

beehives

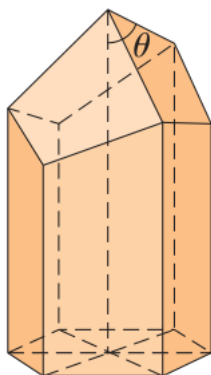
August 20, 2024

1 Beehives

In a beehive each cell is a regular hexagonal prism, as shown in the figure. The amount of wax W in the cell depends on the apex angle θ is given by

$$W = 3.02 - 0.38 \cot \theta + 0.65 \csc \theta$$

Bees instinctively choose θ so as to use the least amount of wax possible.

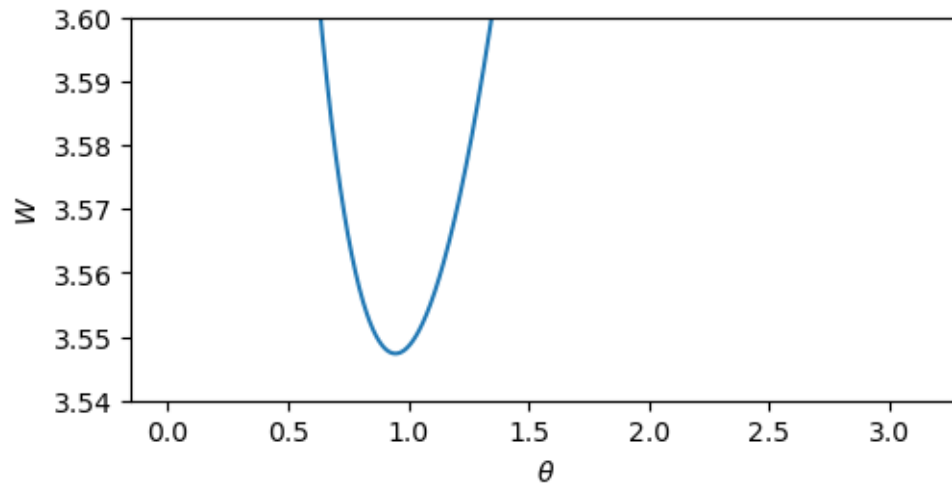


(a) Use a graphing device to graph W as a function of θ for $0 < \theta < \pi$.

```
[3]: import matplotlib.pyplot as plt
import numpy as np
```

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[25]: x = np.linspace(0, np.pi, 1000)[1:-1]
fig, ax = plt.subplots(figsize=(5, 2.57), layout='constrained')
ax.plot(x, 3.02-(0.38/np.tan(x))+(0.65/np.sin(x)))
plt.ylim((3.54,3.6))
ax.set_xlabel(r"$\theta$")
ax.set_ylabel(r"$W$")
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[25]: Text(0, 0.5, '$W$')
```



(b) For what value of θ does W have its minimum value?

[Note: Biologists have discovered that bees rarely deviate from this value by more than a degree or two.]

I think, its approximately 0.9 radian or 51.6 degree