

(2)

Consider the stimulus (in other words, a passage):

The Brookdale Public Library will require extensive physical rehabilitation to meet the new building codes passed by the town council. For one thing, the electrical system is inadequate, causing the lights to flicker sporadically. Furthermore, there are too few emergency exits, and even those are poorly marked and sometimes locker.

Suppose that the author of this argument was allowed only one sentence to convey her meaning. Do you think she would waste her time with the following statement? Would she walk away satisfied that her main point was communicated?

The electrical system [at the Brookdale Public Library] is inadequate, causing the lights to flicker sporadically.

Probably not. Given a single opportunity, she would have to state the first sentence to convey her real purpose:

The Brookdale Public Library will require extensive physical rehabilitation....

That is the conclusion. If you pressed the author to state her reasons for making that statement, she would then cite the electrical and structural problems with the building. That is the evidence for her conclusion.

But does that mean that an evidence statement like, "The electrical system is inadequate" can't be a conclusion? No, we're just saying it's not the conclusion for this particular argument. Every idea, every new statement, must be evaluated in the context of the stimulus in which it appears.

For the statement above to serve as the conclusion, the stimulus would be:

The electrical wiring at the Brookdale Public Library was installed over 40 years ago, and appears to be corroded in some places (evidence). An electrician, upon inspection of the system, found a few frayed wires as well as some blown fuses (evidence). Clearly, the electrical system at the Brookdale Public Library is inadequate (conclusion).

To succeed in Critical Reasoning, you have to be able to determine the precise function of every sentence in the stimulus. Use structural signals when attempting to isolate evidence and conclusion. Key words in the stimulus-such as because, for, since- usually indicate that evidence is about to follow, whereas therefore, hence, thus, and consequently usually signal a conclusion.

2. Preview the question.

Before you read the stimulus, look over the question. This will give you some idea about what you need to look for as you read. It gives you a jump on the question.

Suppose the question with the library argument above ask the following:

The author supports her point about the need for rehabilitation at the Brookdale library by citing which of the following?

If you were to preview this question stem before you read the stimulus, you would know what to look for in advance—namely, evidence, the “support” provided for the conclusion. Or if the question stem asked you to find an assumption on which the author is relying, you would know in advance that a crucial piece of the argument was missing, and you could think about that right off the bat.

Previewing the stem allows you to set the tone of your attack, and thus saves you time in the long run. As you’ll soon see, this technique will come in especially handy when we discuss methods for the various question types.

3. Paraphrase the author’s point.

After you read the stimulus, paraphrase the author’s main argument to yourself. That is, restate the author’s ideas in your own words. Frequently, the authors in Critical Reasoning say pretty simple things in complex ways. So if you mentally translate the verbiage into a simpler form, the whole thing should be more manageable.

In the library argument, for instance, you probably don’t want to deal with the full complexity of the author’s stated conclusion:

The Brookdale Public Library will require extensive physical rehabilitation to meet the new building codes just passed by the town council.

Instead, you probably want to paraphrase a much simpler point:

The library will need fixing-up to meet new codes.

Often, by the time you begin reading through the answer choices you run the risk of losing sight of the gist of the stimulus. So restating the argument in your own words will not only help you get the author's point in the first place, it will also help you hold on to it until you've found the correct answer.

4. Judge the argument's persuasiveness.

You must read actively, not passively. Active readers are always thinking critically, forming reactions as they go along. They question whether the author's argument seems valid or dubious. Especially when you are asked to find flaws in the author's reasoning, it's imperative to read with a critical eye.

How persuasive is the argument about the library, let's ask? Well, it's pretty strong, because the evidence certainly seems to indicate that certain aspects of the library's structure need repair. But without more evidence about what the new building codes are like, we can't say for sure that the conclusion of this argument is valid. So this is a strong argument but not an airtight one.

Since part of what you're called on to do here is to evaluate arguments, don't let yourself fall into the bad habits of the passive reader-reading solely for the purpose of getting through the stimulus. Those who read this way invariably find themselves having to read the stimuli twice or even three times. Then they're caught short on time. Read the stimuli right the first time-with a critical eye and an active mind.

5. Answer the question being asked.

One of the most disheartening experiences in Critical Reasoning is to understand the author's argument fully but then supply an answer to a question that wasn't asked. If you're asked for an inference supported by the argument, selecting the choice that paraphrases the author's conclusion will earn you no points. Neither will selecting a choice that looks vaguely like a summary of the author's evidence if you're asked for an assumption.

The classic example of this error occurs on “Strengthen/Weaken” questions. When you’re asked to strengthen or weaken an argument, you can be sure that there will be one, two, even three answer choices that do the opposite of what’s asked. Choosing such a wrong choice is less a matter of failing to understand the argument than of failing to remember the task at hand.

The question stem will always ask for something very specific. It’s your job to follow the test maker’s line of reasoning to the credited response.

Also, be on the lookout for “reversers,” words such as not and except. These little words are easy to miss, but they change entirely the kind of statement you’re looking for among the choices.

6. Try to “prephrase” an answer.

This principle, which is really an extension of the last one, is crucial. You must try to approach the answer choices with at least a faint idea of what the answer should look like. That is, “prephrase” the answer in your own mind before looking at the choices. This isn’t to say you should ponder the question for minutes—it’s still a multiple-choice test, so the right answer is on the screen. Just get in the habit of framing an answer in your head.

Once you have prephrased, scan the choices. Sure, the correct choice on the exam will be worded differently and will be more fleshed out than your vague idea. But if it matches your thought, you’ll know it in a second. And you’ll find that there’s no more satisfying feeling in Critical Reasoning than prephrasing correctly, and then finding the correct answer quickly and confidently.

Continuing with the library situation, suppose you were asked:

The author’s argument depends on which of the following assumptions about the new building codes?

Having thought about the stimulus argument, you might immediately come up with an answer—here that the argument is based on the assumption that the new codes apply to existing buildings as well as to new buildings under construction. After all, the library will have to be rehabilitated to meet the new codes, according to the author. Clearly, the assumption is that the codes apply to existing buildings. And that’s the kind of statement you would look for among the choices.

Don't be discouraged if you can't always rephrase an answer. Some questions just won't have an answer that jumps out at you. But if used correctly, prephrasing works on many questions. It will really boost your confidence and increase your speed on the section when you can come up with a glimmer of what the right answer should look like, and then have it jump right off the page at you.

7. Keep the scope of the argument in mind.

When you're at the point of selecting one of the answer choices, focus on the scope of the argument. Most of the wrong choices on the section are wrong because they are "outside the scope." In other words, the wrong answer choices contain elements that don't match the author's ideas or that go beyond the context of the stimulus.

