

② A HANDY CALCULATOR!

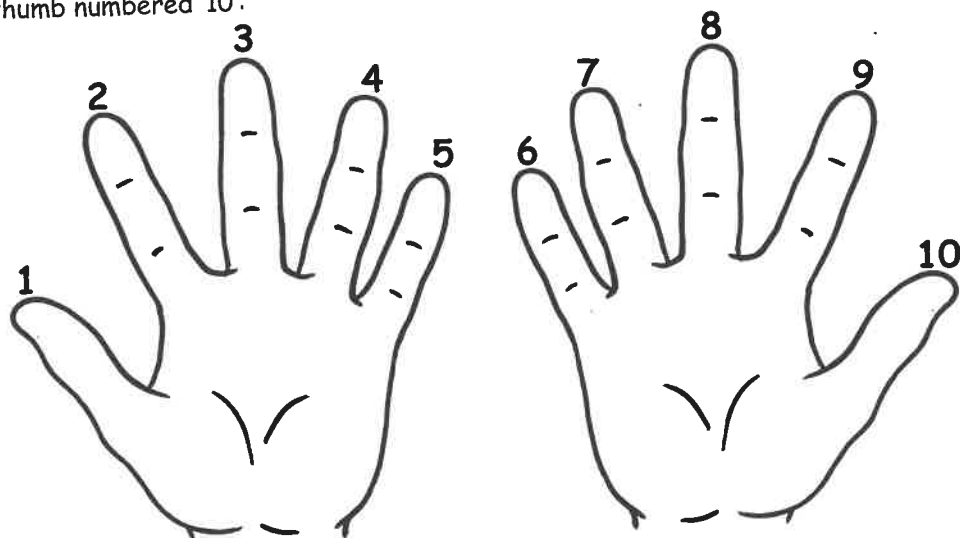
This is a great way of doing the nine-times-table if you have trouble learning and remembering it by heart, as many people do!

WHAT YOU NEED:

- Both your hands with all ten fingers

WHAT TO DO:

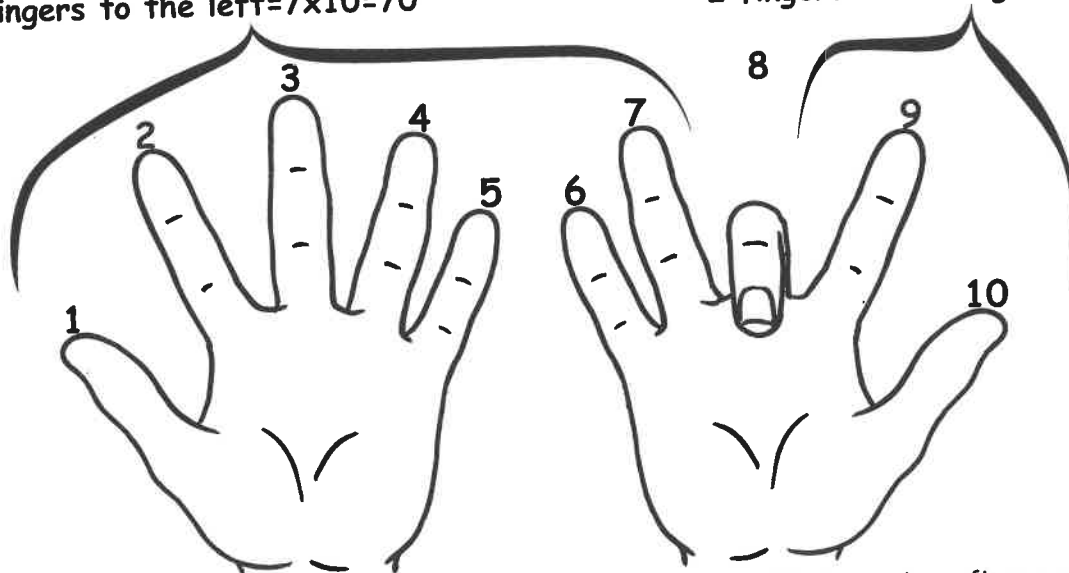
1. Hold your hands up with palms facing you and with all ten fingers straight and spread a little apart. Mentally number your fingers from 1 to 10, from left to right, with your left thumb numbered '1' and your right thumb numbered '10':



2. First, you bend over the numbered finger that is the same as the number you want to multiply nine by. For example, suppose you want the answer to 8 times 9. First, bend your '8' finger over:

7 fingers to the left = $7 \times 10 = 70$

2 fingers to the right = $2 \times 1 = 2$



3. To get to the answer, count the number of straight fingers to the LEFT of your bent finger as how many 'tens' you have and the number of fingers to the RIGHT of your bent finger as how many 'units' you have. You then add the 'tens' and 'units' together. So, with our 8 times 9 example, you have 7 fingers to the LEFT of your bent 8 finger (fingers 1 to 7) which makes 70, and two fingers to the RIGHT (fingers 9 and 10) which makes 2. And $70 + 2 = 72$. So, your handy calculator says that $8 \times 9 = 72$, which it does!

SOME THINGS YOU COULD INVESTIGATE

Why not try your nine-times-table 'handy calculator' against some of the nine-times-table you may already know to make sure it works? For example, try $2 \times 9 = 18$, $5 \times 9 = 45$, $9 \times 9 = 81$ and $10 \times 9 = 90$.

5 MAGIC NUMBER CARDS

WHAT YOU NEED:

- Four small sheets of paper (or card)
(make them small enough and you'll be able to carry them around in your pocket!)
- A pencil (or pen)
- A friend

WHAT TO DO:

1. Using your sheets of paper (or card) and your pencil (or pen), carefully copy and make the four Magic Number Cards shown below (otherwise just use this page of the book!)

Card A

1	3	5	7
9	11	13	15

Card B

2	3	6	7
10	11	14	15

Card C

4	5	6	7
12	13	14	15

Card D

8	9	10	11
12	13	14	15

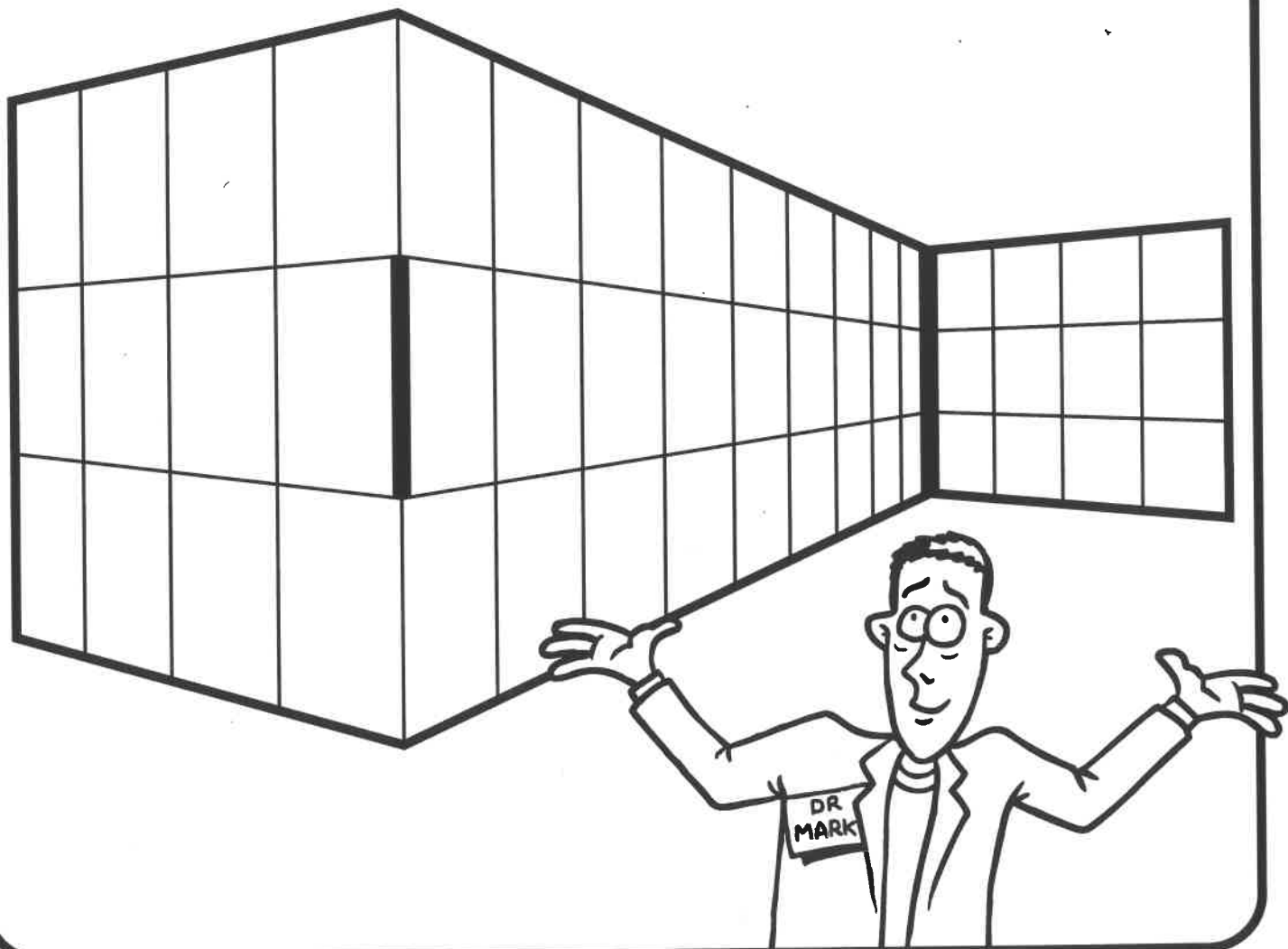
2. Ask a friend to look at the Magic Number Cards and choose a number between 1 and 15.
3. Ask them NOT to tell you the number they have chosen.
4. Ask them to tell you ALL the cards where they can see their number (for example, if they choose the number 3, they should tell you that their number is on cards A and B)
5. You then ADD together the first numbers you can see on each of the cards they named.
(NOTE: the first number on Card A is 1, B is 2, C is 4, and D is 8)

