13 CHAPTER

Probability, Permutation and Combination

DIRECTIONS (Qs. 1-5) : Study the given information carefully and answer the questions that follow :

Anurn contains 6 red, 4 blue, 2 green and 3 yellow marbles.

(SBI Rural Bus. PO 2010)

1. If four marbles are picked at random, what is the probability that at least one is blue?

   (a) $\frac{4}{15}$ (b) $\frac{69}{91}$

   (c) $\frac{11}{15}$ (d) $\frac{22}{91}$

   (e) None of these

2. If two marbles are picked at random, what is the probability that both are red?

   (a) $\frac{1}{6}$ (b) $\frac{1}{3}$

   (c) $\frac{2}{15}$ (d) $\frac{2}{5}$

   (e) None of these

3. If three marbles are picked at random, what is the probability that two are blue and one is yellow?

   (a) $\frac{3}{31}$ (b) $\frac{1}{5}$

   (c) $\frac{18}{455}$ (d) $\frac{7}{15}$

   (e) None of these

4. If four marbles are picked at random, what is the probability that one is green, two are blue and one is red?

   (a) $\frac{24}{455}$ (b) $\frac{13}{35}$

   (c) $\frac{11}{15}$ (d) $\frac{1}{3}$

   (e) None of these

5. If two marbles are picked at random, what is the probability that either both are green or both are yellow?

   (a) $\frac{5}{91}$ (b) $\frac{1}{35}$

   (c) $\frac{1}{3}$ (d) $\frac{4}{105}$

   (e) None of these

DIRECTIONS (Qs. 6-8) : Study the given information carefully and answer the questions that follow :

A basket contains 4 red, 5 blue and 3 green marbles.

(SBI Associates Bank PO 2010)

6. If three marbles are picked at random, what is the probability that either all are green or all are red ?

   (a) $\frac{7}{44}$ (b) $\frac{7}{12}$

   (c) $\frac{5}{12}$ (d) $\frac{1}{44}$

   (e) None of these

7. If two marbles are picked at random, What is the probability that both are red ?

   (a) $\frac{3}{7}$ (b) $\frac{1}{2}$

   (c) $\frac{2}{11}$ (d) $\frac{1}{6}$

   (e) None of these

8. If three marbles are picked at random, What is the probability that at least one is blue ?

   (a) $\frac{7}{12}$ (b) $\frac{37}{44}$

   (c) $\frac{5}{12}$ (d) $\frac{7}{44}$

   (e) None of these

DIRECTIONS (Qs. 9-10) : Study the given information carefully and answer the questions that follow :

A committee of five members is to be formed out of 3 trainees, 4 professors and 6 research associates. In how many different ways can this be done if : **(SBI Associates Bank PO 2010)**

9. The committee should have all 4 professors and 1 research associate or all 3 trainees and 2 professors ?

   (a) 12 (b) 13

   (c) 24 (d) 52

   (e) None of these

10. The committee should have 2 trainees and 3 research associates ?

    (a) 15 (b) 45

    (c) 60 (d) 9

    (e) None of these

11. In how many different ways can the letters of the word 'SECOND be arranged ? **(SBI Clerk 2011)**

    (a) 720 (b) 120

    (c) 5040 (d) 270

    (e) None of these

12. In how many different ways can the letters of the word 'SIMPLE' be arranged ? **(SBI Clerk 2011)**
(a) 520 (b) 120
(c) 5040 (d) 270
(e) None of these

13. In how many different ways can the letters of the word 'BELIEVE' be arranged ? **(IBPS Clerk 2011)**
(a) 840 (b) 1680
(c) 2520 (d) 5040
(e) None of these

14. In how many different ways can the letters of the word 'VIRTUAL' be arranged among themselves? **(IBPS Clerk 2011)**
(a) 840 (b) 5040
(c) 2520 (d) 1680
(e) None of these

15. In how many different ways can the letters of the word 'MARKERS' be arranged? **(IBPS Clerk 2011)**
(a) 840 (b) 5040
(c) 2520 (d) 1680
(e) None of these

16. In how many different ways can the letters of the word' 'VENTURE' be arranged? **(IBPS Clerk 2011)**
(a) 840 (b) 5040
(c) 1260 (d) 2520
(e) None of these

17. In how many different ways can the letters of the word 'TROUBLE' be arranged ? **(IBPS Clerk 2011)**
(a) 840 (b) 5040
(c) 1260 (d) 2520
(e) None of these

18. Out of five girls and three boys, four children are to be randomly selected for a quiz contest. What is the probability that all the selected children are girls? **(SBI Associates PO 2011)**
(a) $\frac{1}{14}$ (b) $\frac{1}{7}$
(c) $\frac{5}{17}$ (d) $\frac{2}{17}$
(e) None of these

DIRECTIONS (Qs. 19-23) : Study the given information carefully to answer the questions that follow. (SBI PO Mains 2012)

An urn contains 4 green, 5 blue, 2 red and 3 yellow marbles.

19. If four marbles are drawn at random, what is the probability that two are blue and two are red?
(a) $\frac{10}{1001}$ (b) $\frac{9}{14}$
(c) $\frac{17}{364}$ (d) $\frac{2}{7}$
(e) None of these

20. If eight marbles are drawn at random, what is the probability that there are equal number of marbles of each colour ?
(a) $\frac{4}{7}$ (b) $\frac{361}{728}$
(c) $\frac{60}{1001}$ (d) $\frac{1}{1}$
(e) None of these

21. If two marbles are drawn at random, what is the probability that both are red or at least one is red ?
(a) $\frac{26}{91}$ (b) $\frac{1}{7}$
(c) $\frac{199}{364}$ (d) $\frac{133}{191}$
(e) None of these

22. If three marbles are drawn at random, what is the probability that at least one is yellow ?
(a) $\frac{1}{3}$ (b) $\frac{199}{364}$
(c) $\frac{165}{364}$ (d) $\frac{3}{11}$
(e) None of these

23. If three marbles are drawn at random, what is the probability that none is green ? **(IBPS PO 2011)**
(a) $\frac{2}{7}$ (b) $\frac{253}{728}$
(c) $\frac{10}{21}$ (d) $\frac{14}{91}$
(e) None of these

