1. $P(4, 2) = 4 \cdot 3 = 12$

2. $P(5, 1) = 5 = 5$

3. $P(6, 3) = 6 \cdot 5 \cdot 4 = 120$

4. $P(5, 4) = 5 \cdot 4 \cdot 3 \cdot 2 = 120$

5. $C(10, 3) = \dfrac{P(10, 3)}{3!} = \dfrac{10 \cdot 9 \cdot 8}{3 \cdot 2 \cdot 1} = 120$

6. $C(12, 2) = \dfrac{P(12, 2)}{2!} = \dfrac{12 \cdot 11}{2 \cdot 1} = 66$

7. $C(5, 4) = \dfrac{P(5, 4)}{4!} = \dfrac{5 \cdot 4 \cdot 3 \cdot 2}{4 \cdot 3 \cdot 2 \cdot 1} = 5$

8. $C(6, 3) = \dfrac{P(6, 3)}{3!} = \dfrac{6 \cdot 5 \cdot 4}{3 \cdot 2 \cdot 1} = 20$

9. $P(7, 1) = 7$

10. $P(5, 5) = 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 120$

11. $P(n, 1) = n$

12. $P(n, 2) = n \cdot (n-1) = n^2 - n$

13. $C(4, 4) = \dfrac{P(4, 4)}{4!} = \dfrac{4 \cdot 3 \cdot 2 \cdot 1}{4 \cdot 3 \cdot 2 \cdot 1} = 1$

14. $C(n, 2) = \dfrac{P(n, 2)}{2!} = \dfrac{n \cdot (n-1)}{2 \cdot 1} = \dfrac{n(n-1)}{2}$

15. $$\begin{aligned} C(n, n-2) &= \frac{P(n, n-2)}{(n-2)!} \\ &= \frac{n \cdot (n-1) \cdots 4 \cdot 3}{(n-2) \cdot (n-3) \cdots 2 \cdot 1} \\ &= \frac{n \cdot (n-1)}{2 \cdot 1} \\ &= \frac{n(n-1)}{2} \end{aligned}$$

16. $C(n, 1) = \dfrac{P(n, 1)}{1!} = \dfrac{n}{1} = n$

17. $6! = 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 720$

18. $$\begin{aligned} \frac{10!}{4!} &= \frac{10 \cdot 9 \cdot 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}{4 \cdot 3 \cdot 2 \cdot 1} \\ &= 10 \cdot 9 \cdot 8 \cdot 7 \cdot 6 \cdot 5 \\ &= 151,200 \end{aligned}$$

19. $\dfrac{9!}{7!} = \dfrac{9 \cdot 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}{7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1} = 9 \cdot 8 = 72$

20. $7! = 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 5040$

21. Permutation; order matters

22. Permutation; order matters

23. Combination; order does not matter

24. Permutation; order matters

25. Neither

26. Neither

27. $4! = 4 \cdot 3 \cdot 2 \cdot 1 = 24$ ways

28. $6! = 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 720$ ways

29. $C(9,7) = \dfrac{P(9,7)}{7!} = \dfrac{9 \cdot 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3}{7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1} = 36$ selections

30. $C(5,3) = \dfrac{P(5,3)}{3!} = \dfrac{5 \cdot 4 \cdot 3}{3 \cdot 2 \cdot 1} = 10$ pizzas

31. $C(8,4) = \dfrac{P(8,4)}{4!} = \dfrac{8 \cdot 7 \cdot 6 \cdot 5}{4 \cdot 3 \cdot 2 \cdot 1} = 70$ ways

32. $$\begin{aligned} C(100,5) &= \frac{P(100,5)}{5!} \\ &= \frac{100 \cdot 99 \cdot 98 \cdot 97 \cdot 96}{5 \cdot 4 \cdot 3 \cdot 2 \cdot 1} \\ &= 75,287,520 \text{ ways} \end{aligned}$$

33. $$\begin{aligned} P(65,5) &= 65 \cdot 64 \cdot 63 \cdot 62 \cdot 61 \\ &= 991,186,560 \text{ ways} \end{aligned}$$

