

NOTECARD and PROBLEM SOLUTION TECHNIQUE

To succeed in college, problems and solutions in math lectures and textbooks must be **identified, recorded, organized, practiced, and stored in long term memory** in order to be recalled when needed. The **Notecard Problem and Solution Technique (NPST)** helps learners do these important tasks required for learning and accurate recall. Using **NPST**, many math learners have uncovered a previously hidden ability to learn and remember math better than ever before and earn higher grades.

A benefit from **NPST** is it is an **easy way to gather and organize problems and solutions** to be learned. A 2nd benefit is it **saves time by speeding the understanding and learning** of problems and solutions that may appear on quizzes and exams. A 3rd benefit is often **better exam and final course grades**.

HOW TO DO NPST FOR MATH AND PHYSICS

This problem and solution organization format involves setting up problems and solutions in a manner that promotes, *not inhibits*, the understanding and learning of solutions. This format minimizes the risk of memorizing problems and solutions without understanding *how to solve* the various kinds of math problems. In textbooks or lectures, **NPST** is a simple way to organize math notes into a format that speeds understanding, learning, and recall of problem solutions.

1. The **1st step** involves **purchasing notecards** on which problems and solutions will be recorded. These cards may be 3 x 5, 4 x 6, or 5 x 8 inches in size depending on the amount of material to be recorded and the size of one's handwriting.
2. The **2nd step** entails placing **problems on one side of a notecard**. **On the other side, solutions are built, step-by-step**. Having step-by-step solutions speeds understanding and learning.
3. In **step 3**, a narrative or **verbal description of what is done in each step is included** in solutions. Learners with dominant verbal learning ability, as opposed to dominant quantitative learning ability, can use their verbal learning strengths to learn math solutions.

4. The **4th step** involves practicing solutions by looking at problems and attempting solutions on scrap paper. This method promotes faster understanding of solutions and speeds accurate recall. It also acts as a check of what has and has not been learned *before* an exam is taken when something can still be done about it. The more often notecards are practiced, the more likely information is to move from short-term memory toward long-term memory; that is, become learned.

The Secret To Success In Math & Physics Classes

Tell me
Tell me
Tell me



Unless learners practice doing solutions repeatedly and regularly it is difficult to impossible to learn and remember solutions

and this is normal



In this sense, learning and remembering solutions to math problems are more like a sport than many other subjects. A person must practice and practice, over and over, to improve skill in a sport, even after a particular skill has been mastered.

For example, even though Michael Jordan was an excellent jump shooter, he still practiced thousands of jump shots every week. To master solutions to math problems, many learners must practice solutions over and over, *even solutions that have been learned*. This practice reduces careless mistakes, increases understanding, speeds solutions on exams and quizzes, and builds confidence in one's ability to do math regardless of past performance.

THE ADVANTAGES OF NPST FOR MATH AND PHYSICS STUDENTS

1. Notecards are **easily portable** in a pocket or purse making them convenient to practice during short, once wasted, periods of time such as riding to and from school, between classes, during meals, etc.
2. Notecards are a fast way to practice, review, and **reduce overall study time**.
3. **Material to be learned is recalled and applied in the same manner as it is on exams.** That is, learners see problems and practice doing solutions from memory just as they would on exams and quizzes. It is said that learners become better at that which they practice. If learners practice seeing problems and practice doing solutions from memory, they become better at doing this at exam time. If learners practice *not doing solutions* from memory, they become better at that, also.
4. **It's easier to recognize correct solutions when seeing exam problems.** When instructors compose exams, they select problems similar to those in lectures and textbooks. Learners must recognize those problems, recall and provide solutions from memory. Learners who practice seeing problems that could appear on exams, and practice recognizing and doing solutions, are practicing the precise activity they must do for exams.
5. Learners can **show notecards to instructors** before exams are taken and find out if the most helpful kinds of problems have been selected and if solutions are complete and accurate. This activity demonstrates to instructors that learners are exerting a serious effort to master the material. That may be an advantage to learners for instructors to know who is putting forth a serious effort to learn when it comes to grade reports.

