The OCR Guide to

Problem Solving

Version 1

OCR
Oxford Cambridge and RSA

This guide on problem solving has been produced by OCR to help you understand the skills and techniques you will need to develop, practise and use when studying for your chosen qualification. This guide has not been written to accompany a specific qualification but focuses on research skills that relate to many areas of education and types of work environments. Other skills guides are available at http://www.ocr.org.uk/i-want-to/skills-guides/.

Contents

The world is changing

Two generations ago you might have expected to have your working life mapped out and the knowledge you left school with was probably largely still relevant by the time you retired.

In the 21st century we live in very different ways. Change is accelerating to the point that a learner may need to prepare for a career that has not yet been invented. Technology has changed the way we work, the way we live, the way we play and the way we learn. We have never lived like this before and are finding new solutions to problems that have never arisen before.

In order to achieve in this age, learners need not just sound knowledge but also vital skills like the ability to solve problems. They need to be able to face new and hitherto unseen problems, confident in their ability to find workable solutions. They need to possess both logical and creative problem-solving skills and understand the difference between the two.

This guide outlines a few traditions of problem solving. It explores some theories and explains where these skills have been put to use historically and in our world today.

See if you can solve the problems as you go through this guide, and check your answers against the solutions at the end.

Logical problem solving

Logic is the pursuit of proof through a structured system of enquiry.

Logical problem solving requires that you establish rules from which to construct a valid argument. A simple example might be:

1. Berlin is in Germany.
2. I have been to Berlin.

Therefore, you can deduce that I have been to Germany.

Logic grew out of disciplines developed in the ancient world in China, India and Greece. It was the Greek Aristotelian logic that most influenced modern scientific and mathematical thinking.

All sciences demand you use logical systems of problem solving and enquiry, but logic can and should be applied to any subject at school and in your daily life.

There are three kinds of logical enquiry:

1. Deductive reasoning applies general rules to specific problems, as in mathematical or philosophical problems.

2. Inductive reasoning creates general rules from specific observations, for example when finding patterns and gathering evidence in scientific enquiry.

3. Abductive reasoning begins like inductive reasoning, using specific but incomplete observations to come up with the most likely general rules. It is most commonly used in daily decision making during medical diagnosis and in criminal investigations, when there is rarely a full picture. It's a 'best fit' approach.

1. Deductive reasoning

Useful in mathematics and computing

Deductive reasoning is a way of solving a specific problem by applying known general rules. It is a top-down method of using pure logic.

Problem a) Apples, oranges, or apples and oranges?

A fruit supplier has mixed up all the labelling on their produce. There are three sacks of fruit labelled:

- apples & oranges
- apples
- oranges.

No sack is labelled accurately. If you could put your hand in one sack and pull out a piece of fruit, could you deduce which label belongs with which sack?

Using deductive reasoning, you can work out that:

- No sack is labelled correctly
- There are only three potential possibilities – apples, oranges, or a mix of apples and oranges.

Hint - Only one of the sacks will allow you to continue to deduce what the other sacks contain. Can you figure out which one?

8 Problem solving

The fictional detective Sherlock Holmes used deductive problem solving skills. The trouble with his approach is that it assumes that all elements can be known elements. In the real world of crime solving there has to be an interrogation of evidence, much more like abductive reasoning. Sometimes not all the evidence is available and detectives work alongside forensic scientists to put together a hypothesis of the most likely series of events.

"When you have eliminated all which is impossible, then whatever remains, however improbable, must be the truth."

Sherlock Holmes

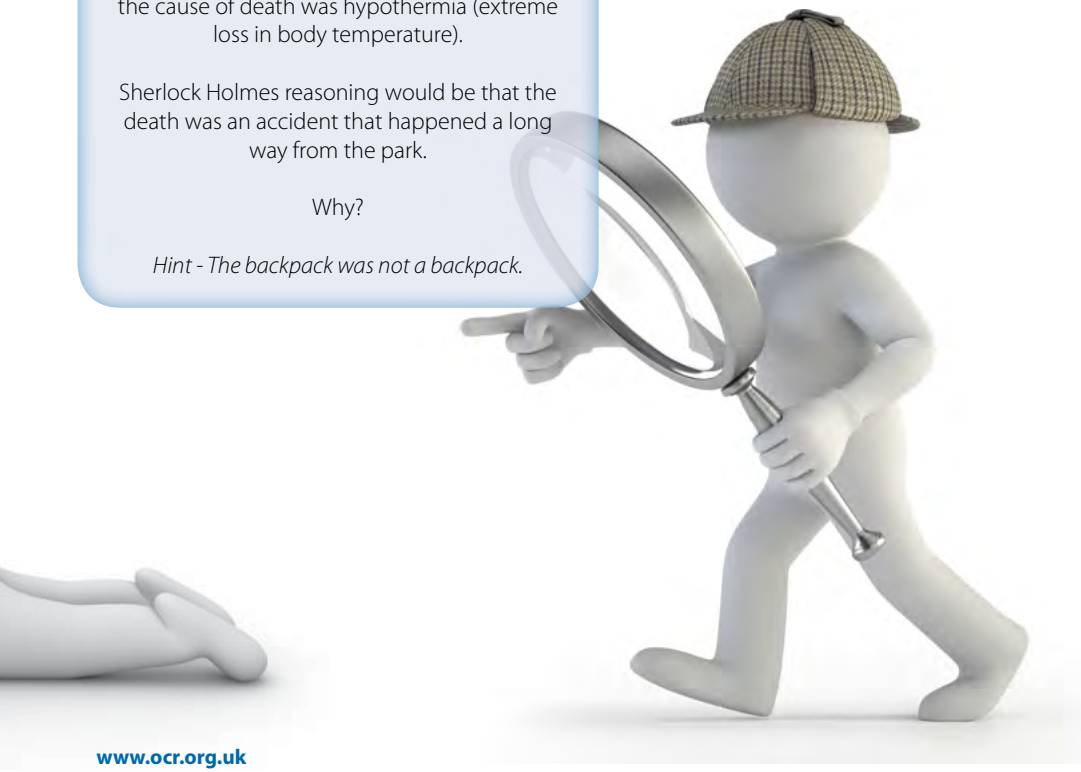
Problem b) Elementary

The body of a backpacker was found face down in Hyde Park. Almost every bone of his body had been shattered. Despite this, it is believed that the cause of death was hypothermia (extreme loss in body temperature).

Sherlock Holmes reasoning would be that the death was an accident that happened a long way from the park.

Why?

Hint - The backpack was not a backpack.



