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The IQ Workout Series

MAXIMIZE YOUR BRAINPOWER

1000 new ways to boost your mental fitness

Philip Carter and Ken Russell

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Introduction

> There is no man living who isn't capable of doing more than he thinks he can do.
>
> Henry Ford
>
> Every production of genius must be the production of enthusiasm.
>
> Benjamin Disraeli

Despite the enormous capacity of the human brain, we only use on average 2% of our potential brainpower. This is the amount of information available to us consciously, and the rest is locked within our subconscious mind. There is, therefore, the potential for each of us to expand our brainpower considerably.

This book sets out to show that by regular practice on different types of tests and puzzles each one of us has the capacity to maximize our brainpower and strengthen our performance at different types of brain activity. Just as gymnasts are able to improve their performance, and increase their chances of success, at whatever level they are competing, by means of punishing training schedules and refinement of technique, in the same way this book provides the reader with a series of mental workouts covering areas of creative thinking, problem solving, memory, logical thought and mental agility.

Most of us take our brain for granted, believing there is little we can do to improve the brain we have been born with. Also,

because we know so little about the human brain, there is the fear factor – the fear of the unknown that we do not even like to think about, let alone talk about – however, the brain is the most vital organ in the human body and our most valuable asset. It gives rise to our perceptions and memory, and it shapes our speech, skills, thoughts and feelings, yet it is perhaps the part of our body which we tend to neglect the most.

In the past few decades we have become much more aware of the importance of the human brain, its functioning and its relationship to our body, in fact, we have learned more about the brain in the past decade or so than in all of the previous centuries.

We are now becoming more aware than ever that we all have the capacity to put our brain to even more use by exploring new avenues, experiences and learning adventures. It is our hope that this book, a follow-up to our earlier volume, *Increase Your Brainpower*, will go some way to boosting the brain potential, increasing the confidence and unleashing much untapped creativity of many of our readers.

About the brain

Study of other animals suggests a relationship exists between brain size and intelligence levels. The dolphin, for example, has an unusually large brain and is considered one of our planet's most highly intelligent creatures. Human brain size levelled off about 100,000 years ago. Unlike animals, there is no relationship between brain size and intelligence level in humans. When it comes to human brain size, therefore, bigger is not necessarily better. In fact, scientists believe bigger could be worse, because increased size may impede rapid communication between nerve cells within the brain.

In vertebrates the brain is the portion of the central nervous system within the skull. Often referred to as *grey matter* it is,

in humans, a mass of pink-grey tissue and weighs approximately 1.3 kg (3 lb).

The brain is the control centre for virtually every vital activity necessary for survival including movement, sleep, hunger and thirst. In addition, all human emotions including love, hate, anger, elation and sadness are controlled by the brain. It also receives and processes signals that are sent to it from other parts of the body and from sources external to the body.

The brain comprises three distinct but connected parts: the cerebrum, the cerebellum and the brain stem. The largest part of the brain is the cerebrum which makes up approximately 85% of the brain's weight. It has a large surface area called the cortex and is divided by a fissure into identical right and left hemispheres. The cerebrum is responsible for many vital functions including speech, smell, hearing, behaviour, vision and memory.

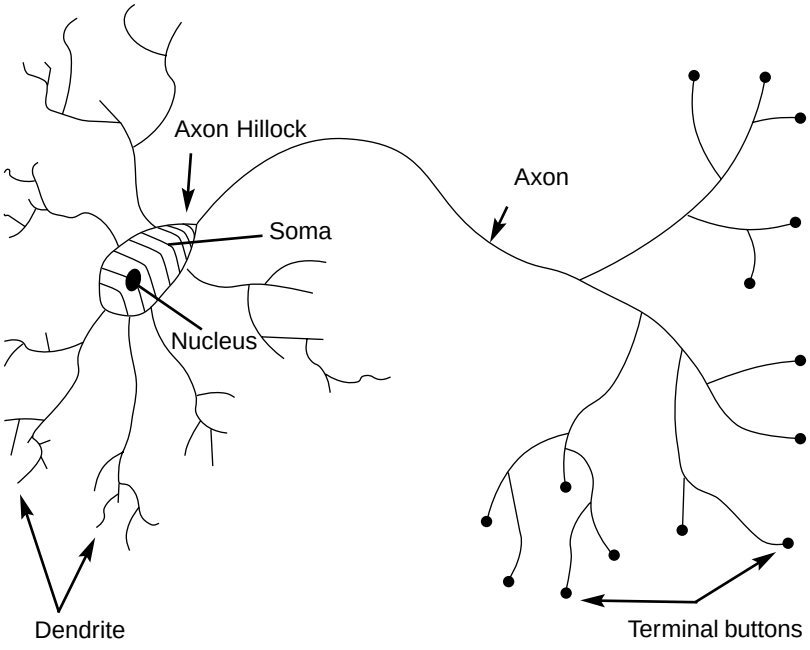
The cerebellum lies at the back part of the cranium and is composed of two hemispheres connected by white fibres called the vermis. The cerebellum is essential to the control of movement and acts as a reflex centre for co-ordination and maintenance of equilibrium.