Some answer choices are too narrow, too broad, or have nothing to do with the author's points. Others are too extreme to match the argument's scope—they're usually signaled by such words as all, always, never, none, and so on. For arguments that are moderate in tone, correct answers are more qualified and contain such words as usually, sometimes, probably.

To illustrate the scope principle, let's look again at the question mentioned above:

The author's argument depends on which of the following assumptions about the new building codes?

Let's say one of the choices read as follows:

The new building codes are far too stringent.

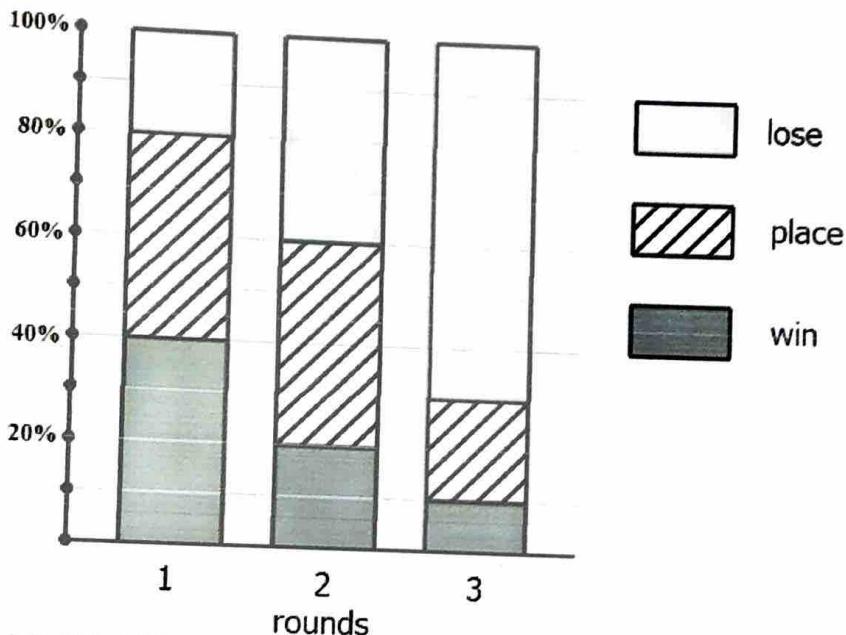
Knowing the scope of the argument would help you to eliminate this choice very quickly. You know that this argument is just a claim about what the new codes will require: that the library be rehabilitated. It's not an argument about whether the requirements of the new codes are good, are justifiable, or ridiculous. That kind of value judgment is outside the scope of this argument.

Recognizing scope problems is a great way to eliminate dozens of wrong answers quickly.

looking at "commuter trains", we can easily eliminate the other three. Notice "commuter trains" increased from 7 M to 9M, a 2M increase which is slightly more than one quarter of 7. That's the answer, and we didn't need the calculator.

1(b) In 2005, there were 8M car commuters, and $3 + 5 + 9 + 8 = 25$ M commuters total. That means, car users were $8/25$. Multiply this fraction by $4/4$ to get $32/100 = 32\%$.

2) In a certain academic competition, there are three rounds, and three possible results in each round. The folks who "lose" acquire no commendations and do not advance to the next round. The folks who "place", acquire a set of commendations for that round, but do not advance to the next round. The folks who "win" acquire a set of commendations for that round, and, in the case of the first two rounds, advance to the next round; in the case of the third round, the "win" means winning the entire competition. The following chart shows, on average, the percentages of participants who achieve the three results in each of the three rounds.



2a) If 100,000 participants start this process, and if all the percentages in the chart are correct, _____ people of them would win the entire competition.

800
3,200
7,000
10,000

2b) Exactly _____ % of participants who start acquire exactly two sets of commendations.

16
16.8
20
21.6

2)(a) Suppose 100,000 start. In the first round, 40%, or 40,000 are able to "win" and advance to the second round. In the second round, 20% of 40,000 = 8,000 are able to "win" and advance to the third round. In the third round, 10% of 8,000 = **800** win the entire competition.

2)(b) How are the people who win exactly two sets of commendations? They form two groups. One group are the people who win the first round and place in the second, thus winning two commendations and not advancing. The others are the folks who win the first round, win the second round, but lose the third round, thus earning only two sets of commendations even though they advanced to the third round.

Folks who (1st = win, 2nd = place) = $(0.40)*(0.40) = 0.16 = 16\%$

TABLE ANALYSIS QUESTIONS

Example Questions

Example Question #1 : Table Analysis

Rank	Train		Passengers	
	City	Code	Number	% Change
8	Sacramento	SAC	1231	3.1
2	Reno	RNO	948	-0.7
12	Salt Lake City	SLT	1134	2.3
6	Glenwood Springs	GLN	1014	1.8
3	Denver	DEN	724	-1.2

The table above give information for 2013 on the total passengers for 5 train stations in the western United States. These stations were chosen because in 2013 they were among the most popular. The table also includes the percent increase and decrease from the previous year.

Consider the following statements and determine whether the statements are true or false based on the information provided by the table.

- I. The percent of change in the passenger count from 2012 created the rank identifier for 2013.
- II. The train station that has the median number of passengers also has the median rank.

III. Over 50 percent of the stations that experienced a percentage increase are in the state of Utah.

Possible Answers:

I. True

II. False

III. False

I. True

II. True

III. False

I. False

II. True

III. False

I. False

II. True

III. True

I. False

II. False

III. True

Correct answer:

I. False

II. True

III. False

Explanation:

Examining the table conclusions can be made on each of the statements.

Rank	Train		Passengers	
	City	Code	Number	% Change
8	Sacramento	SAC	1231	3.1
2	Reno	RNO	948	-0.7
12	Salt Lake City	SLT	1134	2.3
6	Glenwood Springs	GLN	1014	1.8
3	Denver	DEN	724	-1.2

Looking at option I. The percent of change in the passenger count from 2012 created the rank identifier for 2013.

Looking at the ranks, it is seen that rank 2 which is the highest given, belongs to Reno. Reno's station also had a percent decrease from the previous year. Therefore making this statement false.

Looking at option II. The train station that has the median passengers also has the median rank.

If the passenger counts were reorganized from lowest to highest is would look as follows,

724,948,1014,1134,1231

The ranks if ordered in this same way would be as follows,

2,3,6,8,12

Since there are five entries, the median occurs at the third entry which would be passenger count 1014 and rank 6. Both of these belong to the train station at Glenwood Springs. Therefore making this statement true.

Looking at option III. Over 50 percent of the stations that experienced a percentage increase are in the state of Utah.

The stations that experienced a percentage increase belong to Glenwood Springs, Salt Lake City, and Sacramento. Glenwood Springs is a city in Colorado, Salt Lake City is a city in Utah, and Sacramento is a city in California. Only one station is in Utah therefore making this statement false.

