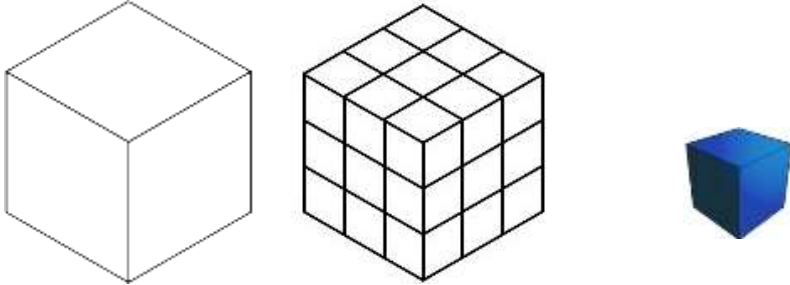


All Cubed Out!

This resource was written by Derek Smith with the support of CASIO New Zealand. It may be freely distributed but remains the intellectual property of the author and CASIO.

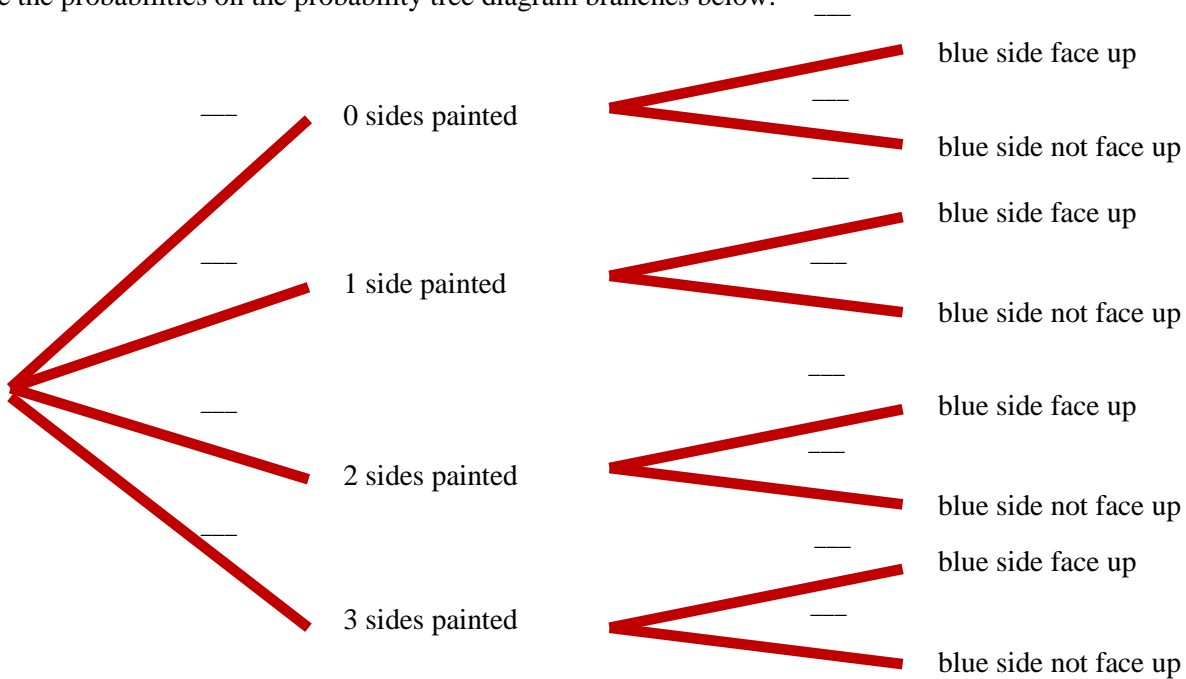
A cube is painted blue all over and then cut into 27 ($3 \times 3 \times 3$) equal sized smaller cubes. The 27 cubes are then placed inside a bag and one of the cubes is randomly drawn from the bag. This randomly selected cube is then rolled. What is the probability that this cube lands with a non-painted side facing up?



| | | | | | | | |
|--------------------------------|----------|----------|----------|----------|----------|----------|----------|
| Number of sides painted | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Number of cubes | 1 | 6 | 12 | 8 | 0 | 0 | 0 |

| | | | | | | | |
|--------------------------------|----------------|----------------|-----------------|----------------|----------|----------|----------|
| Number of sides painted | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Probability | $\frac{1}{27}$ | $\frac{6}{27}$ | $\frac{12}{27}$ | $\frac{8}{27}$ | 0 | 0 | 0 |

Place the probabilities on the probability tree diagram branches below.



Complete the calculation below:

$$\begin{aligned} \text{Prob}(\text{cube lands with non-painted side face up}) &= \text{Prob}(0 \text{ sides painted} \cap \text{blue side face up}) + \text{Prob}(1 \text{ sides painted} \cap \text{blue side face up}) + \\ &\quad \text{Prob}(2 \text{ sides painted} \cap \text{blue side face up}) + \text{Prob}(3 \text{ sides painted} \cap \text{blue side face up}) \\ &= \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad} \\ &= \underline{\quad} \end{aligned}$$

If a cube is painted blue all over and then cut into $n \times n \times n$ equal sized smaller cubes. All of these cubes are placed inside a bag and one of the cubes is randomly drawn from the bag. This randomly selected cube is then rolled. What is the probability that this cube lands with a non-painted side facing up?

