驗

(1)台灣西南沿海相貝類大量死亡之研究 (1970 年一 1976 年)

(2)民房與民地之收購一國立台灣海洋學院之經驗 (1981 年一 1986 年)

(3)鯉魚高濃度鋅之研究 (1973 年一 1981 年) (1990 年一今)

5.”獨創性”在”科學研究”與”一般事務”

科學研究最重要的似乎是「獨創性」，一項研究是不是有價值，最重要的是要看它，能不能解答前人所不解決的問題。最好的研究，是他的結果，可以提供許多人參考。最有價值的行政工作，似乎也需要有“獨創性”。照著以前規定，來辦理行政工作，似乎最方便。但是，如果能解決前人所不能解決的行政困難，應該有更大的意義。(民國七十四年十二月廿三日，於革命實踐研究院，總理紀念週上演講，40 分鐘講完)

6.“精讀”論文 (教科書) 之方法

(1)先看該書目錄 (或每章之第 1 頁)。

(2)把該章所有圖及表皆先看一次。

(3)再瀏覽 (像看報紙) 該章，但仔細看每一個標題。

(4)瀏覽中，畫下重要與需記的地方，或生字 (但先不查生字)，不懂的跳過去，準備“細讀”。

(5)稍仔細看“細讀”部份。

(6)將全章再翻一次。

第五章 實驗之記錄、進行以及安全注意

(初稿，1974 年於中研院)
(2000 年 8 月版)

一、 實驗筆記之記錄

1.編簿號

例 ”TL05”：TL 表實驗項目，05 表本數。

2.編頁數

例 ”05008”：05 表第幾本，008 表頁數。

3.註明日期

4.記錄

a..正面：記實驗主線，如 sample 的製備，反應的條件，
結果的記錄－圖形，數據

例： “sample 1028”

↓…..

↓

↙ ↘

sample 5008-1 sample 5008-2

b.副面：記實驗雜事：如計算，補充，注意事項。

5.實驗計劃事先擬好，實驗前試藥儀器找全，如此可使實驗不會中斷，一氣呵成。

6.筆記本預留空白：用於作圖、表格，使實驗完後就立刻知結果。

7.Summary：在實驗作到一段落後，作一整理。

a.由整理獲得新觀念，使結果提前顯示。

b.避免重覆操作，浪費時間。

8.預留第一頁作題綱(contents)：記錄

a.題目

b.頁數

9.如有新的裝置，日後可能用得著，或書上有關實驗者，可記於背面並述說原理。

10.在筆記本的後頁記下絕妙好辭，以備日後寫報告之用。

二、進行實驗的一般準則

1.研究的態度

自己思考，自己尋找方法，以持久的毅力與恆心，完成實驗。

2.不可操急

實驗需要以一定的韻律，從從容容的進行。

3.查文獻及立計畫

實驗開始之前，須先詳細調查文獻，再立詳細計畫，勿冒然從事，以免浪費時間。

4.實驗的歧路

何時應做何實驗，何時應中止或修正，常須自行判斷，判斷之正確與良否依經驗與學識而定。

5.成功與失敗

如預料的實驗不一定是成功的實驗，勿輕易判定某一實驗是"失敗了"；不如意的實驗常導致新事實的發現。

三、化學實驗一般注意事項

1.實驗要注意保持清潔

平時須隨時保持實驗室，實驗台和實驗器具的整潔，實驗完畢，須立刻將實驗桌整理乾淨，並將玻器洗滌清潔，勿隨意拿別人實驗器具。

2.實驗日記必須立刻書寫

實驗日記必須記錄現象，數據，反應過程和其他實驗時所遭遇的種種問題，並應立刻記錄，以免日後遺忘；自恃記憶良好，而在日後補寫之報告，極易成為"作文"。

3.不怕麻煩

實驗絕不可馬虎，化學實驗最易發生失敗者，為"怕麻煩"，而隨隨便便之實驗者；為怕麻煩，常會招致更多麻煩。

4.實驗中勿離開實驗台

實驗中須時時觀察反應過程，且實驗情況條件(如自來水之供應，停電事件，室溫變化等)常會變化，須隨時控制，故於實驗中不可離開實驗台。

5.未知的實驗須小心從事之

從事未曾做過之實驗，須先詳細查書，仔細計劃步驟，而未用過的藥品，須先查藥典，如"Merck index"及化學辭典等，以明瞭其性質；另外，亦須考慮"財力"—如試藥及設備之價格等。