The brain stem is made up of all the structures lying between the cerebrum and the spinal cord and is divided into several components which regulate, or are involved in, many vital activities necessary for survival. These include, for example, eating, drinking, temperature regulation, sleep, emotional behaviour, sexual activity and cardiac and respiratory functions.

Oxygen and glucose are supplied to the brain by two sets of cranial arteries known as the vascular system. Of all the blood pumped by the heart, 25% is circulated within the brain tissue by a large network of cerebral and cerebellar arteries.

Communication in the brain takes the form of electrical impulses which run along pathways connecting the various

sectors. These connections are formed by a group of dendroids which are threadlike extensions that grow out of neurons, the specialized cells of the nervous system. As well as dendroids, neurons have extensions called axons. Dendrites bring information to the cell body and axons take information away from the cell body.



Composition of a neuron

Each neuron is a cell that uses biochemical reactions to receive, process and transmit information, or messages, through an electrochemical process.

The branches of a neuron's dendrite (the dendritic tree) are connected to a thousand neighbouring neurons. It is when one of these neurons fire that a positive or negative charge is

received by one of the dendrites. The strengths of all the charges are added together and the aggregate input is then passed to the soma, the cell body. The primary function of the soma and its nucleus is not the processing of incoming and outgoing data but is to perform the continuous maintenance required to keep the neuron functional. It is the axon hillock which is the part of the soma that concerns itself with the signal. If the aggregate input is greater than the axon hillock's threshold, this causes the neuron to fire and an output signal is transmitted down the axon.

Neurons are the oldest and longest cells in the body and we have many of the same neurons for our whole life. Although other cells die and are replaced, many neurons are never replaced when they die, therefore, we have fewer neurons when we are old compared to when we are young. On the other hand data published in the late 1990s shows that in at least one area, the hippocampus, new neurons can grow in adult humans.

The more connections there are between the brain's hundred billion neurons, the more efficiently it will work. Connections form as a result of two elements: inherited growth patterns, and in response to external and internal stimuli.

Large amounts of brain activity, the kind that goes on in a healthy and active brain, can stimulate growth of new dendroids, fostering further connections between neurons and improving overall brain functioning.

In addition to 100 billion neurons, there are about 10 to 50 times that many glial cells in the brain, in fact, these small cells account for about half the brain's weight and are now sometimes referred to as the brain's housekeepers.

Traditionally, glia has been thought of as mere support for the brain's neural network, however, scientists are now discovering that glial cells may play a much greater role in the

brain's communication than previously thought. Although glial cells do not carry nerve impulses, they do have many important functions without which neurons would not work properly. These include providing physical and nutritional support for neurons by cleaning up brain debris, transporting nutrients to neurons, holding neurons in place, digesting parts of dead neurons, providing insulation to neurons in the central nervous system and peripheral nervous system and providing physical support to neurons in the peripheral nervous system.

Although research into the importance of glial cells is still in its infancy, neurobiologists have demonstrated that, by themselves, pure populations of nerve cells and glia connect together poorly, however, the combination of the two cell types result in strong connections between nerve cells. In the brain such connections allow nerve cells to transmit messages about activities such as thought, memory and movement, however, the weakening of these connections could be responsible for memory loss, symptoms of strokes and Alzheimer's disease.

The human brain is an infinitely complex subject and these complexities are, and will continue to be, the subject of much debate. As technological methods become more advanced, and our knowledge of the functions of the brain increases, these issues will be increasingly revealed, as will treatments for abnormal diseases of the brain such as strokes, brain disorders, Parkinson's disease and cerebral palsy.

If you have any questions about the tests included in this, or any of the other books in the IQ Workout Series, please email us at: iqworkoutseries@wiley.co.uk.