The Socratic approach

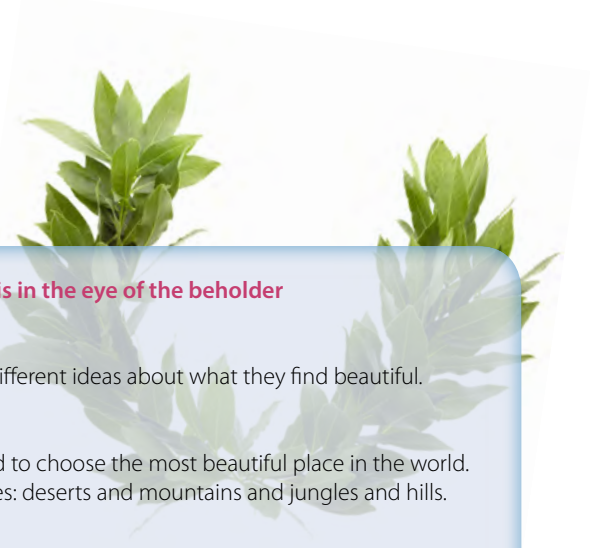
Useful in citizenship, religious studies, politics, philosophy and critical thinking

The Greek philosopher Socrates developed this method of enquiry and problem solving.

It usually takes the form of a discussion in which hypotheses are examined, eliminated or adjusted when there is ambiguity or when ideas contradict each other.

In this way the questioner and answerer probe ideas until they find a hypothesis that can stand up to all their questions.

It is an approach that is most useful in tackling broad abstract ideas.



Hypothesis - Beauty is in the eye of the beholder

Why is this a commonly held belief?
Because it explains why people have very different ideas about what they find beautiful.

How could we prove this idea?
We could ask people from all over the world to choose the most beautiful place in the world. They would choose a diverse range of places: deserts and mountains and jungles and hills.

Are there any alternative explanations?
It could be that people find beauty where they have been taught to find beauty. It could be dependent on the culture that you were brought up in. It could be dependent on the experiences you have and what you have seen.

What is this alternative hypothesis then?
The appreciation of beauty is learned and is dependent on what you have seen and experienced.

Can you give an example of this idea in practice?
If, for example, someone had spent their whole life in the North Pole and hadn't seen any other environments, they would find beauty in ice and snow.

Can this analogy be extended and tested?
If someone came to visit the North Pole and asked the person to show them the most beautiful place there, the visitor might agree that it is beautiful.

What does this infer?
That perhaps there are universal ideas of beauty, but that we can accept lots of different versions.

Problem solving

Hypotheses for you to approach

Use some of the questions from the example on page 9 to start you off.

Money is the root of all evil.

Multiculturalism leads to a more harmonious society.

I am the product of all my relationships and if I had lived my life entirely alone, I would not have a personality.

The death penalty is an acceptable sentence for someone who has taken the life of another person.

Thought experiments

Used by philosophers, scientists and psychologists
Useful in citizenship, religious studies, philosophy, psychology and critical thinking

When dealing with big, abstract ideas like 'What is it to be human?' or 'What is morality?' philosophers often use extreme examples in order to find the core of the problem in hand. These thought experiments help the enquirer to establish whether an argument might be valid by testing the extreme version. There are many famous thought experiments, like 'Schrodinger's cat' and 'Einstein's light beam'.

Theo's car

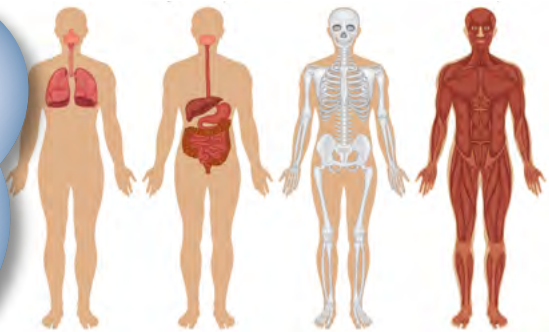
1) Theo buys a car from a local garage. As soon as he gets it, he has problems….with everything! He takes the car back to the garage time after time, and the mechanic replaces the parts. After many visits, the mechanic has replaced every part of Theo's car.

Now, does Theo have the same car? Or is it another car?

2) Suppose that the mechanic is a crook and all these parts didn't need replacing. He replaced them and kept the old parts. He put the old parts together and made another car, just like the original.

Which car is Theo's? The one made of the original parts or the one he has, made up of new parts?

Here is a version of a very old thought experiment, **Theseus' ship.** This was constructed to look at the idea of 'self'. Are we the sum of our body parts? Cells entirely renew every seven years, so are we still the same person? Are there parts of us, like our brain or our memory, that are more us than other parts of our body? Why?



Problem solving

Thought experiments can also help us to understand what underlying general principles we live by and use in our daily life. They allow us to explore and identify our moral compass as in this example, which is a version of 'The Trolley car' thought experiment.

This thought experiment helps us explore whether we believe that it is better to allow one death in order to save more lives. Is it better to act, knowing you are killing someone, than not act and allow many to die? Is it different to send a train into a man's path, or push a man into a train's path?

The runaway train

You are on a bridge over a large railway junction when you spot a runaway train hurtling down the track without a driver.

From this distance you can see the train is speeding down the track where four men are working on the line. The impact will surely kill them all. You are too far away to attract their attention but you have time to get to the signal box and change the direction of the train.

If you pull a lever in the signal box, the train will be diverted to another track on which only one man is working.

Do you pull the lever?

Alternative
Perhaps you decided that, morally, it was better to pull the lever and sacrifice one man's life than to allow four men to die. If so, what if the scenario were slightly different? Your option is not to pull a lever, but to push another man off the bridge into the path of the train in order to save the four men. Would you push the man to his death? Is pushing a man to his death the same as directing a train towards him?

Game theory

Used in psychology, maths, philosophy, business, politics, military strategy and gaming

Game theory grew out of the mathematical observation of poker players but was adopted as an approach to political, military and economic problems. The theory rests on the premise that order and 'equilibrium' can be maintained when all participants act in purely self-interested ways.

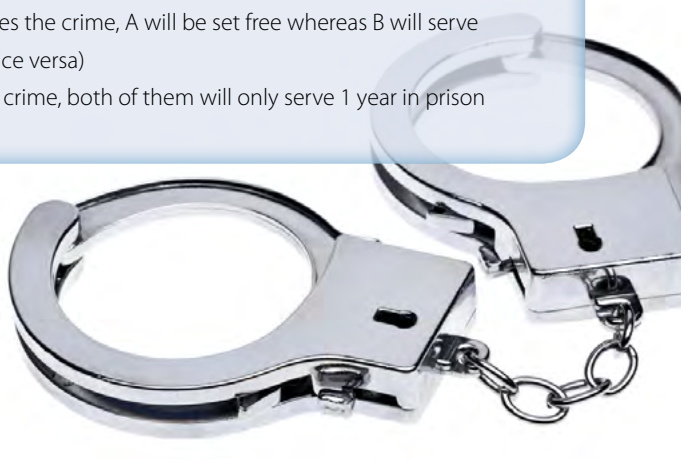
During The Cold War, America needed to solve the problem of how not to become involved in nuclear war with the Soviet Union. They turned to game theory. Both sides entered an arms race, creating more and more nuclear weapons as a way of holding equilibrium. Simply put, no one wanted to start a war because of the extreme consequences to themselves.