6. Learners find out what has and has not been learned BEFORE AN EXAM OR QUIZ when something can still be done about it. Learned and not-yet-learned material is readily visible and can be separated into two stacks of notecards; the "known" and "not yet known" piles. This way, it is easy to see where to focus time and energy in studying math.
7. Learners have fewer concentration problems while learning from textbooks because learners are *actively involved* in seeking specific problems and solutions.
8. Learners can conquer the "Blank Mind Syndrome." Many learners read by stroking words and problems with their eyes or rereading highlighted problems and solutions. With this method of study, learners are commonly not able to remember what was just read let alone recall solutions to problems at exam time. *This is normal.* Placing problems on notecards and practicing recalling solutions, step-by-step, makes it easier to remember what was just covered and increases recall for exams and quizzes.

The following examples provide a model of well-organized notecards in math.

FRONT	BACK								
<p>p. 233</p> <hr style="border: 1px solid red;"/> <p style="text-align: center; font-style: italic;">Find the inverse of $f(x) = 2^x$</p>	<div style="text-align: center; border: 2px solid black; border-radius: 50%; width: fit-content; margin: 0 auto 10px auto; padding: 5px;">The solution in quantitative</div> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;">1. $y = 2^x$</td> <td style="width: 50%; padding: 5px;">1. Replace $f(x)$ with y</td> </tr> <tr> <td style="padding: 5px;">2. $x = 2^y$</td> <td style="padding: 5px;">2. Interchange x & y</td> </tr> <tr> <td style="padding: 5px;">3. $y = \log_2(x)$</td> <td style="padding: 5px;">3. Solve for y by definition of log</td> </tr> <tr> <td style="padding: 5px;">4. $f^{-1}(x) = \log_2(x)$</td> <td style="padding: 5px;">4. Replace y with $f^{-1}(x)$</td> </tr> </table>	1. $y = 2^x$	1. Replace $f(x)$ with y	2. $x = 2^y$	2. Interchange x & y	3. $y = \log_2(x)$	3. Solve for y by definition of log	4. $f^{-1}(x) = \log_2(x)$	4. Replace y with $f^{-1}(x)$
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<p>p. 187</p> <hr style="border: 1px solid red;"/> <p style="text-align: center; font-style: italic;">Solve $2^x = \frac{1}{8}$</p>	<div style="text-align: center; border: 2px solid black; border-radius: 50%; width: fit-content; margin: 0 auto 10px auto; padding: 5px;">The solution in words</div> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;">1. $2^x = \frac{1}{2^3}$</td> <td style="width: 50%; padding: 5px;">1. Rewrite 8 as 2^3</td> </tr> <tr> <td style="padding: 5px;">2. $2^x = 2^{-3}$</td> <td style="padding: 5px;">2. Define negative exponent</td> </tr> <tr> <td style="padding: 5px;">3. 1 to 1 property of exponential equation</td> <td></td> </tr> </table>	1. $2^x = \frac{1}{2^3}$	1. Rewrite 8 as 2^3	2. $2^x = 2^{-3}$	2. Define negative exponent	3. 1 to 1 property of exponential equation			
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FRONT

p. 32

$$\text{Prove } \log_a(M) = \frac{\log_b(M)}{\log_b(a)}$$

BACK

- | | |
|--------------------------------------|---------------------------------|
| 1. Let $x = \log_a(M)$ | 1. $\log_a(M) = \text{unknown}$ |
| 2. $a^x = M$ | 2. Rewrite in expo. form |
| 3. $\log_b(a^x) = \log_b(M)$ | 3. Take \log_b of both sides |
| 4. $x \log_b(a) = \log_b(M)$ | 4. Expon. prop. of log |
| 5. $x = \frac{\log_b(M)}{\log_b(a)}$ | 5. Divide both sides by |

