1. Firstly, we factorise the left hand side of the equation.

$$3x^2 - 8xy + 4y^2 = (3x - 2y)(x - 2y)$$

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and so on. There are four solutions in total: $(4, 5)$, $(-4, -5)$, $(4, 3)$ and $(-4, -3)$.

2. Complete the square, then take difference of two squares. Answers are $(x^2 - 2x + 2)(x^2 + 2x + 2)$ and $(x^2 - $

$$\sqrt{2}x + 1)(x^2 + \sqrt{2}x + 1).$$

3. Suppose $x \le y \le z$. Then $5=8 = 1=x + 1=y + 1=z \le 3=x$, fo $x < 5$. This means there are only 4 possible values for x.

   $x = 1$: No solution

   $x = 2$: Solve $1=y + 1=z = 1=8$. So $8 \le y \le 2 \cdot 8$. Testing y values in this range gives $(9, 72)$ and $(10, 40)$

   $x = 3$: Solve $1=y + 1=z = 7=24$. Since $1=4 < 1=y + 1=z < 1=3$. So $3 \le y \le 2 \cdot 4$. Testing y values in this range gives $(4, 24)$ and $(6, 8)$

   $x = 4$: Solve $1=y + 1=z = 3=8$. Answers $(3, 24)$ and $(4, 8)$

4. The octagon is not regular!

5. Treat it as an arithmetic progression. Answer is 4.

6. (a) $(7) = 2$, $(10) = 4$ and $(25) = 3$.

(b) If $\tau(m) = 2$, m is a prime; if $\tau(m)$ is odd, then m is a square.

(c) Use the prime factorisation of n. If $n = p_1^{\alpha_1} p_2^{\alpha_2} \cdots p_k^{\alpha_k}$ for distinct primes, $p_1, \ldots, p_k$, then $\tau(n) = (\alpha_1 + 1)(\alpha_2 + 1) \cdots (\alpha_k + 1)$.

Senior Questions

1. Use partial fractions to express S as a telescoping sum. Thus $\dfrac{1}{(3n-2)(3n+1)} =$