24. Which of the following words can be written in 120 different ways? **(IBPS Bank Clerk 2012)**
(a) STABLE (b) STILL
(c) WATER (d) NOD
(e) DARE

25. In how many different ways can the letters of the word 'CREAM' be arranged ? **(SBI Clerk 2012)**
(a) 720 (b) 240
(c) 360 (d) 504
(e) None of these

26. In how many different ways can the letters of the word 'THERAPY' be arranged so that the vowels never come together ? **(IBPS PO/MT 2012)**
(a) 720 (b) 1440
(c) 5040 (d) 3600
(e) 4800

27. A bag contains 13 white and 7 black balls. Two balls are drawn at random. What is the probability that they are of the same colour ? **(IBPS PO/MT 2012)**
(a) $\frac{41}{190}$ (b) $\frac{21}{190}$
(c) $\frac{59}{190}$ (d) $\frac{99}{190}$
(e) $\frac{77}{190}$

28. In how many ways the letters of the word SACRED can be arranged so that vowels come together ? **(Indian Overseas Bank PO 2013)**
(a) 240 (b) 120
(c) 320 (d) 720
(e) None of these

DIRECTIONS (Qs. 29–31) : Study the information carefully to answer the questions that follow.

A bucket contains 8 red, 3 blue and 5 green marbles. **(IBPS RRB OS 2013)**

29. If 4 marbles are drawn at random, what is the probability that 2 are red and 2 are blue ?

(a) $\frac{11}{16}$ (b) $\frac{3}{16}$

(c) $\frac{11}{72}$ (d) $\frac{3}{65}$

(e) None of these

30. If 2 marbles are drawn at random, what is the probability that both are green ?

(a) $\frac{1}{8}$ (b) $\frac{5}{16}$

(c) $\frac{2}{7}$ (d) $\frac{3}{8}$

(e) None of these

31. If 3 marbles are drawn at random, what is the probability that none is red ?

(a) $\frac{3}{8}$ (b) $\frac{1}{16}$

(c) $\frac{1}{10}$ (d) $\frac{3}{16}$

(e) None of these

DIRECTIONS (Qs. 32-36): From the following, different committees are to be made as per the requirement given in each question. (IBPS RRB OS 2013)

In how many different ways can it be done ?

10 men and 8 women out of which 5 men are teachers, 3 men doctors and 2 businessmen. Among the women, 3 are teachers, 2 doctors, 2 researchers and 1 social worker.

32. A Committee of 5 in which 3 men and 2 women are there

(a) 3360 (b) 8568

(c) 4284 (d) 1680

(e) None of these

33. A Committee of 4 in which at least 2 women are there

(a) 1260 (b) 1820

(c) 3060 (d) 1890

(e) None of these

34. A Committee of 5 in which 2 men teachers, 2 women teach ers and 1 doctor are there

(a) 75 (b) 150

(c) 214 (d) 20

(e) None of these

35. A Committee of 7.

(a) 31824 (b) 1200

(c) 9600 (d) 15912

(e) None of these

36. A Committee of 3 in which there is no teacher and no doctor

(a) 100 (b) 120

(c) 10 (d) 12

(e) None of these

37. A bag contains 7 blue balls and 5 yellow balls. If two balls are selected at random, what is the probability that **none** is yellow? **(SBI PO 2013)**

(a) $\frac{5}{35}$ (b) $\frac{5}{22}$ (c) $\frac{7}{22}$ (d) $\frac{7}{33}$

(e) $\frac{7}{66}$

38. A die is thrown twice. What is the probability of getting a sum 7 from both the throws? **(SBI PO 2013)**

(a) $\frac{5}{18}$ (b) $\frac{1}{18}$ (c) $\frac{1}{9}$ (d) $\frac{1}{6}$

(e) $\frac{5}{36}$

39. In how many different ways can the letters of the word 'LEADING' be arranged in such a way that the vowels always come together? **(IBPS PO/MT 2014)**

(a) 360 (b) 480

(c) 720 (d) 5040

(e) None of these

40. In a class, there are 15 boys and 10 girls. Three students are selected at random. The probability that 1 girl and 2 boys are selected, is: **(IBPS PO/MT 2014)**

(a) $\frac{21}{46}$ (b) $\frac{25}{117}$ (c) $\frac{1}{50}$ (d) $\frac{3}{25}$

(e) None of these

DIRECTIONS (Qs. 41-43) : Read the following information to answer these questions. (Corporation Bank SO 2014)

There are 9 red, 7 white and 4 black balls in an urn.

41. Two balls are drawn at random from the urn. What will be the probability that both the balls are red ?

(a) $\frac{18}{95}$ (b) $\frac{9}{95}$ (c) $\frac{9}{10}$ (d) $\frac{8}{95}$

(e) $\frac{5}{19}$

42. If two balls are selected at random what is the probability that one ball is white and the other ball is red ?

(a) $\frac{91}{190}$ (b) $\frac{63}{190}$ (c) $\frac{5}{19}$ (d) $\frac{4}{95}$

(e) $\frac{71}{190}$

43. In how many different ways can the letters of the word RUMOUR be arranged ?

(a) 180 (b) 720 (c) 30 (d) 90

(e) None of these

DIRECTIONS (Qs. 44-46): Study the following information carefully to answer the questions that follow. A box contains 2 blue caps, 4 red caps, 5 green caps and 1 yellow cap: (SBI Clerk 2015)

44. If four caps are picked at random, what is the probability that none is green ?

(a) $\frac{7}{99}$ (b) $\frac{5}{99}$ (c) $\frac{7}{12}$ (d) $\frac{5}{12}$

(e) None of these

45. If three caps are picked at random, what is the probability that two are red and one is green ?

(a) $\frac{9}{22}$ (b) $\frac{6}{19}$ (c) $\frac{1}{6}$ (d) $\frac{3}{22}$

(e) None of these

46. If one cap is picked at random, what is the probability that it is either blue or yellow?

(a) $\frac{2}{9}$ (b) $\frac{1}{4}$ (c) $\frac{3}{8}$ (d) $\frac{6}{11}$

(e) None of these

47. In how many ways letter of the world BANKING can be arranged so that vowels always come together?

(IBPS Clerk-2015)

(a) 240 (b) 120 (c) 720 (d) 540

(e) None of these

DIRECTIONS (Qs. 48-49) : Study the following information carefully to answer the questions that follow-

(IBPS PO Prelim 2015)

A committee of five members is to be formed out of 5 Males, 6 Females and 3 Children. In how many different ways can it be done if-?

