THE OFFICIAL GUIDE COMPANION

12th Edition Official Guide for GMAT® Review Quantitative Problem Explanations

This book provides detailed, step-by-step approaches to every Problem Solving and Data Sufficiency question in *The Official Guide for GMAT Review, 12th Edition.*

The Official Guide Companion

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The Official Guide Companion is a supplement to our

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April 1st, 2010

Dear Student,

Thank you for picking up the Manhattan GMAT Official Guide Companion ("OGC" for short). This book is designed to accompany the *Official Guide for GMAT Review 12th Edition,* which we feel should be the primary resource for those studying for the GMAT. However, if there is one issue that our students cite about the Official Guide, it is that the explanations are not always as helpful as they could be. We hope that this book addresses that need by providing clear, step-by-step breakdowns of every math problem in the Official Guide.

There were many people involved in getting this book into your hands. We are indebted to our Instructors Josh Braslow, Faruk Bursal, Jen Dziura, Steven Jupiter, Stacey Koprince, Ben Ku, Ron Purewal, Jon Schneider, Emily Sledge, and Hemanth Venkataraman for their hard work drafting and editing the explanations. Our office hours ace Horacio Quiroga let us know which problems students routinely struggle with, giving rise to the Hot List. Graham Riske and Carrie Shuchart each took a turn reviewing before handing it over to David Mahler for his fine editorial eye. Last, Dan McNaney arranged and formatted the book in its current form.

We would also be remiss if we didn't acknowledge Zeke Vanderhoek, the founder of ManhattanGMAT. Zeke was a lone tutor in New York when he started the Company in 2000. Now, ten years later, MGMAT has Instructors and offices nationwide, and the Company contributes to the studies and successes of thousands of students each year.

At Manhattan GMAT, we continually aspire to provide the best Instructors and resources possible. We hope that you'll find our dedication manifest in this book. If you have any comments or questions, please e-mail me at andrew.yang@manhattangmat.com. I'll be sure that your comments reach Dave, Chris, and the rest of the team—and I'll read them too.

Best of luck in preparing for the GMAT!

Sincerely,

Andrew Yang
President
Manhattan GMAT

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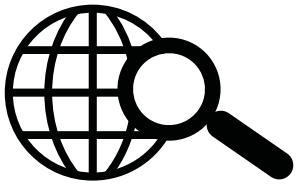

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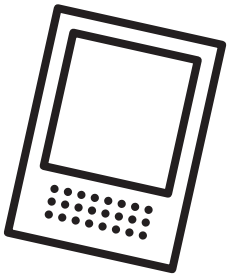

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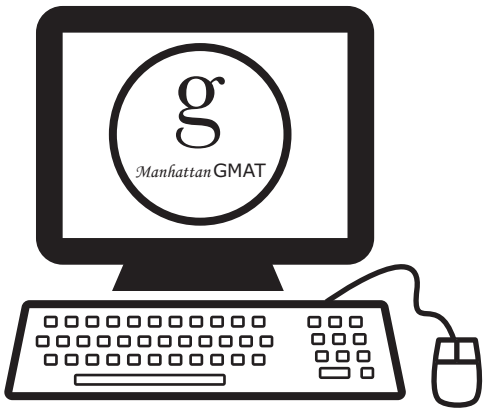
6 Computer Adaptive Online Practice Exams

The 6 full-length computer adaptive practice exams included with the purchase of this book are delivered online using Manhattan GMAT's proprietary computer-adaptive test engine. The exams adapt to your ability level by drawing from a bank of more than 1,200 unique questions of varying difficulty levels written by Manhattan GMAT's expert instructors, all of whom have scored in the 99th percentile on the Official GMAT. At the end of each exam you will receive a score, an analysis of your results, and the opportunity to review detailed explanations for each question. You may choose to take the exams timed or untimed.



The content presented in this book is updated periodically to ensure that it reflects the GMAT's most current trends and is as accurate as possible. You may view any known errors or minor changes upon registering for online access.

Important Note: The 6 computer adaptive online exams included with the purchase of this book are the SAME exams that you receive upon purchasing ANY book in Manhattan GMAT's 8 Book Strategy Series.

Official Guide Tracker

The Manhattan GMAT Official Guide Tracker tracks your accuracy and speed on problems from the Official Guide. It breaks down analyses by format, topic and subtopic. You can sort and filter by any field. This version has been updated as of September 1, 2009, and includes references to the 12th edition of the main OG and the 2nd Edition OG Quantitative and Verbal Reviews.