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Example Question #2 : Table Analysis

The table displays the academic class spread among Dawn County schools in 2005.

Academic Class List			
Academic Class	Schools Offering Class	% of Schools Offering	% Student Enrollment
AP English	4	50	467
English	6	75	700
Math	8	100	934
AP Calculus	4	50	467
Gym	5	63	588
Painting	2	25	233
Sculpting	1	13	121
Study Hall	5	63	588
French	4	50	467
Latin	3	38	355
German	4	50	467
Spanish	4	50	467

Based on the given information in the table, select the options that can be proven to be true.

- I. No class is offered in less than one-third of the schools.
- II. Every school in the district offers either Gym or at least one Art class (Painting or Sculpting).
- III. Math is an academic class that is offered in all schools in Dawn County.

Possible Answers:

II.

I. and II.

II. and III

I.

III.

Correct answer:

III.

Explanation:

Examining the table given, the truth of the statements can be identified.

OR

Integrated Reasoning Two-Part Analysis questions are presented in the form of two questions that relate to the same information. The questions are followed by five or six answer choices, and the answers to each of the two questions may be the same or different.

EXAMPLE:

A high-school music department is putting together a two-day music festival to highlight the students' talents. The schedule for the two days will adhere to the following rules:

1. Five musical performances are scheduled for each day.
2. The majority of the performances on one of the days will be composed of woodwind instruments (clarinets, flutes, saxophones, oboes, or bassoons)
3. The other day will primarily feature solo performances.

Currently, 8 of the performances (4 each day) have been scheduled. The music department must add one additional performance on each day:

Day 1

Smooth Jazz Group (10th Grade, Saxophone Trio)

Rock Your Socks Off (12th Grade, Vocal Group)

Dustin & Karen (11th Grade, Flute Duo)

James (11th Grade, Trumpet Solo)

Day 2

Adam (10th Grade, Vocal Solo)

John (11th Grade, Clarinet Solo)

Rachel (12th Grade, Brass Solo)

4 Blind Mice (9th Grade, Woodwind Quartet)

The music department must add one additional performance on each day.

Based on the rules above, identify a performance that following:

I. A performance that can be scheduled on either day.

II. A performance that cannot be scheduled on either day.

Possible Answers:

I. Jenny & Molly (12th Grade, Flute Solo)

II. James & Jimmy (10th Grade, Vocal Duo)

I. Susan (12th Grade, Flute Solo)

II. James & Jimmy (10th Grade, Vocal Duo)

I. Susan (12th Grade, Flute Solo)

II. Kimmy (10th Grade, Trumpet Solo)

I. Susan (12th Grade, Flute Solo)

II. Henry (12th Grade, Violin Solo)

I. Susan & Tina (12th Grade, Flute and Clarinet Duo)

II. James & Jimmy (10th Grade, Vocal Duo)

Correct answer:

I. Susan (12th Grade, Flute Solo)

II. James & Jimmy (10th Grade, Vocal Duo)

Explanation:

Recall the criteria for this particular problem.

Five musicians are scheduled to play each day. To feature the departments strengths, the majority of the musicians on one of the days will be composed of woodwind instruments (clarinets, flutes, saxophones, oboes, bassoons) and the other day will be primarily solo musicians.

Looking at day one it is clear that represents the woodwind day and day two represents the solo day.

Therefore, for someone to be able to play either day that student must play a woodwind instrument and be doing a solo. For a musician(s) to play neither day it must be a group that is composed of instruments other than woodwind.

Also recall that violins are string instruments, trumpets are brass instruments, and vocal is ones voice.

Keeping all of this in mind, the correct answer is,

- I. Susan (12th Grade, Flute Solo)
- II. James & Jimmy (10th Grade, Vocal Duo)

Multi-Source Reasoning

As the name suggests, Multi-Source Reasoning (MSR) questions comprise information from more than one source. An MSR question will have two or three tabs of information; however, you can view only one tab at a time by clicking it. You are probably already familiar with this format as you encounter tabs in your daily use of internet browsers. The tabs contain a combination of written passages, graphs, diagrams, tables, or other types of visual information.

A typical MSR dataset will have three questions; however, you will find three to six questions in Official Guide per dataset. You can find both multiple-choice questions and dichotomous-choice questions.

For multiple-choice questions, five answer choices given. You have to select the correct answer choice. Alternatively, the dichotomous question presents three statements, values, or expressions. You may be asked whether, according to the information, each statement is True/False, Yes/No, Acceptable/Not Acceptable, Supported/Not Supported, or can be Inferable/Not Inferable. As with Table Analysis prompts, Multi-Source Reasoning prompts are dynamic, and you are expected to know how to effectively use the available interactivity.

Strategies and Concepts

For some test-takers, the MSR seems at first glance to be the most intimidating part of the Integrated Reasoning section of GMAT, but once you have your

approach, you will find it is not something you need to be afraid of. The MSR Questions are similar to the Critical Reasoning section, so as you prepare for that section, you are exercising the skills you will need here. While the official online guide presents the MSR with six questions about one dataset, you are more likely to encounter three questions. On average, you have 7.5 minutes to complete all the questions in each dataset.

Because you can only look at one of the tabs at a time, it is important to quickly look over the tab headings and the information each tab has to make a mental note of what kind of information can be quickly found again when it is time to answer questions. You can expect to find verbal-based questions, quant-based questions, and questions which mix of the two.

Process of Solving MSR Questions

1. Understand the data set

Briefly read over the information given in each tab. Understand it, but do not read it more than once at this stage. Then read the question. The nature of the MSR is that you will be given a lot of information relative to the amount of time you have. It is more time effective to read the questions as soon as you have a handle of the type of information you have and go back to read carefully once you know what you are looking for. Remember that only one question will be visible at a time, and you have on average 7.5 minutes to answer all three MSR questions.

2. Understand the question

Read the question and make sure you understand it. Remember that the strategy here is to only do one brief read of the dataset before going to the question, so be sure you understand what is being asked.

3. Develop an approach

You will have to gather information from more than one tab. For example, a question might ask about a company's profit. Suppose Tab 1 gives details about revenue and sales, whereas Tab 2 gives details about budget and cost. You must sift through both tabs to get the answer. With this in mind, although it is not suggested that you deeply read each tab, you do want to have a good general idea of what you can find in the different tabs to be able to go back and read carefully

when needed. Consider taking notes if the table headers aren't enough information to jog your memory.

4. Apply the approach

Now that you have an idea of what each tab holds, read the question, and scan again for key words, phrases, or figures to be able to answer the question as quickly as possible. Do your scratch work neatly, as you may need to use some calculations again to answer another question.