The prisoners' dilemma is a classic example of how two self-interested parties gain the best outcome by cooperating.

The prisoners' dliemma

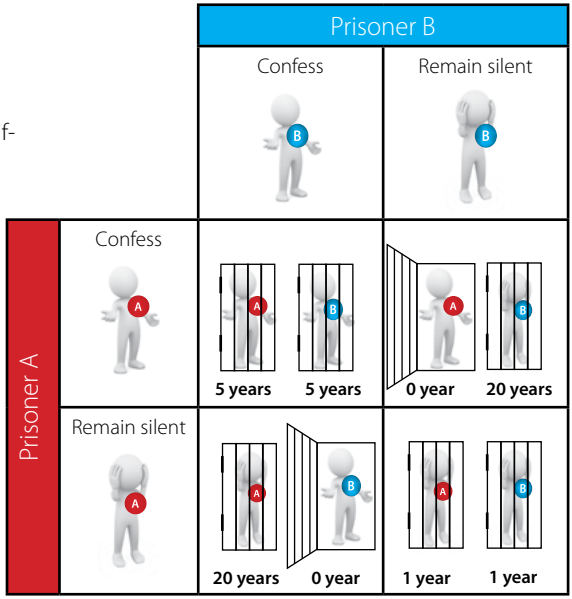
Two members of a criminal gang are arrested and imprisoned. Each prisoner is in solitary confinement with no means of speaking to or exchanging messages with the other. The police admit they don't have enough evidence to convict the pair on the principal charge. They plan to sentence both to a year in prison on a lesser charge. Simultaneously, the police offer each prisoner a deal.

- If A and B both confess the crime, each of them serves 5 years in prison
- If A confesses but B denies the crime, A will be set free whereas B will serve 20 years in prison (and vice versa)
- If A and B both deny the crime, both of them will only serve 1 year in prison



Problem solving

Because betraying your partner (by confessing) always rewards more than cooperating with them, all purely rational self-interested prisoners would betray the other, and so the only possible outcome for two purely rational prisoners is for them both to betray each other. The interesting part of this result is that pursuing individual reward logically leads the prisoners to both betray, but they would get a better reward if they both cooperated. In reality, humans display a systematic bias towards cooperative behaviour in this and similar games, much more so than predicted by simple models of "rational" self-interested action.



Business and marketing strategy use game theory to decide on pricing, for example. The biggest gain might be to undercut competitors and yet the best option for both is to have a similar pricing structure.

When releasing new products, companies need to decide whether they steal the lead and release a product early, or do further testing and release the best product instead.

In both of these examples, businesses often act in the best self-interest by cooperating, albeit unofficially, with competition.

Retrograde analysis

Used in forensic science, criminal investigations and gaming

This is a problem-solving technique used by grandmaster chess players. In game theory it's called *backward induction*.

When faced with an infinite number of directions in which a game of chess can go, many grandmasters prefer to have an idea of the best endgame and then work towards it.

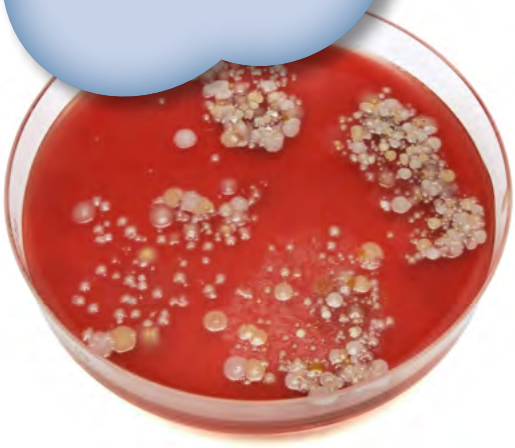
There are millions of options for the first few moves of a chess game but by the end, when there are fewer pieces, there can be fewer potential outcomes. Grandmasters will often learn the configuration of these endgames so that they have strategies ready for when they reach this point. Beyond that, however, they can be actively working towards the endgame that they would like to play.

Retrograde analysis is used in forensics. When estimating time of death, for example, scientists use equations to work backwards from the evidence that they have at the time of the examination. Similarly, blood/alcohol levels can be estimated at the time of an accident, by working backwards from the reading taken some time afterwards.

Problem c) Bacteria

Bacteria that double every day are happily colonising a petri dish. By day twenty one the dish is full.
On what day was the dish half full?

Hint - Work backwards.



Problem solving

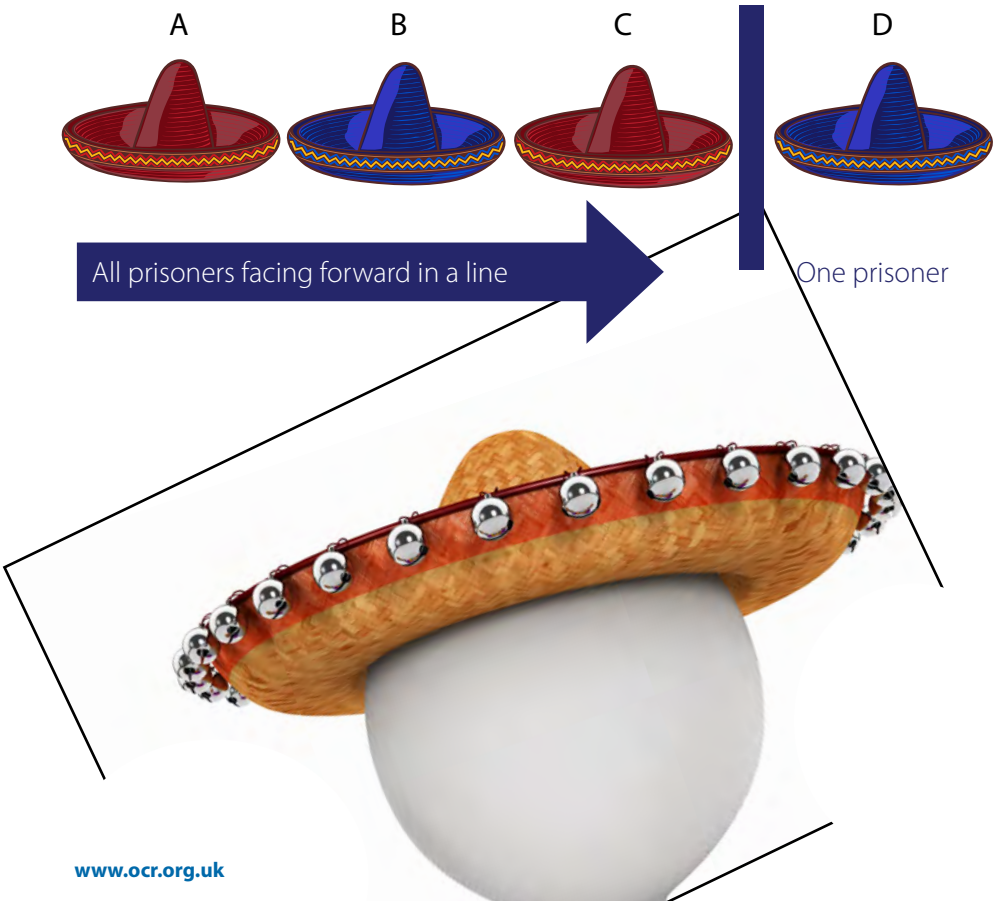
Problem d) The Mexican hat dilemma

Prisoners A,B,C and D are taken from their cells by guards. Three are lined up behind each other facing a wall, while the fourth is positioned on the other side of the wall. The governor informs them that he has placed hats on their heads, two red and two blue. He said that if any one of them could guess the colour of their own hat they would all go free but if they were wrong they would be shot. The Prisoners can only see the hats of the men in front of them and no one can see through the wall.