6.物質丟棄時應注意之事項

a.勿輕易丟棄，暫時收集以備不時之需。

b.發火性物質，如磷等，勿隨便丟棄。

c.強酸，強鹼，勿隨意丟棄；可棄入水槽者，丟後以多量水充洗之。

d.黏著性物質勿隨意丟棄。

e.強氧化劑勿隨意丟棄，以免爆炸。

7.火災發生時之處理。

a.做危險性大的實驗，須有他人同留在實驗室。

b.打開揮發性溶劑(如 ether, acetone)的瓶蓋時，勿接近火燄。

c.衣服著火時，應迅速在地面翻滾，勿驚慌亂跑。

d.注意滅火器的位置的使用方法。

e.注意實驗室的耐火性。

8.酸，鹼濺到時之處理

a.強酸濺到時

勿用衛生紙或毛巾擦拭，迅速至水龍頭沖洗，再以 dilute NH_4OH 或石灰水或 $NaHCO_3$ 處理之，再以硼酸水處理。

b.強鹼濺到時

先用稀醋酸中和，再沖洗。

c.衣服濺到酸時

先以 dilute NH4OH 中和，再以水沖洗。

9.磨砂玻璃使用時應注意事項

a.磨砂口的蓋子務必以繩綁緊。

b.乾燥的磨砂勿轉動，以免磨砂受損。

c.潤滑劑

在轉動磨砂前，磨砂中須滴一兩滴 solvent，做為潤滑之用；普通在磨砂口塗以凡士林或 silicon grease (用於高真空時)；瓶內液體不可接觸。

10.插於橡皮塞中玻棒的取出法

11.危險藥品的取用法

a.引火性溶劑

須在砂盆中取出。

b.劇毒性藥品

於傾出或加熱時，須在毒氣櫃操作。

c.迴流裝置冷凝管的上端不可塞緊。

d.藥品具有毒性蒸氣者，取出時外面須置以冰塊。

12.負傷及火傷的應急處理

實驗受傷時，應即刻找尋醫師，如未能即刻就醫時應：

a.玻璃割傷時，先止血，再將受傷部位加以消毒清潔；玻璃碎片濺入眼睛時，以洗瓶將玻璃沖出，再找眼科醫師。

b.酸鹼濺傷

若酸濺入眼睛，先以水沖洗，再用 0.1-0.2% $NaHCO_3$ 或用 1-3% 的硼酸水洗，再以水將硼酸洗淨；弱酸濺入眼睛裡，可以硼酸水洗。

c.火傷

(a)中性熱液燙傷

輕度時，用氧化鋅油冷敷，受傷部份大時，可以稀薄的單寧酸塗之。

(b)熱的酸鹼燙傷。

(c)溴水燙傷

以水沖洗，再以硫代硫酸鈉($Na_2S_2O_3$)沖洗之。

13.有機溶煤的廢液勿丟棄，留下來可為玻璃器皿和機器的洗滌之用。

四、實驗室的安全---疲勞與實驗

1.在做化學實驗的時候，須要具有良好的健康狀況。

2.不要勉強連續做實驗，以免造成錯誤，最好將實驗以外的事或休息時間，安排於實驗之間，以免疲勞。

3.避免吸入試藥所產生的蒸氣。

4.盡可能不要同時做兩種以上的實驗。

五、實驗室安全---防火與防爆

1.沒做過的實驗，沒用過的藥品，一定要查書。

2.防火。

a. 可溶性溶媒和發火性物質

ether, acetone, alcohol, petroether, xylene, toluene , CS_2, chloroform, ehyl acetate。

b. 自發性發火物質

黃磷，Na, K。

c. 引火性溶媒不可大量置放在實驗台上，且溶媒之瓶不可置於實驗台上。

d. 引火性溶媒之加熱用圓底 flask 及 beaker，並用水浴。

e. 沸石不可於加熱中加入。

3.爆炸之危險

a. Na, K, P 等自然發火和爆炸。

b. Na, K 和脂肪族鹵化物，會產生爆炸。

c. 廢 ether 回收時，其中若含有過氧化物，易爆炸；所以舊的 ether 和 nitro-化合物蒸餾時要注意。

d. 測定未知物質的 melting point 要注意，尤其是含 nitro-之化合物。

e. sample 的封口和開口時，須用水冷卻，並用布裹住筒部。

f. 氧化劑須注意避免激烈反應。

g. 和水起激烈反應的物質

如 Na, K, carbide (碳化物)，生石灰，無水氧化鋁等。