Example

Tab 1



In the mosquito repellent market currently, there are four major companies in the retail industry. The following figure shows the sales volume distribution of mosquito repellent products.



Tab 2

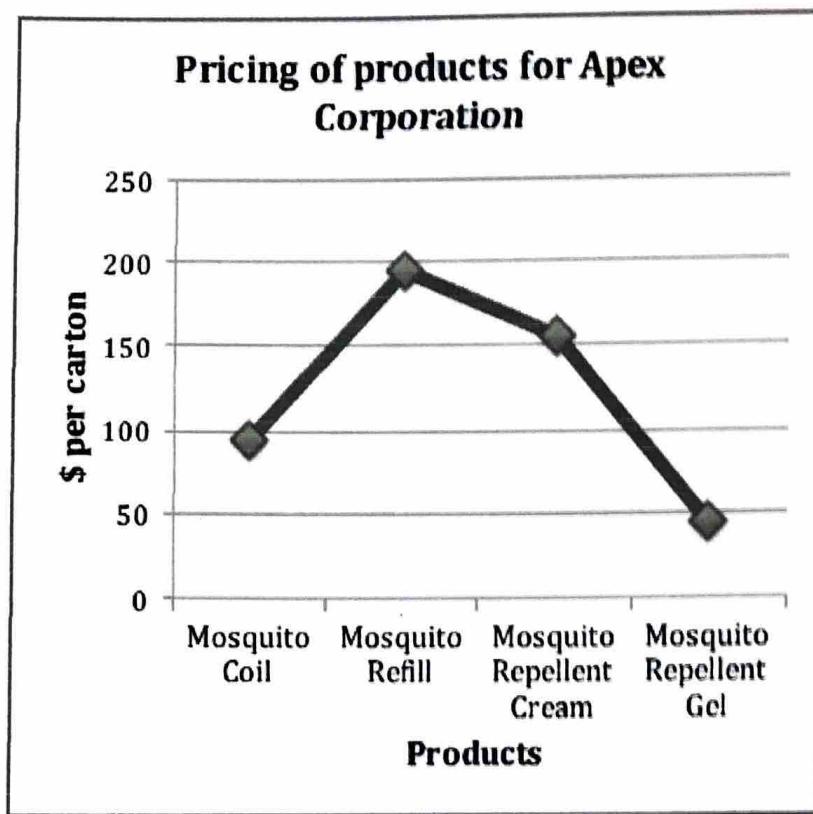
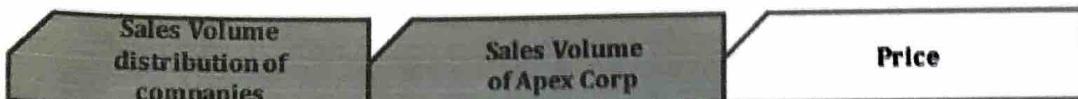


The table below presents the region-wise and product-wise sales volume distribution of the Apex Corporation.

Products	North	South	East	West	Total
Mosquito Repellent Coll	124	140	106	50	420
Mosquito Repellent Refill	100	110	90	70	370
Mosquito Repellent Cream	46	140	98	6	290
Mosquito Repellent Gel	24	98	32	16	170
Total	294	488	326	142	1,250

Unit: '000 cartons

Tab 3



Question 1

For each of the following statements, select "Yes" if the statement is true based on the information provided; otherwise select "No."

	Yes	No	
A	<input type="radio"/>	<input type="radio"/>	The difference between the sales volume of Austere Corporation and Pedro Corporation is more than 1,250,000 cartons.
B	<input type="radio"/>	<input type="radio"/>	For the Apex Corporation, sales revenue from the Eastern region is more than that from the Northern region.
C	<input type="radio"/>	<input type="radio"/>	For the Apex Corporation, sales revenue from Mosquito Coil is more than that from Mosquito Refill.

Solution 1

- Part A: From Tab 1, you know that the percent sales volume for the Apex Corporation is 22% of the total sales volume of all five companies. From Tab 2, you know that the sales volume of the Apex Corporation is 1,250,000 cartons. So, $22\% \times (\text{total sales}) = 1,250,000$

- Again, from Tab 1, you will find that the percent difference of the sales volume of the Austere Corporation and the Pedro Corporation is $32-10=22\%$, which is equal to the percent sales volume of Apex. Hence, the answer is exactly 1,250,000, not more. The correct answer is "No."
- Part B:** In a nutshell, you are asked to find out for Apex Corporation whether Revenue from the Eastern region > Revenue from the Northern region

This question may appear to be time-consuming, but the GMAT never asks a question that is too time-consuming. So, there must be an alternate approach.

We find that the sales volumes of Coil and Refill products are more for the Northern region than for the Eastern region, while the opposite is true for Cream and Gel products. You must analyze which mosquito repellent(s) will contribute more in revenue to a region when sales volumes are multiplied with their respective prices. Clearly, the impact of the Cream product is very high, as the Eastern region sells $98,000-46,000=52,000$ more mosquito repellent Cream than does the Northern region. Also, its price (\$150 per carton) is second highest among all the products. This is going to contribute more in revenue to the Eastern region compared to the Northern region. Though Northern region sells $100,000-90,000=10,000$ more units of the highest priced (\$195 per carton) mosquito repellent Refill, its impact is relatively low as $10,000 \ll 52,000$. Similarly, though Northern region sells $124,000-106,000=18,000$ more units of low priced (\$95 per carton) mosquito repellent Coil, its impact is relatively low. So collectively, we find that $(10,000+24,000=34,000) \ll 52,000$. So, the answer would be "Yes." In fact, the Eastern-region revenue is more than Northern-region's by \$4,760,000.

The correct answer is "Yes."

The table below presents the computation.

Products & Price	North	East
Mosquit o		
Repellen t Coil (\$95)	$124 \times 95 = 11,780$	$106 \times 95 = 10,070$
	$124 \times 95 = 11,780$	$106 \times 95 = 10,070$
Mosquit o		
Repellen t Refill (\$195)	$100 \times 195 = 19,500$	$90 \times 195 = 17,550$
	$100 \times 195 = 19,500$	$90 \times 195 = 17,550$
Mosquit o		
Repellen t Cream (\$155)	$46 \times 155 = 7,130$	$98 \times 155 = 15,190$
	$46 \times 155 = 7,130$	$98 \times 155 = 15,190$
Mosquit o		
Repellen t Gel (\$45)	$24 \times 45 = 1,080$	$32 \times 45 = 1,440$
	$24 \times 45 = 1,080$	$32 \times 45 = 1,440$
Total (\$'000)	39,490	44,250

- Part C: Fetching the data from Tabs 2 and 3, you will find that the carton price of the Refill (\$195 per carton) is almost double that of the Coil (\$95 per carton), while sales volume of the Refill is a mere $\approx 10\%$ less than that of the Coil. Collectively, the revenue from the Refill sales would be more than that from the Coil sales.