48. The committee should consist of 2 Males, 2 Females and 1 Child?

(a) 450 (b) 225 (c) 55 (d) 90

(e) None of these

49. The committee should include all the 3 Childs?

(a) 90 (b) 180 (c) 21 (d) 55

(e) None of these

50. In how many different ways can 4 boys and 3 girls be arranged in a row such that all the boys stand together and all the girls stand together? **(IBPS PO Main 2015)**

(a) 75 (b) 576 (c) 288 (d) 24

(e) None of these

51. In how many different ways can the letters of the word 'PRIDE' be arranged ? **(IBPS PO Main 2015)**

(a) 60 (b) 120 (c) 15 (d) 360

(e) None of these

52. There are 8 brown balls, 4 orange balls and 5 black balls in a bag. Five balls are chosen at random. What is the probability of their being 2 brown balls, 1 orange ball and 2 black balls?

(IBPS PO Main 2015)

(a) $\frac{191}{1547}$ (b) $\frac{180}{1547}$ (c) $\frac{280}{1547}$ (d) $\frac{189}{1547}$

(e) None of these

53. A box contains 2 blue, 3 green and 5 red balls. If three balls are drawn at random, what is the probability that all balls are different in color? **(IBPS IT Specialist 2016)**

(a) $\frac{3}{10}$ (b) $\frac{1}{4}$ (c) $\frac{3}{7}$ (d) $\frac{4}{11}$

(e) $\frac{2}{9}$

54. A five digit number is formed with the digits 0,1,2,3 and 4 without repetition. Find the chance that the number is divisible by 5. **(IBPS PO Mains 2016)**

(a) 3/5 (b) 1/5 (c) 2/5 (d) 4/5

(e) None of these

55. A box contains 5 green, 4 yellow and 3 white marbles. Three marbles are drawn at random. What is the probability that they are not of the same colour ? **(IBPS PO Mains 2016)**

(a) 40/44 (b) 44/41 (c) 41/44 (d) 40/39

(e) 44/39

56. From a pack of 52 cards, 3 cards are drawn together at random, What is the probability of all the cards are king ?

(IBPS PO Mains 2016)

(a) $\frac{1}{5225}$ (b) $\frac{1}{5525}$ (c) 5525 (d) $\frac{1}{525}$

(e) None of these

57. From a group of 4 men ,3 women, 2 persons are selected at random, Find the probability at least one man is selected ?

(IBPS RRB 2016 Exam)

(a) $\frac{6}{7}$ (b) $\frac{7}{6}$ (c) $\frac{5}{6}$ (d) $\frac{11}{21}$

(e) $\frac{12}{21}$

58. There are 27 cards having number 1 to 27. Two cards are picked at random one by one. What is the probability that sum of number on these 2 cards is odd ?

(SBI PO Prelim Exam 2017)

(a) $\frac{13}{27}$ (b) $\frac{8}{13}$ (c) $\frac{182}{729}$ (d) $\frac{14}{27}$

(e) None of these

DIRECTIONS (Qs. 59-61) : There are three bags A, B and C. In each bag there are three types of colored balls Yellow, Green and Black.

(SBI PO Main Exam 2017)

In bag A, no. of yellow colored balls are y and no. of green colored balls are g. Number of green colored balls are 4 more than the number of yellow colored balls. When one ball is picked at random then the probability of getting black color ball is $\frac{5}{13}$.

The value of y is $18\frac{2}{11}\%$ less than g.

In bag B, number of yellow colored balls is $22\frac{2}{9}\%$ more than that of bag A. If two balls are picked at random from bag B then the probability of getting both green color ball is $\frac{4}{37}$. Total number of balls in bag B is 75.

In bag C, the ratio of number of green colored balls and number of black colored balls is 7 : 5. Total number of green and black colored balls is 36. If one ball is picked at random then the probability of getting one yellow ball is $\frac{7}{13}$.

59. If x number of yellow balls from bag B are taken and placed into bag A and 20% of black balls from bag A are taken and placed into in bag B. If we pick one ball from bag B then the probability that the ball is of black color is $\frac{11}{26}$. Then find the value of x?

(a) 5 (b) 6 (c) 3 (d) 2

(e) None of these

60. If one ball picked at random from each of the bag A and bag B then find the probability that both of the balls are of the same color?

(a) $\frac{21\times47}{65\times75}$ (b) $\frac{22\times43}{65\times75}$

(c) $\frac{11\times17}{65\times75}$ (d) Can't be determined

(e) None of these

61. Difference between the number of green balls in bag A and bag C is how much percent more/less than the sum of the number of black balls in bag A and bag C together?

(a) 100% (b) 95%

(c) 97.5% (d) 102.5%

(e) None of these

62. A bag contains 6 Red, 5 Green and 4 Yellow coloured balls. 2 balls are drawn at random after one another without replacement then what is the probability that atleast one ball is Green. **(IBPS RRB Scale-I Prelim 2017)**

(a) $\frac{2}{3}$ (b) $\frac{4}{5}$ (c) $\frac{3}{8}$ (d) $\frac{4}{7}$

(e) $\frac{2}{7}$

63. In bag A there are 8 red balls, X green balls and 6 yellow balls. Probability of drawing one green ball from bag A is 3/5. In bag B there are (X-3) red balls, (X-9) green balls and 6 yellow balls. 2 balls are drawn from bag B. Find the probability that both the balls are red colour?

(IBPS RRB Scale-I Main 2017)

(a) 12/63 (b) 13/70 (c) 14/75

(d) 17/70 (e) None of these

64. One ball is picked up randomly from a bag containing 8 yellow, 7 blue and 6 black balls. What is the probability that it is neither yellow nor black? **(IBPS SO IT Officer Pre. 2018)**

(a) 3/4 (b) 4/7 (c) 2/9 (d) 1/3

(e) None of the above

65. In a box there are 12 blue ball, X red balls & 20 green balls. Probability of choosing one red ball from the given box is $\frac{1}{3}$. Then find the sum of red and blue balls in the box?