After a time one of the prisoners deduces which colour hat he has on.

Which prisoner worked it out and how did he do it?

Hint – The prisoner needs to be thinking about what other prisoners must see.



Pattern recognition

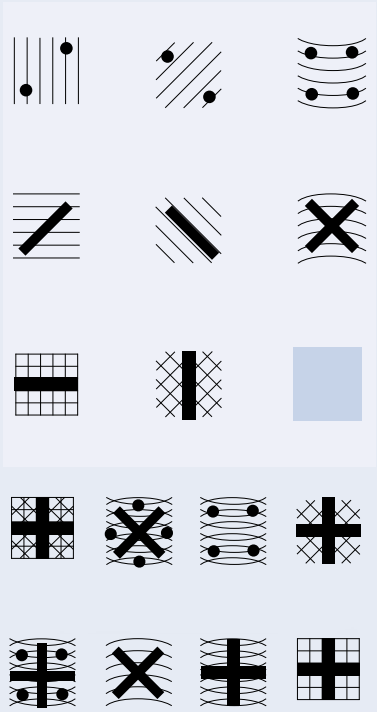
Used in communication, business, finance, meteorology, geology, medicine and policing
Useful in maths, science and computing

Pattern recognition is an important problem-solving skill. If you know the pattern, you can predict what comes next.

Coding and code breaking

Secret codes have always been used to secure information in transit. A code is a pattern that encrypts a message and unencrypts it once it has been received. During the Second World War it is believed that the code breakers of Bletchley Park became so efficient at unencrypting German messages that they reduced the length of the war by two years, thus saving the lives of countless people on both sides of the conflict. They were supported in their speed and efficiency by the world's first digital computer, Colossus.

Problem e) Pattern recognition
What is the next pattern in the sequence? Choose from the eight options below.



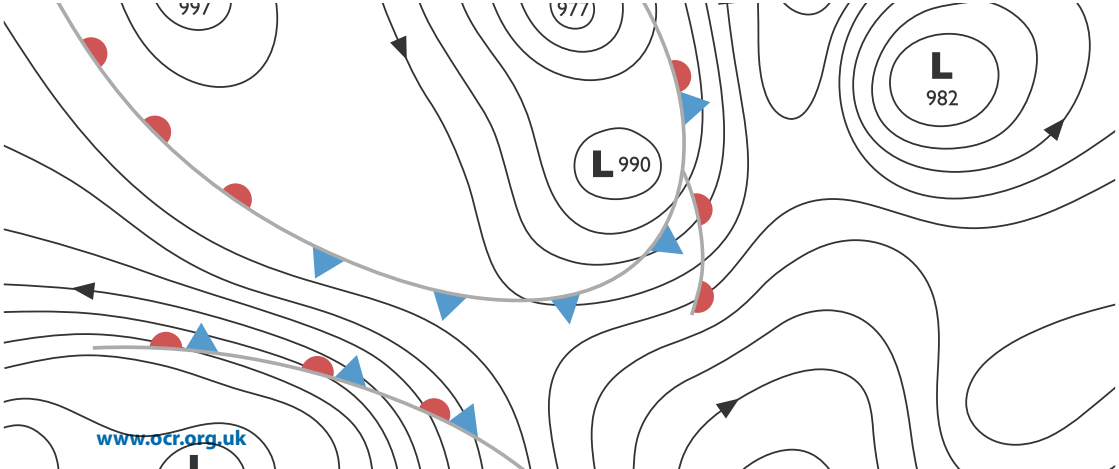
Problem solving

Algorithms

The instructions programmed into Colossus during World War Two were the first algorithms. Algorithms are a set of rules or instructions to be followed to solve problems. Many of these programs now are set to recognise and react to patterns in nature, in trading stocks and shares, and in criminality.

Weather forecasting relies on pattern recognition, so that predictions can be made. These predictions, though not always accurate in long-range forecasting, have saved countless lives by alerting people to severe weather conditions.

Much of the trading of stocks and shares nowadays is automated. Computers recognise trading patterns, which then trigger instructions to move stock. These programs, in competing with each other, operate without giving away recognisable patterns. In effect the coding and code breaking of the past is now being played out entirely digitally.



Trial and error

Used in scientific and medical research, engineering, design and the arts
Useful in maths, science, computing, engineering, art and design and textiles

In low-risk situations where there is the time to experiment, the trial and error (or trial and improvement) method is a great way to solve problems. Clearly, this would not be the chosen method for a bomb disposal expert or a heart surgeon, since they have very little room for error in their practice. However, in many situations, much can be gained from learning from mistakes.

The scientific method - hypothesis and theory

The impact of science in solving problems in the world is almost immeasurable. Some of the most powerful ideas have come from scientific enquiry. An idea without all the evidence in place is a **hypothesis.** It seems to be valid but without all the evidence we don't know. Once the evidence is assembled and seems to match the hypothesis it then becomes a **theory**. Technically, all theories can be modified with new evidence, so scientists continue to test theories in the hope of gaining deeper understanding and continuing to solve problems using this time-tested approach.

Problem f) The measuring jug dilemma

Can you measure exactly four litres of water exactly using only a three litre and a five litre jug? Neither jug has any markings except to indicate it is full.

Hint – You need to throw some water away.

"Most of the important things in the world have been accomplished by people who have kept on trying when there seemed to be no hope at all."

