Calculus II: Assignment 2e

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Bhaskara II (1114-1185), also known as Bhaskaracharya ("Bhaskara the Teacher"), was an Indian mathematician and astronomer who continued the Indian tradition of writing mathematics in verse. Here are two problems from his book on arithmetic, *Lilavati*, which was named after and dedicated to his daughter. "Lilavati" apparently means "playful", and a number of the problems in the book fit the title. Here are two such problems from *Lilavati*, taken from the prose translation by Henry Colebrooke [1].

> *54. Out of a swarm of bees, one-fifth part settled on a blossom of Columba; and one-third on a flower of Silìnd'hrì; three times the difference of those numbers flew to the bloom of a Cutája. One bee, which remained, hovered and flew about in the air, allured at the same moment by the pleasing fragrance of a jasmin and pandanus. Tell me, charming woman, the number of bees.*
>
> *68. The square-root of half the number of a swarm of bees is gone to the shrub of jasmin; and so are eight-ninths of the whole swarm; a female is buzzing to one remaining male that is humming within a lotus, in which he is confined, having been allured to its fragrance at night. Say, lovely woman, the number of bees.*

Problem 1. Solve problem 54, given above.

Solution 1.

$$
\begin{aligned}
b &= \frac{1}{5}b + \frac{1}{3}b + 3b(\frac{1}{3} - \frac{1}{5}) + 1 \\
b &= \frac{1}{5}b + \frac{1}{3}b + 3b(\frac{1}{3} - \frac{1}{5}) + 1 \\
b &= \frac{1}{5}b + \frac{1}{3}b + \frac{2}{5}b + 1 \\
b &= \frac{14}{15}b + 1 \\
15b &= 14b + 15 \\
15b - 14b &= 15 \\
b &= 15
\end{aligned}
$$

Let b count the bees
Give a fifth to a third and another two fifths
Recall the jasmine and give one
Then both by fifteen taking fourteen gives b

Definitely not my proudest work, but I'm doing a physics degree for a reason ;)

Problem 2. Solve problem 68, given above.

Solution 2.

$$
\begin{aligned}
b &= \sqrt{\frac{1}{2}b} + \frac{8}{9}b + 2 \\
b &= \frac{\sqrt{b}}{\sqrt{2}} + \frac{8}{9}b + 2 \\
b - \frac{8}{9}b - 2 &= \frac{\sqrt{b}}{\sqrt{2}} \\
\frac{1}{9}b - 2 &= \frac{\sqrt{b}}{\sqrt{2}} \\
(\frac{1}{9}b - 2)^2 &= \frac{1}{2}b \\
0 &= \frac{1}{81}b^2 - \frac{4}{9}b + 4 - \frac{1}{2}b \\
0 &= \frac{1}{81}b^2 - \frac{17}{18}b + 4 \rightsquigarrow \frac{\frac{17}{18} \pm \sqrt{\left(-\frac{17}{18}\right)^2 - 4(\frac{1}{81})(4)}}{2\frac{1}{81}}
\end{aligned}
$$

So there are either 72 or $\frac{9}{2}$ bees. Since fractional bees are unrealistic, we probably have 72 bees.

Let b count the bees
Root half and add eight-ninths
Think of the lovers, add two
Square, expand, and set to nil
Employ a formula and reason a solution

References

[1] *Algebra, with Arithmetic and mensuration, from the Sanscrit of Brahmegupta and Bhàscara*, Henry Thomas Colebrooke, 1817. Online at: `ttps://arc`ive.org/stream/algebrawitharith00brahuoft#mode/2up