2/9/99

$$\text{Solve } x^2 + 5x + 5 = -1 \text{ for } x$$

- | | |
|---------------------------|-------------------------|
| 1. $x^2 + 5x + 6 = 0$ | 1. Add 1 to both sides |
| 2. $(x+3)(x+2) = 0$ | 2. Factor binomial |
| 3. $x + 3 = 0$ | 3. Set each factor = 0 |
| ...or | |
| $x + 2 = 0$ | |
| 4. If $x = -3$ | 4. Add -3 to both sides |
| $(-3)^2 + 5(-3) + 5 = -1$ | |
| $9 - 10 + 5 = -1$ | |
| $-1 = -1$ | |
| 5. If $x = -2$ | 5. Add -2 to both sides |
| $(-2)^2 + 5(-2) + 5 = -1$ | |
| $4 - 10 + 5 = -1$ | |
| $-1 = -1$ | |

Scotch Tape

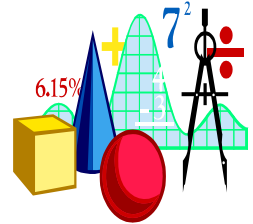
It is a good idea to select several examples for each type of problem that could appear on an exam and place them on notecards. The next step is to practice.

PRACTICING

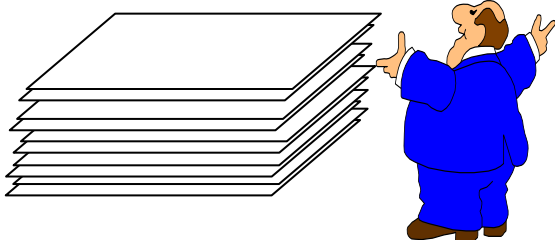
solutions to problems is the **secret** to preventing careless errors and forgetting

HOW TO PRACTICE SOLUTION ON NOTECARDS

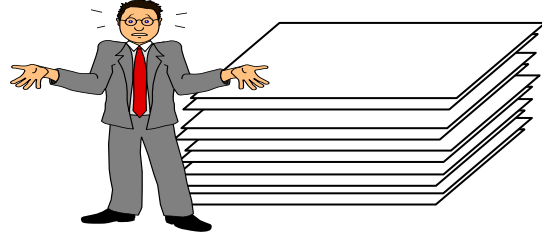
1. **Look at a problem** on a notecard.
2. **Attempt the solution** on scrap paper as completely as possible, **from memory**, and **step-by-step**. Practicing in this manner will:
 - a. help **organize solutions** in the mind, step-by-step, thus increasing recall at test time. Organized material is easier to remember than disorganized material. Practicing solutions also makes building on exams much easier because solutions are done just the way they are practiced. During a test, no time is wasted organizing solutions or deciding what are the steps.
 - b. **reduces or eliminates careless errors**.
 - c. provide an **immediate self-test on how well material has been learned before a test is taken when something can still be done about it**. How well solutions for each style of problem are known becomes readily apparent because solutions can either be done correctly or they cannot on the 1st try. This eliminates entering an exam or quiz "believing" or "feeling" the material has been learned when it has not.
3. Turn the card over and **check** the accuracy of the solution.
4. Place the card in the **"I know it" pile if solved correctly**.
5. If solutions are partially or completely **incorrect, read the solution aloud while you correct your attempt**. Turn the card over, look at the problem, and attempt a solution again *from memory*. Do this step as many times as needed until the solution is done correctly from memory. Then, place this notecard in *the "I don't know it, yet"* pile because the solution was missed on the 1st attempt. Only now go on to the next notecard.



"I know it" pile



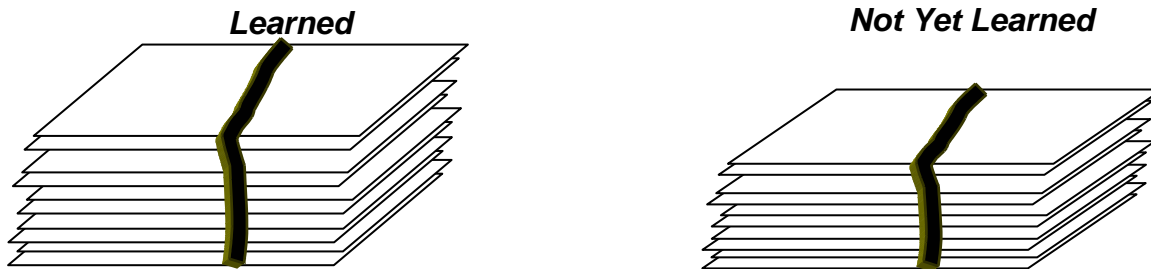
"I don't know it, yet" pile



6. **Practice the "I don't know it, yet" pile, at least, every other day**. Practice "known" notecards about every 2 to 3 days to keep the information fresh in the memory and to prevent forgetting. The more often notecards are reviewed, the speed of learning increases and the ability to recall is faster and more accurate.