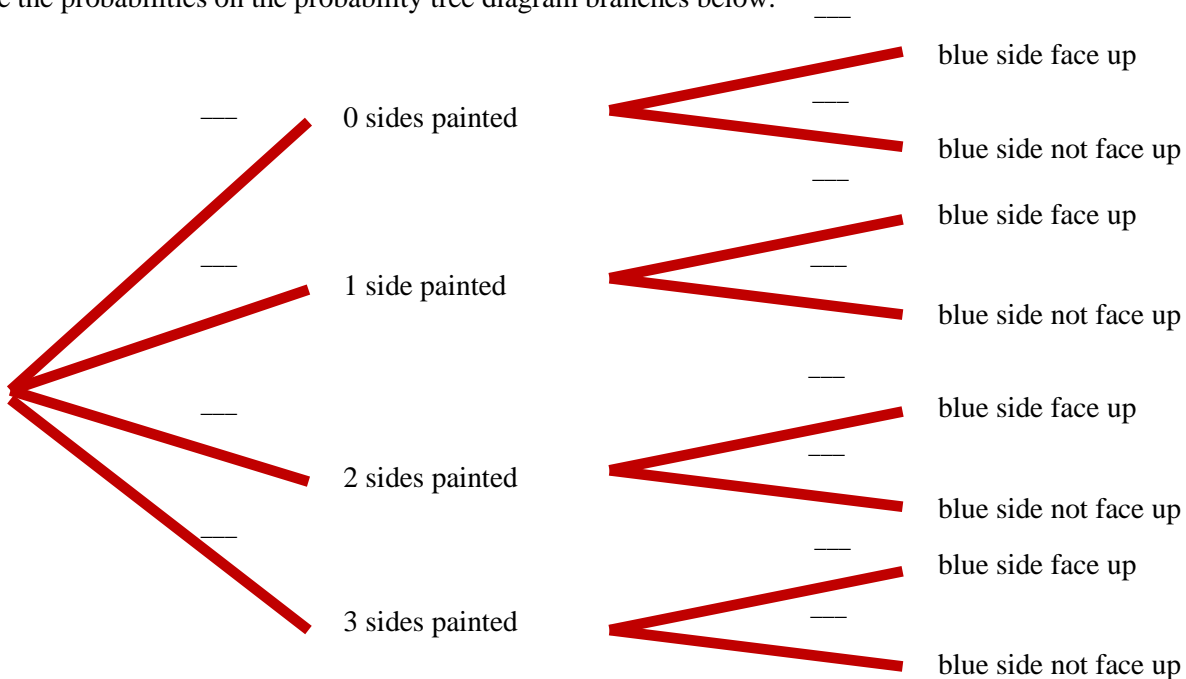
Complete the tables below:

| Shape number | Number of small cubes | Number of sides painted blue | | | | | | |
|--------------|-------------------------------|------------------------------|---|----|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | 27 ($= 3^3$) | 1 | 6 | 12 | 8 | 0 | 0 | 0 |
| 2 | 64 ($= 4^3$) | | | | | | | |
| 3 | 125 ($= 5^3$) | | | | | | | |
| 4 | 216 ($= 6^3$) | | | | | | | |
| ... | ... | | | | | | | |
| n | $n \times n \times n (= n^3)$ | | | | | | | |

Question: What patterns do you see?

| Number of sides painted | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|-------------------------|-----------------------|-----------------------|-----------------------|-----------------------|---|---|---|
| Probability | $\frac{\square}{n^3}$ | $\frac{\square}{n^3}$ | $\frac{\square}{n^3}$ | $\frac{\square}{n^3}$ | 0 | 0 | 0 |

Place the probabilities on the probability tree diagram branches below.



Complete the calculation below:

$$\begin{aligned} \text{Prob(cube lands with non-painted side face up)} &= \text{Prob}(0 \text{ sides painted} \cap \text{blue side face up}) + \text{Prob}(1 \text{ sides painted} \cap \text{blue side face up}) + \\ &\quad \text{Prob}(2 \text{ sides painted} \cap \text{blue side face up}) + \text{Prob}(3 \text{ sides painted} \cap \text{blue side face up}) \\ &= \underline{\hspace{2cm}} + \underline{\hspace{2cm}} + \underline{\hspace{2cm}} + \underline{\hspace{2cm}} \\ &= \underline{\hspace{2cm}} \end{aligned}$$

Answers for each \square are: $8, (2 - n)2, (2 - n)2, (2 - n)2, 6(n - 2), 2, 8$

For more..., visit: <http://jwilson.coe.uga.edu/EMT668/emt668.student.folders/SeitzBrian/EMT669/painted.cube/painted.html>

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