The correct answer is "No."

Question 2

If the Pedro Corporation sells exactly the same kinds of mosquito repellent products as does Apex Corporation: Coils, Refills, Cream, and Gel, and it has the same proportion of sales volume for the four products as does Apex Corporation, then how many Gel cartons did the Pedro Corporation sell?

- (A) 38,000
- (B) 77,000
- (C) 170,000
- (D) 374,000
- (E) 1,250,000

Solution 2

The sales volume of Gel for the Apex Corporation is 170,000. The percent share of sales volume for the Apex Corporation is 22% of all five companies, while for Pedro, it is 10%. Clearly, the sales volume of Gel for Pedro was

$$170,000 \times 10\% = 77,000 \text{ cartons}$$

The correct answer is option B.

Question 3

Keeping the total sales volume the same for the Apex Corporation, which of the following rearrangement of sales volume of products will generate more sales revenue than currently?

- (A) Reduce the Mosquito Coil sales volume by half and increase the sales volume of Mosquito Repellent Gel by the same amount.
- (B) Reduce the Mosquito Refill sales volume by one-third and increase the sales volume of Mosquito Repellent Cream by the same amount.
- (C) Reduce the Mosquito Cream sales volume by 20% and increase the sales volume of Mosquito Repellent Gel by the same amount.
- (D) Reduce the Mosquito Coil sales volume by 33.33% and increase the sales volume of Mosquito Repellent Cream by the same amount.
- (E) Reduce the Mosquito Repellent Cream sales volume by 66.66% and increase the sales volume of Mosquito Coil by the same amount.

Solution 3

In all the options, the sales volume of one kind of mosquito repellents is reduced and that of another kind is increased by the same amount. So, the revenue can be increased if a product with a lower price is replaced by a product with a higher price. In one instance, reduced sales volume of the Coil (\$95 per carton) is offset

by the relatively high-priced Mosquito Cream (\$155 per carton). This move will certainly increase the revenue. For the other options, the revenue will decrease. The correct answer is option D.

UNCritical Reasoning

The opposite of logical reasoning is uncritical thinking, examples of which are fuzzy thinking, believing what somebody says simply because they raise their voice, and narrowly thinking about a problem without bringing in the most relevant information.

Scientific Reasoning

Scientific reasoning is the foundation supporting the entire structure of logic underpinning scientific research.

It is impossible to explore the entire process, in any detail, because the exact nature varies between the various scientific disciplines.

Despite these differences, there are four basic foundations that underlie the idea, pulling together the cycle of scientific reasoning.

1. Observation

Most research has real world observation as its initial foundation. Looking at natural phenomena is what leads a researcher to question what is going on, and begin to formulate scientific [questions](#) and [hypotheses](#). Any theory, and prediction, will need to be tested against observable data.

2. Theories and Hypotheses

This is where the scientist proposes the possible reasons behind the phenomenon, the laws of nature governing the behavior.

Scientific research uses various scientific reasoning processes to arrive at a viable [research problem](#) and hypothesis. A theory is generally broken down into individual hypotheses, or problems, and tested gradually.

3. Predictions

A good researcher has to predict the results of their research, stating their idea about the outcome of the experiment, often in the form of an [alternative hypothesis](#).

Scientists usually test the predictions of a theory or hypothesis, rather than the theory itself. If the predictions are found to be incorrect, then the theory is incorrect, or in need of refinement.

4. Data

Data is the applied part of science, and the results of real world observations are tested against the predictions. If the observations match the predictions, the theory is strengthened. If not, the theory needs to be changed. A range of statistical tests is used to test predictions, although many observation based scientific disciplines cannot use statistics.

The Virtuous Cycle

This process is cyclical: as experimental results accept or refute hypotheses, these are applied to the real world observations, and future scientists can build upon these observations to generate further theories.

Differences

Whilst the scientific reasoning process is a solid foundation to the scientific method, there are variations between various disciplines.

For example, social science, with its reliance on case studies, tends to emphasize the observation phase, using this to define research problems and questions.

Physical sciences, on the other hand, tend to start at the theory stage, building on previous studies, and observation is probably the least important stage of the cycle.

Many theoretical physicists spend their entire career building theories, without leaving their office. Observation is, however, always used as the final proof.

Scientific Reasoning, as the name implies, doesn't test your knowledge, but rather tests your ability to reason, as well as your ability to analyze and understand data. The questions provide you with everything you need to know – you have to reason your way through like a scientist using the scientific method.

PRACTICE QUESTIONS

Proteins

Proteins are large molecules consisting of many amino acids joined together. They form the basis of many different body tissues and play an essential role in a variety of biological processes such as catalyzing chemical reactions, transporting molecules such as oxygen, our immune system and transmitting messages between cells. Some proteins have a structural role, for instance, movements of the proteins actin and myosin are responsible for the contraction of skeletal muscle. A property of many proteins is that they specifically bind to a certain molecule or class of molecules. Antibodies are an example of globular proteins that attach to one particular type of molecule. In fact, the enzyme-linked immunosorbent assay (ELISA), uses antibodies to detect various biomolecules in the blood, making it one of the most sensitive tests in modern medicine. Enzymes, however are probably the most important group of proteins. Virtually every reaction in a living cell requires an enzyme to lower the activation energy of the reaction.

1. Which of the following is not an example of a protein?

- a. Actin
- b. Myosin
- c. Amino acid
- d. Antibodies

2. Enzymes are known to catalyze reactions in the body. What does this mean?

- a. They create a chemical reaction
- b. They speed up chemical reactions
- c. They are involved in chemical reactions
- d. Provide energy for the reaction to occur

3. Which of the following is not a feature of enzymes?

- a. They lower the energy needed to begin a reaction
- b. They are specific
- c. They are proteins
- d. They are antibodies

4. Which of the following is another example of a structural protein that can be found in the human body?

- a. Haemoglobin
- b. Keratin
- c. Insulin
- d. Estrogen

The Effect of Insulin on Glucose Uptake and Metabolism

The hormone insulin is another example of a protein. It plays a number of roles in the body's metabolism helping it to control blood glucose levels. Insulin signals the liver, muscle and fat cells to remove glucose from the blood, helping cells to take up glucose to use as energy. If the body has sufficient energy, insulin signals the liver to take up glucose and store it as glycogen.

To regulate glucose, insulin binds to its receptor (1), which in turn starts many protein activation cascades (2). These include translocation of the Glut-4 transporter to the plasma membrane and influx of glucose (3), glycogen synthesis (4), glycolysis (5) and fatty acid synthesis (6).

