13. PROBABILITY

1. A family has two children. What is the probability that both the children are boys given that at least one of them is a boy?

2. In a school there are 1000 students, out of which 430 are girls. It is known that out of 430, 10% of the girls study in class XII. What is the probability that a student chosen randomly studies in class XII given that the chosen student is a girl?

3. A die is thrown three times. Events A and B are defined as below:
   A : 4 on the third row.
   B : 6 on the first and 5 on the second row.
   Find the probability of A given that B has already occurred.

4. A die is thrown twice and the sum of the numbers appearing is observed to be 6. What is the conditional probability that the number 4 has appeared at least once?
   Determine P(E|F) in questions 5 to 8.

5. A coin is tossed is tossed three times, where
   (a) E : head on third toss.
       F : heads on first two toss.
   (b) E : atleast two heads.
       F : at most two heads.
   (c) E : at most two tails.
       F : at least one tail.

6. Two coins are tossed once, where
   (a) E : tail appears on one coin.
       F : one coin shows head.
   (b) E : no tail appears.
       F : no head appears.

7. A die is thrown 3 times
   E : 4 appears on the third toss.
   F : 6 and 5 appears respectively on first two toss.

8. Mother, father and son line up at random for a family picture.
   E : son on one end
   F : father in middle

9. A black and a red dice are rolled.
   (a) Find the conditional probability of obtaining a sum greater than 9, given that the black die resulted in 5.
   (b) Find the conditional probability of obtaining the sum 8, given that the red die resulted in a number less than 4.

10. A fair die is rolled. Consider events
    E = {1, 3, 5}, F = {2, 3} and G = {2, 3, 4, 5}.
    Find
    (a) P(E|F) and P(F|E)
    (b) P(E|G) and P(G|E)
    (c) P((E ∪ F)|G) and P((E ∩ F)|G)

11. Assume that each born child is equally likely to a boy or a girl. If a family has 2 children, what is the conditional probability that both are girls given that
    (a) The youngest is a girl.
    (b) At least one is a girl.

12. An instructor has a question bank consisting of 300 easy true/ false questions, 200 difficult true/ false questions, 500 easy multiple choice question and 400 difficult multiple choice question. If a question is selected at random from the question bank, what is the probability that it will be an easy question given that it is a multiple choice question?

13. Consider the experiment of throwing a die, if a multiple of 3 comes up, throw the die again and if any other number comes, toss a coin. Find the conditional probability of the event "the coin shows a tail" given that "at least one die shows 3".

14. If $P(A) = \dfrac{7}{13}$, $P(B) = \dfrac{9}{13}$ and $P(A \cap B) = \dfrac{4}{13}$, evaluate P(A|B).

15. 10 cards numbered 1 to 10 are placed in a box, mixed up thoroughly and then one card is drawn randomly. If it is known that the number on the drawn card is more than 3, what is the probability it is an even number?

16. Consider the experiment of tossing a coin. If the coin shows head, toss it again but if it shows tail, then throw a die. Find the conditional probability of the event that "the die shows a number greater than 4" given that "there is at least one tail".

17. Given that E and F are events such that $P(E) = 0.6$, $P(F) = 0.3$ and $P(E \cap F) = 0.2$, find $P(E|F)$ and $P(F|E)$.

18. Evaluate $P(A \cup B)$, if $2P(A) = P(B) = \dfrac{5}{13}$ and $P(A|B) = \dfrac{2}{5}$.

19. If $P(A) = \dfrac{6}{11}$, $P(B) = \dfrac{5}{11}$ and $P(A \cup B) = \dfrac{7}{11}$, find:
    (a) $P(A \cap B)$ (b) $P(A|B)$
    (c) $P(B|A)$

20. Given that the two numbers appearing on throwing two dice are different. Find the probability of the event "the sum of numbers on the dice is 4".