(SBI PO PRE-2018)

(a) 40 (b) 24 (c) 28 (d) 36 (e) 32

66. What is the probability of forming word from the letters of word "TUESDAY" such that all vowels come together?

(SBI PO PRE-2018)

(a) $\frac{8}{35}$ (b) $\frac{1}{7}$ (c) $\frac{3}{35}$ (d) $\frac{17}{35}$ (e) $\frac{2}{7}$

67. Panas has 15 yellow, pink and white balls in his bag. Number of each balls is different in the bag. Difference between yellow ball and pink ball is same as difference between pink ball and white ball. Probability of selecting one white ball from the bag is greater than 0.2, then number of white balls in the bag can be **(IBPS PO Main-2018)**

(A) 3 (B) 4

(C) 5 (D) 7

(E) 9

(a) Only B, C, D and E (b) Only B, D, E

(c) All A, B, C, D and E (d) Only C, D, E

(e) Only A, B, D, E

68. In a bag which contains 60 pens, there are 27 blue pens and some black and red pens. If two pens are picked up from the bag without replacement, then the probability of the first pen being blue and second being black is 9/59. Find the number of red pens in the bag. **(IBPS Clerk Main-2019)**

(a) 16 (b) 13 (c) 10 (d) 14 (e) 8

69. What is the probability that when 2 dice and 4 coins are thrown simultaneously, there is a sum of 7 on the dice and at least 2 heads on the coins? **(SBI Clerk Main-2019)**

(a) $\frac{13}{96}$ (b) $\frac{11}{96}$ (c) $\frac{12}{169}$ (d) $\frac{11}{125}$

(e) None of These

70. There are 6 red, 8 black and 6 blue balls in a bag. Out of these balls, 6 balls are picked out at random from the bag. Then, what is the probability that 2 are red, 2 are black and 2 are blue ball ? **(IBPS RRB PO Prelim-2019)**

(a) $\frac{13}{54}$ (b) $\frac{12}{52}$ (c) $\frac{14}{52}$ (d) $\frac{28}{104}$

(e) $\frac{14}{36}$

71. There are Three chairs in a meeting hall. A meeting is conducted and attended by x number of people. Find the value of x if the number of ways x people can be made to sit is 60. **(IBPS RRB PO Main-2019)**

(a) 4 (b) 3 (c) 5 (d) 6

(e) 8

72. A box contains 23 balls numbered 1 to 23. A ball is drawn and then another ball is drawn without replacement. What is the probability that both balls are even numbered?

(IBPS RRB PO Main-2019)

(a) $\frac{5}{23}$ (b) $\frac{7}{23}$ (c) $\frac{3}{23}$ (d) $\frac{5}{21}$

(e) None of these

73. Rohit randomely picks two mobile from a bag containing 20 black mobile and 30 red mobile. What is the probability of Rohit picking, randomely 2 mobile of different colours?

(IBPS RRB Clerk Main-2019)

(a) $\frac{14}{49}$ (b) $\frac{24}{49}$ (c) $\frac{25}{104}$ (d) $\frac{12}{49}$

(e) None of these

Answers & Explanations

1. (b) Number of way of selecting 4 marbles out of 15 marbles

$= {}^{15}C_4 = \frac{15\times14\times13\times12}{4\times3\times2\times1} = 1365$

Number of ways of selecting 4 marbles when no one is blue $= {}^{11}C_4 = \frac{11\times10\times9\times8}{4\times3\times2\times1} = 330$

Probability of getting 4 marble (when no one is blue)

$= \frac{330}{1365} = \frac{22}{91}$

Probability that at least one is blue $= 1-\frac{22}{91} = \frac{69}{91}$

2. (e) Number of ways of selecting 2 red marbles from 6 red marbles $= {}^6C_2 = 15$

Number of ways of selecting 2 marbles from urn $= {}^{15}C_2 = 105$

Required Probability $= \frac{15}{105} = \frac{1}{7}$

3. (c) Number of ways of selecting 2 blue and one yellow marble $= {}^4C_2 \times {}^3C_1 = 6\times3 = 18$

Number of ways of selecting 3 marble from urn $= {}^{15}C_3 = 455$

Required Probability $= \frac{18}{455}$

4. (a) Number of ways of selecting one green, two blue and one red marble $= {}^2C_1 \times {}^4C_2 \times {}^6C_1$.

$= 2\times6\times6 = 72$

Number of ways of selecting 4 marbles from urn $= {}^{15}C_4$

$= \frac{12\times13\times14\times15}{4\times3\times2\times1} = 1365$

Required Probability $= \frac{72}{1365} = \frac{24}{455}$

5. (d) Number of ways of selecting either two green marbles or two yellow marbles $= {}^2C_2 + {}^3C_2 = 1+3 = 4$

Number of ways of selecting 2 marbles $= {}^{15}C_2 = 105$

Required Probability $= \frac{4}{105}$

6. (d) Total possible outcomes = Number of ways of picking 3 marbles out of 12 marbles = n(S)

$= 12_{C_3}\ \frac{12\times11\times10}{1\times2\times3} = 220$

Favourable number of cases = n(E)

$= {}^3C_3 + {}^4C_3$

$= 1+4 = 5$

$\Rightarrow$ Required probability

$= \frac{n(E)}{n(S)} = \frac{5}{220} = \frac{1}{44}$

7. (e) Total possible outcomes

$= n(S) = {}^{12}C_2 = \frac{12\times11}{1\times2} = 66$

Favourable number of cases = n(E)

$= {}^4C_2 = \frac{4\times3}{1\times2} = 6$

$\Rightarrow$ Required probability

$= \frac{n(E)}{n(S)} = \frac{6}{66} = \frac{1}{11}$

8. (b) Total possible outcomes = $n(S) = {}^{12}C_3 = 220$

Favourable number of ways of picking 3 marbles (none is blue) out of 7 marbles

$= {}^7C_3 = \frac{7\times6\times5}{1\times2\times3} = 35$

$\Rightarrow$ Required probability

$= \left(1-\frac{35}{220}\right) = \left(1-\frac{7}{44}\right) = \frac{37}{44}$

9. (a) Number of combinations

$= \left({}^4C_4 \times {}^6C_1 + {}^3C_3 \times {}^4C_2\right) = 1\times6+1\times6 = 12$

10. (c) Number of combinations

= Selecting 2 trainees out of 3 and selecting 3 research associates out of 6 $= {}^3C_2 \times {}^6C_3$

$= 3\times\frac{6\times5\times4}{1\times2\times3} = 60$

11. (a) The word SECOND consists of 6 distinct letters.