THE ANSWER YOU GET IS THE NUMBER YOUR FRIEND FIRST THOUGHT OF!

7 ILLUSION CONFUSION! - COMPARING CORNERS -

WHAT TO DO:

1. Look at the two thick dark corner lines in the drawing below.
2. Without using a ruler, which thick dark line looks the longest or do they look the same length?



SOME THINGS YOU COULD INVESTIGATE:

1. Use a ruler to measure the actual length of both dark corner lines.
2. Why not try to re-draw the illusion in a different way to see what happens? For example, you could change the length of one or both of the thick dark lines; change the position of one or both of the thick dark lines on the 'grid'; or change the other lines of the grid itself in some way. Remember to only change one thing at a time to make it a 'fair test'.
3. What do you think is going on?

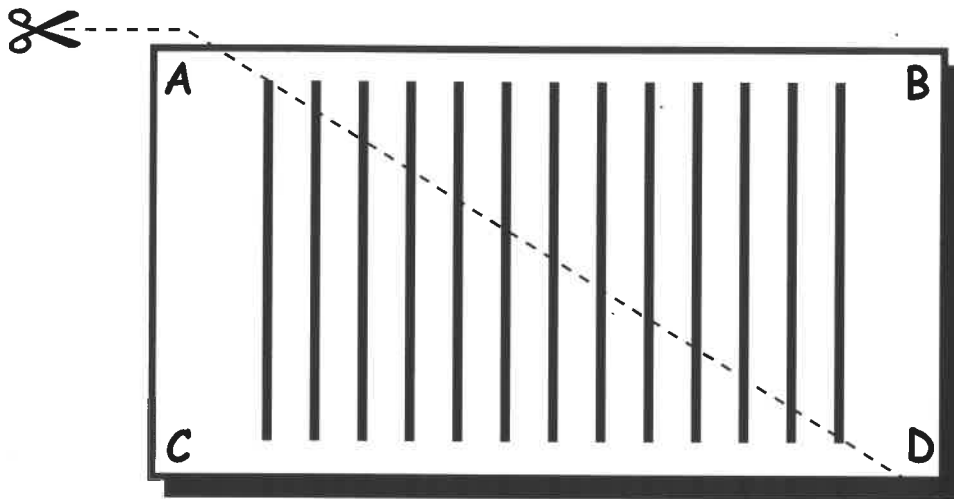
7

ILLUSION CONFUSION!

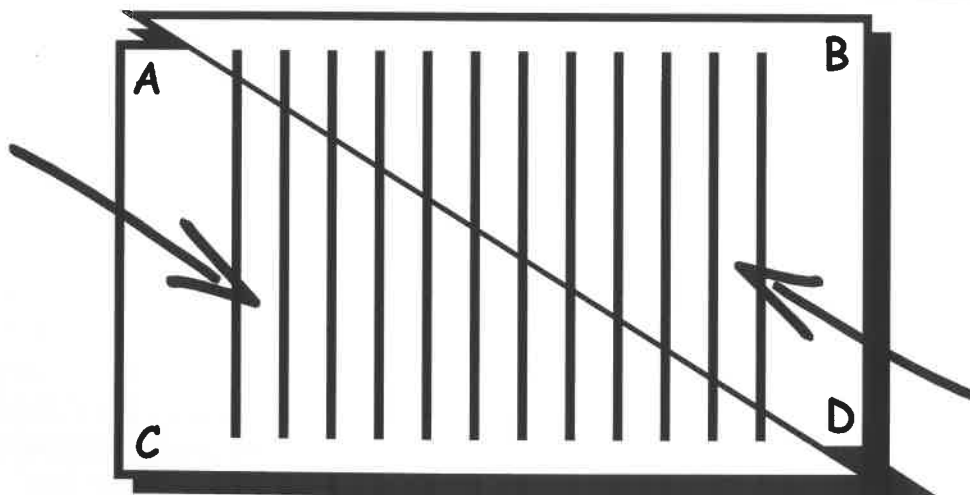
- LOSING LINES -

WHAT TO DO:

1. Take a piece of paper and using a pencil and ruler very carefully draw THIRTEEN thick parallel lines in a rectangular 'block', as shown in the picture just below. Draw the lines 10cm long and 1cm apart. (The lines will be easier to draw if you draw on squared- or graph-paper)
2. Then draw a thin diagonal line AD from one corner of the block of lines to the opposite corner and extend the line to the edge of the paper. Now carefully cut along this line AD.



3. Carefully place the two pieces of paper together again on a table and line up the thirteen lines.
4. Then slowly slide the triangular sheets ACD and ABD past each other along the cut until all the parallel lines line up again as shown below.
5. Now count the parallel lines to see if you still have thirteen.



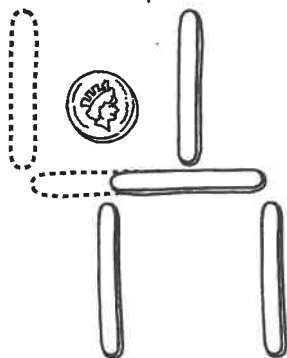
SOME THINGS YOU COULD INVESTIGATE:

1. Why not try drawing the illusion using a different number of parallel lines or different measurements, such as longer or shorter lines and bigger gaps between the lines?
2. What do you think is going on

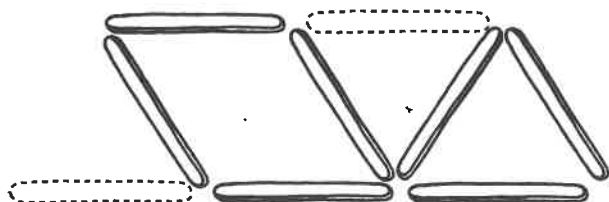
8 STICKY PUZZLES: ANSWERS

NOTE: Dotted lines show the sticks or coins that are moved.