Dale Carnegie

Problem solving

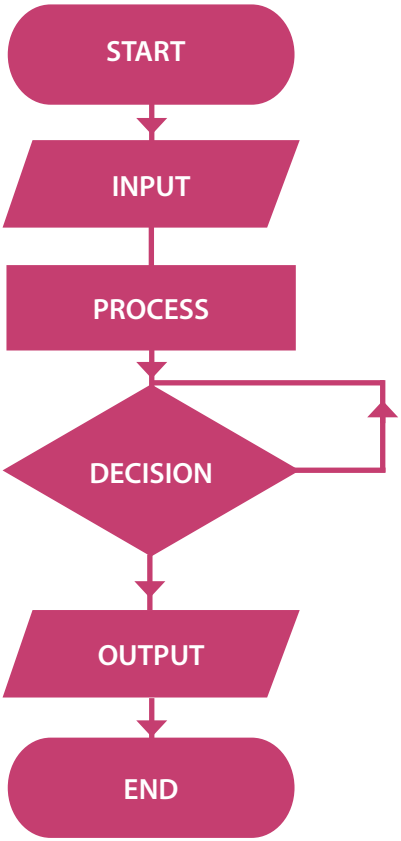
Decision trees, flowcharts and concept fans

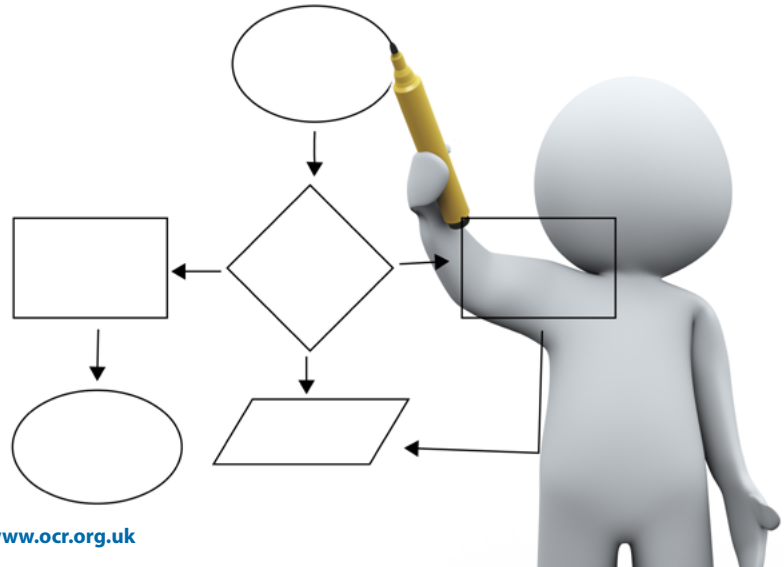
Used in computing, business, design and engineering
Useful in computing, business studies and DT

Flowcharts are used to describe complex multi-step processes to help users locate precisely where problems occur. Flowcharts often use a key to represent different processes at each step.

Decision trees, by comparison, are less formal and can be used to document and describe a logical thought/action process.

Both approaches, in being visual, make complicated ideas and processes much clearer. Both visual mapping systems can be used to solve problems by evaluating and improving each step in isolation, rather than being overwhelmed by the whole.





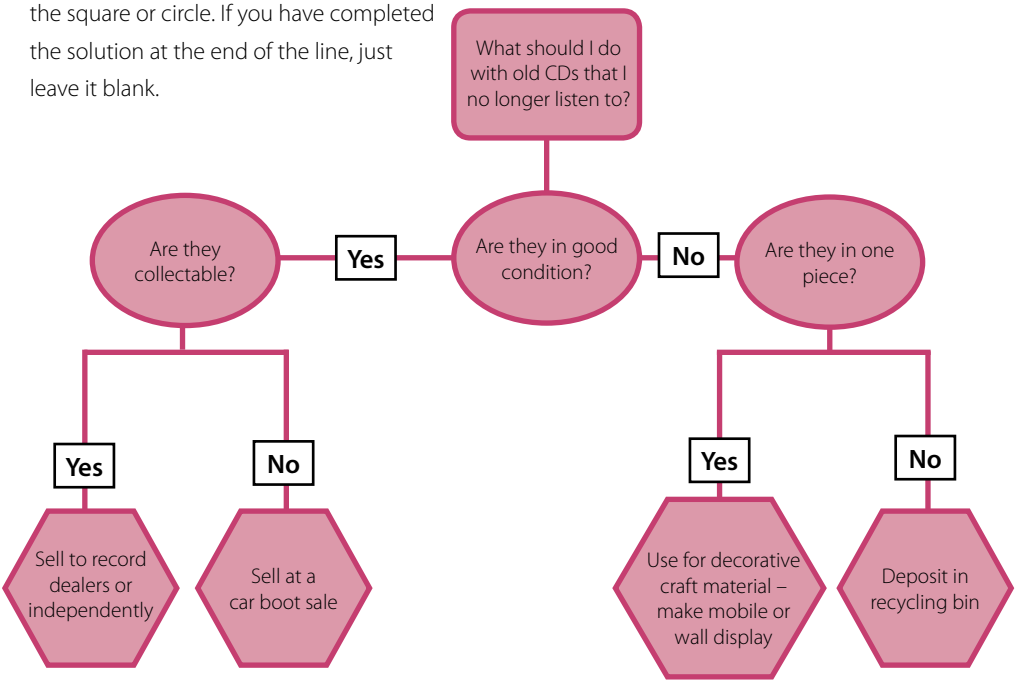
Making a decision tree

To start a decision tree, write down the decision that needs to be made and then draw a small square box around it.

From this box, draw out lines for each possible solution, and write that solution along the line. Keep the lines apart as far as possible so that you can expand your thoughts.

At the end of each line, consider the results. If the result of taking that decision is uncertain, draw a small circle. If the result is another decision then you need to draw another square. Squares represent decisions, and circles represent uncertain outcomes. Write the decision or factor above or next to the square or circle. If you have completed the solution at the end of the line, just leave it blank.

Starting from the new decision squares on your diagram, draw out lines representing the options that you could select. From the circles draw lines representing possible outcomes (hexagonal boxes). Again, make a brief note on the line saying what it means. Keep on doing this until you have drawn out as many of the possible outcomes and decisions as you can see leading on from the original decisions.