GENERAL SUGGESTIONS FOR FASTER LEARNING

- 1) Place only **one problem and its solution per notecard**. This makes it possible to separate the "learned" from "not yet learned" problems and solutions.
- 2) **Avoid writing complete sentences** or spelling out complete words in word problems and solution narrations for each step. Use short phrases for sentences and as many symbols and abbreviations for words as you can. This condenses problems and solutions and leads to less review time and less substance to remember.
- 3) **Indicate where the problem and solutions on each notecard are from** by jotting down *page numbers* (textbooks) or *dates* (lectures). This allows for quick reference in cases of confusion or uncertainty.
- 4) **Keep notecards separate for each course** using rubber bands or different colored cards. Use rubber bands to keep the "learned" cards separate from the "yet to be learned" cards in each subject, also.



- 5) After an exam or quiz, **use detective skills** to look for causes of incorrect answers. If this not done, learners are condemned to repeat the same ineffective study skills on future exams. This means grades will not likely improve. Investigate by comparing information in missed solutions to solutions on notecards. The location (lecture dates or textbook page numbers) of missing or incorrect information for exam solutions will point toward areas where learning skills need modification for better grades on future exams. The steps in this **post-test survey** are as follows:
 1. If complete and correct solutions are **not on notecards** but appear in the text or were given in lecture, pay more attention to spotting the clues that indicate important problems in lectures and textbooks.
 2. If information for correct solutions **is on notecards but missed** on an exam, a greater number of reviews and practices are necessary, a less distractive study environment is needed, or there may be personal concerns which need resolution before more effective learning can take place.
 3. Replace **incorrect information on notecards** immediately. Add missing information to notecards and learn it in preparation for future exams and to aid with problems solving in the future. This is especially valuable when there are comprehensive final exams. Investigating the source of errors in learning processes leads to remedies. Mistakes in identifying important problems and building correct solutions will not be repeated.

ONE NOTECARD VARIATION

One variation of the notecard technique involves the use of notebook paper. This is called the **Cornell System**. A line is drawn 1/3 third of the way from the left side of a sheet of paper. Problems and questions are placed to the left of this line and solutions and answers to the right.

Problems on this side

Solutions this side

<p>text p.292</p> <hr/> <p><input type="radio"/></p> <p><input type="radio"/> Find the inverse of $f(x) = 2^x$.</p> <hr/> <hr/> <hr/> <p><input type="radio"/></p> <p>text p.293-294</p> <hr/> <p>Solve $2^x = \frac{1}{8}$</p> <hr/> <hr/> <p><input type="radio"/></p> <p><input type="radio"/></p>	<hr/> <p>1. $y + 2x \rightarrow y = 2^x$ 1. Replace $f(x)$ with y</p> <hr/> <p>2. $x = 2^y$ 2. Interchange x & y</p> <hr/> <p>3. $Y = \log(x)$ 3. Solve for y by definition of \log</p> <hr/> <p>4. $F^{-1}(x) = \log_2(x)$ 4. Replace y with $f^{-1}(x)$</p> <hr/> <hr/> <p>1. $2^x = \frac{1}{8}$ 1. Rewrite 8 as 2^3</p> <hr/> <p>2. $2^x = 2^{-3}$ 2. Define negative exponent</p> <hr/> <p>3. $X = -3$ 3. 1 to 1 property of exponential equation</p> <hr/> <hr/>
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NPST is one method many learners have found successful in mastering college mathematics courses. As with any new technique, it takes practice and determination to perfect it. With persistence, this technique has the potential to make studying and learning math faster and more enjoyable than ever before.

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