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Part I

of

THE OFFICIAL GUIDE COMPANION

INTRODUCTION

Why This Book

Have you ever ***wanted more from the explanations*** in the Official Guide?

So have we.

Don't get us wrong—we love the Official Guide! As one of the few legit sources of retired GMAT problems, the "OG" should play a central role in your preparation for the exam. It forms a pillar of our curriculum as well.

The problems in the OG are fantastic, by and large. The *explanations,* on the other hand… well, some are just fine. But others can be inadequate, according to both our students and our instructors.

That's why we wrote this book.

Inside, you'll find ***over 450 detailed explanations***—one for every quant problem in the 12th Edition of the Official Guide.

How To Use This Book

1) Do some OG problems.

Here is where to find all the quant problems in *The Official Guide for GMAT Review, 12th Edition*:

Section	Format	Numbers	# of Problems	Pages
Diagnostic Test	Problem Solving	D 1 – D 24	24	20–23
Diagnostic Test	Data Sufficiency	D 25 – D 48	24	25–26
Sample Questions	Problem Solving	PS 1 – PS 230	230	152–185
Sample Questions	Data Sufficiency	DS 1 – DS 174	174	273–288

Notation: a number with just a "D" in front of it, such as D 24, refers to problem 24 in the Diagnostic Test. Among the Sample Questions, "PS" refers to Problem Solving, and "DS" refers to Data Sufficiency.

When you do a set of OG problems, ***should they all be the same topic?*** At first, yes. This is a great way to learn a topic and build skills in a particular area. Later, you should start to mix topics, just as the GMAT itself does.

How many at once? Early on in your preparation, do just a few at once. Later, as the GMAT gets closer, you can lengthen out the sets.

Should you time yourself or not? At first, probably not. Give yourself space to struggle and learn. However, you also need to train yourself to "take a shot" under time pressure. To strike a balance, what some instructors recommend for your first time is that you write down an answer at the 2-minute mark, but keep going until you finish the problem. Record your total time, and if you took over 2 minutes & 30 seconds, put the problem on a list to redo for speed.

Later, as you do longer mixed sets, you should put yourself under exam-like time pressure. Do those sets as if they were "mini-GMAT's," averaging no more than 2 minutes per problem.

2) Go through our explanations.

Each problem is ***Categorized*** with a broad topic and a narrower subtopic.

There are five broad topics, corresponding to our five quantitative Strategy Guides (published separately):

1) **Number Properties** include subtopics such as Divisibility & Primes and Odds & Evens.
2) **FDPs** stand for Fractions, Decimals, & Percents.
3) **EIVs** stand for Equations, Inequalities, & "VICs"—in other words, Algebra.
4) **Word Translations** include various kinds of word problems, such as Rates & Work and Probability.
5) **Geometry** includes subtopics such as Triangles and Circles.

There are numerous subtopics, most of which are self-explanatory. **VICs** stands for "Variables In Choices," which are problems that include variables in the answer choices.

OG Page: We cannot legally reprint the full questions and answer choices, so you should turn to the OG Page in the 12th Edition to see the question itself as you review our explanation.

Within the text of each explanation, you'll find ***Bolded Tools*** or concepts in bold italics. These highlighted terms will help you keep track of major techniques, topics, and themes. For students using this book in conjunction with our Strategy Guides, these tools and concepts are explained in more detail in the Guides.

For some problems, we've included an ***Alternative Approach*** or a second explanation. We have been selective about these inclusions. Theoretically, many problems can be tackled in a variety of ways, but one of those ways is often better than the others. We like to emphasize the *best* way to solve a problem—and it's not always the classic textbook approach, either. We prefer methods grounded in solid conceptual foundations, but we also know that the best solution can be quick and dirty.

As a result, your toolkit will contain many different tools. So that you don't get confused on game day, you need to ***know what your first-choice tool will be for any problem***. That's why we've often included just one thorough explanation and process per question.

However, many problems lend themselves to more than one approach. Also, having more than one way to look at certain problems can deepen your understanding of a whole topic. When we've included a second or even third approach, we've done so for a good reason. ***Be sure to study Alternative Approaches thoroughly.***

Difficulty level: The problems in the Official Guide (outside of the Diagnostic Test) are numbered in order of difficulty, according to the GMAT folks.

How does the GMAT measure difficulty? By the percent of people who get the problem wrong during its experimental stage. The more people get it wrong, the harder the problem must be, right?