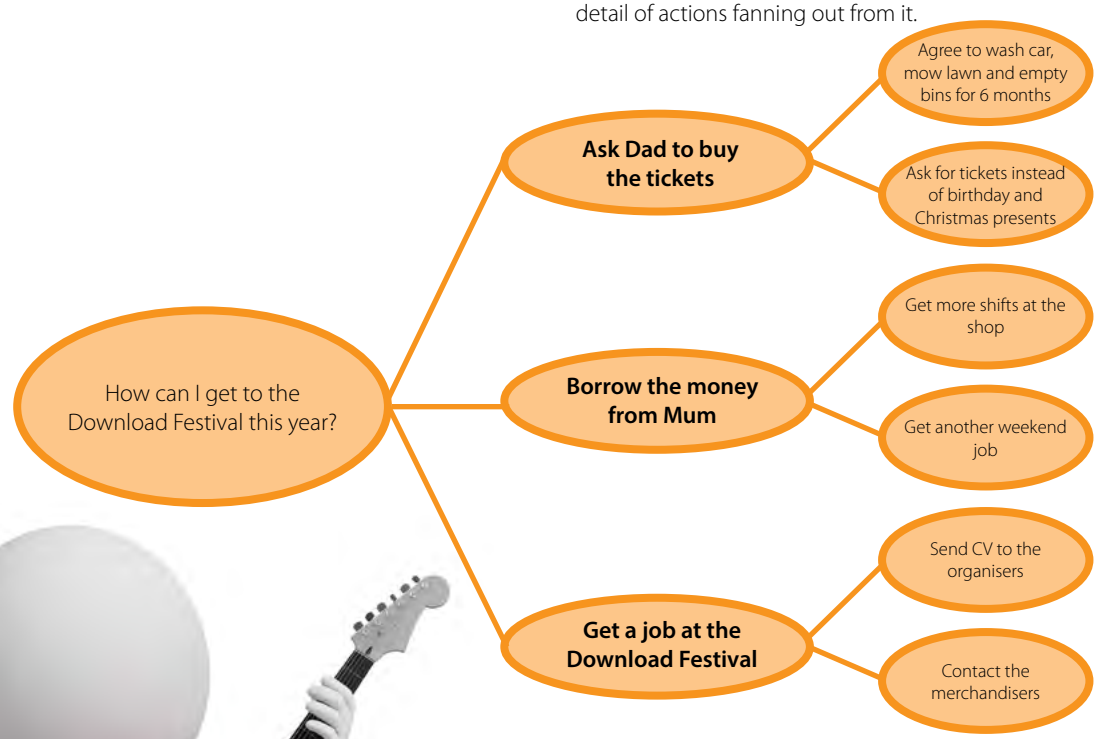


Problem solving

Concept Fans

It is often the case that, when faced with a problem, we go for the first solution we can think of. The first idea is rarely the best though and, even if it is pretty good, it probably needs to be thought out clearly before you can consider it a plan.

Concept fans were devised by Professor Edward De Bono as a way of mapping out a series of alternative solutions beside one another. The ideas 'fan' out from the main issue, objective or problem to be solved. Problem solvers are encouraged to think of a broad range of solutions and each solution has the detail of actions fanning out from it.



SWOT analysis

Used in business, the military and politics
Useful in business studies, design subjects and PHSE

The SWOT analysis is a development of a 'pros and cons' list. The difference is that the matrix is divided into two halves: the internal strengths and weaknesses, which are the things that can be controlled, and external opportunities and threats, which are the things beyond the control or scope of a project.

	Helpful	Harmful
Internal	**Strengths**	**Weaknesses**
External	**Opportunities**	**Threats**

When planning actions, new campaigns and new ideas it is useful to list all the potential outcomes, positive and negative, and any problems that might arise.

It is always useful to predict and pre-empt the effects of an action and, if there is a balance towards weaknesses and threats, perhaps the action should be reconsidered. If the plan goes ahead, however, it will be all the stronger for having pre-empted potential problems.

Getting a Saturday job at the garden centre	
Strengths Earn my own money. Buy what I want. Be able to go out more.	**Weaknesses** Got to get up really early at the weekend. Won't have much time to do homework or see mates.
Opportunities Might be able to get extra work in the holidays. Good work experience for my CV.	**Threats** No buses there, so Mum needs to drop me off and pick me up. Someone might see me in a green tabard!

Assessing credibility

Used in policing, historic research, law
Useful in history, critical thinking, citizenship and PHSE

In an age when we are continually being bombarded by information, the biggest problem we have to solve is whether the information we receive is credible or believable and whether the sources that inform us can be trusted.

R.A.V.E.N. Is the acronym used to cover five areas in which we can judge how credible a source might be.

Reputation
Does the source have a reputation you can trust, e.g. The BBC, Cambridge University ?

Ability to observe
Is the source an eye witness? Can the source give primary evidence?

Vested Interest
Does the source have a reason or motive to persuade you one way or another, e.g. is it an advert or a party political broadcast?

Expertise
Is the source an expert in the field? For example, in a medical debate, a doctor would have lots of credibility.

Neutrality
Does the source have a balanced and unbiased view of the situation, or might they have a prejudiced perspective?

Who would you trust….

in a debate about global warming?
a) A politician
b) A car manufacturer
c) A ecological scientist

when you're buying a new outfit?
a) Your best friend
b) The shop assistant
c) Your mum

in an emergency situation?
a) The man shouting very loudly
b) A police officer
c) Your best friend

Try and decide what credibility criteria you are using when you make these judgements.

Is it that they have expertise?

Is it that they are neutral?

Is it because they have the best ability to observe?

"All credibility, all good conscience, all evidence of truth come only from the senses."

Friedrich Nietzsche

Creative problem solving

Whilst we all need to have logical reasoning skills to work out our problems in a methodical, replicable way, we mustn't underestimate the value of creative thinking skills.

Both logical and creative thinking skills are essential in ALL subjects, though the degree to which you use either is dependent on the nature of the subject. Those individuals that push the boundaries, shift our perceptions and develop inventive solutions have often had moments of pure creative thought, beyond the normal logical paths.

When fiction becomes fact

Whilst we rely on tried and tested scientific approaches to problem solve and innovate, very often our modern inventions were first imagined in fiction: sliding doors, touch screens, mobile phones and Google Glass were all imagined by fiction writers and film makers before they became a reality. This relationship between creative and logical problem solving shows how important both skills are for both creatives and scientists alike.

Universities and employers recognise that creative thinking is a valuable skill to be sought after and developed, but creative thinking, by its nature, is not as methodical as logical reasoning. So how do we go about developing this skill?

Several techniques, developed and used in business and the creative industries help you to look at problems from different perspectives. Here are a few you might find useful.

Collaborative and independent approaches

While both logical reasoning and creative thinking can be achieved very successfully independently, many creative thinking techniques have been designed with teams in mind. While much of the great creative ideas in our world came from daydreams and intensely personal and individualised approaches, there can be huge benefits from sharing and mixing ideas with other people.

"A box without hinges, key, or lid,
yet golden treasure inside is hid.
What is it?"

Tolkien's The Hobbit

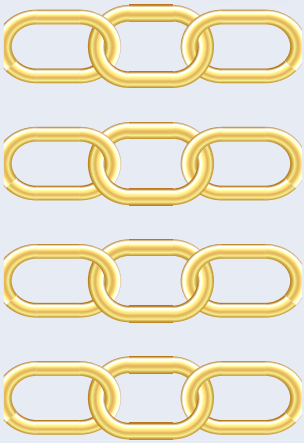
Problem g) The four chain puzzle

A jeweller came home with four short three-link chains. His wife asked how much it would cost to get a goldsmith to join them all so that she could wear it as a necklace.

The jeweller scratched his chin and said, 'Well, the goldsmith charges £5 for breaking each link and £5 to reform them, so it will cost £40'.

His wife said, 'I could get it done for £30'

How could she manage it?



