1. **A**. There are 3! ways of ordering the topics and 3!, 4! and 3! ways of ordering the individual topics. (3!)(3!)(4!)(3!)

2. **B**. There are 9x10x10x10x10=90000 5-digit numbers, half of which (45000) are even.

3. **C**. All digits must be distinct and any set of 5-digits can be put in order in only one way so the answer is $\binom{10}{5} = 252$

4. **C**. $240 = 2^4 \bullet 3 \bullet 5$, so in factors there are 5 choices for a power of 2 (0,1,2,3,4), 2 choices for a power of 3 and 2 for 5. 5x2x2=20.

5. **B**. From any given vertex, one can draw 3 rectangles (ABEF, ADEH and ACEG) multiply by 8 vertices and divide by the 4 vertices in each rectangle 3x8/4=6.

6. **C**. Three distinct triangles can be drawn with a given vertex at the right angle. 3x8=24.

7. **B**. Ten letters are to be permuted but the two 'A's can appear in any order without distinction. 10!/2 = 5(9!).

8. **B**. Using at most one of the A's there are 9x8x7=504 ways. Using both A's, there are 8 letters to choose for the third letter and 3 ways to permute them, 3x8=24. Total 504+24=528.

9. **A**. Of the 8 steps, 4 must be to the right and 4 up and any combination of these will work. So $\binom{8}{4} = 70$

10. **D**. There are two possibilities: 5 steps to the right, 1 to the left and 4 up or 4 steps to the right, 5 up and 1 down. So the answer is $2\frac{10!}{4!5!1!} = 2520$

11. **D**. There are four possibilities. The first has 2 steps to the right, 2 up and 2 diagonally up-right = 6!/(2!2!2!)=15. The others include 4 diagonal steps up-right and either an up-down, 6!/(4!1!1!)=30; left-right, 30; or diagonal up and back, 6!/(5!1!)=6 for a total of 81.

12. **E**. Add three balloons to the allotment so that everyone will get at least one. Lining up the 13 balloons, choose 2 of the 12 gaps between balloons. This corresponds to a division of the balloons. $\binom{12}{2} = 66$

13. **D**. Solve (as in the previous problem) the division of each color and then multiply. $\binom{5}{2}\binom{5}{2}\binom{6}{2} = (10)(10)(15) = 1500$

14. **A**. This is the so called "hockey-stick" formula from Pascal's Triangle. The sum $= \binom{12}{9} = \frac{12x11x10}{3x2} = 220$

15. **E**. The sum of the exponents of any term will be 6, so this problem is equivalent to dividing 6 factors among 3 variables. $\binom{8}{2} = 28$

16. **B**. There are 5C2=10 ways of picking the two teachers that must get their seat right. There are only two ways the other 3 can sit so that they're all in the wrong seat (BCA, CAB). 10x2=20

17. A. The last 4 flips must be THHH. There are 16 possibilities for the first 4 flips but HHHH, HHHT and THHH all result in a sequence of three heads. 16 – 3 = 13.

18. **B**. There are two possibilities for the first person – inside or outside. The other 7 can be place in 7! ways. 2x7! = 10080.

19. **C**. There are 7 kinds of food and he must choose 5 of them. 7 choose 5 = 21.

20. **B**. There are 3 ways to get the 5 servings: 5 different veg. (7C5); 2 servings of 1 kind and 1 of 3 others (7C1)(6C3) or 2 of 2 kinds and 1 of a third (7C2)(5C1). Adding, you get 266.

21. **E**. The digit 5 must be picked and of the digits 1, 2, 3 and 4 you pick two and also two from 6, 7, 8 and 9. Once picked there are 5!=120 numbers that can be made. 6x6x120 = 4320.

22. **C**. This is the partition problem. In this case, the easiest way to solve it is via a list: 9+2+1, 8+3+1, 7+4+1, 7+3+2, 6+5+1, 6+4+2, 5+4+3.

23. **B**. There are 2 partitions of 5 that will work: 2+2+1 means that of the 4 boxes, we choose 2 to get balls and of the remaining 2 boxes, I choose 1 to get a ball. 4C2 x 2C1 = 6 x 2 = 12. The other partition is 2+1+1+1 and there are 4 ways of choosing the box that gets 2 balls. 12+4=16.

24. **C**. Treat "ABC" as 1 big letter. There are 24 ways of permuting ABC, A, B, and C. However, two are indistinguishable: ABC A B C and A B C ABC leaving 23.

25. **B**. There are 1260 ways total 7!/(2!2!) with 180 starting with 'A', 360 starting with 'E', 180 starting with 'L' , 180 with 'S' and 360 beginning with 'T'. The 900^{th} word will be the last word starting with 'S' or STTLEEA.

26. **E**. There are 6! ways of rolling 5 different numbers and 5! ways of each straight. 6! – 2x5! = 480.

27. **A**. A must be in the subset and B cannot be. C can either be in the subset of not (2 possibilities) – same for D, E, F and G. 2^5 = 32.

28. **A**. If a double is drawn (7 ways) it matches with 6 others. 6x7=42. If something other than a double is drawn (21 ways) then it matches with 12 others. 21x12=252. But each pair was counted twice, so the answer is (42+252)/2=147.

29. **B**. One could start with 1 dog, 1 cat, notice that there is only 1 permutation, CD or 1/2 the possible permutations. With 2 each there are 2, (CCDD and CDCD) or 1/3 the possibilities; etc. The answer is then (1/6)(10C5) = 42.
OR – consider a sequence for which there are more dogs than cats at some point n=2k+1 (at 2k there are an equal number). In this sub-sequence, switch the k+1 D's to C's and vice versa getting a total sequence of 10 with 4 D's and 6 C's. On the other hand, take any sequence of 6 C's and 4 D's and stop when there is one more C than D (this must happen by the 9^{th} letter). Now reverse the C's and D's again and you get a sequence of 5 each that has more Dogs than Cats at some point. The number of good permutations is then 10C5 – 10C6 = 42.

30. **D**. The number of girls is 2, 3 or 4 and boys 2, 1 or 0 respectively. (4C2)(6C2) + (4C3)(6C1) + (4C4)(6C0) = (6)(15)+(4)(6)+(1)(1)=115