CHALLENGE

43

25 In the movie *Die Hard: With a Vengeance*, Bruce Willis and Samuel L. Jackson are presented with a 5 gallon jug and a 3 gallon jug and a water fountain. They are then given 30 seconds to fill the larger jug with exactly 4 gallons of water, before they'll be blown to smithereens. Your task is to find a solution (your 30 seconds starts now!).
If instead Bruce and Sam start with a 15 gallon jug and a 6 gallon jug, and are again after exactly 4 gallons of water in one of the jugs, can they still do it? Under what conditions can you solve this sort of puzzle?
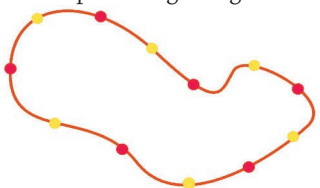
26 What symbol comes next?

ꢀ ♥ 8 ꢁ ꢂ ꢃ ꢄ ꢅ

27 There are two jugs of the same size, one containing water and one containing wine. A cup of water is taken from the first jug and added to the wine. Then, a cup of the mixture is taken from the second jug and added to the water. Is there now more water in the wine or wine in the water?

28 In how many different ways can you make change for a dollar using 5, 10, 20 and 50 cent coins?

29 In the movie *Fermat's Room*, four potential victims have to solve the following problem, or die a horrible death: How can you measure exactly 9 minutes using two hourglasses, one a 4 minute hourglass and the other a 7 minute hourglass? The hourglasses can be turned over at any stage, but always have to be running: you cannot lay them on their sides.

30 Your friend has a necklace with 12 equally spaced beads. Impress her by using her necklace to make a perfect right angle.

31 At least one of John's two children is a girl. What are the chances that they are both girls?

32 Starting with a rectangular bar of chocolate you and your chocoholic friend take turns breaking the bar along the lines separating the squares. You keep breaking pieces until only individual squares are left. The person who makes the last break gets to eat all the chocolate. Who wins?
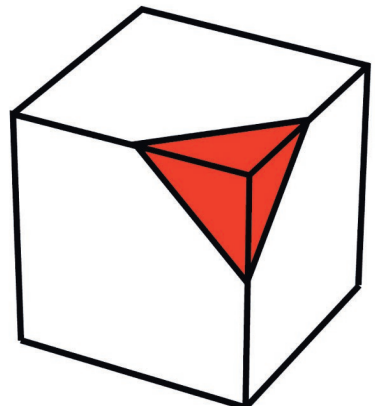
33 Three playing cards are placed in a row. To the right of a King there is a Queen or two Queens. To the left of a Queen there is a Queen or two Queens. To the left of a Heart there is a Spade or two Spades. To the right of a Spade there is a Spade or two Spades. What are the three cards?

34 What number is this?

$$1 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{1+\dots}}}$$

35 A boat can travel under its own power at 20 kilometers per hour. Wanda takes the boat downstream, with a river flowing at 10 kilometers per hour, and then she brings the boat back upstream again. What is the average speed of the boat for the trip?
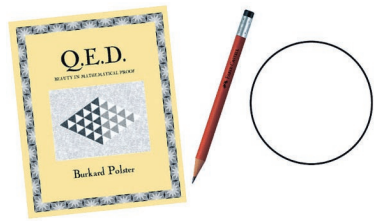
36 It is easy to slice a cube with a flat plane to expose an equilateral triangular face. What about a square? A regular pentagon? A regular hexagon?

37 Your pocket contains 36 coins, and you empty your pocket onto a table. What are the chances that an even number of heads comes up?

38 You receive three boxes of lollies. One contains only mints, the second only chocolates, and the third contains a mixture of the two. The boxes are meant to have labels identifying the contents, but the labels have been mixed up and each box is now incorrectly labelled. What is the minimum number of lollies you need to sample to decide which box is which?
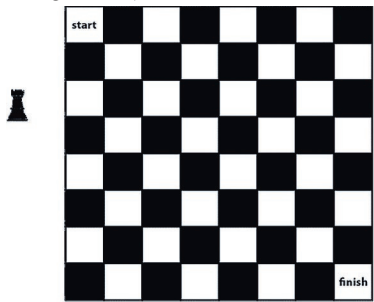
39 You find a circle drawn on the floor and your life depends on finding the exact centre of this circle. The only tools you have are a book and a pencil. How can you do this?

40 What is the following mystery number?
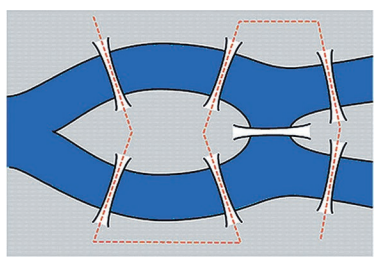3.142857142857142857…

3 POINT QUESTIONS

41 Place one of the major chess pieces (not a pawn) in the top left square of the board. Your mission is to move the piece to the bottom right square of the board, visiting each square of the board exactly once. For which pieces (bishop, knight, rook, queen, king) can you do this? Can you show that it is impossible for the other pieces? Of course, only legal chess moves are permitted. Except for the knight, if a piece moves to a distant square it is considered to have visited all the squares that it has passed through along the way.

