12. We'll try to find regular polygons that when stacked radially around a central vertex cover the whole $360°$. For any such regular polygon, assume that we stack n copies. Then, the internal angle of that polygon must be equal to $(360/n)°$. In other words, we are on a quest to finding out integers that divide 360 and can be candidates for being internal angles of regular polygons. We can achieve this by doing two things: (a) listing all the factors of 360 and finding those that can be written in the form $180 - 360/m$, which is the formula for the internal angle of a regular m sided polygon. It turns out (although not demonstrated here on account of sheer laziness) that the only integers that satisfy this requirement are 60, 90 and 180, which are of course the internal angles of equilateral trianges, squares and regular hexagons respectively. This concludes the proof.

13. Consider the set of all linear combinations of the form $x_1n_1 + x_2n_2 + ... + x_sn_s$. Clearly, the integers $abs(n_1)$, $abs(n_2)$, ... $abs(n_s)$ themselves belong to this set. Now consider the smallest positive integer c that belongs to this set. Clearly, $c <= abs(n_1)$, $c <= abs(n_2)$, ... and $c <= abs(n_s)$. Consider the remainder r obtained by dividing $abs(n_1)$ by c. We can write r as $abs(n_1) - qc$ for some quotient q. Since $abs(n_1)$ and c can both be written in the linear combination form above, so too can r. However, since c is the smallest positive such linear combination, r cannot be positive. In other words, we must have $r = 0$, or equivalently, $c|abs(n_1)$. We can similarly derive that $c|abs(n_2)$, ... and $c|abs(n_s)$. This tells us that c is a common divisor of n_1, n_2, ... and n_s. In particular $c|d$, where $d = GCD(n_1, n_2, ...n_s)$. Since c can be expressed as a linear combination of the above form, so too can d. This concludes the proof. In fact, since d must divide all integers of the linear combination form above, we must have $d|c$, which leads us to the conclusion that $c = d$.

17. The proof is a special case of proof for exercise 18. Replace m and n both with 2.

18. Assume that $\sqrt[n]{m}$ is rational i.e. can be expressed as a ratio of integers a/b. We'll prove that this leads to a contradiction. Raise both sides of the equation to the nth power. This yields $m = a^n/b^n$. The prime factorization of a^n and b^n must contain primes raised to an integer that is a multiple of n. Even as the primes in the numerator and denominator cancel out to yield m (on the LHS), the resulting prime factorization must still contain primes raised to an integer that is a multiple of n. This implies that m is the nth power of some integer, which contradicts what we have been told about m. This concludes the proof.