STICKY PUZZLES 1

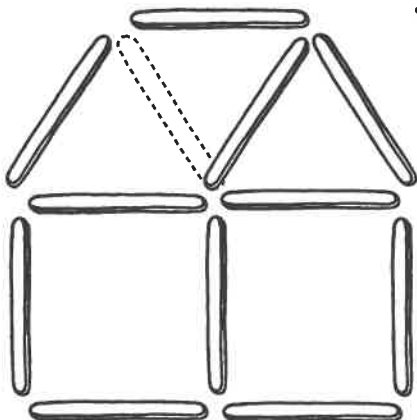


STICKY PUZZLES 2

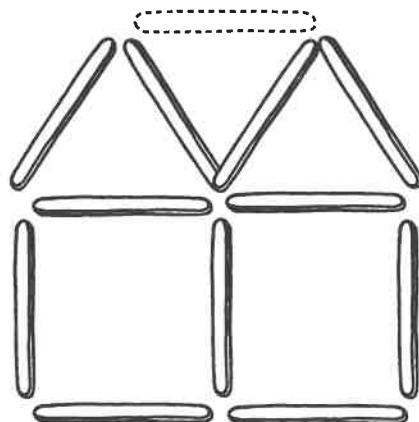


STICKY PUZZLES 3

1.

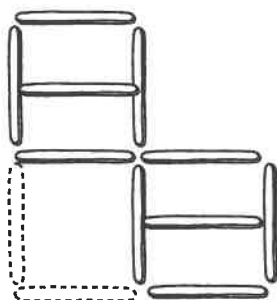


2.

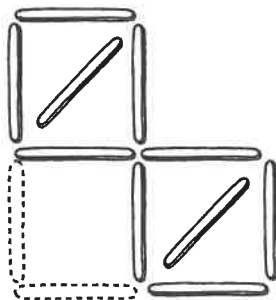


STICKY PUZZLES 4

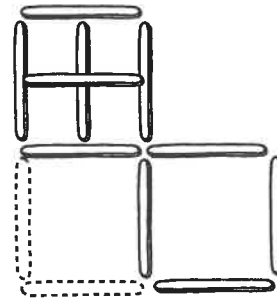
1



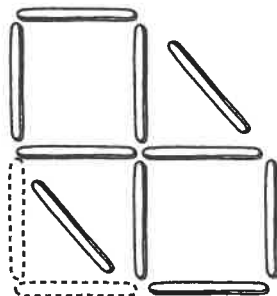
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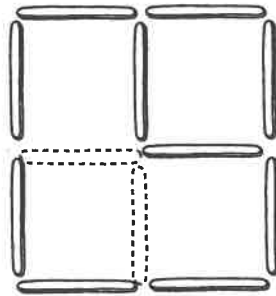
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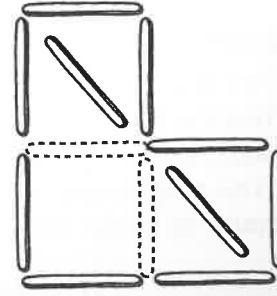
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5



6



9 PUZZLING PIECES!

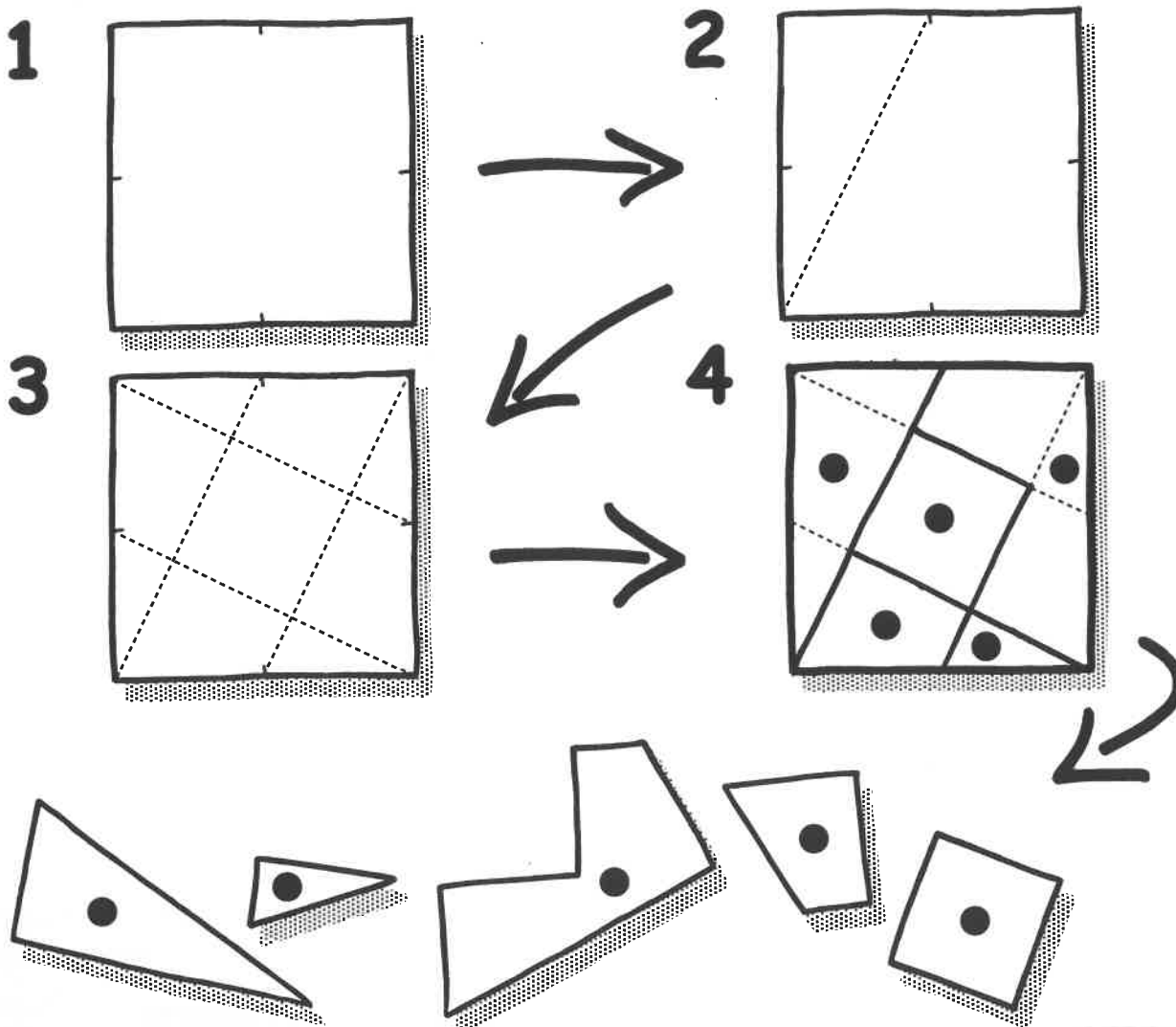
WHAT YOU NEED:

- A sheet of paper or card
- A pencil
- A ruler
- A pair of scissors

WHAT TO DO:

First we need to make our 'Puzzling Pieces'.

1. Using your pencil and ruler, draw a square on your sheet of paper (or card) and make a tiny pencil mark exactly halfway along each edge of the square
2. Draw a faint, straight line extending between the pencil mark along the top edge of your square down to the bottom-left corner
3. Draw similar lines from each of the remaining three pencil marks to their corresponding opposite corners.
4. Draw the darker lines along the faint lines as shown in figure 4 below, and draw a small spot on each of the five main outlined shapes you can see (the spots are so you know which side should be facing up)
5. Finally, carefully cut up the square until you have the five separate pieces



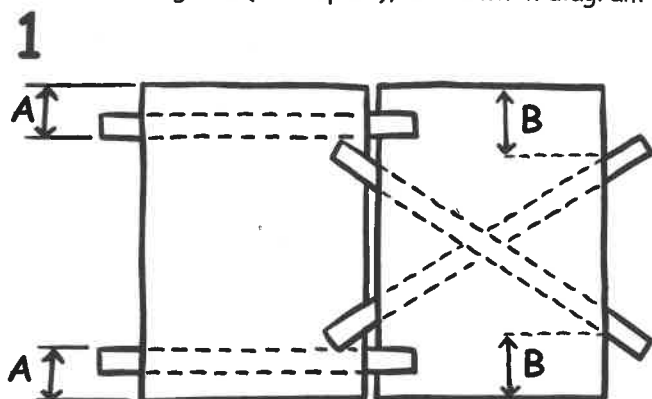
16 MAGIC MILKMAN'S WALLET!