$\Rightarrow$ Number of arrangements

$= 6!$

$= 6\times5\times4\times3\times2\times1 = 720$

12. (e) The word SIMPLE consists of 6 distinct letters

$\Rightarrow$ Number of arrangements $= 6!$

$= 6\times5\times4\times3\times2\times1 = 720$

13. (a) The word BELIEVE consists of 7 letters in which E comes thrice.

$\Rightarrow$ Required number of arrangements $= \frac{7!}{3!}$

$= \frac{7\times6\times5\times4\times3\times2\times1}{3\times2\times1} = 840$

14. (b) There are seven letters in the word "VIRTUAL". Therefore, number of different ways in which these letters can be arranged

$= 7! = 7\times6\times5\times4\times3\times2 = 5040$

15. (c) The word "MARKERS" has seven letters, and seven letters can be arranged ! 7 ways.

But the letter 'R' appears twice.

$\therefore$ The number of possible ways

$\frac{7!}{2!} = 2520$

16. (d) There are 7 letters in the given word VENTURE in which E comes twice.

$\Rightarrow$ Total number of ways $= \frac{7!}{2!} = 7 \times 6 \times 5 \times 4 \times 3 = 2520$

17. (b) Required ways $= 7! = 7 \times 6 \times 5 \times 3 \times 2 \times 1 = 5040$

18. (a) Total number of ways of selecting 4 children out of 8

$$= {}^{8}C_4 = \frac{8 \times 7 \times 6 \times 5}{1 \times 2 \times 3 \times 4} = 70$$

Number of ways of selecting 4 girls out of $5 = {}^{5}C_4 = 5$

Required probability $= \frac{5}{70} = \frac{1}{14}$

19. (a) According to question,

$$n(S) = {}^{14}C_4 = \frac{14!}{(14-4)!4!} = \frac{14!}{10!4!}$$

$$= \frac{14 \times 13 \times 12 \times 11}{4 \times 3 \times 2 \times 1} = 1001 \left[\because {}^{n}C_r = \frac{n!}{(n-r)!r!} \right]$$

and $n(E) = {}^{5}C_2 \times {}^{2}C_2 = \frac{5!}{(5-2)!2!} \times \frac{2!}{(2-2)!2!}$

$$= \frac{5 \times 4}{2 \times 1} \times \frac{2 \times 1}{1 \times 2 \times 1} = 10$$

$\Rightarrow$ Required probability $= \frac{n(E)}{n(S)} = \frac{10}{1001}$

20. (c) According to question,

$$n(S) = {}^{14}C_8 = \frac{14!}{(14-8)!8!} \times \frac{14!}{6!8!}$$

$$= \frac{14 \times 13 \times 12 \times 11 \times 10 \times 9}{6 \times 5 \times 4 \times 3 \times 2 \times 1} = 3003$$

and $n(E) = {}^{4}C_2 \times {}^{5}C_2 \times {}^{2}C_2 \times {}^{3}C_2$

$$= \frac{4!}{(4-2)!2!} \times \frac{5!}{(5-2)!2!} \times \frac{2!}{(2-2)!2!} \times \frac{3!}{(3-2)!2!}$$

$$= \frac{4!}{2!2!} \times \frac{5!}{3!2!} \times \frac{2!}{0!2!} \times \frac{3!}{1!2!}$$

$$= \frac{4 \times 3}{2 \times 1} \times \frac{5 \times 4}{2 \times 1} \times \frac{1}{1} \times \frac{3}{1} = 180$$

$\Rightarrow$ Required probability $= \frac{n(E)}{n(S)} = \frac{180}{3003} = \frac{60}{1001}$

21. (e) According to question,

$$n(S) = {}^{14}C_2 = \frac{14!}{(14-2)!2!} = \frac{14 \times 13}{2 \times 1} = 91$$

$\therefore$ Probability of at least one red marble

$$= 1 - \frac{{}^{12}C_2}{{}^{14}C_2} = 1 - \frac{66}{91} = \frac{91-66}{91} = \frac{25}{91}$$

22. (b) According to question,

$$n(S) = {}^{14}C_3 = \frac{14!}{(14-3)!3!} = \frac{14 \times 13 \times 12}{3 \times 2 \times 1} = 364$$

Number of ways to draw no yellow marble $= {}^{11}C_3$

$\Rightarrow$ Required probability

$$= 1 - \frac{{}^{11}C_3}{{}^{14}C_3} = 1 - \frac{165}{364} = \frac{364-165}{364} = \frac{199}{364}$$

23. (e) According to question,

$$n(S) = {}^{14}C_3 = \frac{14!}{(14-3)!3!} = \frac{14 \times 13 \times 12}{3 \times 2 \times 1} = 364$$

and $n(E) = {}^{10}C_3 = \frac{10!}{(10-3)!3!} = \frac{10 \times 9 \times 8}{3 \times 2 \times 1} = 120$

$\Rightarrow$ Required probability $= \frac{n(E)}{n(S)} = \frac{120}{364} = \frac{30}{91}$

24. (c) (1) The word STABLE has six distinct letters.

$\Rightarrow$ Number of arrangements = 6 !

$= 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 720$

(2) The word STILL has five letters in which letter 'L' comes twice.

$\Rightarrow$ Number of arrangements

$= \frac{5!}{2} = 60$

(3) The word WATER has five distinct letters.

$\Rightarrow$ Number of arrangements = $5 ! = 5 \times 4 \times 3 \times 2 \times 1 = 120$

(4) The word 'NOD' has 3 distinct letters.

$\Rightarrow$ Number of arrangements = $3 ! = 6$

(5) Number of arrangements = $4 ! = 24$

25. (e) $\underset{1}{C}\underset{2}{R}\underset{3}{E}\underset{4}{A}\underset{5}{M}$

Required number of ways = 5!

