E 1. $x^2 - 15x - 54 = (x - 18)(x + 3)$. No equation is satisfied by 18, and -3 satisfies only $6x + 15 = 2x + 3$.

B 2. For an angle a, $180 - a = k(90 - a)$ or $a = \frac{90k - 180}{k - 1}$. If k = 2, a = 0, so k > 2. If k = 3, a = 45°.

D 3. Since hypotenuse PR in right ΔPQR is twice leg PQ, ΔPQR is a 30-60 right triangle with ∠QRP = 30° and $QR = \sqrt{3}$. The same argument shows ∠SRP = 30°, so ΔSQR is equilateral and $SQ = QR = \sqrt{3}$.

D 4. $16^{-2} = .00390625$ and $16^{-2.25} = .001953125$, so $\log_{16} .002$ is closer to -2.5 than any other choice.

E 5. The parallelogram which is their intersection has base the hypotenuse of a 30-60 right triangle with longer leg 60 ft, and altitude 50 ft. The base is then $\frac{120}{\sqrt{3}}$ ft and the area is $\frac{120(50)}{\sqrt{3}}$ or about 3464 sq ft.

A 6. The larger kitten must weigh half of 12 lb (since its weight equals the other 2), the smaller kitten must weigh a third of 12 lb (since its weight is half the other 2), so the puppy must weigh 12 - 6 - 4 = 2 lb.

B 7. If R is the final result, $(R - 2) + (R + 2) + (R/2) + 2R = 45$ and $R = 45(2/9) = 10$. The numbers are then 8, 12, 5, and 20 with a product of 9600.

D 8. Since 2002 = 2(7)(11)(13), its positive integer factors are 1, 2, 7, 11, 13, 2(7), 2(11), 2(13), 7(11), 7(13), 11(13), 2(7)(11), 2(7)(13), 2(11)(13), 7(11)(13). The palindromes are 1, 2, 7, 11, 22, 77, 1001.

B 9. Draw the diameter of the larger circle which passes through the center of the smaller circle. The required segment goes from the larger to the smaller circle along this diameter and has length b - a - d.

A 10. The set can be rewritten as $\{24^{1000}, 28^{1000}, 32^{1000}, 27^{1000}, 25^{1000}\}$, so the first one is smallest.

C 11. There is one ending 0 in n! for every factor of 5 in every number ≤ n, so the number of ending zeros for n! is n/5 + n/25 + n/125 + ... (all rounded down). A little trial and error shows n = 360.

A 12. Solving the equations $p + j + s = 60$ and $30p + 80j + 120s = 4400$ simultaneously yields $p = 8 + 0.8s$ and $j = 52 - 1.8s$. If $j \ge 0$, $s \le 260/9$, so $s \le 28$. But 25 is the largest value of s for which p is an integer.

C 13. Since $\cos 3x \cos x - \sin 3x \sin x = \cos(3x + x)$, the equation is equivalent to $\cos 4x = 0$. Thus 4x is an odd multiple of $\pi/2$, and x is an odd multiple of $\pi/8$. The interval $[-8\pi, 8\pi]$ has 64 such multiples.

D 14. If the triangle's legs are s and $\sqrt{K}$, then $s + \sqrt{K} + \sqrt{s^2 + K} = K$ and $(1/2)s\sqrt{K} = K$. But this implies $s = 2\sqrt{K}$. Substitution yields $3\sqrt{K} + \sqrt{5K} = K$, so $K = (3 + \sqrt{5})^2 = 14 + 6\sqrt{5}$, and a + b + c = 25.

D 15. To leave a remainder of 1 on division by 2, 3, 4, 5, and 6, the number must be 1 more than a multiple of 60. The smallest such number divisible by 7 is 301, whose largest prime factor is 43.

E 16. There are 10(9)(8) = 720 ways to select 3 different digits, but only 1/6 of them, or 120, have nondecreasing order. There are 90 ways to select 2 different digits, with half having nondecreasing order. The digits a,b produce 2 sequences, a,a,b or a,b,b, for 90 more. Finally, there are 10 sequences a, a, a.

C 17. Since AMA > TYC and AMA - TYC < 10, A = T + 1. Also, M = 0 and Y = 9 (otherwise, the difference ≥ 10). The uniqueness condition eliminates AMA = 808, 707, 606, and the only solutions are 505 - 498 or 497, 404 - 398 or 396, 303 - 298, 297, 296, or 295, and 202 - 198, 197, 195, or 194.

B 18. ΔDCF is similar to each of the 3 small triangles formed by the intersection of the 2 rectangles. Solving a few similarity proportions shows the required region to be a trapezoid with height 12 and bases 40 and 15. Its area is thus 12(40 + 15)/2 or 330.

B 19. The required region is an isosceles right triangle with hypotenuse 20 ft, a three-quarter circle with radius 20 ft, and two 135° sectors with radii $20 - 10\sqrt{2}$ ft (forming another three-quarter circle). The total area is $\frac{1}{2}(10\sqrt{2})^2 + \frac{3}{4}(400\pi) + \frac{3}{4}\pi(20 - 10\sqrt{2})^2 = 100 + 750\pi - 300\pi\sqrt{2}$, or about 1123 sq ft.

E 20. P(the numbers are different) = 8/9 (since for each first number, there are 8 different second numbers). P(the numbers are different if they add to k) is 1, if k is odd (since two numbers with odd sum are never equal), and (k-2)/(k-1) if k is even (since of the k-1 such sums, exactly one of them has two equal values). Independence means the two probabilities are equal, but this cannot happen if the second one is 1; thus k is even, and (k-2)/(k-1) = 8/9, meaning k = 10.