WHAT YOU NEED:

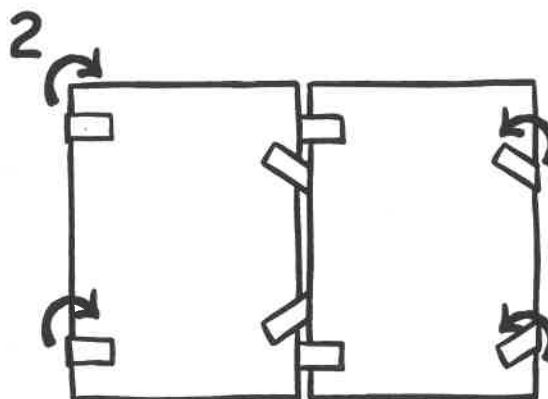
- Two pieces of stiff card - say, about A5 size: approximately 21cm x 15cm (bigger or smaller is also OK)
- Four paper strips - each about 15mm wide and long enough to fix onto the cards as shown in the diagrams (if you're using the card sizes I've mentioned above, then your paper strips will need to be about 20cm long).
- Pencil
- Ruler
- Scissors
- Good glue for sticking card and paper (or a stapler)
- Some paper money (or a similar sized piece of paper - just make sure that your piece of paper is a little smaller than your pieces of stiff card and that one side of the paper looks different from the other)

WHAT TO DO:

1. Lay the four strips under the two cards so that the eight ends are sticking out, with the cards positioned side-by-side and almost touching, as shown in diagram 1. Make sure the inside edges of the two horizontal strips are nearer to the top and bottom of the cards than are the two crossed strips, as I've shown below with measurement 'A' smaller than 'B'.
2. Glue (or staple) the eight ends onto the top surfaces of the cards. The four ends sticking out from between the two cards are already in position for fixing but the other four ends sticking out from the outside left and right edges of the two cards will need to be folded back over the edges of the cards and glued (or stapled), as shown in diagram 2.

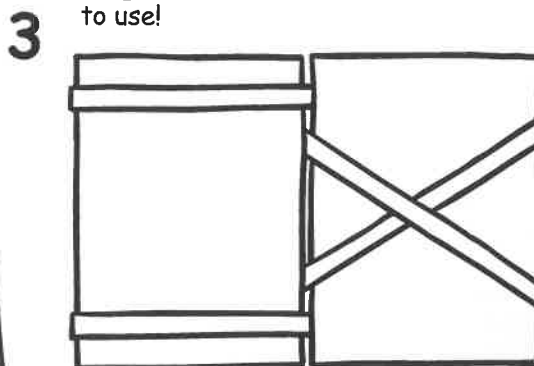


'A' must be SMALLER than 'B'



The first time I saw the 'Magic Wallet' was when I was very young - about 5 or 6 years old, I think. Our milkman used to have one and he kept paper money in it. On Saturdays he would come to our house to collect the money for all the milk he'd delivered during the previous week (which was quite a lot because there was my mum and dad plus three of my brothers, three sisters and me!). I think the wallet he had was made of two rectangular pieces of stiff board covered in leather, joined together in a rather peculiar and clever way using four elastic straps, similar to the way I've shown in the pictures. The straps were also there to hold the paper money inside. When you gave the milkman paper money he would put it into this very peculiar wallet in a very peculiar way. He would rest the money in the fold of the wallet, close the wallet and open it again, and the money would now be tucked behind the straps! He could also make it look like the money 'magically' moved from one side of the wallet to the other just by closing the wallet and opening it again! Totally weird! Anyway, it wasn't until I grew up that I learnt how to make the Magic Wallet for myself. I also discovered, by the way, that it's sometimes called the 'Milkman's Wallet'. So that's why I'm calling it the 'Magic Milkman's Wallet', in honour of my old milkman!

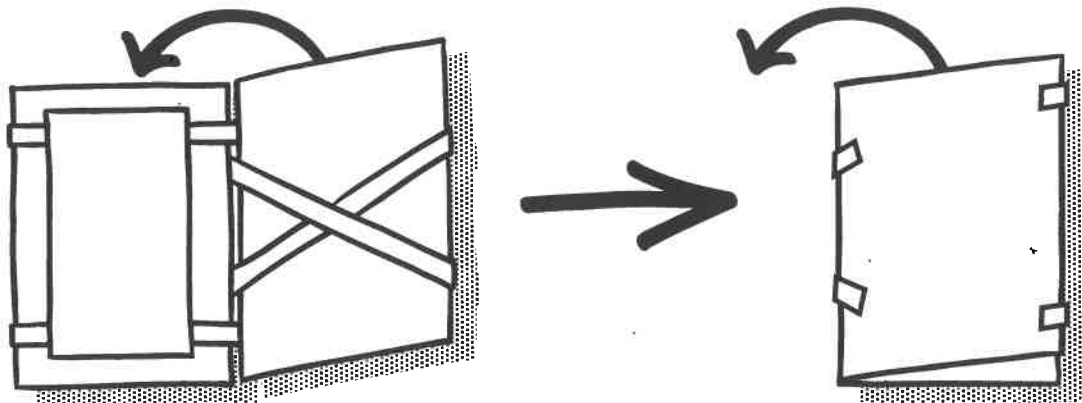
3. If you've used glue, wait for it to dry before moving anything. Then turn your completed 'Magic Milkman's Wallet' over and it's ready to use!



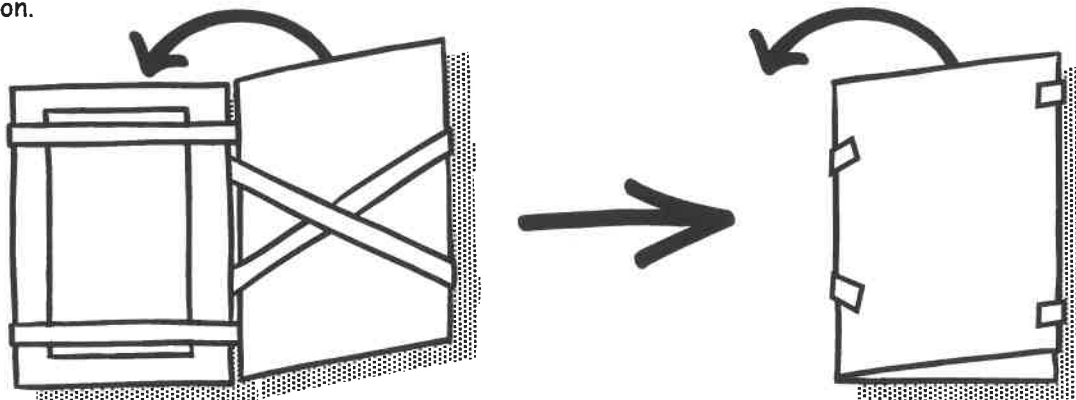
THE COMPLETED
MAGIC MILKMAN'S WALLET!

SOME THINGS YOU COULD INVESTIGATE:

1. Hold the wallet open in one hand like a book and rest your paper money (or other piece of paper) on the wallet so that it rests on top of the two horizontal paper strips as shown below. Close the right side of the wallet over it. What happens when you try to re-open the wallet but this time from the folded edge on the right-hand side? Try to describe what's going on.
(HINT: Also note which way up your piece of paper is facing before and after you re-open the wallet)



2. Repeat investigation 1 above, but this time rest the piece of paper on top of the crossed strips.
3. Hold the wallet open in one hand like a book and tuck your paper money underneath the two horizontal paper strips as shown below. Close the right side of the wallet over it. What happens when you try to re-open the wallet but this time from the folded edge on the right-hand side? Try to describe what's going on.