Sure… most of the time. But what if the problem is utterly confusing, but there's some backdoor way to guess the answer without understanding what's going on? What if the wrong answer choices aren't as well-designed as they could be?

When this happens, a truly hard problem might measure too easy on the GMAT's yardstick. Or an easy problem might measure too hard, in fact.

We think that in the OG, ***the vast majority of problems are positioned pretty well*** by order of inherent difficulty. But from mounds of student feedback, we know that some low-numbered problems are conceptually tricky, and some high-numbered problems are easier than their neighbors.

That's why ***our instructors have given each problem a difficulty range:*** 300–500, 500–600, 600–700, or 700–800. Use these grades, together with the OG numbering, to judge how hard a problem really is.

Finally, when you're reviewing, don't forget to ***check the explanation in the Official Guide!*** Sometimes these explanations can shed real additional light on problems. But if you find yourself getting confused, abandon ship. A few explanations in the Official Guide can actually make matters worse.

3) Redo the problem right away—or very soon.

Don't stop after you've read the explanation. To cement your learning, ***put pen to paper one more time***. Force yourself to solve the problem all over again—maybe even right away. Or put it on a list for the weekend. But try to get two "touches on the ball" before you forget.

The goal is not exposure, but mastery. You're far better off doing fewer OG problems overall, if you can truly *own* those problems by doing them more than once. Here's the test: are you absolutely *certain* that you could do that problem again quickly, easily, and accurately, if you were to see it on the GMAT in a month? If not, you haven't mastered it. Put it on a list to redo.

4) Track your progress.

Keep track of your progress with our OG Tracker, an Excel spreadsheet that you can download from our website. ***Simply enter your answers and your times,*** and the OG Tracker will automatically crunch the numbers. You can easily analyze your accuracy and speed by topic and subtopic.

Horacio's Hot List

Students in our courses have access to weekly online Office Hours. Horacio Quiroga, one of our favorite instructors, has done thousands of Office Hour sessions with our students, who often bring OG problems for review. Over time, Horacio has seen many of the same problems come up again and again, so he's built a "Hot List" of ***33 extra-tricky problems that deserve your attention***.

Hot List Problem	*Beginning of Stem*	*Page in OG*	*Page in This Book*
D 11 (Diagnostic Test)	Of the three-digit integers…	22	24
D 13	If s and t are positive integers…	22	25
D 15	The product of all the…	22	26
D 16	If $\sqrt{3-2x}$ …	22	26
D 24	Aaron will jog home…	23	29
PS 11	Which of the following…	153	50
PS 32	$\sqrt{(16)(20)}$...	156	59
PS 50	If y is an integer…	159	66
PS 82	If n is an integer…	163	79
PS 87	A necklace is made…	164	81
PS 89	If s is the product…	164	82
PS 98	On a scale that measures…	166	86
PS 130	Which of the following inequalities…	170	101
PS 148	If x, y, and k are positive numbers…	173	109
PS 149	During a trip, Francine traveled…	173	111
PS 157	For any positive integer n…	174	115
PS 163	This year Henry will save…	175	117
PS 191	Pat will walk from Intersection X…	179	131
PS 192	The ratio, by volume, of soap…	179	131
PS 202	If $m > 0$…	181	137
PS 204	John and Mary were each paid…	181	138
DS 45	If r is a constant…	276	173
DS 69	Of the four numbers…	278	185
DS 73	If m is an integer…	279	187
DS 87	Is the number of seconds…	280	194
DS 89	Is the number of members…	280	195

continued on next page…

Hot List Problem	*Beginning of Stem*	*Page in OG*	*Page in This Book*
DS 90	If k, m, and t are positive integers…	280	196
DS 102	While on a straight road…	281	202
DS 115	For any integers x and y…	283	208
DS 128	A school administrator will assign…	284	216
DS 154	If n is a positive integer…	287	230
DS 156	Is 5^k less…	287	231
DS 171	What is the tens digit…	288	238

In the explanations that follow, we've marked these 33 problems with a ***Hot Tamale*** (🌶) and given additional care to our explanations on those problems.

We've also included a special appendix to identify recurring themes within the Hot List and provide further comments about each problem:

- How students typically go wrong
- What you should focus on in the problem
- What we think of the explanation printed in the OG (which occasionally creates more confusion than it clears up)

Look at the Hot List appendix (Part V) only after you've tried the problems.

Official Guide Problem Lists By Category

The last part of this book (Part VI) lists all the OG math problems by topical category. If you want a list of all the problems about Triangles, for instance, you can find it there. We have classified problems only by their major topic. For problems that involve more than one topic, this classification is a judgment call. For the sake of simplicity, each problem only appears once in these lists.