$= 5 \times 4 \times 3 \times 2 \times 1 = 120$

26. (d) No. of vowels in the word THERAPY

= 2 i.e. E and A

In such cases we treat the group of two vowels as one entity or one letter because they are supposed to always come together. Thus, the problem reduces to arranging 6 letters i.e. T, H, R, P, Y and $\boxed{\text{EA}}$ in 6 vacant places.

No. of ways 6 letters can be arranged in 6 places = 6!

$= 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 720$

But the vowels can be arranged themselves in 2 different ways by interchanging their position. Hence, each of the above 720 arrangements can be written in 2 ways.

$\Rightarrow$ Required no. of total arrangements when two vowels are together $= 720 \times 2 = 1440$

Total no. of arrangements of THERAPY = 7!

$= 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 5040$

No. of arrangement when vowels do not come together

$= 5040 - 1440 = 3600$

27. (d) No. of ways of getting 2 white balls = $^{13}C_2$
No. of ways of getting 2 black balls = $^{7}C_2$
Probability of getting 2 same colour ball

$$= \frac{\text{Probability of 2 white balls or Probability of 2 Black balls}}{\text{Total number of balls drawn}}$$

$$\Rightarrow \frac{^{13}C_2 + {}^{7}C_2}{^{20}C_2} \Rightarrow \frac{\frac{13!}{2!\times 11!} + \frac{7!}{2!\times 5!}}{\frac{20!}{18!\times 2!}}$$

$$\Rightarrow \frac{\frac{13\times 12\times 11!}{2!\times 11!} + \frac{7\times 6\times 5!}{2!\times 5!}}{\frac{20\times 19\times 18!}{18!\times 2!}} = \frac{13\times 12 + 7\times 6}{20\times 19}$$

$$\Rightarrow \frac{198}{380} = \frac{99}{190}$$

28. (a) The word SACRED consists of 4 consonants (SCRD) and two vowels (AE). On keeping vowels together we get SCRD (AE).
$\Rightarrow$ Number of arrangements = 5! × 2!
$= 5\times 4\times 3\times 2\times 1\times 1\times 2 = 240$

29. (d) Total number of marbles = 8 + 3 + 5 = 16
n(S) = Exhaustive number of cases
= Number of ways of drawing 4 marbles out of 16

$$= {}^{16}C_4 = \frac{16\times 15\times 14\times 13}{1\times 2\times 3\times 4} = 1820$$

n(E) = Number of cases when 2 marbles are red and 2 are blue.

$$= {}^{8}C_2 \times {}^{3}C_2 = \frac{8\times 7}{1\times 2}\times\frac{3\times 2}{1\times 2} = 84$$

$$\Rightarrow \text{Required probability} = \frac{84}{1820} = \frac{3}{65}$$

30. (e) $n(S) = {}^{16}C_2 = \frac{16\times 15}{1\times 2} = 120$

$$n(E) = {}^{5}C_2 = \frac{5\times 4}{1\times 2} = 10$$

$$\text{Required probability} = \frac{10}{120} = \frac{1}{12}$$

31. (c) $n(S) = {}^{16}C_3 = \frac{16\times 15\times 14}{1\times 2\times 3} = 560$

Out of the three drawn marbles none is red.
Clearly they will be either blue or green.

$$\Rightarrow n(E) = {}^{8}C_3 = \frac{8\times 7\times 6}{1\times 2\times 3} = 56$$

$$\Rightarrow \text{Required probability} = \frac{n(E)}{n(S)} = \frac{56}{560} = \frac{1}{10}$$

32. (a) The committee consists of 3 men and 2 women.
Out of 10 men. 3 men can be selected in $^{10}C_3$ ways.
and out of 8 women can be selected in $^{8}C_2$ ways
Total number of selections

$$= {}^{10}C_3 \times {}^{8}C_2 = \frac{10\times 9\times 8}{1\times 2\times 3}\times\frac{8\times 7}{1\times 2} = 3360$$

33. (d) Let's look at following cases :
(i) 2 women & 2 men
(ii) 3 women & 1 man
(iii) 4 women
$\Rightarrow$ Total number of selections
$= {}^{8}C_2 \times {}^{10}C_2 + {}^{8}C_3 \times {}^{10}C_1 + {}^{8}C_4$

$$= \frac{8\times 7}{1\times 2}\times\frac{10\times 9}{1\times 2} + \frac{8\times 7\times 6\times 10}{1\times 2\times 3} + \frac{8\times 7\times 6\times 5}{1\times 2\times 3\times 4}$$

$= 1260 + 560 + 70 = 1890$

34. (b) Out of 5 men 2 teachers, can be selected in $^{5}C_2$ ways.
Out of 3 women teachers, 2 can be selected in $^{3}C_2$ ways.
Out of 5 doctors 1 can be selected in $^{5}C_1$ ways.
Total number of selections

$$= {}^{5}C_2 \times {}^{3}C_2 \times {}^{5}C_1 = \frac{5\times 4}{1\times 2}\times\frac{3\times 2}{1\times 2}\times 5 = 10\times 3\times 5 = 150$$

35. (a) Out of 18 persons, a committee of 7 persons is to be formed.
Total number of selections $= {}^{18}C_7$

$$= \frac{18\times 17\times 16\times 15\times 14\times 13\times 12}{1\times 2\times 3\times 4\times 5\times 6\times 7} = 31824$$

36. (c) The committee has no teachers and no doctor.
Out of 18 persons, there are 8 teacher and 5 doctors.
$\Rightarrow$ Total number of selections
= Number of ways of selecting 3 persons out of remaining 5 persons

$$= {}^{5}C_3 = \frac{5\times 4\times 3}{1\times 2\times 3} = 10$$

37. (c) Blue balls = 7
Yellow balls = 5
None-ball out of two yellow
i.e. Both balls are blue
Total balls = 12

$$\Rightarrow \text{P (both blue balls)} = \frac{7}{12}\times\frac{6}{11} = \frac{7}{22}$$

38. (d) Total possible outcomes when A die is thrown twice = 36
Outcome for getting a sum 7 from both throwns
$= 6\ \{(1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1)\}$

$$\Rightarrow P(E) = \frac{6}{36} = \frac{1}{6}$$

39. (c) The word 'LEADING' has 7 different letters.
When the vowels EAI are always together, they can be supposed to form one letter.
Then, we have to arrange the letters LNDG (EAI).
Now, 5 (4 + 1 = 5) letters can be arranged in 5! = 120 ways.
The vowels (EAI) can be arranged among themselves in 3! = 6 ways.
$\therefore$ Required number of ways = (120 × 6) = 720.