34. $$\begin{aligned} P(36,5) &= 36 \cdot 35 \cdot 34 \cdot 33 \cdot 32 \\ &= 45,239,040 \text{ ways} \end{aligned}$$

35. $C(10,5)=\dfrac{P(10,5)}{5!}=\dfrac{10\cdot 9\cdot 8\cdot 7\cdot 6}{5\cdot 4\cdot 3\cdot 2\cdot 1}=252$ ways

36. $C(8,4)=\dfrac{P(8,4)}{4!}=\dfrac{8\cdot 7\cdot 6\cdot 5}{4\cdot 3\cdot 2\cdot 1}=70$ ways

37. $C(100,3)=\dfrac{P(100,3)}{3!}=\dfrac{100\cdot 99\cdot 98}{3\cdot 2\cdot 1}=161,700$ possible samples

$C(7,3)=\dfrac{P(7,3)}{3!}=\dfrac{7\cdot 6\cdot 5}{3\cdot 2\cdot 1}=35$ defective samples

38. $C(17,10)=\dfrac{P(17,10)}{10!}=\dfrac{17\cdot 16\cdot 15\cdot 14\cdot 13\cdot 12\cdot 11\cdot 10\cdot 9\cdot 8}{10\cdot 9\cdot 8\cdot 7\cdot 6\cdot 5\cdot 4\cdot 3\cdot 2\cdot 1}=19,448$ possibilities

39. $P(150,3)=150\cdot 149\cdot 148=3,307,800$ ways

40. $5!=5\cdot 4\cdot 3\cdot 2\cdot 1=120$ ways

41. $C(52,5)=\dfrac{P(52,5)}{5!}=\dfrac{52\cdot 51\cdot 50\cdot 49\cdot 48}{5\cdot 4\cdot 3\cdot 2\cdot 1}=2,598,960$ hands

42. $C(8,5)=\dfrac{P(8,5)}{5!}=\dfrac{8\cdot 7\cdot 6\cdot 5\cdot 4}{5\cdot 4\cdot 3\cdot 2\cdot 1}=56$ hands

43. $C(13,5)=\dfrac{P(13,5)}{5!}=\dfrac{13\cdot 12\cdot 11\cdot 10\cdot 9}{5\cdot 4\cdot 3\cdot 2\cdot 1}=1287$ hands

44. $C(26,5)=\dfrac{P(26,5)}{5!}=\dfrac{26\cdot 25\cdot 24\cdot 23\cdot 22}{5\cdot 4\cdot 3\cdot 2\cdot 1}=65,780$ hands

45. $5!=5\cdot 4\cdot 3\cdot 2\cdot 1=120$ ways

46. $P(6,3)=6\cdot 5\cdot 4=120$ signals

47. **a.** $C(10,4)=\dfrac{P(10,4)}{4!}=\dfrac{10\cdot 9\cdot 8\cdot 7}{4\cdot 3\cdot 2\cdot 1}=210$ ways

b. $C(10,6)=\dfrac{P(10,6)}{6!}=\dfrac{10\cdot 9\cdot 8\cdot 7\cdot 6\cdot 5}{6\cdot 5\cdot 4\cdot 3\cdot 2\cdot 1}=210$ ways

c. They are the same because taking four sweaters is the same as leaving 6 sweaters.

48. **a.** $C(12,3)\cdot C(9,4)=\dfrac{P(12,3)}{3!}\cdot\dfrac{P(9,4)}{4!}=\dfrac{12\cdot 11\cdot 10}{3\cdot 2\cdot 1}\cdot\dfrac{9\cdot 8\cdot 7\cdot 6}{4\cdot 3\cdot 2\cdot 1}=220\cdot 126=27,720$ ways

b. $C(12,4)\cdot C(8,3)=\dfrac{P(12,4)}{4!}\cdot\dfrac{P(8,3)}{3!}=\dfrac{12\cdot 11\cdot 10\cdot 9}{4\cdot 3\cdot 2\cdot 1}\cdot\dfrac{8\cdot 7\cdot 6}{3\cdot 2\cdot 1}=495\cdot 56=27,720$ ways

c. The order of giving the books does not matter.