As we mentioned earlier, you should do topic-focused sets of problems while you are still learning the basic concepts and skills related to each topic. Over time, you should start to mix up the sets, so that you get used to seeing problems out of context. After all, the GMAT itself is a big mixed set.

Practice Tests

As a bonus for buying this book, you get free access to our 6 Computer Adaptive Tests, which contain over 1200 GMAT-like problems written by our instructors. Be sure to ***log onto our website*** and take advantage of these exams as part of your overall GMAT preparation. See pages 7–8 for details.

Part II

of

THE OFFICIAL GUIDE COMPANION

DIAGNOSTIC TEST EXPLANATIONS

D 1. FDPs: Digits & Decimals
Difficulty: 500–600 **OG Page:** 20

This ***Decimals*** problem requires us to translate the relationship described in the question into a mathematical expression. Then we must determine which of the given choices is equivalent to that expression.

First, we are told that the customer purchased a total of 6 compact discs, the first for $15.95 and the remaining 5 for $3.99 each. The total cost, then, can be expressed as follows:

5(3.99) + 15.95

Since this does not match any of the choices, we must figure out which choice is equivalent to the above expression. The easiest way to begin is to compare the 15.95 portion of the above expression to the choices.

(A) 5(4.00) + 15.90. Here, 15.90 is 0.05 less than 15.95. In order for this choice to be equivalent, the 0.05 needs to be made up for in the other part of the expression. Since 4.00 is 0.01 greater than 3.99, if we multiply 4.00 by 5, we will make up the 0.05 difference exactly. We can also express 4.00 as (3.99 + 0.01), which turns the expression into 5(3.99 + 0.01) + 15.90 or 5(3.99) + 0.05 + 15.90, which is the same as 5(3.99) + 15.95. **CORRECT**

(B) Since 15.95 is the same here, we can see that 5(4.00) is too large (by 0.05).

(C) Here, both 5(4.00) and 16.00 are too large (each by 0.05).

(D) 5(4.00 − 0.01) is the equivalent of 5(3.99). Thus, we would need to add 15.95. However, we are given only 15.90, which is too small (by 0.05).

(E) 5(4.00 − 0.05) is the equivalent of 5(3.95). Since 15.95 is the same here, we can see that this choice will be too small (by 0.20).

Notice that it would be slow and difficult to compute the actual total cost, as well as the values of the expressions in each of the answer choices.

The correct answer is (A).

D 2. Number Properties: Consecutive Integers
Difficulty: 300–500 **OG Page:** 20

This problem asks us to determine the difference between the ***Averages*** (arithmetic means) of two different sequences of ***Consecutive Integers***: 200 through 400, and 50 through 100. The ***Average Formula*** tells us that in general, the average of a set of numbers is found by dividing the sum of the numbers by the number of terms:

$$A = \frac{S}{n}$$

However, when the number of terms is large, finding the sum through simple addition would take far too long. Instead, we may use a shortcut: the average of an evenly spaced set of numbers is simply the middle term. Any set of consecutive integers is evenly spaced, so this shortcut is legal in this situation.

If the middle term is not particularly easy to find, we can use an alternative method for computing the average of an evenly spaced set: find the average of the first and the last term.

For the two given sequences, the means of each sequence can be found as follows:

$A_1 = (200 + 400)/2 = 300$

and

$A_2 = (50 + 100)/2 = 75$

The desired difference is therefore:

$A_1 - A_2 = 300 - 75 = 225$

The correct answer is (D).

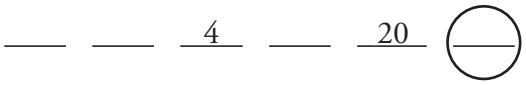
D 3. EIVs: Formulas & Functions
Difficulty: 500–600 **OG Page:** 20

The problem gives us this ***Sequence*** for all $n \geq 3$:

$$A_n = \frac{A_{n-1} + A_{n-2}}{2}$$

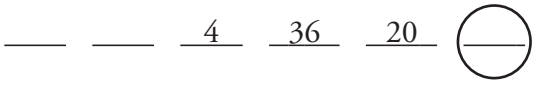
This recursive formula for the sequence can be translated into words this way: Any term beyond the first two is equal to half the sum of the previous two terms.