5. The process above shows how glucose is controlled in a healthy individual. What would be the outcome if this process failed to operate correctly?

- a. Heart Disease
- b. Cancer
- c. Diabetes
- d. Pancreatitis

6. Name the organ responsible for making the hormone insulin.

- a. Small intestine
- b. Gall Bladder
- c. Liver
- d. Pancreas

7. Insulin is another example of a protein. Which of the following statements best describes the role of insulin in the body?

- a. Insulin regulates how the body stores and uses glucose and fat.
- b. Insulin turns glucose into glycogen
- c. Insulin triggers the formation of fatty acids
- d. Insulin allows glucose transporter-4 to move glucose through the plasma membrane

8. Name the cellular process that all cells require glucose as a reactant for:

- a. Photosynthesis
- b. Cell division
- c. Respiration
- d. Reproduction

9. Which of the following conclusions are correct, relating to insulin's effect on glucose uptake?

- a. When blood glucose levels are low, insulin causes the liver as well as muscle and fat cells to remove glucose from the blood.
- b. Insulin prevents glucose from moving through the glucose transporter molecule when glucose levels are high
- c. The more glucose is in the blood; the more insulin is released to control it
- d. Insulin triggers the muscle cells to take up excess glucose and store it as glycogen.

**Population Dynamics
Beneficial Mutations**

In many cases mutations that cause changes in protein sequences can be harmful to an organism. However, on occasion, in a given environment, some mutations can have a positive effect, for example, it may allow a mutant organism to withstand particular environmental stresses better than wild-type organisms, or reproduce more quickly. In these cases, a mutation will tend to become more common in a population through natural selection.

In an experiment, random mutations were introduced into a vesicular stomatitis virus by site-directed mutagenesis, and the fitness of each mutant was compared with the ancestral type, the processed results can be seen below. A fitness of zero, less than one, one, more than one, respectively, indicates that mutations are lethal, deleterious, neutral, and advantageous.

10. Which level of fitness is most frequent in the virus after introduction?

- a. Lethal
- b. Deleterious
- c. Neutral
- d. Advantageous

11. What is the total frequency of individuals with deleterious fitness?

- a. 2.8
- b. 0.33
- c. 0.4
- d. 5

12. Comment on the frequency of the mutation in the population, if it was left for several generations.

- a. The mutation will become more common in the population
- b. The mutation will become less common in the population
- c. The mutation will remain static in the population
- d. This mutation will cause the population to become extinct

13. Which of the following statements is true regarding this example of natural selection:

- a. Natural selection determines which trait (mutant or ancestral) will survive.
- b. Natural selection acts on the genotype of the virus
- c. Natural selection will determine the environment the virus is in.
- d. None of these

ANSWER KEY

1. C

Choices A and B are incorrect as the text tells us they are structural proteins. Choice C is correct as amino acids

are the sub-units which join together to make a protein. Choice D is also incorrect as the text tells us that they are globular proteins.

2. B

Choices A and D are incorrect – enzymes reduce the amount of energy needed, they do not create the reaction or provide the energy. Choice B is correct – the definition of a catalyst “speeding up a chemical reaction by lowering the amount of energy needed.” Choice C is incorrect – enzymes are not involved in reactions, they are not a reactant nor become a product, which is why they can be reused again once a reaction has finished.

3. D

Enzymes lower the energy needed to begin the reaction, they are specific, meaning that each enzyme only catalyzes one reaction. The text also tells us that they are proteins; therefore choices A, B and C are incorrect. Enzymes are not antibodies. Therefore choice D is the correct choice.

4. B

Choice A – hemoglobin is a globular protein, carrying oxygen in red blood cells and is incorrect. Choice B is correct as keratin is a protein found in skin and nails, a building material for the body. Choice C is incorrect – insulin controls blood glucose levels. Choice D is incorrect – estrogen is the female reproductive hormone.

5. C

An inability to make or produce sufficient levels of insulin results in diabetes.

6. D

Choice A is incorrect; this is where food is digested before it enters the bloodstream. Choice B is incorrect, this where bile is stored C is incorrect; the liver does store excess glucose taken out of the blood as glycogen. D is correct; the pancreas is responsible for producing insulin

7. A

A is correct; insulin helps control blood glucose levels by signaling the liver and muscle and fat cells to absorb glucose from the blood. If the body has enough energy, insulin signals the liver to take up glucose and store it as glycogen. Choice B is incorrect; insulin does not turn glucose into glycogen; this is the product that the liver turns glucose into for storage. Choice C is incorrect as it only gives a partial answer. Choice D is incorrect as this is a partial answer.

8. C

Choice A is incorrect as glucose is a product of photosynthesis and only occurs in plants. Choice B is incorrect as glucose is not used directly in cell division C is correct as glucose is one of the essential reactants needed for respiration. D is incorrect as glucose is not a primary reactant needed for reproduction.

9. C

Choice A is incorrect as this occurs when blood glucose levels are high. Choice B is incorrect as insulin will allow glucose to cross the plasma membrane removing excess glucose from the bloodstream. Choice C is the correct answer; the concentration of glucose directly correlates to the amount of insulin needed. Choice D is incorrect as this process occurs in the liver.

10. A

Choice A is correct – the greatest frequency in the population is a fitness of 0, which is considered lethal.

11. B

($0.3 \times 0.02 + 0.4 \times 0.02 + 0.6 \times 0.05 + 0.7 \times 0.05 + 0.8 \times 0.05 + 0.9 \times 0.15 = 0.325$) (0.33 rounded)

12. B

For a mutation to become widespread in a population it needs to be inherited by the offspring. Alleles that are lethal or deleterious are not passed on in most cases, as the carrier often does not reach reproductive maturity. Therefore we can expect the mutation to become less common, making choice B is correct.

13. A

Choice A is correct, as the interactions between individuals and their environment (i.e., the trait)

are what determines whether their genetic information will be passed on or not. In this case, the individuals who are wild type would have a higher level of fitness and therefore be more likely to reproduce (or in the case of viruses, replicate) and pass on their non-mutant genotype.

STRATEGIC REASONING :

As the name suggests, strategic reasoning involves a strategy. A coordinated action plan focused on significant success. In principle, this type of reasoning is used in times of war and then in the world of commerce.

You can develop strategic thinking in your everyday life. For example, you go on a trip and pack our things, thinking ahead and assuming what you need to take in case of bad weather, an illness, losing documents or money. Another helpful tip is to gather as much as possible information and try to analyze it before planning.

Strategic Reasoning: Features and Exercises to Promote It

Strategic reasoning is a concept that started to make a splash in marketing. On the other hand, it is perfectly applicable to other fields, in addition to commercial or professional domains. In fact, it is a useful approach in virtually all sectors.

