1. What is the smallest positive even integer that is a multiple of 11?

Proposed by Evan Zhang.

Answer: $\boxed{22}$

Solution: If our integer is even, it must be a multiple of 2. The smallest integer that is both a multiple of 2 and 11 is $2 \cdot 11 = \boxed{22}$.

2. What is the smallest positive perfect square that is divisible by 8?

Proposed by Sam Easaw.

Answer: $\boxed{16}$

Solution: For a perfect square to be divisible by 8, it needs to be the square of a multiple of 4. The smallest multiple of 4 is 4, and $4^2 = \boxed{16}$.

3. What is the sum of the smallest and largest 2-digit integers whose squares end in a 6?

Proposed by Evan Zhang.

Answer: $\boxed{110}$

Solution: The only way for a square k^2 to end in a 6 is if k has units digit 4 or 6. It is easy to check that the other possible units digits of k give k^2 a units digit that is not 6. Thus, the smallest 2-digit integer that ends in a 4 or 6 is 14, and the largest is 96, so the answer is $14 + 96 = \boxed{110}$.

4. Kenneth is thinking of a 3-digit number. When he removes the units digit of the number, his new number is divisible by 15. When he removes the hundreds digit of the number, his new number is still divisible by 15. What is the largest possible 3-digit number that Kenneth could be thinking of?

Proposed by Sam Easaw.

Answer: $\boxed{900}$

Solution: Let the number when he removes the units digit be U and the number when he removes the hundreds digit be H. Consider that U and H must have a units digit of either 0 or 5, since they are divisible by 15. If U has units digit 5, then H can be either 50 or 55, but since neither of these are divisible by 15, U must have units digit of 0. Thus H can either be 00 or 05, so H is just 00. We can now pick a hundreds digit that maximizes U. Since 90 is the largest 2-digit multiple of 15 that ends in 0, the answer is $\boxed{900}$.

5. Mr. Kirk is playing a card game that involves dealing out an entire deck of cards evenly among all players. When Mr. Kirk plays a 3-player, 4-player, or 5-player game, he has 1 card left over after distributing the cards. What is the smallest possible size of his deck?

Proposed by William Roe.

Answer: $\boxed{61}$

Solution: Let the smallest size of the deck be N. Note that if Mr. Kirk instead had $N - 1$ cards, he would be able to distribute all of his cards equally. The smallest amount of cards that satisfies this condition is $\text{lcm}(3, 4, 5) = 3 \cdot 4 \cdot 5 = 60$, where lcm is the least common multiple. Thus, the answer is $N = 60 + 1 = \boxed{61}$.

6. A semiprime is a number that is the product of two distinct primes. Yunyi takes the product of two semiprimes and finds the resulting number has n factors. What is the sum of all possible values of n?

Proposed by Evan Zhang.

Answer: $\boxed{37}$

Solution: Let one semiprime be $m = p \cdot q$ and the other be $n = r \cdot s$, for some primes $p \neq q$ and $r \neq s$. Thus, $mn = pqrs$. We can split this product into three cases:

- If $p \neq q \neq r \neq s$, then $mn = pqrs$ has $n = 2^4 = 16$ factors.
- If $p = r, q \neq s$, then $mn = p^2qs$ has $n = 3 \cdot 2^2 = 12$ factors.
- If $p = r, q = s$, then $mn = p^2q^2$ has $n = 3^2 = 9$ factors.

Thus, the answer is $16 + 12 + 9 = \boxed{37}$.

7. How many positive integer divisors of 20^{26} have an odd number of divisors?

Proposed by Siyuan Yan.

Answer: $\boxed{378}$

Solution: Note that $20^{26} = (4 \cdot 5)^{26} = 2^{52} \cdot 5^{26}$. All factors of this number can be expressed as $d = 2^m 5^n$, for some $0 \leq m \leq 52$ and $0 \leq n \leq 26$. The number of divisors of d is given by $(m+1)(n+1)$. For this number to be odd, m and n must both be even, as $m+1$ and $n+1$ will both be odd. Thus, we can choose m from $0, 2, \ldots, 52$, and n from $0, 2, \ldots, 26$. We thus have 27 possible values of m and 14 possible values of n, giving an answer of $27 \cdot 14 = \boxed{378}$.

8. Let $S(n)$ denote the sum of digits of n. How many positive integers $k < 1000$ exist such that there exists some positive integer n that satisfies $k = n - S(n)$?

Proposed by Tane Park.

Answer: $\boxed{99}$

Solution: Each time n increases by 1, $S(n)$ either increases by 1 as well by increasing the units digit, or decreases by carrying the units digit when the units digit is 9. Now, consider $n - S(n)$. Note that when the units digit of n is not 9, we see that $(n+1) - S(n+1) = n + 1 - (S(n) + 1) = n - S(n)$. When the units of n is 9, digit carry happens, so $S(n)$ decreases whereas n increases and thus the value of $n - S(n)$ must always strictly increase. Thus, we can say that $n - S(n)$ is a non-decreasing quantity. Now, we can note that the sets

$$\{1, ..., 9\}, \{10, ..., 19\}, ..., \{990, \ldots, 999\}, \{1000, \ldots, 1009\}$$

each produce a unique value less than or equal to 1000:

$$0, 9, \ldots, 972, 999$$

as each successive set represents one digit carry, increasing the value of $n - S(n)$. Here, every set except for the first set produces a positive value, and every set after the last set will produce a value greater than 1000. Therefore, our answer is $(1000/10) - 1 = \boxed{99}$.