We are given the third and fifth terms. Arrange them in a ***Sequence Diagram***, leaving blanks for unknown terms (the question asks for the sixth term, so a circle is placed around the sixth slot):



We can use the values of the third and fifth terms to find the fourth term. If $n = 5$:

$$A_5 = \frac{A_4 + A_3}{2}$$
$$20 = \frac{A_4 + 4}{2}$$
$$40 = A_4 + 4$$
$$36 = A_4$$



Now that we know the fourth and fifth terms, we can use them to get the sixth term:

$$A_6 = \frac{A_5 + A_4}{2}$$
$$A_6 = \frac{20 + 36}{2}$$
$$A_6 = 28$$

The correct answer is (E).

D 4. <u>Word Translations</u>: Overlapping Sets
Difficulty: 600–700 **OG Page:** 20

In this ***Overlapping Sets*** problem, people in the group invest or do not invest in municipal bonds. They also invest or do not invest in oil stocks. Some people invest in both bonds and stocks, and some in neither.

To avoid unnecessary computation, we can fill in a ***Double-Set Matrix*** with the given percents.

Oil Stocks?		*Municipal Bonds?*		
		Yes	***No***	***Total***
	Yes			
	No			
	Total			

Because we are using percents, the total population will be 100(%). 35 percent of the people invest in mutual bonds, so 35 goes in the bottom left box. 18 percent invest in oil stocks, so we put an 18 in the top right box. 7 percent invest in oil stocks AND municipal bonds, so we put a 7 in the top left box. Finally, the question asks for the probability that someone invests in municipal bonds but NOT in oil stocks, so we shade the middle left box, because that is the value that we want.

Oil Stocks?		*Municipal Bonds?*		
		Yes	***No***	***Total***
	Yes	7		18
	No	?		
	Total	35		100

In a Double-Set Matrix, the first two entries in any row or column will add up to the third entry. In the left column, 7 plus the value of the shaded box will equal 35. Therefore, 28 percent of the people invest in municipal bonds, but NOT in oil stocks. Thus, the ***Probability***, which equals $\frac{\textit{desired outcomes}}{\textit{total outcomes}}$, is $\frac{28}{100} = \frac{7}{25}$. This is the **answer**.

It turns out that the given total number of people (2,500) is irrelevant. However, we could use this piece of information to calculate the actual number of people in each category and fill in the matrix with the results:

(0.35)(2,500) = 875 people invested in municipal bonds,
(0.18)(2,500) = 450 people invested in oil stocks,
(0.07)(2,500) = 175 people invested in both.

Oil Stocks?		*Municipal Bonds?*		
		Yes	***No***	***Total***
	Yes	175		450
	No	?		
	Total	875		2,500

Of the 875 people who invested in municipal bonds, 175 of them also invested in oil stocks, so 875 – 175 = 700 people invested in municipal bonds but NOT in oil stocks.

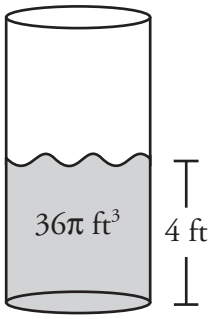
The probability $\frac{\textit{Investors of muncipal bonds but NOT oil stocks}}{\textit{Total people in the group}}$

$= \frac{700}{2,500} = \frac{7}{25}$.

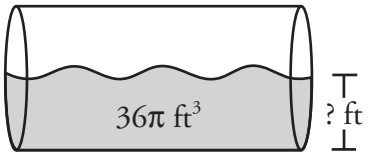
The correct answer is (B).

D 5. Geometry: Circles & Cylinders
Difficulty: 300–500 **OG Page:** 20

This ***Cylinders*** problem specifies that a closed cylindrical tank contains 36π cubic feet of water, which represents half of the tank's total capacity. We also know that, when the cylinder is upright, the height of the water is 4 feet. A diagram is not given, so our first task is to ***Draw a Picture***. Be sure to label the cylinder:



The problem asks us to turn the tank on its side and calculate the new height of the water above the ground.



The water still represents half of the total volume of the cylinder regardless of whether the cylinder is upright or on its side. The new height, therefore, reaches halfway up the circular face of the cylinder. This height is equivalent to the circle's radius. If we find the radius, we will also have found the new height. We can calculate the radius using the formula for the ***Volume of a Cylinder***. When the cylinder is upright, the water has a volume of 36π cubic feet and a height of 4 feet.

$Volume = \pi r^2 h$

$36\pi = \pi r^2 (4)$

$36 = 4r^2$

$9 = r^2$

$3 = r$

The radius is 3 feet. Therefore, the new height of the water is also 3 feet.