The approach that looks at today with a future perspective is called strategic reasoning. In other words, it refers to those who are able to anticipate the effect of actions, to have a long-term vision, a creative vision and directed towards the success of punctual goals.

As the name suggests, strategic reasoning involves a strategy. A coordinated action plan focused on significant success. In principle, this type of reasoning is used in times of war and then in the world of commerce. On the other hand, as we mentioned before, it can apply to any other subject.

Characteristics of strategic reasoning

The first thing to mention about strategic reasoning is that it is not learned with a book. Many people compare their learning to learning to walk, swim or ride a bike. **It is not something theoretical, but something that is learned and reinforced with practice.**

We reason strategically when we respect these characteristics:

- **Know where to arrive.** It is necessary to have a clearly defined goal or purpose. Otherwise, the strategy is meaningless.
- **Know how good we are.** It is necessary to have the capacity to define the current situation and the distance that separates from the objective to be reached.
- **To know how to define a way forward.** This is the central point of the strategy. It involves knowing how to get what we are offered.

- **Know how to self-assess and correct.** Strategic reasoning requires flexibility to constantly monitor what is being done and to be able to redefine the trajectory.

In order to think strategically, you need a dose of realism, a capacity for reflection, synthesis and an overall vision. In fact, these abilities are not born of nothing, they must be developed through practice.

Three keys to strategic reasoning

In strategic reasoning, many abilities have an influence. On the other hand, three of them are decisive. They are because they allow to build the axis of this way of thinking: strategy.

These abilities are:

- **The ability to eliminate predictive models.** It is not possible to adopt a model of action and stick to it stubbornly. The strategy is constantly renewing itself. Thus, it is necessary to have an open mind to direct, constantly redirect and address uncertainty.
- **The ability to formulate questions.** In strategic reasoning, the questions are much more important than the answers. If you can define a question, half of the way is already covered.
- **The ability to identify key points.** It is necessary to learn to separate the important from the random, to know to distinguish the decisive factors is fundamental. This allows for more accurate monitoring and refocusing actions on these aspects where necessary.

Strategic reasoning is not the same as "strategic planning". The first is an intellectual capacity that is oriented. The second is the application of this ability to a concrete aspect or situation.

Exercises to develop strategic reasoning

There are many ways to develop strategic reasoning. It starts from playing chess, to making daily assumptions and testing them. On the other hand, **for starters you can do some simple exercises.** Their effectiveness in disciplining the mind so that it acquires the ability to put in place strategies has been proven.

The most recommended simple exercises are:

- **Do something totally different.** The idea is to offer you to do something you have never done before. It can be something very simple, like changing your daily path to work. You must remain attentive to everything. Then you will have to describe the experience on a paper. Write down what you discovered.

- **Play the model.** It's about choosing someone you admire deeply. The mechanics is similar to that of a role play. You take the character and you inhale his way of thinking. Then, all day long, you behave as if you were that person. At the end of the day, you describe what you discovered.
- **Crazy questions.** Every day, try to ask yourself a question about something that is unusual. This should not be a question that seeks information, but induces an analysis. Try to answer them without using any information. Start hypotheses. Then search and check. For example, why are the eyes round?

Strategic reasoning is an ability that facilitates the achievement of goals. It is for this reason that it is practically applicable to everything. It helps you think in a more orderly way, but above all to think about success and the long term.

ANALYTICAL REASONING

Q:

Find the minimum number of straight lines required to make the given figure.



A) 11

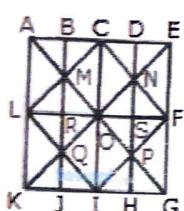
B) 14

C) 16

D) 17

Answer & Explanation Answer: B) 14

Explanation:



The horizontal lines are AK, BJ, CI, DH and EG i.e. 5 in number.

The vertical lines are AE, LF and KG i.e. 3 in number.

The slanting lines are LC, CF, FI, LI, EK and AG i.e. 6 in number.

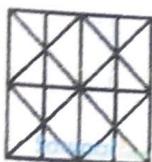
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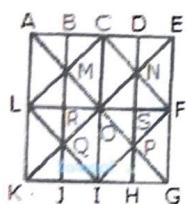
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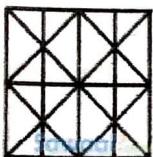
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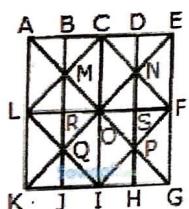
B) 14

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D) 17

Answer & Explanation **Answer: B) 14**

Explanation:



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The vertical lines are AE, LF and KG i.e. 3 in number.

The slanting lines are LC, CF, FI, LI, EK and AG i.e. 6 in number.

Thus, there are $5 + 3 + 6 = 14$ straight lines in the figure.

Q:

Choose the alternative which is closely resembles the water image of the given combination/figure.

ADVANCE

1) ADVANCE 2) NAVDA 3) EAVDA 4) NONE

A) 1

B) 2

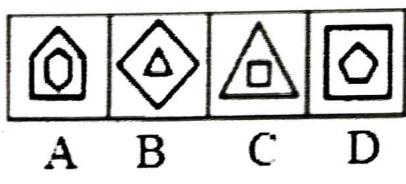
C) 3

D) 4

Answer & Explanation Answer: B) 2

Q:

Select the figure that does NOT belong in the following group.



A) B

B) A

C) D

D) C

Answer & Explanation Answer: A) B

Q:

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Vineet is taller than Raman but shorter than Jyoti. Sumit is the shortest. Deepak is taller than Sumit but shorter than Raman. Who is the tallest?

A) Jyoti

B) Raman

C) Vineet

D) Deepak

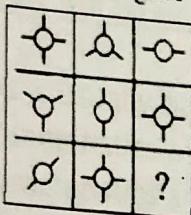
Answer & Explanation

Answer: A) Jyoti

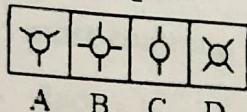
Q:

Select the Answer figure that fits in the blank space in the given problem figure.

Problem Figure



Answer Figures



A) D

B) C

C) B

D) A

Answer & Explanation

Answer: D) A

TYPES OF BIASES

Bias is an inclination, prejudice, preference or tendency towards or against a person, group, thing, idea or belief. Biases are usually unfair or prejudicial and are often based on stereotypes, rather than knowledge or experience. Bias is usually learned, although some biases may be innate. Bias can develop at any time in an individual's life.

Bias is a uniquely human attribute. In some cases, the bias may be subconscious, and the individual may not be aware that they are experiencing bias towards others. Although biases can sometimes be positive or helpful to the individual, in the majority of cases, biases will be negative or damaging.