Blue-sky thinking (or Thinking outside the box)

Used in business, media, IT and creative industries
Useful in business studies, visual arts, DT, computing and science

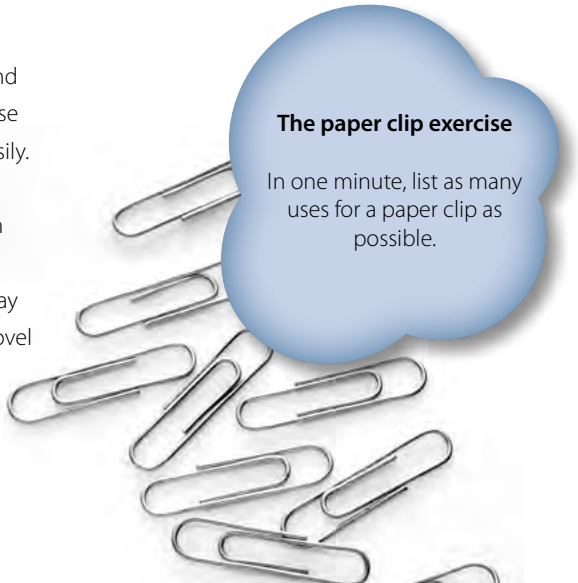
This way of thinking involves looking beyond the problem to solve it. Often we are so close to a problem that we can't see solutions easily.

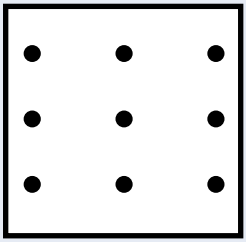
Sometimes we need to look at the problem from an entirely fresh perspective. Creative thinking like this can entirely change the way a problem is dealt with and can produce novel and unique approaches.

Exercises like coming up with as many uses for a paperclip as possible can help teams loosen up their thinking, forcing them to be creative and ingenious with their ideas.

The paper clip exercise

In one minute, list as many uses for a paper clip as possible.





Problem h) Join the dots

Without taking your pencil off the page, is it possible to join all these dots with four straight lines?

It is possible….someone's even figured out a way of doing it with three straight lines.

Hint – think 'outside the box'.

'Chance favours the prepared mind'
Louis Pasteur

In the history of invention there are countless examples of how a change in perspective results in an innovative, sometimes world-changing product.

In 1856, whilst looking for a cure for malaria, chemist William Perkin accidentally created a big purple mess which became 'mauve', the first synthetic dye, beginning a revolution in fashion and clothing. His research was picked up much later and used to pioneer chemotherapy.

In 1904, pharmacist John Pemberton, whilst experimenting with a tonic for headaches, created the recipe for Coca Cola.

A Matter of perspective

Sometimes all you have to do is take a fresh look at something to get an entirely different picture.

Is this a picture of an old or young lady?

Can you see both?

Problem solving

Lateral thinking

Used in business, media, it and creative industries
Useful in business studies, visual arts, DT, computing and science

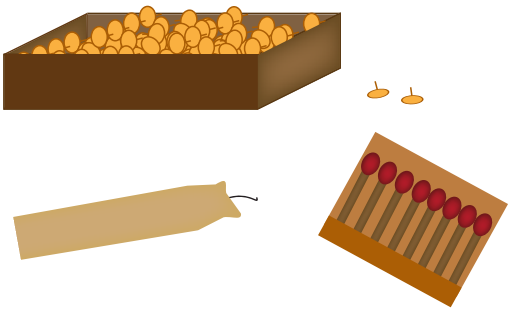
Lateral thinking was first termed by Professor Edward De Bono in 1967.

Simply put, it is the ability to use your imagination to look at a problem in a fresh way and come up with a new solution. We often approach problem solving with lots of assumptions and follow a set of rules and procedures based upon those assumptions. Lateral thinking allows us to re-imagine the problem without these artificial assumptions and rules.

Many businesses actively recruit people with this skill. Without lateral thinking, companies can't innovate and create new products. Any company that wants to stay ahead of the competition needs to recruit people who are capable of creative thinking. This skill is highly prized in creative industries such as the media and advertising, and is valued across a range of different industries and professions, including retail, law, management consultancy and IT.

Problem i) The lift problem

A man lives on the tenth floor of a block of flats. Every morning he takes the lift to the ground floor and leaves for work. When he returns in the evening however, he takes the lift to the seventh floor and walks to the tenth. He hates walking, so why does he do this?



Problem j) The creative candle holder

Here is a well-known exercise to test your creative thinking skills.

A book of matches, a box of drawing pins and a candle are on the table.

Using these items you are to make a wall-mounted candleholder.

De Bono's thinking hats

Useful in citizenship, RS, philosophy, critical thinking, PHSE and ethics

In making complex decisions we think in lots of different ways. We might start with an overview of a problem, think of an alternative approach and decide intuitively that it's the right solution. The problem is that there are many ways to approach problem solving, so how do we know that we have chosen the right one? Perhaps we were being particularly optimistic or unrealistic on that day. Perhaps we were overly judgemental and failed to look at the facts impartially.

Professor Edward De Bono developed a process to separate different thinking approaches into distinct categories in order to assist a more methodical and balanced system of problem solving and decision making. De Bono identified six distinct ways of thinking, all of which have value.

Using the Six Thinking Hats® can really help collaborative teams make informed decisions because the participants adopt one of the thinking hats, rather than bringing their own position to the table. The Six Thinking Hats can be used by individuals too, who perhaps want to plan out all sides to an issue in order to give their response balance and perspective.

Facts, figures and information

Logical and positive

Intuition and emotions

Creativity and alternatives

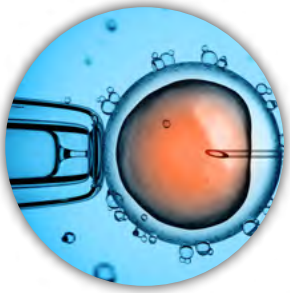
Judgement and caution

Overview, process control

Yellow hat

Green hat

White hat



Stem cell research

Blue hat

Red hat

Black hat

Solutions

Problem a) Apples, oranges or apples and oranges? (page 7)

The only sack that can give you the chance to deduce the others is the one marked 'apples and oranges'. For example, if you pull an orange from this sack then you know that this is the sack of oranges. If all the sacks are mislabelled then the sack labelled apples is not the sack of oranges so must be the sack of both apples and oranges, leaving the sack labelled oranges, which then must be the sack containing apples.

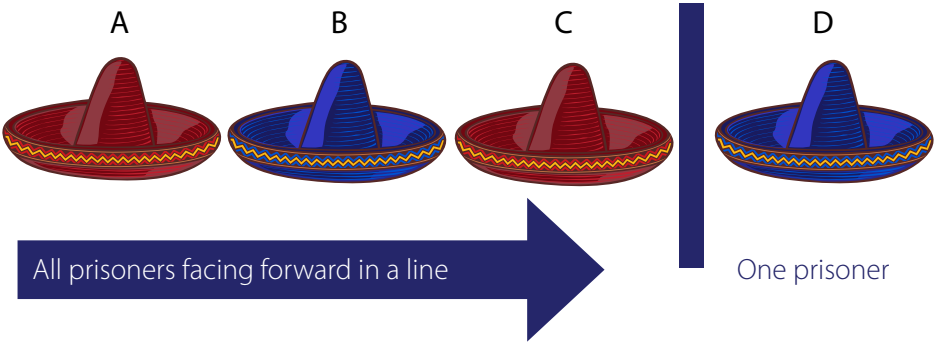
	Pull out an orange	Pull out an apple
Labelled Apples	It is either O or A&O	It must be A&O
Labelled Oranges	It must be A&O	It is either A or A&O
Labelled Apples & Oranges	It is O	It is A

Puzzle b) Elementary (page 8)

Well done if you guessed that the most likely reason that all the body's bones were shattered was because of a fall from a great height. This might lead you to a further assumption that the body fell from so high up in the atmosphere that it froze. Perhaps then you guessed that the backpack was an unopened parachute and, like Sherlock, you deduced that this was the accidental death of a sky diver.

