1. Find all the real solutions $x$ of the equation

$$\sqrt{(x + 1972098 - 1986)/(x + 986049)} + \sqrt{(x + 1974085 - 1988)/(x + 986049)} = 1$$

where $\sqrt{}$ indicates the non-negative square root.

2. Find all the real-valued functions $f$ defined on the set $D$ of natural numbers $x \geq 10$ and satisfying the functional equation

$$f(x + y) = f(x)f(y)$$

for all $x, y \in D$.

3. Find a pair of integers $r, s$ such that $0 < s < 200$ and

$$\frac{45}{61} \frac{s}{r} \frac{59}{80}.$$ 

Also prove that there is exactly one such pair $r, s$. 

4. The triangle ABC has orthocentre H. The feet of the perpendiculars from H to the internal and external bisectors of angle BAC (which is not a right angle) are P and Q. Prove that PQ passes through the middle point of BC.

5. Numbers \( d(n, m) \) with \( m, n \) integers, \( 0 \leq m \leq n \), are defined by

\[
d(n, 0) = d(n, n) = 1 \quad \text{all } n \geq 0
\]

and

\[
md(n, m) = md(n-1, m) + (2n - m) d(n-1, m-1)
\]

for \( 0 < m < n \). Prove that all the \( d(n, m) \) are integers.

6. Show that the least positive value of

\[
\frac{x^2 + y^2}{y},
\]

where \( x, y \) are real numbers such that

\[
7x^2 + 3xy + 3y^2 = 1,
\]

is \( \frac{1}{2} \).

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REMEMBER: A FRESH SHEET FOR EACH QUESTION WITH NAME AND QUESTION NUMBER ON EVERY SHEET