42 In *A Beautiful Mind*, John Nash (Russell Crowe) is quizzing his students. Two bicycles start out 1 mile apart, and are coming together, each traveling at a speed of 10 miles per hour. There is a fly on bicycle A, and he flies towards bicycle B at 20 miles per hour. The fly then travels back to A, then forwards again to B, and so on, until the two bikes collide and the poor fly is squashed. How far does the fly travel in total?

43 Federer and Nadal are playing the fifth and final set at Wimbledon. It is 6 games all and there are no tiebreakers: the winner is the first to get two games in front. Federer has a ⅔ chance of winning a game when he is serving and Nadal has a ¾ chance of winning each of his service games. What are the chances that Federer will win this final set?

44 Here is one of the most famous puzzles of all time. The town of Mathsberg has seven bridges. Can you walk through the town so that you cross each bridge exactly once?
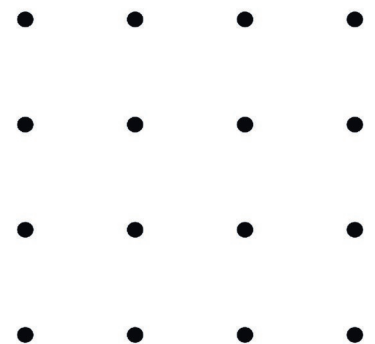
45 You decide to walk up the 10 steps to your apartment differently each day, by mixing 1-step and 2-step jumps. How many different ways can you do this?

46

27   31   30   ?

47 A class of 30 children are asked if they did their maths homework last night. Each student flips two coins. If both coins come up heads then they lie, and otherwise they tell the truth. 20 students say they did their homework. How many students (roughly) actually did their homework?
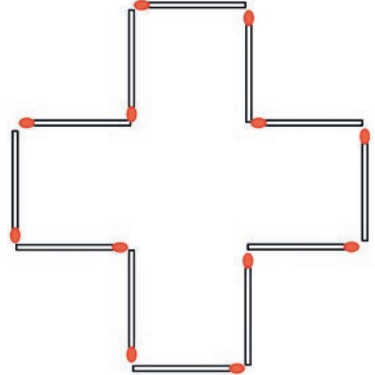
48 A student asks his professor: "What are the ages of your three children?" The professor answers: "If you multiply their ages you get 36, and if you add them you get my house number." "I know your house number, but that's not enough information!" says the student. To that the professor answered: "True. The oldest lives upstairs." What are the ages of the three children?

49 How many squares can you make using any four points from the grid below as corners? How many equilateral triangles?

50 Five students go to the teacher to get back their tests. But the teacher is so confused that each of the students receives someone else's test. How many ways are there to do this?
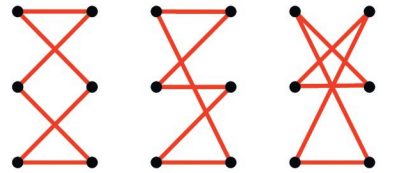
51 The matches make a cross of area 5. Is it possible to rearrange the matches into a shape of area exactly 8? What about an area of 4? What about an area of π?

52 A watch has an hour hand and a minute hand. What is the first time after midnight when the two hands will be pointing in exactly opposite directions? A second watch has an hour hand, a minute hand and a second hand. Is there a time of day when the three hands are symmetrically placed, with 120 degrees between each pair of hands?
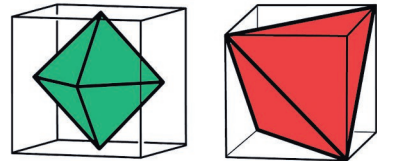
53 You have a shoe with six equally spaced eyelets. A lacing of this shoe consists of six straight lines that zigzag back and forth, and altogether form a complete loop. How many different lacings of this shoe are there? Which among these lacings is of the shortest length?

54 Suppose we invest $1 at 100% annual interest. Then at the end of the year we will have $2. However, if instead we receive 50% interest after each six months, then the compounding means that at the end of the year we will have $2.25. What if we receive 25% interest after each three months? As the time increments get smaller and smaller, how do the final amounts change? Do the amounts grow as large as we want, or do the amounts level off?

55 The cubes have side length 1. What are the volumes of the two bodies inscribed in the cubes? The six corners of the octahedron are at the midpoints of the faces of the cube. The four corners of the tetrahedron are at the corners of the cube.

56 666, 36, 1316, 11131116, 31133116, ??? What's the next number?

57 Decipher the following message:
000000000000000111111111000111 1111111100111111111111100110010 0011001100010001001111101111 1001110001111000111111111110000 010 101010000011010100000011 11111000000000000000000.

58 John places two poles in the ground, one of them 3 meters high and one 2 meters high. He then ties ropes from the top of each pole to the base of the other pole. How high off the ground do the ropes cross?

59 Imagine a rubber rope one meter long. A worm starts at one end and travels along the rope at 1 centimeter each second. At the end of each second, the rope is stretched, so that it is one meter longer than before. The worm is carried along with the stretching. Does the worm ever reach the end of the rope?

60 The squares have area 1. What are the areas of the pink lens in the first square, and the bulging yellow square inside the second square?