Problem c) Bacteria (page 15)

If you started trying to design mathematical equations to answer this question, you were working from the wrong direction. Well done if you realised that if bacteria doubled every day then the petri dish was half full on the day before, i.e. day twenty.



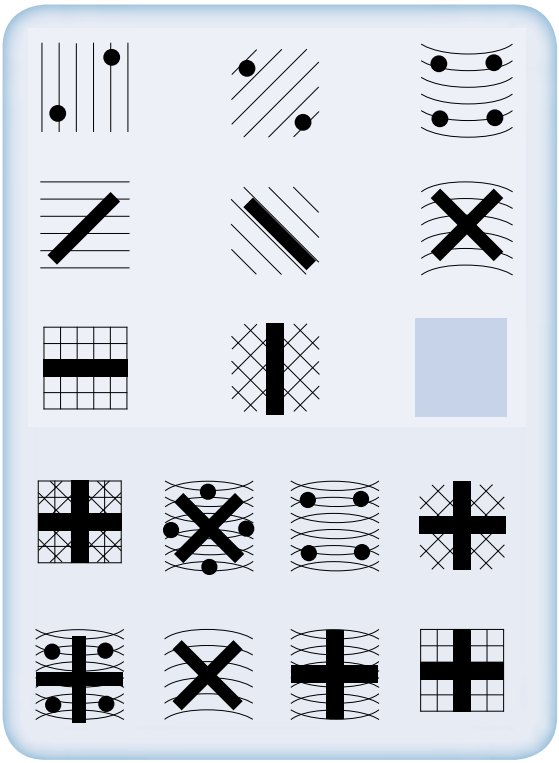
Problem d) The Mexican hat dilemma (page 16)

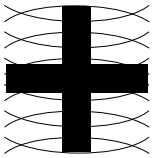
To solve this problem, it's important you put yourself in the mind of the prisoners and imagine what they might be thinking. For example, both prisoner D and C would be thinking that they couldn't solve the puzzle as they couldn't see any hats. Prisoner A would be thinking that he could see both blue and red hats, so he could only guess what colour he

be wondering why prisoner A hadn't solved the problem and realised that it was because he could see both red and blue hats. Since he could see a red hat in front of him, this must mean he had a blue hat on his own head. Well done if you solved this one!

Problem e) Pattern recognition (page 17)

If you follow the patterns laterally to the right, as three different patterns, you will see that the thin background lines in stage one turn 45° at stage 2, while the bolder line or dot moves 90°. In the third stage of the pattern, both bold foreground dots or strips from the previous two positions appear together while the thinner background lines have curved. So, the logical solution to the final solution is….





Problem f) The measuring jug dilemma (page 19)

Can you measure exactly four litres of water using only a three litre and a five litre jug?

Yes, eventually you can.

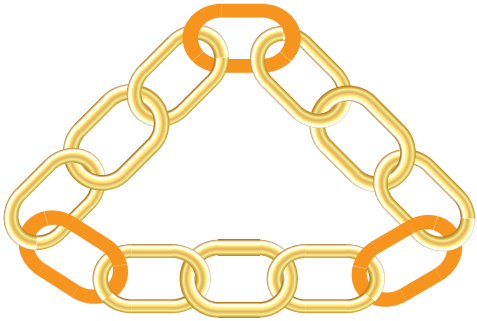
If you use the three litre jug to fill the five litre jug, you can get four litres in two pourings. The first time, you use the whole three litres but the second time you top up the jug using two litres, so that you have one litre left in your three litre jug.

Now empty the five litre jug and pour into it the one litre from the three litre jug. All you need to do now is fill the three litre jug again and top up the one litre that is in the five litre jug. Four litres is now in the five litre jug.

Problem solving

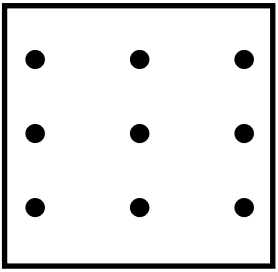
Problem g) The four-chain puzzle (page 26)

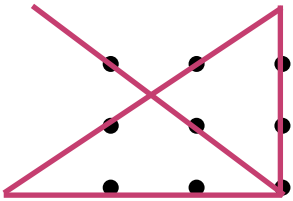
This puzzle can be solved by simply separating the links of one, three-link chain and using these separated links to connect the other three chains.

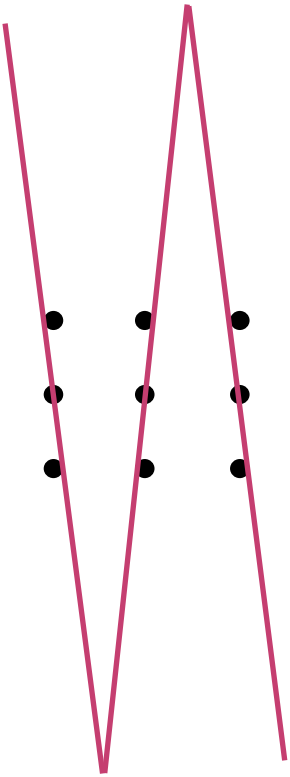


Problem h) Join the dots (page 27)

As illustrated here, it is not only possible to join all the dots with four continuous straight lines, but it can be done with only three. Most people struggle because they try to stay within the bounds of the box-shape that the dots create.





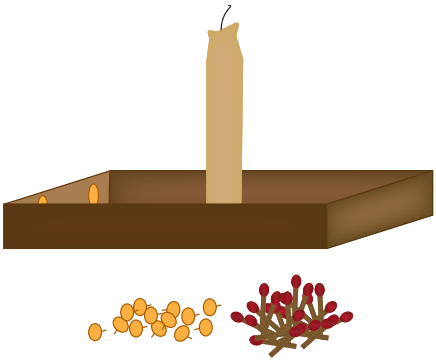


Problem i) The lift puzzle (page 28)

There's only one possible reason why the man rides the lift to the seventh floor. He is too short to reach the buttons above the seventh.

Problem j) The creative candle holder (page 28)

Well done if you designed something like this!



The box becomes the base. The drawing pins are used to secure the base to the wall and the matches….well, they're only there to light the candle.

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