40. (a) Let S be the sample space and E be the event of selecting 1 girl and 2 boys.
Then, n(S) = Number ways of selecting 3 students out of $25 = {}^{25}C_3$

$$= \frac{(25 \times 24 \times 23)}{(3 \times 2 \times 1)} = 2300.$$

also, $n(E) = ({}^{10}C_1 \times {}^{15}C_2)$

$$= \left[10 \times \frac{15 \times 14}{2 \times 1}\right]$$

$= 1050.$

$$\therefore P(E) = \frac{n(E)}{n(S)} = \frac{1050}{2300} = \frac{21}{46}$$

41. (a) Total possible outcomes
= Selection of 2 balls out of (9 + 7 + 4 = 20) balls

$$= {}^{20}C_2 = \frac{20 \times 19}{1 \times 2} = 190$$

Favourable outcomes = Selection of 2 balls out of 9 red balls

$$= {}^{9}C_2 = \frac{9 \times 8}{1 \times 2} = 36$$

$$\Rightarrow \text{ Required probability} = \frac{36}{190} = \frac{18}{95}$$

42. (b) Total possible outcomes = 190
Favourable outcomes = Selection of 1 ball out of 9 red balls and 1 ball from 7 white balls
$= {}^{9}C_1 \times {}^{7}C_1 = 9 \times 7 = 63$

$$\Rightarrow \text{Required probability} = \frac{63}{190}$$

43. (a) The word RUMOUR consists of 6 letters in which each of R and U comes twice.
Number of arrangements

$$= \frac{6!}{2!2!} = \frac{6 \times 5 \times 4 \times 3 \times 2 \times 1}{2 \times 2} = 180$$

44. (a) Total number of caps = 12
Total result $n(S) = {}^{12}C_4$.

$$n(S) = \frac{12!}{4! \cdot 8!} = \frac{12 \times 11 \times 10 \times 9 \times 8!}{4 \times 3 \times 2 \times 1 \times 8!} = 5 \times 99$$

n(E) = Out of 7 caps, number of ways to pick 4 caps

$$= {}^{7}C_4. = \frac{7!}{4! \cdot 3!} = \frac{7 \times 6 \times 5 \times 4 \times 3!}{4 \times 3 \times 2 \times 1 \times 3!} = 35$$

$$p(E) = \frac{n(E)}{n(S)} = \frac{35}{5 \times 99} = \frac{7}{99}$$

45. (d) Total number of caps = 12

$$n(S) = {}^{12}C_3 = \frac{12!}{3! \cdot 9!} = \frac{12 \times 11 \times 10 \times 9!}{3 \times 2 \times 1 \times 9!} = 220$$

$n(E_1)$ = Out of 4 red caps, number of ways to pick 2 caps $= {}^{4}C_2$

$$= \frac{4!}{2! \cdot 2!} = \frac{4 \times 3 \times 2 \times 1}{2 \times 1 \times 2 \times 1} = 6.$$

$n(E_2)$ = Out of 5 green caps, number of ways to pick one cap $= {}^{5}C_1 = 5$

$$p(E) = \frac{n(E_1) \times n(E_2)}{n(S)} = \frac{6 \times 5}{220} = \frac{3}{22}$$

46. (b) Total number of caps = 12
$n(S) = {}^{12}C_1 = 12$
Out of (2 blue + 1 yellow) caps number of ways to pick one cap $n(E) = {}^{3}C_1 = 3$

$$\text{Required probability } p(E) = \frac{n(E)}{n(S)} = \frac{3}{12} = \frac{1}{4}$$

47. (c) $[(6!)/(2!)] \times (2!) = 360 \times 2 = 720$
$[(6!)/(2!)]$ = letters formed, 2!-Vowels.

48. (a) Number of ways $= {}^{5}C_2 \times {}^{6}C_2 \times {}^{3}C_1 = 450$

49. (d) Number of ways $= {}^{11}C_2 \times {}^{3}C_3 = 55.$

50. (c) Required number of ways $= 4! \times 3! \times 2! = 288.$

51. (b) 'PRIDE' has five different letters.
So, it can be arranged in 5 ! = 120 ways

52. (c) Total possible outcomes $= {}^{17}C_5$

$$= \frac{17 \times 16 \times 15 \times 14 \times 13}{1 \times 2 \times 3 \times 4 \times 5} = 6188$$

Total favourable outcomes $= {}^{8}C_2 \times {}^{4}C_1 \times {}^{5}C_2$

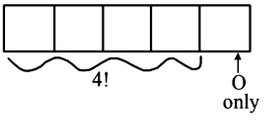
$$= \frac{8 \times 7}{1 \times 2} \times 4 \times \frac{5 \times 4}{1 \times 2} = 28 \times 4 \times 10 = 1120$$

$$\text{Required probability} = \frac{1120}{6188} = \frac{280}{1547}$$

53. (b) Total balls = 10

$$\text{So probability} = \frac{{}^{2}C_1 \times {}^{3}C_1 \times {}^{5}C_1}{{}^{10}C_3} = \frac{1}{4}$$

54. (b) Total 5 digit numbers possible $= 4 \times 4! = 48$
($\because$ 0 can not be on 10000^{th} place)
Numbers divisible by 5 =



$= 1! \times 4!$

$$\therefore P(E) = \frac{4!}{4 \times 4!} = \frac{1}{4}$$

55. (c) $n(E) = {}^{5}C_3 + {}^{4}C_3 + {}^{3}C_3 = 10 + 4 + 1 = 15$
$n(S) = {}^{12}C_3 = 220$

$$P = \frac{n(E)}{n(S)} = \frac{15}{220} = \frac{3}{44}$$

(it is probability when all 3 are of same colour)

$$\therefore \text{ Required probability} = 1 - \frac{3}{44} = \frac{41}{44}$$

56. (b) $n(S) = {}^{52}C_3 = \frac{132600}{6} = 22100$

$n(E) = {}^{4}C_3 = \frac{24}{6} = 4$

$p = \frac{4}{22100} = \frac{1}{5525}$

57. (a) ${}^{7}C_2 = \frac{7\times6}{2} = 21$

${}^{4}C_1 \times {}^{3}C_1 + {}^{4}C_2 = 4\times3 + \frac{4\times3}{2}$

$= 4\times3 + \frac{4\times3}{2} = 12+6 = 18$

$P = \frac{18}{21} = \frac{6}{7}$

58. (d) Odd sum is there when one card drawn is odd and another even.