4. Repeat investigation 3 above, but this time tuck the piece of paper underneath the crossed strips.

SOME THINGS YOU MIGHT'VE DISCOVERED

FROM INVESTIGATING 1 & 2:

From both 1 & 2 you should have discovered that:

- you could in fact re-open the wallet perfectly well from the folded edge
- when you re-opened the wallet the paper was tucked underneath the crossed strips
- the paper was facing the same way up for 1 but the other way up for 2
- the paper was resting against the same piece of stiff card before AND after you re-opened the wallet for 1, but swapped from resting against one piece of stiff card to the other for 2
- the pairs of strips swap from resting against one piece of stiff card to the other when you re-open the wallet

FROM INVESTIGATING 3 & 4:

From both 3 & 4 you should have discovered that:

- as with 1 & 2, you could in fact re-open the wallet perfectly well from the folded edge
- the paper was resting against the same piece of stiff card before AND after you re-opened the wallet
- the paper always faces the same way up
- when you re-opened the wallet the paper was tucked underneath the crossed strips for 3, and tucked underneath the horizontal strips for 4
- the pairs of strips swap from resting against one piece of stiff card to the other when you re-open the wallet

17 BRAIN STRETCHERS!

WHAT YOU NEED:

- The Brain Stretchers that follow - I've given you ALL the information you need, plus a useful clue if you need it, to answer each problem.
So you have no excuse for getting any wrong!
- Your brain - you can try all of the 'Brain Stretcher' problems on your own if you want to
- A pen (or pencil) and some paper might be useful for making notes
- The answers on pages 106 to 109 to check your answers

1. A man has to get a fox, a chicken and a sack of corn across a river. He has a small rowing boat but it can only carry him and one other thing. If the fox and the chicken are left alone together, the fox will eat the chicken. If the chicken and the corn are left together, the chicken will eat the corn. How does the man get them all across the river?

CLUE:

Remember that the boat can carry things both ways across the river



2. Two children and one adult need to get across a river. They have a boat but the boat can only carry one adult OR two children. How do they all get across?

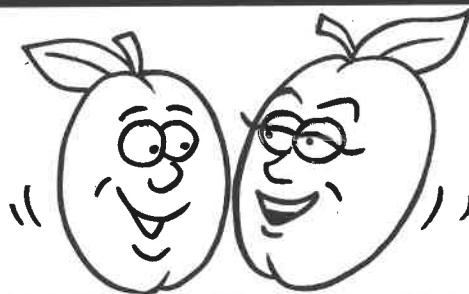
CLUE:

Remember that the boat can carry things both ways across the river

3. Mr. & Mrs. Plum have six daughters and each daughter has one brother. How many people are in the plum family?

CLUE:

Not as many as you might at first think.



4. Two fathers and two sons went fishing. Each of them caught a fish and none of them caught the same fish. However, they only caught a total of three fish. How is this possible?

CLUE:

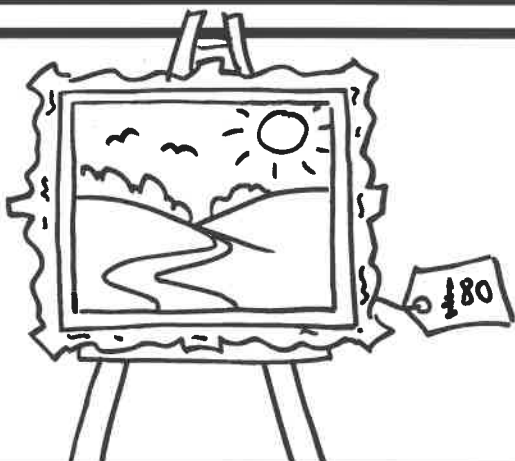
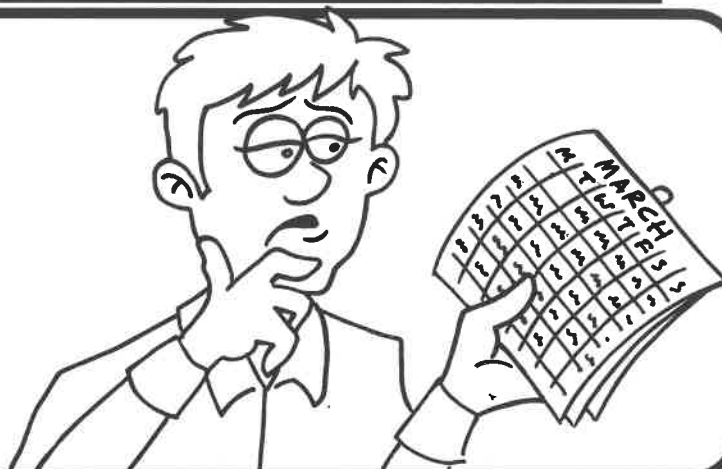
There are only three fishermen, but how so?

17 BRAIN STRETCHERS!

5. If today is Monday, what is the day after the day before the day before tomorrow?

CLUE:

It might be easier to work through the sentence backwards and break it down into segments.



6. A shop bought a painting for £70, sold it for £80, bought it back for £90, and sold it again for £100. Did the shopkeeper make any money? What amounts?

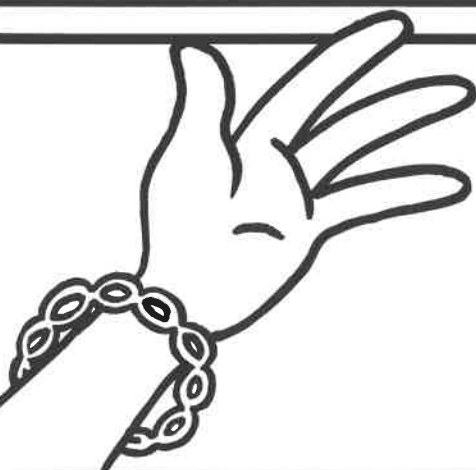
CLUE:

Start off with some money in the till, say, £100

7. If 2 hours ago it was as long after one o'clock in the afternoon as it was before one o'clock in the morning, what time would it be now?

CLUE:

"As long after as it was before" is the same as saying, "halfway between".



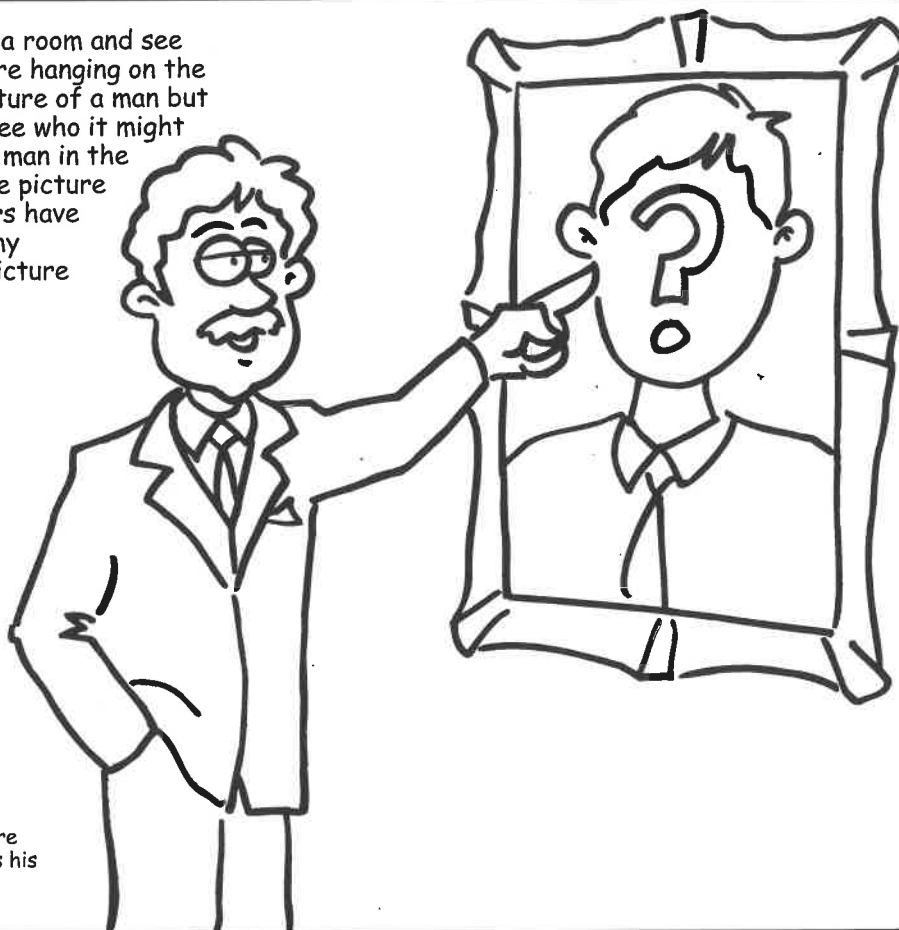
8. You have four identical small pieces of gold chain, each made of three links. You need to have the four pieces linked together to make a closed bracelet or circle. The jeweller charges £5 for each link that has to be opened and closed again. What is the minimum it will cost to have the bracelet made? Explain your answer?

