The following data is from “Note on the spectral lines of hydrogen” by J. J. Balmer dated 1885. Numerical values are hydrogen line wavelengths in units of 10^{-10} meter. (Data for H_I is not included here because H_I is not a hydrogen line. The H_I data is for Fraunhofer line H which is ionized calcium.)

	H_α	H_β	H_γ	H_δ	H_ϵ	H_ζ	H_η	H_ϑ	H_ι
Van der Willigen	6565.6	4863.94	4342.80	4103.8	–	–	–	–	–
Angstrom	6562.10	4860.74	4340.10	4101.2	–	–	–	–	–
Mendenhall	6561.2	4860.16	–	–	–	–	–	–	–
Mascart	6560.7	4859.8	–	–	–	–	–	–	–
Ditscheiner	6559.5	4859.74	4338.60	4100.0	–	–	–	–	–
Huggins	–	–	–	–	–	3887.5	3834	3795	3767.5
Vogel	–	–	–	–	3969	3887	3834	3795	3769†

(†The value given in the paper is 6769 which is an obvious typo.)

From this data, Balmer determined that

$$\hat{y} = \frac{m^2}{m^2 - 2^2} \times 3645.6 \times 10^{-10}\,\text{meter}$$

where $\hat{y}$ is the predicted wavelength and m is determined by the hydrogen line according to the following table.

$$\begin{array}{cccccccccc} & H_\alpha & H_\beta & H_\gamma & H_\delta & H_\epsilon & H_\zeta & H_\eta & H_\vartheta & H_\iota \\ m = & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11 \end{array}$$

Just for the fun of it, use linear regression in R to compute the model coefficient.

```
m = c(3,3,3,3,3,4,4,4,4,4,5,5,5,6,6,6,7,8,8,9,9,10,10,11,11)

x = m^2 / (m^2 - 4)

y = c(
6565.60,6562.10,6561.62,6560.70,6559.50,
4863.94,4860.74,4860.16,4859.80,4859.74,
4342.80,4340.10,4338.60,4103.80,4101.20,
4100.00,3969.00,3887.50,3887.00,3834.00,
3834.00,3795.00,3795.00,3767.50,3769.00)

coef(lm(y ~ 0 + x))
```

The result is

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3645.296
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which is a little bit smaller than Balmer’s value.

The actual value is now known to be

$$\frac{4}{R_H} = 3647.05 \times 10^{-10}\,\text{meter}$$

where R_H is the Rydberg constant for hydrogen

$$R_H = 1.09677576 \times 10^7\,\text{meter}^{-1}$$

R_H was obtained by Googling “rydberg constant for hydrogen.”

Balmer’s paper in German can be found here:
`https://babel.hathitrust.org/cgi/pt?id=wu.89048352553&view=1up&seq=94`