1

Creativity

If we were to remove a brain from the skull we would see that it is made up of two almost identical hemispheres. These two hemispheres are connected by a bridge, or interface, of millions of nerve fibres called the corpus callosum which allows them to communicate with each other. Thus, the human brain consists of three main parts, the left hemisphere, the right hemisphere and the all-important interface between these two hemispheres.

In order to work to its full potential, each of these hemispheres must be capable of analysing its own input first, only exchanging information with the other half, by means of the interface, when a considerable amount of processing has taken place.

Because both hemispheres are capable of working independently, human beings are able to process two streams of information at once. The brain then compares and integrates the information to obtain a broader and more in-depth understanding of the concept under examination.

In the early 1960s the American psychologist Roger Sperry showed by a series of experiments, first using animals whose corpus callosum had been severed, and then on human patients whose corpus callosum had been severed in an attempt to cure epilepsy, that each of the two hemispheres has developed specialized functions and has its own private

sensations, perceptions, ideas and thoughts, all separate from the opposite hemisphere. As their experiments continued, Sperry, who won the 1981 Nobel Prize for medicine for his work in this area, and his team were able to reveal much more about how the two hemispheres were specialized to perform different tasks.

For most people the left side of the brain is analytical and functions in a sequential and logical fashion and is the side which controls language, academic studies and rationality. On the other hand, the right side is *creative* and intuitive and leads, for example, to the birth of ideas for works of art and music.

This is where the interface between the two halves of the brain becomes so important. In order for the subconscious of the right-hand hemisphere to function, it needs the fuel, in other words data, which has been fed into, collated and processed by the left-hand hemisphere.

The real danger is the overburdening of the left-hand hemisphere with too much data, and too quickly, to the extent that the creative side of the brain is unable to function to its full potential. On the other hand, lack of data fed into the left-hand hemisphere could result in the creative side, or right-hand hemisphere, drying up. It is, therefore, desirable to strike the right balance between right and left hemispheres in order for the brain to work to its full potential. The term *creativity* refers to mental processes that lead to solutions, ideas, concepts, artistic expression, theories or products that are unique and novel. Because it is such a diverse subject in which there are so many different ways in which creativity manifests itself, and because in so many people it is to a great extent unexplored, creativity is very difficult, if not impossible, to measure.

The French mathematicians Poincaré and Hadamard defined the following four stages of creativity:

1 Preparation – the attempt to solve a problem by normal means.

2 Incubation – when you feel frustrated that the above methods have not worked and as a result you then move on to other things.

3 Illumination – the answer suddenly comes to you in a flash via your subconscious.

4 Verification – your reasoning powers take over as you analyse the answer which has come to you, and you assess its feasibility.

The right-hand hemisphere of the human brain, which controls the creative functions, is the side of the brain which is under-used by the majority of people. Because it is under-used, much creative talent in many people remains untapped throughout their life. Until we try, most of us never know what we can achieve, for example, one in three people in Britain have the desire to write a novel, yet only a very small percentage of these people progress any further than the initial stage of just thinking about it.

We all have a creative side to our brain, therefore we all have the potential to be creative. However, because of the pressures of modern living and the need for specialization, many of us never have the time or opportunity, or indeed are given the encouragement, to explore our latent talents, even though most of us have sufficient ammunition to realize this potential in the form of data which has been fed into, collated and processed by the brain over many years.

Writers, indeed all artists, must, therefore, use both halves of the brain. They must use the right side of the brain to create things, and the left side of the brain to organize things. The creative and intuitive right side is able to cope

with complexity and this is where insights originate, whilst the left side controls language, academic studies and rational intellectual work. The problem is, especially as in so many people the left half of the brain is possessively dominant, getting these two halves of the brain to pass information back and forth and work together.

In order to perform any creative task it is necessary to encourage your right side to start its creative juices flowing, in other words, move your mental processes, albeit temporarily, from the dominant left side across to the creative right side. This may sound an easy enough task in theory, but not so easy to put into practice.

Like many other tasks, or pleasures, the majority of us never know what we can achieve until we try. Having then tried, we instinctively know whether we find it enjoyable or whether we have a talent or flair for it. Then, if these signs are positive, we persevere. By cultivating new leisure activities and pursuing new pastimes it is possible for each of us to exploit the potential and often vastly under-used parts of the human brain.

The following exercises, while different in themselves, are all designed with the object of improving or recognizing your own powers of mental productivity, generation of ideas and artistic skills.

Tests of creativity

Progressive matrices test (Answers, see pp. 167–8)

The ten questions here are designed to test and exercise your appreciation of pattern and design, your ability to think laterally and to explore with an open mind the various possibilities that might lead to a correct solution.