CLUE:

It's less than £20

17 BRAIN STRETCHERS!

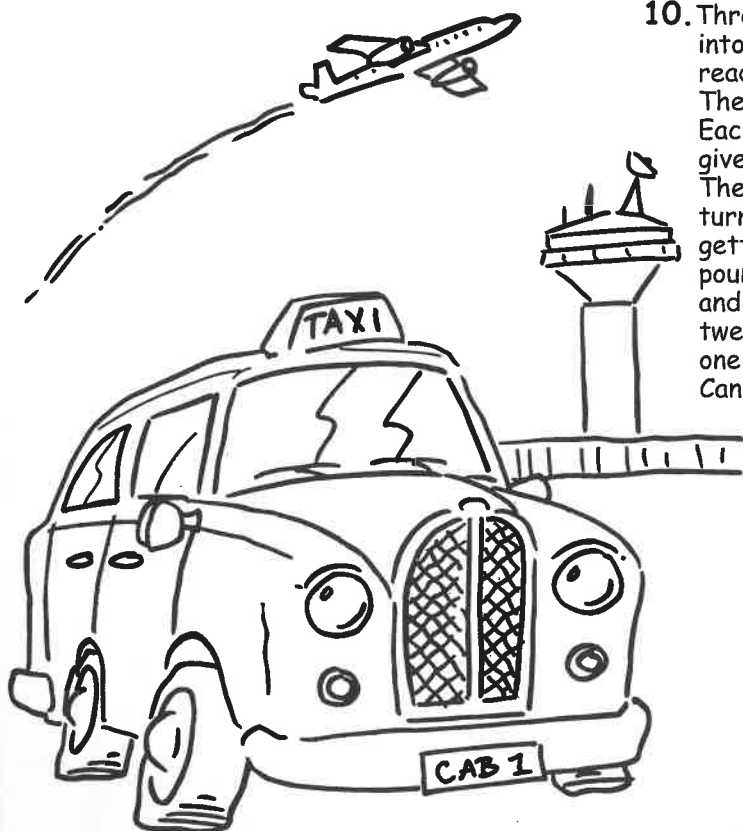
9. You look through a doorway into a room and see a man looking at a portrait picture hanging on the wall. You can see that it is a picture of a man but you can't see clearly enough to see who it might be. So you ask the man who the man in the picture is. The man points to the picture and replies, "Brothers and sisters have I none and this man's father is my father's son." Whose portrait picture is the man looking at? Explain your answer.



CLUE:

It might be easier to imagine that you are the man talking and remember that he is his father's son.

10. Three friends agree to share a taxi from the airport into the nearest town. When they arrive, the meter reads £25. Each friend gives the driver a £10 note. The driver gives them back five £1 coins as change. Each man then takes one of the £1 coins and they give the driver the remaining two £1 coins as a tip. They get out and the taxi drives away. One friend turns to the others and says, "Just a minute, after getting back a £1 coin each, we each spent nine pounds, which makes twenty-seven pounds altogether, and the driver has two pounds, bringing the total to twenty-nine pounds. So what happened to the other one pound?" Can you explain the answer?



CLUE:

How much money did the driver get altogether?

17 BRAIN STRETCHERS!

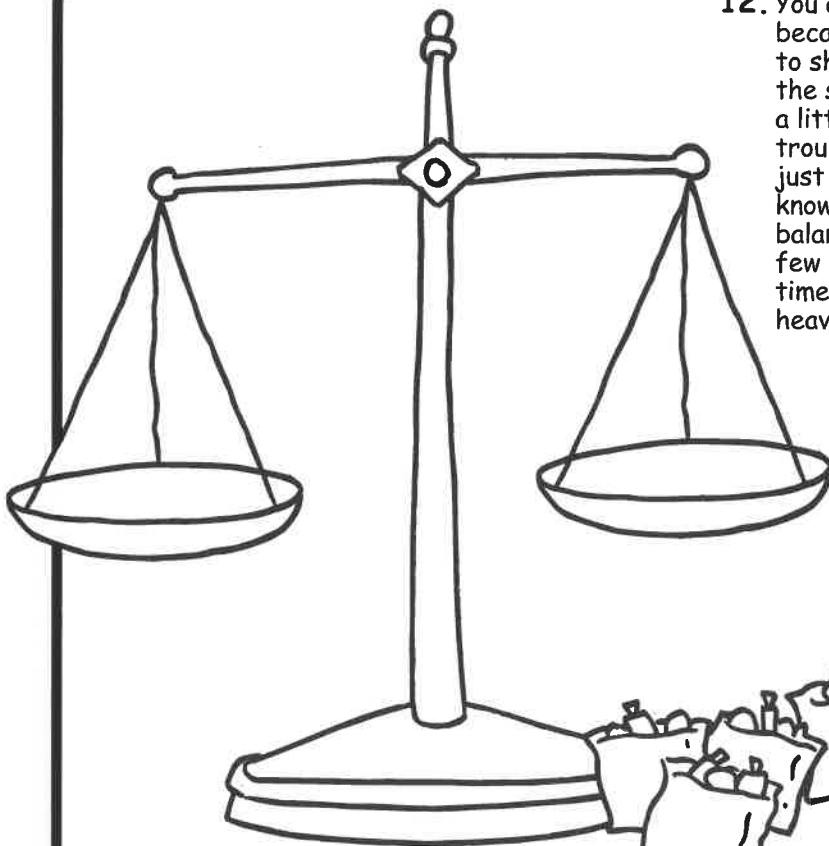
11. In the entrance hallway of a large, tall building there are three light switches in a row in the **OFF** position. Each switch controls 1 of 3 light bulbs in passageways on the very top floor above. You may move any of the switches but you only have enough time to go upstairs to inspect the bulbs once. How can you work out the switch used for each light bulb with just one inspection of the light bulbs in the passageways above?



CLUE:

You will need to be able to touch the light bulbs.

12. You and eight friends have been having a small party because it's your birthday. You have nine 'goody-bags' to share out. The bags and contents are all exactly the same apart from in one bag, which you know has a little something extra in it especially for you. The trouble is, apart from knowing that your bag must be just a little bit heavier than the others, you don't know which bag it is. However, you do have a set of balance scales in the kitchen big enough to hold a few bags in each pan. What is the least number of times you will need to use the scales to find your heavier 'goody-bag'?



CLUE:

Most people calculate three or four times, but it's not! How so?

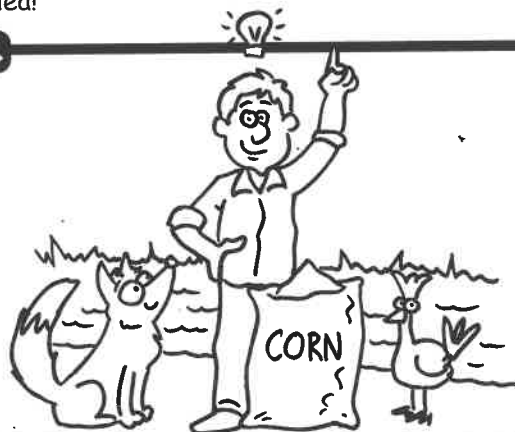
17 BRAIN STRETCHERS-ANSWERS

If you look carefully you'll notice that the answer boxes on the following pages are exactly the same size and in exactly the same position as the corresponding question boxes on the previous pages. This will make it a bit easier for you to match up the correct answer box with the corresponding question box. Most importantly, it'll be very useful if you decide to make a copy of a question page and copy the corresponding answer page onto the other side of the copy sheet. If you wanted to, you could also then cut out each question from the copy page and make a set of 'Brain Stretcher Cards', with the question on one side and the answer on the other!