Bias is usually based on stereotypes relating to the physical characteristics of an individual or the group they identify with. These characteristics are often immutable, meaning they do not change over time.

The most common biases are based on characteristics such as:

- Race.
- Ethnicity.
- Gender.
- Religion.
- Sexual orientation.
- Socioeconomic background.
- Educational background.

One of the biggest effects of bias is judgement, which can result in discriminatory practices. As some biases can be helpful and are used in heuristic decision-making, it is important to find the balance between helpful biases and negative, prejudicial biases.

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It can be almost impossible to be completely unbiased. It is a natural human instinct to make judgements based on first impressions and pre-conceived ideas or knowledge. However, by being aware of these judgements and ensuring biases are not unconscious, we can avoid the harmful stereotyping and discriminatory practices that often result from biases. For more information on discrimination, consult our [knowledge base](#).

How many types of bias are there?

There are hundreds of different types of bias that have been identified. These different categories of bias have multiple bias examples within them. Let's take a look at the main different types of bias.

Cognitive bias

This is the most common type of bias. Research suggests that there are more than 175 different types of cognitive bias. It refers to deviation from standards of judgement whereby you may create inferences, assessments or perceptions that are unreasonable. You may also recollect past experiences incorrectly. These perceptions may dictate a person's behaviour or attitude, either in a positive or negative way.

Prejudices

A prejudice is a pre-judgement or prior opinion that a person makes before they are given the relevant facts and information. When a prejudice takes place, this pre-judgement is usually negative or unfavourable. Prejudices are usually based on factors such as race, religion, gender, sexual orientation, age, disability, social class or language.

Contextual bias

This refers to when experts who have good intentions are vulnerable to making incorrect decisions, based on external

influences or influences that are irrelevant or unrelated to the situation. This can result in a loss of objectivity and can cause the experts to develop subconscious expectations.

Contextual biases can be found in academia, research, forensic analysis, publications and court situations. Contextual bias can also occur in the media. It can influence how stories are selected and reported.

Contextual biases are most commonly reported in law enforcement. Racial profiling and victim-blaming are both examples of common contextual biases. [Gov.uk](#) reported that in 2019/2020, there were 6 Stop and Searches for every 1,000 White people, compared to 54 Stop and Searches for every 1,000 Black people. This means Black people were 9 times more likely to be stopped by law enforcement than white people.

Unconscious or implicit bias

This is related to implicit stereotypes and is when you unconsciously attribute certain qualities to certain social groups. This can then influence your perceptions, attitudes and behaviour towards this social group. There are many different types of unconscious bias. We will look at some examples of unconscious bias later.

Statistical bias

This is related to the process of data collection. Statistical bias can affect the way a research sample is selected or the way that data is collected. It can result in misleading results that differ from the accurate representation. Statistical bias examples include forecast bias, the observer-expectancy effect, selection bias, reporting bias and social desirability bias.

What are the two main types of bias?

There are two main types of bias to be aware of, conscious bias and unconscious bias.

Conscious bias

Conscious bias is sometimes known as explicit bias. This is a type of bias that you are aware of. The bias is happening consciously, in that you know you are being biased and are acting with intent. An individual with conscious bias is likely to be explicit with their beliefs and attitudes and behave with clear intent.

The biased attitudes and behaviours are processed at a conscious level. A conscious bias that is extreme is usually characterised by negative behaviour, such as physical or verbal harassment. It can also manifest as exclusionary behaviour.

Conscious biases are prejudices. They usually discriminate against people or groups of people. There is usually malicious intent involved in conscious biases.

Unconscious bias

Unconscious bias is also known as implicit bias. It is a very different bias than conscious bias for several reasons. Unconscious biases are beliefs and attitudes that operate outside of a person's awareness and control. Unconscious bias can be in direct contrast with the beliefs and values you think you hold. You may not even be aware that you hold these biases, or that they are affecting your attitudes and behaviours.

Unconscious biases are difficult to identify. They may influence your actions and behaviours more than conscious biases, without you realising it. Unconscious bias usually involves no malicious intent, as a person may be unaware of their bias and the effect it is having. We will look more at unconscious bias later.

RECOGNIZING IMPLICATIONS

To recognize implications, it is important to first note how important it is based on how often or in how much detail it is discussed. Further, context is an important element for figuring out what the implication of something is, and readers can use tools like graphic organizers to help them recognize implications.

How can recognizing implications in a reading passage help active readers? And how can readers recognize implications? In this lesson we'll look at how to recognize implications and the link between implications, inferences, and predictions in reading.

Active Reading

Rasheed is an ok reader, but sometimes he struggles to understand the implications of what he's reading. That is, he struggles to figure out how smaller parts of a piece can relate to the big picture of the piece.

Active reading involves constructing meaning from the words on the page. There are many tools and skills to help readers be actively engaged in the process of reading. One of the tools that readers can use while reading involves recognizing **implications**, or connections and suggestions about what's going on.

To help Rasheed with recognizing implications of the ideas in a reading passage, let's look closer at how implications can influence predictions and inferences while reading.

Predictions & Inferences

Rasheed is reading a mystery novel. He keeps noticing that there are certain small things that are described in the book, but he's not sure how they relate to the rest of the book. For example, does he really need to know that one of the characters carries a flashlight with her everywhere she goes?

There's a rule that writers know, that's usually attributed to the playwright Anton Checkov. The rule goes that if there's a gun on the wall in the first act, it must go off by the third act. Basically, this means that if something is described in a piece of writing, it should have some relevance to the overall story.

Of course, not every writer follows this rule, but many do, and Rasheed could benefit from remembering it as he reads. If writers include only important information, then the implications of what is happening or what is described in one part of a piece relate to what will happen later on.

Look at Rasheed's book: there's a character who is always described as having a flashlight on her. What are the implications of this? Well, it depends. It could be a clue. If, for example, the victim was murdered with a flashlight or killed someplace really dark, the flashlight could be a hint that this is the killer. In this way, Rasheed can view the implications as a type of prediction of what will happen later.

But what if the victim in Rasheed's mystery novel was murdered with a gun in a well-lit room? In that case, what's the point of the flashlight?

In addition to predictions, implications can also be recognized as a tool for making **inferences**, or figuring out what the writer isn't directly saying in a passage. For example, maybe the flashlight is in the book because the writer is trying to tell the readers something about that character. Maybe she's someone who is always prepared, or maybe she's a worrywart who carries the flashlight around because she always thinks the worst is going to happen.

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The point here is that the implications of a character's words and action can hint at something larger. Perhaps it's that the character is a certain way, or that he or she will do a certain thing later. Perhaps what they do and say relate to the theme of the book. For example, maybe one of the themes in the book that Rasheed is reading has to do with light and darkness, and the flashlight is a way of bringing that theme out.