In tests of intelligence, a matrix is an array of squares in which one of the squares has been omitted, and where you must choose the correct missing square from a number of options. It is, therefore, necessary to study the matrix to decide what pattern is occurring, either by looking across each line and down each column, looking at the array as a whole or looking at the relationship between different squares within the array.

The test that follows consists of ten questions which gradually increase in difficulty as the test progresses, first starting with 2×2 arrays, then 3×3 arrays and finally 4×4 arrays. The tests call for a great deal of creative right-brain thinking and you must apply your mind to each set of diagrams in order to appreciate the patterns and sequences that are occurring.

You have 45 minutes in which to solve the ten questions.

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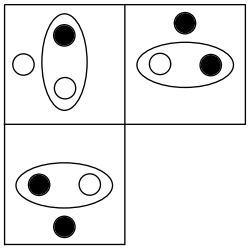

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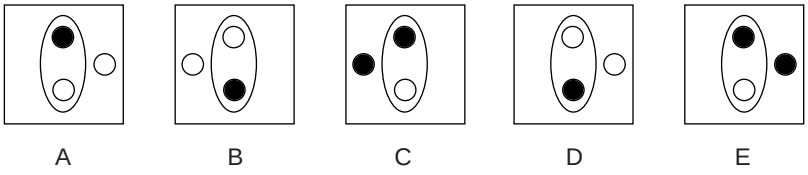

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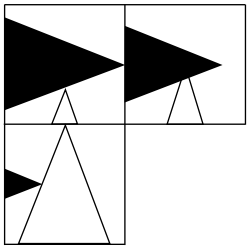

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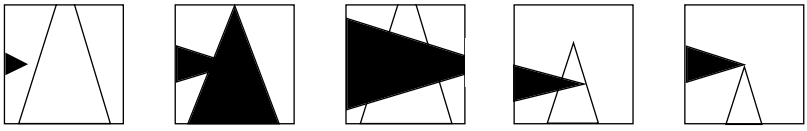

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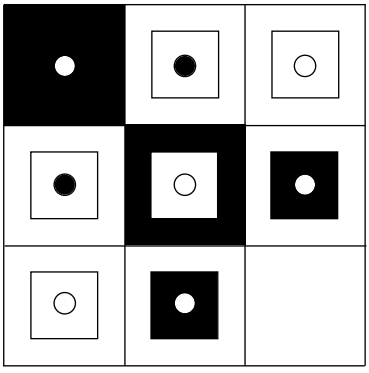

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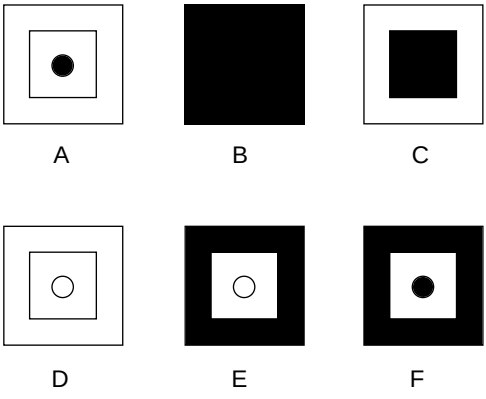

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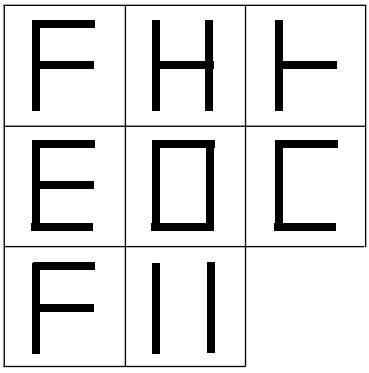

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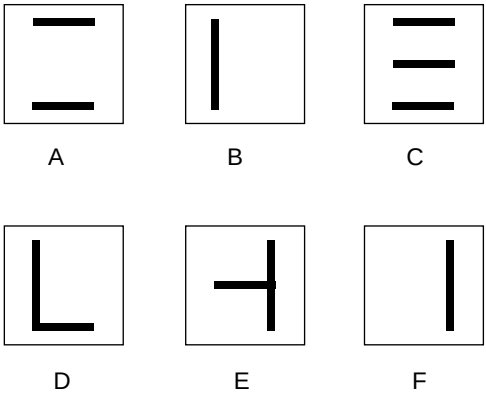