What a great idea!

ANSWER

1. Man carries chicken across, man leaves chicken and comes back; man then carries fox across, man leaves fox and carries chicken back; man leaves chicken and carries corn across, man leaves fox and corn together and goes back to fetch the chicken.



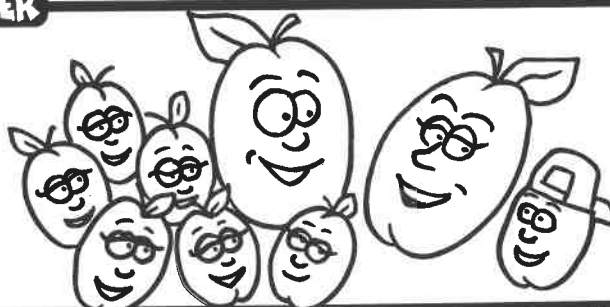
ANSWER



2. Both children row over together; one child rows the boat back again; that child gets out of the boat and lets the adult row over; adult gets out and lets other child row back again to pick up the remaining child.

ANSWER

3. There are nine Plums in the family. Since each daughter shares the same brother, there are six girls, one boy and Mr. & Mrs. Plum; that makes nine.



ANSWER

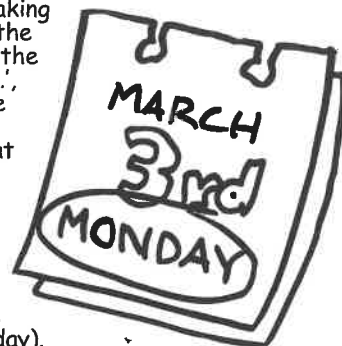


4. The clue says there are three fishermen. Therefore, one of the fathers must also be a son. This becomes clear when you see that the three fishermen are a son, his father and his father's father (or grandfather). Just because one man fits into both categories of father and son doesn't mean he should be counted twice.

17 BRAIN STRETCHERS-ANSWERS

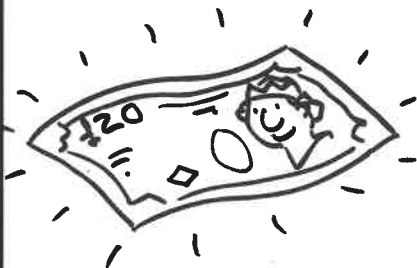
ANSWER

5. The answer is 'Monday'. How so? Well, working backwards through the sentence and breaking it down into smaller segments as I suggested you first get: 'If today is Monday, what is the day after the day before (the day before tomorrow)?' Well, thinking about the words in the brackets, you might've realised that another way of writing, '...the day before tomorrow...', would be the word, 'today' (because today is the day before tomorrow). OK so far? So we could now re-write the whole sentence as, 'If today is Monday, what is the day after the day before today?' Already you may be able to see the correct answer. If not let's look at another group of words I'll put in brackets from this re-written sentence: 'If today is Monday, what is the day after (the day before today)?'. Well, another way of writing, '...the day before today...', would be the word, 'yesterday' (because yesterday is the day before today). So our new sentence would read, 'If today is Monday, what is the day after yesterday?' Got the final answer now? No? OK, let's break down one more group of words I'll put in brackets from this last sentence: 'If today is Monday, what is (the day after yesterday)?'. As you might've worked out by now, instead of writing, '...the day after yesterday', we could write just, 'today' (because today is the day after yesterday). So that leaves us with our final 'reduced' sentence as: 'If today is Monday, what is today?' Well, hopefully you can see by now that today must be Monday! Phew!



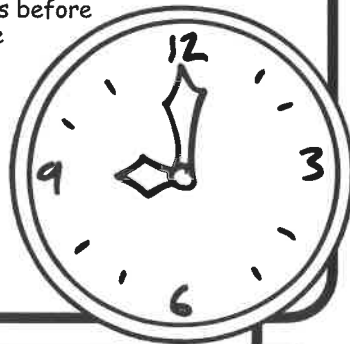
ANSWER

6. Interestingly, most people get this question wrong with answers such as the shopkeeper gained £10, £30, £0 or that the shopkeeper actually lost £10 or £20. The shopkeeper actually makes a gain or profit of £20. How so? One of the problems people seem to have with this question is that they try to work with sums which take bigger numbers away from smaller numbers, giving them minus or negative numbers. This gives many people problems. So, let's work through the problem starting off, as I suggested in my clue, with £100 in the till. Remember when the shop buys anything, that takes money out of the till, and when the shop sells anything, that adds money to the till. So, here goes. The shop buying the painting for £70 leaves £30 in the till (because £100 - £70 = £30); selling the painting for £80 gives a total of £110 in the till (because £30 + £80 = £110); buying the painting back for £90 leaves £20 in the till (because £110 - £90 = £20); and finally, selling the painting again for £100 gives £120 in the till (because £20 + £100 = £120). Since the shopkeeper already started with £100 in the till and now has £120, he has made a gain or profit of £20. For those of you who like playing around with minus or negative numbers, this is what you get: $-£70 + £80 - £90 + £100 = £20$.

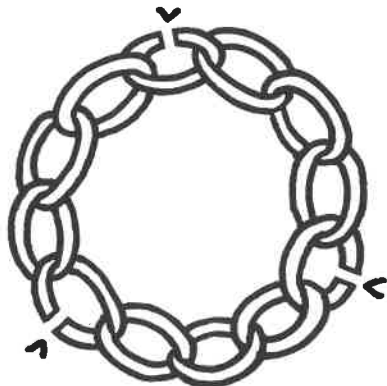


ANSWER

7. The time now must be 9 o'clock in the evening or 9.00 p.m. or 21.00. Remember my clue mentioned that, "As long after as it was before" is the same as saying "halfway between". So, you could re-write the original sentence as, 'If 2 hours ago it was halfway between one o'clock in the afternoon and one o'clock in the morning, what time would it be now?'. I think that makes it a little easier to think about. Breaking the sentence into segments also helps. First, think about the part which in the original sentence says, '...as long after one o'clock in the afternoon as it was before one o'clock in the morning...', or in my re-write now says, '...halfway between one o'clock in the afternoon and one o'clock in the morning...'. Well, if you think about them carefully, you may be able to work out that both part-sentences are saying, '7 o'clock in the evening' (7 o'clock in the evening is halfway between one o'clock in the afternoon and one o'clock in the morning, because that there are 12 hours between both one o'clocks, and half of 12 hours is 6 hours. And 1 o'clock plus 6 hours gives 7 o'clock). So, if instead of writing, '...as long after one o'clock in the afternoon as it was before one o'clock in the morning...', we write just, '...7 o'clock in the evening...', the original sentence becomes, 'If 2 hours ago it was 7 o'clock in the evening, what time would it be now?'. I hope you can more clearly see that the time 'now' must be 9 o'clock in the evening (because 7 o'clock plus 2 hours gives us 9 o'clock).



