



OPEN CHALLENGE '07



1. RACING HOME

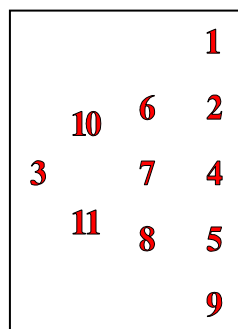
The total distance travelled was $6 \times 37.73 = 226.38$ miles.
There were at least 20 riders in the race.

Competitors	Start	Finish	Time Taken	Av. Speed	Position
1 and 2	10.30.00	12.30.00	2 hours	113.19 mph	
3 and 4	10.30.10				
5 and 6	10.30.20	12.29.37	1 hour 59 min 17s	113.88 mph	
7 and 8	10.30.30				
9 and 10	10.30.40				
11 and 12	10.30.50				
13 and 14	10.31.00				
15 and 16	10.31.10				
17 and 18	10.31.20				
19 and 20	10.31.30	12.29.37	1 hour 58 min 7s	115 mph	FIRST

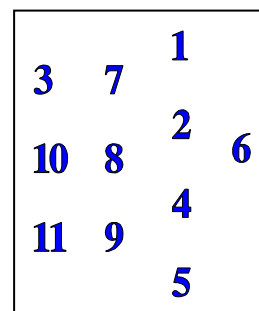
The greatest average speed was 116.19 mph achieved by number 1 on his last lap.

2. FORMATION FOOTBALL

LIVERPOOL



EVERTON



3. BRIDGE THE GAP

Let the bridges be v, w, x, y and z.

There are six routes starting at bridge v.

v y z w x v z y w x v y x w z v z x w y v w x y z v w x z y

There are six routes starting at bridge w.

w y z v x w z y v x w y x v z w z x v y w v x y z w v x z y

There are four routes starting at bridge x.

x y v w z x y w v z x z v w y x z w v y

This gives a total of 16 different routes.

As this is even Euan Euler will finish on the same side as he started.

4. SLAVE CHAIN

The nine links can be positioned in 9! ways. (i.e. 362 880)

However as the two circular links cannot be together the number of ways this can happen (2x8!) must be deducted. (i.e. 80 640) This gives a total of 282 240 ways.

However, one of the links is like a figure eight and either end could be joined so the last result must be doubled. (i.e. 564 480 ways)

As indicated each link can be positioned in two ways so this total must be multiplied by 2⁹. (i.e. 289 013 760 ways)

Thus there are 289 013 760 ways in which the slaves could have been linked.

5. BE PREPARED

Let the scouts be A, B, C, D, E, F, G, H and I

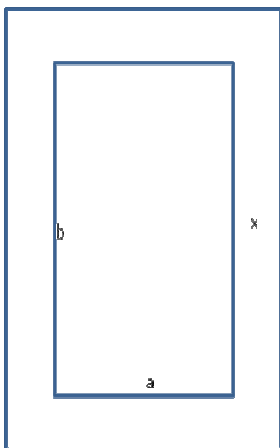
A	B	C	B	F	H	F	A	G	A	D	H	G	B	I	D	C	A
D	E	F	E	I	A	I	D	B	B	E	G	C	F	D	E	H	B
G	H	I	C	G	D	H	C	E	F	I	C	H	A	E	I	G	F

Every scout will then have walked by the side of every other scout once and once only.

Dealing with the general case; 12n + 9 scouts may walk in triplets on 9n + 6 occasions, where n may be zero or any integer.

Thus a troop of 21 scouts may walk 15 ways.

6. FRAMING THE MONA LISA



$$(a + 2x)(b + 2x) = ab + 2ax + 2bx + 4x^2$$

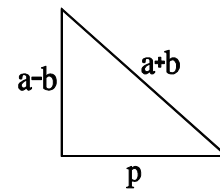
$$\therefore ab = 2ax + 2bx + 4x^2$$

$$\therefore 4x^2 + 2(a + b)x - ab = 0$$

$$\therefore x = \frac{-2(a + b) \pm \sqrt{4(a + b)^2 + 4 \times 4ab}}{8}$$

$$\therefore x = \frac{-(a + b) + \sqrt{(a + b)^2 + 4ab}}{4}$$

$$\therefore x = \frac{-(a + b) + \sqrt{a^2 + 6ab + b^2}}{4}$$



Using the right angled triangle:

$$p = \sqrt{(a + b)^2 - (a - b)^2}$$

$$p = \sqrt{4ab}$$

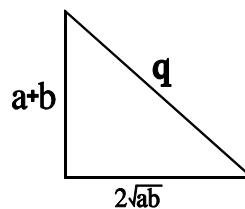
$$p = 2\sqrt{ab}$$

Using the right angled triangle:

$$q = \sqrt{(a + b)^2 + 4ab}$$

$$q = \sqrt{a^2 + 6ab + b^2}$$

Thus x can be found by taking the length of a+b from q and then dividing the string in half and then half again.



BONUS!

QUESTION	CELEBRATION	ANNIVERSARY
1. RACING HOME	Isle of Man TT races	100 YEARS
2. FORMATION FOOTBALL	City of Liverpool Charter	800 YEARS
3. BRIDGE THE GAP	Birth of Euler	300 YEARS
4. SLAVE CHAIN	Abolition of the slave trade	200 YEARS
5. BE PREPARED	Foundation of Scout movement	100 YEARS
6. FRAMING THE MONA LISA	Completion of the Mona Lisa	500 YEARS

Arranging these anniversaries in ascending order gives:

100, 100, 200, 300, 500, 800.

This is a Fibonacci sequence.