49. $C(8,\ 2) = \dfrac{P(8,\ 2)}{2!}$
$= \dfrac{8 \cdot 7}{2 \cdot 1}$
$= 28$ games

50. $3C(6,\ 2) = \dfrac{3P(6,\ 2)}{2!}$
$= \dfrac{3 \cdot 6 \cdot 5}{2 \cdot 1}$
$= 45$ games

51. $26C(69,\ 5) = \dfrac{26P(69,\ 5)}{5!}$
$= \dfrac{26 \cdot 69 \cdot 68 \cdot 67 \cdot 66 \cdot 65}{5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}$
$= 292,201,338$ outcomes

52. $4! \, 5 \cdot 4! = 4 \cdot 3 \cdot 2 \cdot 1 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$
$= 2880$ batting orders

53. $\dfrac{C(59,6)}{C(49,6)} = \dfrac{45,057,474}{13,983,816} \approx 3.22$ Choice (b)

54. You buy (2)(110) = 220 tickets per week
$\dfrac{C(59,6)}{220} = \dfrac{45,057,474}{220} \approx 204,806.7$ weeks or
3938.6 years; choice (d)

55. Moe: $C(10,\ 3) = \dfrac{P(10,\ 3)}{3!}$
$= \dfrac{10 \cdot 9 \cdot 8}{3 \cdot 2 \cdot 1}$
$= 120$ choices

Joe: $C(7,4) = \dfrac{P(7,4)}{4!}$
$= \dfrac{7 \cdot 6 \cdot 5 \cdot 4}{4 \cdot 3 \cdot 2 \cdot 1}$
$= 35$ choices

Thus Joe is correct.

56. $4 \cdot 4 \cdot 4 \cdot C(9,3) = 4 \cdot 4 \cdot 4 \cdot \dfrac{P(9,3)}{3!}$
$= 4 \cdot 4 \cdot 4 \cdot \dfrac{9 \cdot 8 \cdot 7}{3 \cdot 2 \cdot 1}$
$= 64 \cdot 84$
$= 5376$ ways

57. $4! \, P(4,3) \cdot P(5,3) \cdot P(6,3) \cdot P(7,3)$
$24 \cdot 24 \cdot 60 \cdot 120 \cdot 210 = 870,912,000$ pictures

58. $5! \ 3! \ 3! \ 3! \ 3! \ 3!$
$120 \cdot 6 \cdot 6 \cdot 6 \cdot 6 \cdot 6 = 933,120$ ways

59. $3! \ 3! \ 3! \ 3!$
$6 \cdot 6 \cdot 6 \cdot 6 = 1296$ ways

60. $3! \ 4! \ 4! \ 4!$
$6 \cdot 24 \cdot 24 \cdot 24 = 82,944$ ways

61. Through trial are error, you will find that 10 people were at the party.

62. Through trial are error, you will find that 11 teams are in the league.

63. $C(15,3) + (15 \cdot 14) + 15 = 455 + 210 + 15$
$= 680$ side dish options

64. $C(16,3) + (16 \cdot 15) + 16 = 560 + 240 + 16$
$= 816$ possibilities

65. $720 - 3! - 5!$
$720 - 6 - 120 = 594$

66. $5^5 - 5 \cdot 5 \cdot 3 \cdot 1 \cdot 1 = 3125 - 75 = 3050$

67. **a.** $C(45,5) = 1,221,759$ possible lottery tickets

b. $C(100,4) = 3,921,225$ possible lottery tickets

c. The first lottery has a better chance of winning

68. **a.** $\dfrac{C(48,9)}{C(52,13)} \approx 0.00264 = 0.264\%$

b. $\dfrac{C(44,9)}{C(52,13)} \approx 0.00112 = 0.112\%$