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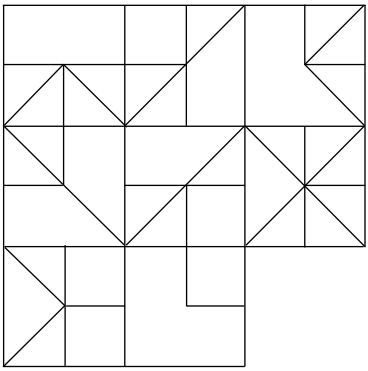

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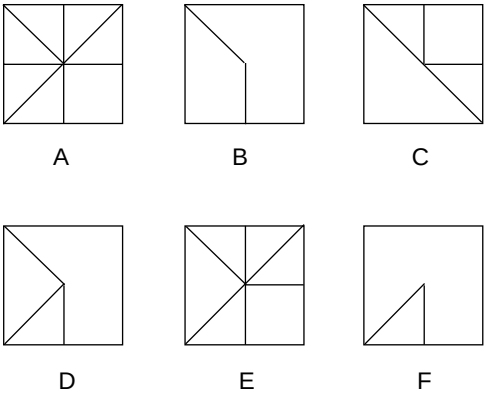

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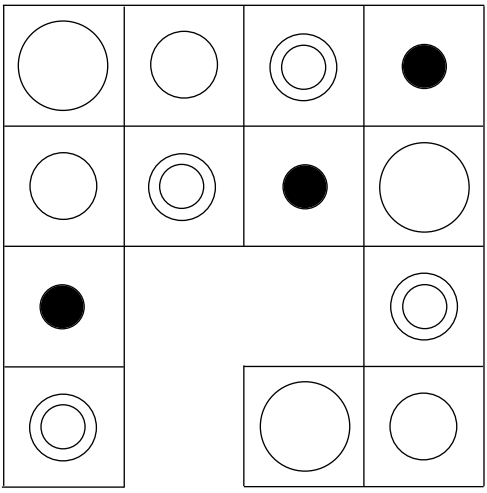

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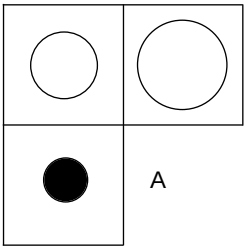

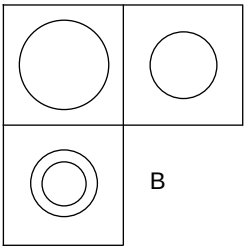

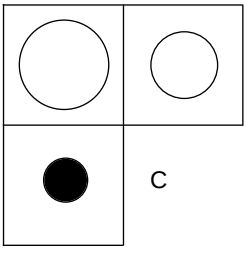

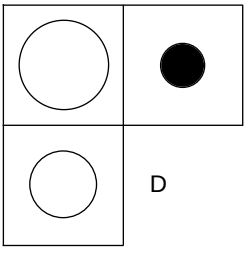

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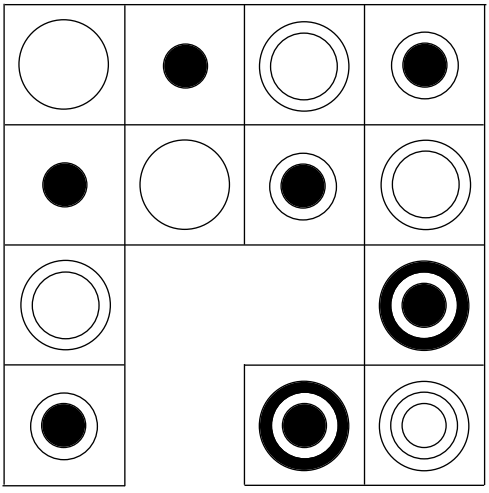

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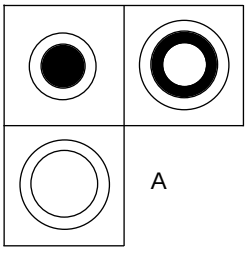