The correct answer is (B).

D 6. Word Translations: Overlapping Sets
Difficulty: 500–600 **OG Page:** 21

In this ***Overlapping Sets*** problem, households can be classified in two ways: whether they use Brand A soap and whether they use Brand B soap. Some households use both brands, and some use neither.

This information can be best represented using a ***Double-Set Matrix*** to show which brands of soap are used. Begin by filling in the numbers given in the question.

	A	***Not A***	***Total***
B	?		
Not B	60	80	
Total			200

Summing the row that contains the "Not B" information, we can find that the total number of households not using Brand B is 140, and thus the total number of households using Brand B is 60. We are told that, for every household that used both brands of soap, 3 used only Brand B soap, which means that 3 times as many people used only Brand B as used both A and B. We can place an x in the box for "Both A and B," and a $3x$ in the box for "B but Not A."

	A	***Not A***	***Total***
B	***x***	***3x***	**60**
Not B	60	80	**140**
Total			200

We can now make an equation using the top row of our matrix:

$x + 3x = 60$
$4x = 60$
$x = 15$ 15 is the **answer**.

Notice that if we solved for $3x$, we would get 45, which is one of the wrong answers. Be sure to answer the question that is asked.

The correct answer is (A).

D 7. Word Translations: Probability
Difficulty: 600–700 **OG Page:** 21

If we select according to the order given in the problem statement (president, then secretary, then treasurer), then this ***Probability*** problem can be solved using the ***Domino Effect*** (multiplying consecutive probabilities). Remember that "AND" implies multiplication and that "OR" implies addition.

The probability that Harry is chosen as secretary incorporates two consecutive events: someone *other* than Harry must be chosen as president, AND then Harry must be chosen from the *remaining* candidates as secretary. These probabilities are 9/10 and 1/9, respectively, so the probability that Harry is chosen as secretary is $\left(\frac{9}{10}\right)\left(\frac{1}{9}\right)=\frac{1}{10}$.

For Harry to be chosen as treasurer, other candidates must first be chosen as president and secretary, with probabilities 9/10 and 8/9. Harry's subsequent probability of being chosen as treasurer is 1/8. As before, all three events must happen: someone else must be chosen as president, AND someone else must be chosen as secretary, AND finally Harry must be chosen as treasurer. The overall probability of Harry's being chosen as treasurer, then, is $\left(\frac{9}{10}\right)\left(\frac{8}{9}\right)\left(\frac{1}{8}\right)=\frac{1}{10}$.

Since Harry cannot be both secretary and treasurer, these outcomes are completely separate. So the probability that Harry is chosen as secretary OR treasurer is $\frac{1}{10}+\frac{1}{10}=\frac{2}{10}$ or $\frac{1}{5}$. This is the **answer**.

We can solve this problem more efficiently using ***Symmetry***. There is nothing special about Harry or about any of the other members. Everyone has exactly the same likelihood of being chosen for any of the three positions. It does not matter that we are choosing these positions sequentially. Therefore, Harry has a 1/10 chance of being chosen as secretary, and he also a 1/10 chance of being chosen as treasurer. He cannot be chosen as both. Thus, the chance that he is chosen as secretary OR as treasurer is $\frac{1}{10}+\frac{1}{10}=\frac{2}{10}$, or $\frac{1}{5}$.

The correct answer is (E).

D 8. FDPs: Fractions
Difficulty: 500–600 **OG Page:** 21

A toy store's revenue in January was a ***Fraction*** of its revenue in November, which was a fraction of its revenue in December. Since no specific amounts are given in the problem, we should pick ***Smart Numbers*** to solve this problem. The revenues in November and January are based directly or indirectly on the revenue in December, so we should pick a Smart Number for the December revenue and then calculate the November and January revenue.

In questions involving fractions, we can choose a Smart Number by multiplying all the denominators given in the question. If we use this number to perform calculations, it is likely that we will be dealing with integers all the way through the problem. In this case, we should choose (5)(4) = 20 as the revenue in December.

The revenue in November is 2/5 the revenue in December, so:

$$\frac{2}{5}(20)=8$$

The revenue in January was 1/4 the revenue in November, which was 8, so:

$$\frac{1}{4}(8)=2$$

The average (arithmetic mean) of the store's revenues in November and January is $\frac{8+2}{2}=5$. Since 20 is 4 times 5, the store's revenue in December is 4 times the average of its revenues in November and January. This is the **answer**.