# *OPEN CHALLENGE '10*
## *SOLUTIONS*

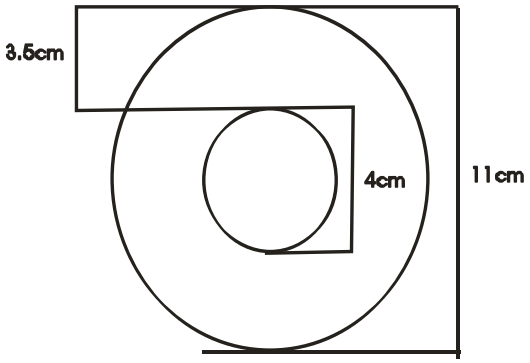
## 1. CHANGING ROOMS

The lowest possible number of moves is 16 and these can be made in seven plays.
Rev. Green moves from Kitchen ⟹ Billiard Room
Col. Mustard moves from Conservatory ⟹ Hall ⟹ Kitchen
Mrs Peacock moves from Study ⟹ Dining Room ⟹ Conservatory ⟹ Hall
Mrs White moves from Lounge ⟹ Ball Room ⟹ Study ⟹ Dining Room ⟹ Conservatory
Rev. Green moves from Billiard Room ⟹ Lounge ⟹ Ball Room ⟹ Study
Col. Mustard moves from Kitchen ⟹ Billiard Room ⟹ Lounge
Mrs Peacock moves from Hall ⟹ Kitchen

| | Start | Finish |
|---|---|---|
| Rev. Green | Kitchen | Study |
| Col. Mustard | Conservatory | Lounge |
| Mrs Peacock | Study | Kitchen |
| Mrs White | Lounge | Conservatory |

## 2. HOW THICK CAN YOU BE?

Don't be confused by spiral winding.
Let the thickness of the paper be $d$ cm and the length be $l$ cm.
Then $l \times d = 50 \times 22 = 1100$ cm.
Area of cross section = $\frac{\pi}{4}\left(11^2 - 4^2\right) \approx 82.47\,cm^2$
So thickness of the tissue is $\approx 82.47 \div 1100 \approx 0.075 cm$
Thickness of all turns on a full roll is 3.5 cm.
So number of turns is $3.5 \div 0.075 \approx 46.7$ turns.
Hence there are 46 full turns of paper on the roll.




## 3. A CUT ABOVE THE REST

If Professor Plum chooses the Red die then Reverend Green would choose the Blue die.

| Red | Blue | | |
|---|---|---|---|
| 2 | 3✓ | 5✓ | 7✓ |
| 4 | 3✗ | 5✓ | 7✓ |
| 9 | 3✗ | 5✗ | 7✗ |

**P(Blue win)** $= \frac{5}{9}$

If Professor Plum chooses the Blue die then Reverend Green would choose the Green die.

| Blue | Green | | |
|---|---|---|---|
| 3 | 1✗ | 6✓ | 8✓ |
| 5 | 1✗ | 6✓ | 8✓ |
| 7 | 1✗ | 6✗ | 8✓ |

**P(Green win)** $= \frac{5}{9}$

If Professor Plum chooses the Green die then Reverend Green would choose the Red die.

| Green | Red | | |
|---|---|---|---|
| 1 | 2✓ | 4✓ | 9✓ |
| 6 | 2✗ | 4✗ | 9✓ |
| 8 | 2✗ | 4✗ | 9✓ |

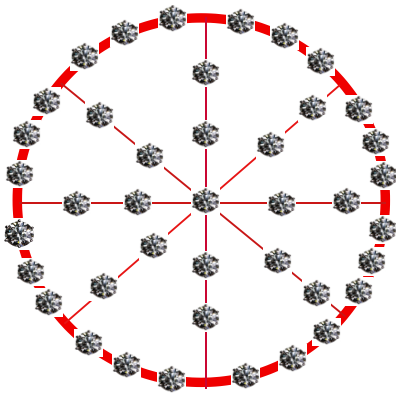
**P(Red win)** $= \frac{5}{9}$

Thus Reverend Green can always choose a die that gives him a greater probability of winning.

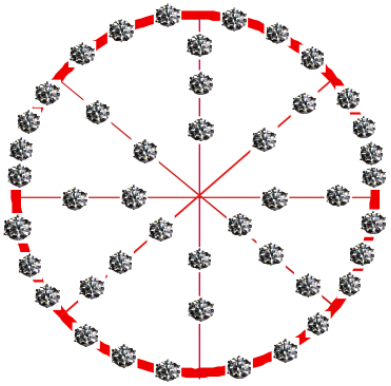
## 4. THE MISSING JEWELS

There are many ways in which the diamonds could have been arranged.
The simplest way was to remove five stones and reset just one in the centre.

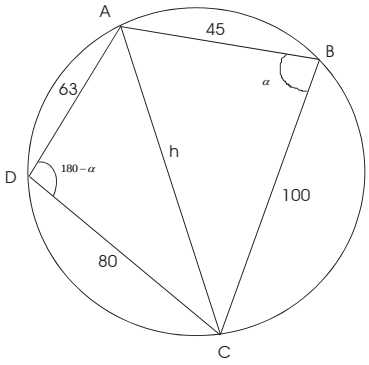
ALTERED



ORIGINAL



## 5. THE REGIMENTAL FLAG




Professor Plum realised that the quadrilateral was cyclic.

$In\,\Delta ADC \quad h^2 = 63^2 + 80^2 - (63\times 80\times 2\times \cos(180-\alpha))$

$In\,\Delta ABC \quad h^2 = 45^2 + 100^2 - (45\times 100\times 2\times \cos\alpha))$

$\therefore 19080\cos\alpha = 1656$

$$\therefore \quad \cos\alpha = \frac{23}{265}$$

$$\therefore \sin\alpha = \frac{264}{265}$$

Area of the flag $= \Delta ABC + \Delta ADC$

$$= \frac{1}{2}45\times 100\times\frac{264}{265} + \frac{1}{2}63\times 80\times\frac{264}{265}$$

$$= 4752cm^2$$

Hence they would need just under half a square metre of material.

## 6. GOING ROUND IN CIRCLES

It can be shown that this cannot be done with 9, 8 or 7 cards.
Using 6 cards we have the two arrangements shown below.


There are many solutions for this, e.g. a=3, b=7 & c=1

### BONUS! WHO DUNNIT?

**Miss Scarlet with the dagger in the library.**