$\Rightarrow$ Required probability

$= \left(\frac{13}{27}\times\frac{14}{26}\right) + \left(\frac{14}{27}\times\frac{13}{26}\right) = \frac{14}{27}$

59. (d) After replacement$\rightarrow$

Yellow no. of balls in bag B = 22 – x

Black no. of balls in bag B = 28 + 5 = 33

Green no. of balls in bag B = 25

Then, $\frac{33}{22-x+33+25} = \frac{11}{26}$

$\frac{33}{80-x} = \frac{11}{26}$

$78 = 80 - x$

$x = 2$

60. (b) Required probability

$= \frac{18}{65}\times\frac{22}{75} + \frac{22}{65}\times\frac{25}{75} = \frac{43\times22}{65\times75}$

61. (c) Required % $= \frac{40-1}{40}\times100$

$= \frac{39}{40}\times100$

$= 97.5\%$

62. (d) According to question,

Probability that no ball is green

$\frac{{}^{10}C_1 \times {}^{9}C_1}{15\times14} = \frac{90}{15\times14} = \frac{3}{7}$

Required probability $= 1 - \frac{3}{7} = \frac{4}{7}$

63. (d) probability of drawing one green ball

$\Rightarrow \frac{x}{14+x} = \frac{3}{5}$

$\Rightarrow 5x = 42 + 3x$

$\Rightarrow x = 21$

$\Rightarrow$ Green balls = 21

In Bag B

Red balls = (x – 3) = (21 – 3) = 18

Green balls = (x – 9) = (21 – 9) = 12

Yellow balls = 6

$\therefore$ Required probability

$= \frac{{}^{18}C_2}{{}^{36}C_2} = \frac{18\times17}{36\times85} = \frac{17}{70}$

64. (d) Total no. of balls = 8 + 7 + 6 = 21

Let, E be the event where the ball can be selected which is neither yellow nor black

Number of events where the ball can be selected which is neither yellow nor black = 7

P(E) = 7/21 = 1/3

65. (c) Atq, $\frac{x}{x+32} = \frac{1}{3}$

x = 16

$\therefore$ sum of red & blue balls = 16 + 12 = 28

66. (b) Total numbers of ways $\rightarrow$ 7!

Favorable numbers of ways $\rightarrow$ 5! × 3!

Probability $\rightarrow \frac{5!\times3!}{7!} = \frac{1}{7}$

67. (b) Let number of yellow, pink and white balls be x, y and z respectively

ATQ,

x – y = y – z

$y = \frac{x+z}{2}$ or 2y = x + z

And $\frac{z}{x+y+z} > 0.2$

$\frac{z}{3y} > \frac{1}{5}$

5z > 3y

If y = 5, then z > 3

If y = 10, then z > 6, but this isn't possible

Hence,

Yellow	Pink	White
6	5	4
4	5	6
3	5	7
2	5	8
1	5	9

5, 5, 5 isn't possible as number of balls is different

Hence, from given numbers only (B), (D) and (E) can be the possible.

So, option, (b) is the correct answer.

68. (b) Total pens = 60

blue pens = 27

Let black pens are x

Then, $\frac{27}{60} \times \frac{x}{59} = \frac{9}{59}$

$\Rightarrow x = 20$

$\therefore$ No. of red pens $= 60 - 20 - 27 = 13$

69. (b) Sum of 7 can be achieved in 4 ways (6, 1), (1, 6), (5, 2), (2, 5) , (3, 4) and (4, 3)

Probability of a sum of 7 on the dice = 6/36 = 1/6

Probability of at least 2 coins showing on head

$$= {}^4C_2\left(\frac{1}{2}\right)^4 + {}^4C_3\left(\frac{1}{2}\right)^4 + {}^4C_4\left(\frac{1}{2}\right)^4$$

$$\Rightarrow (6+4+1)\times\left(\frac{1}{2}\right)^4 = \frac{11}{16}$$

Thus, the required probability $= \frac{11}{16}\times\frac{1}{6} = \frac{11}{96}$

70. (b) Ways to select 6 balls out of 20 balls $= {}^{20}C_6$

Ways to select two red balls $= {}^6C_2$

Ways to select two black balls $= {}^8C_2$

Ways to select two blue balls $= {}^6C_2$

$\therefore$ Required probability $= \frac{{}^6C_2 \times {}^8C_2 \times {}^6C_2}{{}^{20}C_6}$

$$= \frac{15\times 28\times 15}{\frac{20\times 19\times 18\times 17\times 16\times 15}{6\times 5\times 4\times 3\times 2}}$$

$$= \frac{15\times 28\times 15}{4\times 5\times 7\times 13} = \frac{12}{52}$$

71. (c) Number of chairs = 3

Number of persons = x

Number of ways they can be seated $= {}^xP_3 = 60$

$$\frac{x!}{(x-3)!} = 60$$

$x\times(x-1)(x-2) = 60$

$x\times(x^2-3x+2) = 60$

$x^3-3x^2+2x-60 = 0$

$x^2(x-5)+2x(x-5)+12(x-5) = 0$

$(x-5)(x^2+2x+12) = 0$

$\therefore x = 5$

72. (a) There are 11 even numbers in the group 1– 23

$\therefore$ The probability that the first ball is even numbered $= \frac{11}{23}$

Since the ball is not replaced there are now 22 balls left, of which 10 are even numbered..

$\therefore$ The probability that the second ball is even numbered

$$= \frac{10}{22}$$

$\therefore$ Required probability $= \frac{11}{23}\times\frac{10}{22} = \frac{5}{23}$

73. (e) Given, number of black Mobile = 20

Number of red Mobile = 30

Required probability = (black and red)

$$\frac{{}^{20}C_1\times{}^{30}C_1}{{}^{50}C_2} = \frac{20}{25}\times\frac{30}{49} = \frac{24}{49}$$