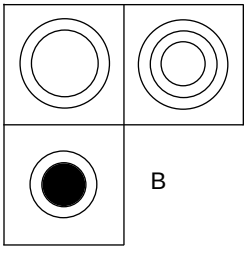

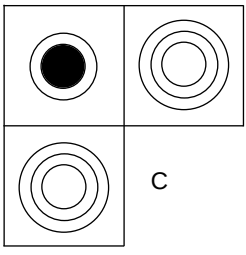

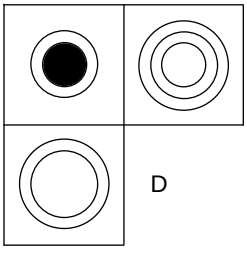

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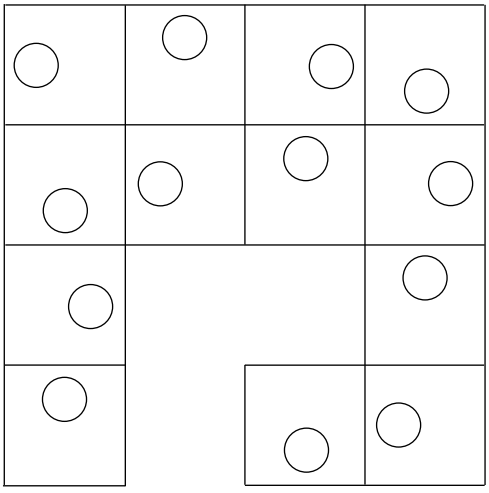

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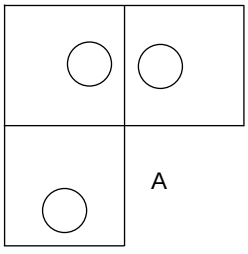

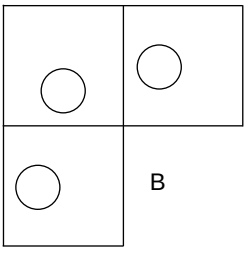

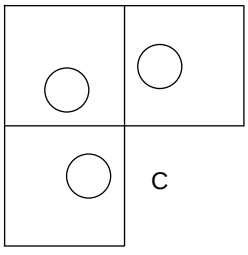

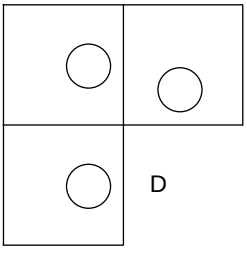

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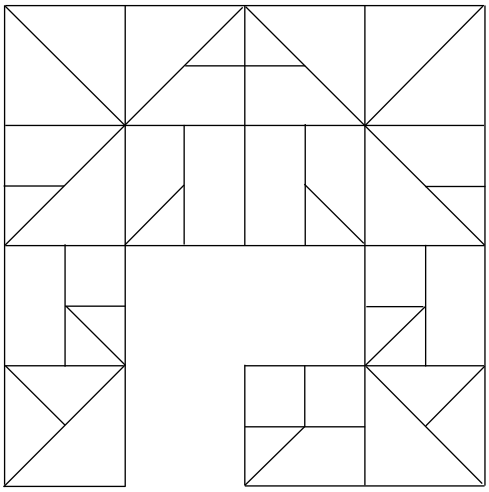

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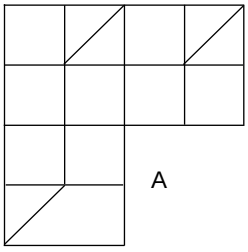
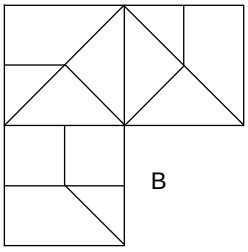
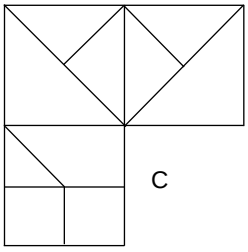
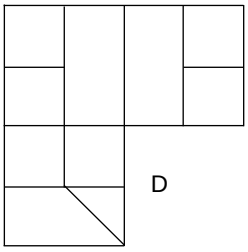
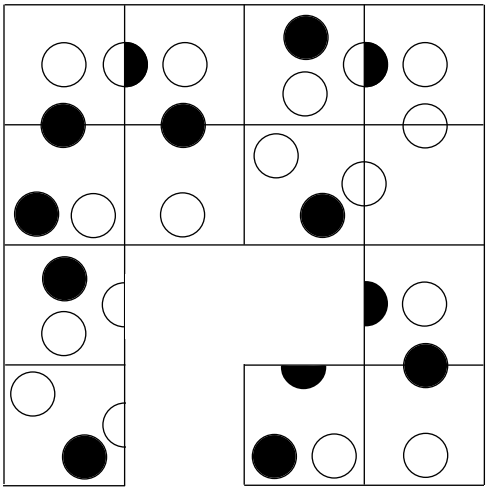








(x)



Which is the missing section?