ANSWER

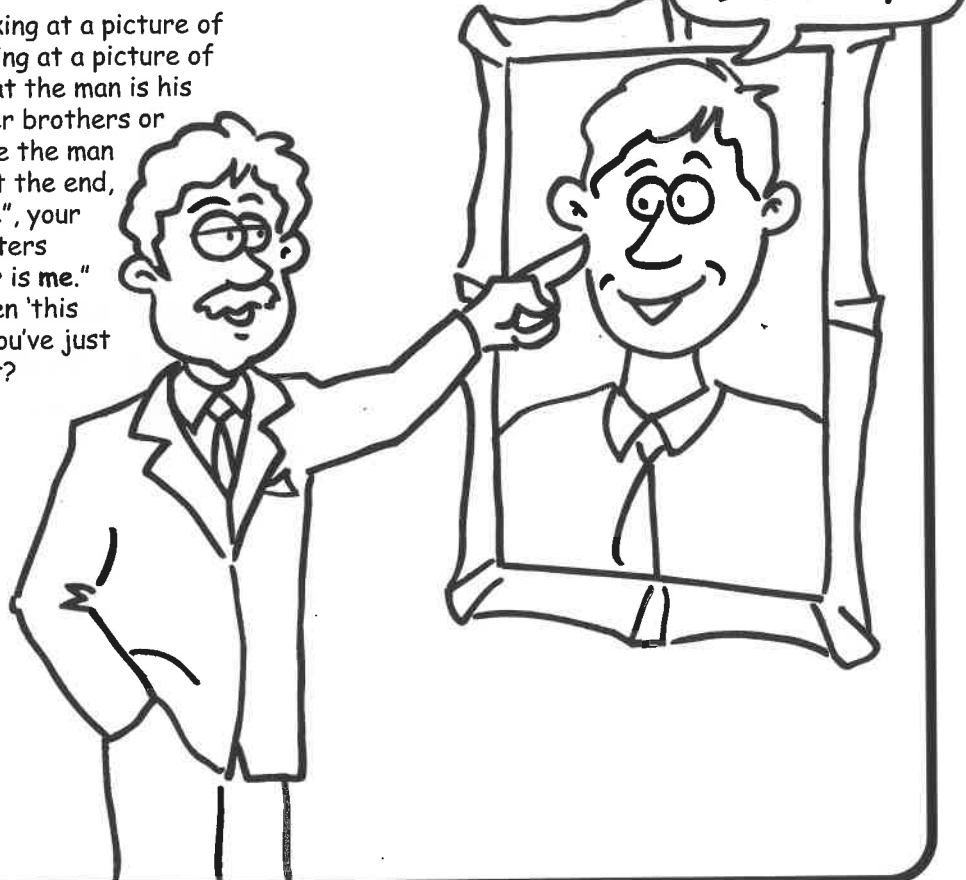


8. The answer is £15 because you only need to open and close three links. Here's how: use three links from one of the pieces of chain to link the other three remaining pieces of chain together to form the bracelet. And since it costs £5 for each link that's opened and closed again, $3 \times 5 = £15$.

17 BRAIN STRETCHERS-ANSWERS

ANSWER

9. A lot of people say that he is looking at a picture of himself. The man is actually looking at a picture of his son. The clue reminds you that the man is his father's son, since he has no other brothers or sisters. Now imagine that you are the man talking. So if instead of saying at the end, "...my father's son", you say, "...me", your reply would be, "Brothers and sisters have I none and this man's father is me." If "...this man's father is me", then 'this man' must be your son, because you've just said that you're his father. Get it?



ANSWER

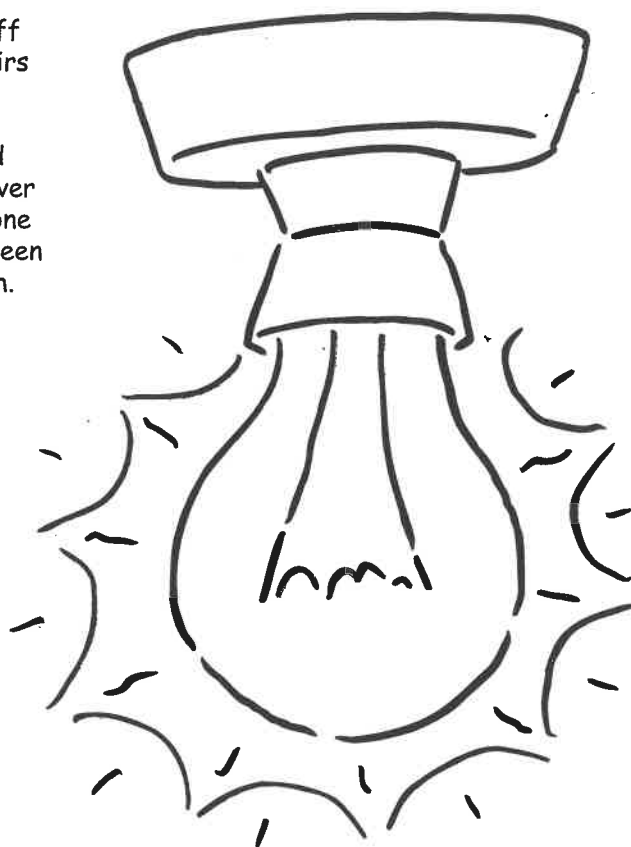


10. To explain this to our friend, all you need to do is add up the total money spent and the total money received. Each friend spent £9, bringing the total spent to £27 ($3 \times 9 = 27$). The taxi cost £25 and the driver got another £2 tip, bringing the total received to £27. So, the money spent by the friends is actually the same as the money received by the taxi driver. Another way of thinking about it is to say that of the £30 given first to the driver, the taxi cost £25, the driver tip was £2, and each of the three friends kept £1. This adds up to £30 ($25 + 2 + 1 + 1 + 1 = 30$). Our friend got it wrong because he was thinking that the £2 tip was in addition to the £27 spent, which would make £29. The £2 tip was actually included in the £27 the friends spent, not in addition to it.

17 BRAIN STRETCHERS-ANSWERS

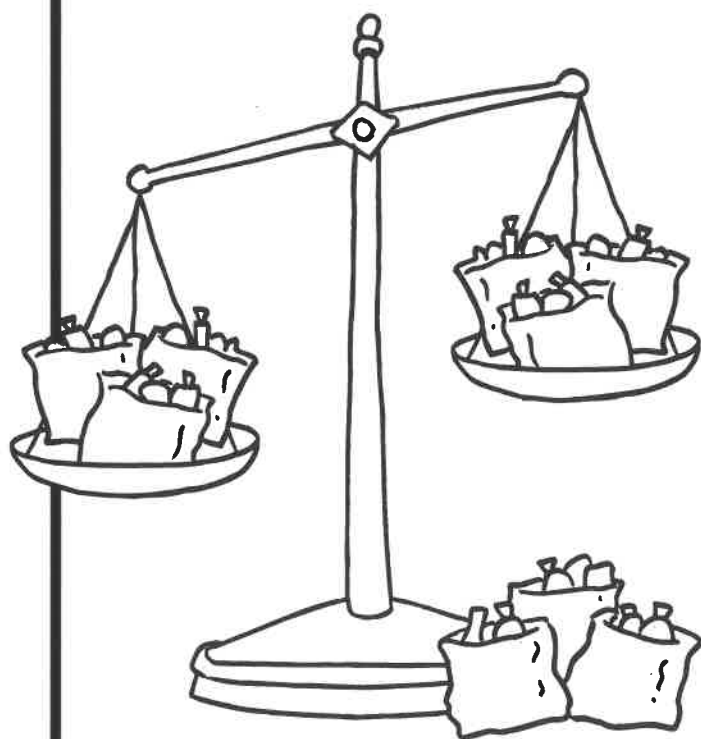
ANSWER

11. Turn switch 1 on for a few minutes; then turn it off again. Turn switch 2 on and leaving it on, go upstairs to inspect the bulbs. The bulb that is on must be controlled by switch 2. Now go and touch the remaining two bulbs which should be off. The cold bulb will be controlled by switch 3 (since it has never been switched on), and the warm bulb will be the one controlled by switch 1, since it had only recently been switched on and off again, and should be still warm.



ANSWER

12. You only need to use the balance scales twice to weigh the bags and find the heaviest one. How so? Well, first divide the nine bags into three groups of three bags each. Next, put one set of three bags in one pan of the balance scales and another set in the other pan. This is your first weighing. If the heavier bag is now on the scales, the group of bags it's with will weigh more and the scales will dip down on that side. So you'll know which group of three bags your heavier bag is in. If the scales stay level and balanced, you know that all the bags in the pans must weigh exactly the same and so your heavier bag must be in the group of three bags which you didn't put on the scales. So either way, after your first weighing you know the group of three bags which contains your heavier bag. With it so far? If so, you may be able to work out the last bit for yourself. You take two of the bags from your selected group of three and put one on each pan of your balance scales. This is your second weighing. If one of them is your heavier bag, it will make the scales dip down on that side and so you'll have found it. If the scales stay level and balanced, you know that the two bags on the scales must be identical and that means your bag must be the one that's left off the scales. Again, either way, you would have found your birthday 'goody-bag'.



By the way, the initial idea for question 12 must go to my crazy friend Rob in 'The Leather Shop' in Boscastle, North Cornwall, England.
Thanks Rob! (I'll be 'swapping' more ideas with you, I hope!)