21. A coupe has two children. Find the probability that both the children are
    (a) Males, if it is known that at least one of the children is male.
    (b) Females, if it is known that the elder child is a female.
    [CBSE 2010]

22. A couple has two children. Find the probability that both are boys, if it is known that:
    (a) One of the children is a boy.
    (b) The older child is a boy.
    [CBSE 2010]

23. Assume that each born child is equally likely to be a boy or a girl. If a family has two children, what is the conditional probability that both are girls? Given that [2014]
    (i) the youngest is a girl.
    (ii) at least one is a girl

24. A die is thrown twice and the sum of the numbers appearing is observed to be 8. What is the conditional probability that the number 5 has appeared at least once?

[CBSE 2003]

25. A die is thrown three times. Events A and B are defined as below:
    A: 5 on the first and 6 on the second throw.
    B: 3 or 4 on the third throw
    Find the probability of B, given that A has already occurred. [CBSE 2015]

26. An urn contains ten black and five white balls. Two balls are drawn from the urn after the other without replacement. What is the probability that both drawn balls are black?

27. Five cards are drawn one by one, with replacement, from a well shuffled deck of 52 cards. Find the probability that
    (i) All the five cards are diamond
    (ii) Only 3 cards are diamond
    (iii) None is a diamond. [CBSE 2014]

28. Three cards are drawn successively, without replacement from a pack of 52 well shuffled cards. What is the probability that first two cards are kings and the third card drawn is an ace?

29. Two cards are drawn at random and without replacement from a pack of 52 playing cards. Find the probability that both the cards are black.

30. A box of oranges is inspected by examining three randomly selected oranges drawn without replacement. If all the three oranges are good, the box is approved for sale, otherwise it is rejected. Find the probability that a box containing 15 oranges out of which 12 are good and 3 are bad ones will be approved for sale.

31. In a hostel, 60% of the students read Hindi newspaper, 40% read English newspaper and 20% read both Hindi and English newspaper. A student is selected at random:
    (a) Find the probability that she reads neither Hindi nor English newspaper.
    (b) If she reads Hindi newspaper, find the probability that she reads English newspaper.

94

(c) If she reads English newspaper, find the probability that she reads Hindi newspaper.

32. Find the probability of drawing a diamond card in each of the two consecutive draws from a well shuffled pack of cards, if the card drawn is not replaced after the first draw. **[CBSE 2002]**

33. A bag contains 5 white, 7 red and 3 black balls. If 3 balls are drawn one by one without replacement, find the probability that none is red. **[CBSE 2002C]**

34. Probability of solving specific problem independently by A and B are $\frac{1}{2}$ and $\frac{1}{3}$ respectively. If both try to solve the problem independently, find the probability that:
    (a) The problem is solved.
    (b) Exactly one of them solves the problem.
    [CBSE 2011]

35. A die is thrown. If E is the event "the number appearing is a multiple of 3" and F be the event "the number is even", then find whether E and F are independent.

36. An unbiased die is thrown twice. Let the event A be "odd number on the first throw" and B the event "odd number on the second throw". Check the independence of the events A and B.

37. Three coins are tossed simultaneously. Consider the event
    E : "three heads or three tails"
    F : "at least two head"
    G : "at most two heads"
    Of the pairs (E, F), (E,G) and (F, G) which are independent? Which are dependent?

38. Prove that if E and F are independent events, then so are the events E and F.

39. If A and B are two independent events, then the probability of occurrence of at least one of A and B is given by $1 - P(A')P(B')$.

40. If $P(A) = \frac{3}{5}$ and $P(B) = \frac{1}{5}$, find $P(A \cap B)$, if A and B are independent events.

41. A fair coin and an unbiased die are tossed. Let A be the event 'head appears on the coin' and B be the event '3 on the die'. Check whether A and B are independent events or not.

42. A die marked 1, 2, 3 in red and 4, 5, 6 in green is tossed. Let A be the event, 'the number is even', and B be the event, 'the number is red'. Are A and B independent?

43. Let E and F be events with $P(E) = \frac{3}{5}$, $P(F) = \frac{3}{10}$ and $P(E \cap F) = \frac{1}{5}$. Are E and F independent?

44. Given that the events A and B are such that $P(A) = \frac{1}{2}$, $P(A \cup B) = \frac{3}{5}$ and $P(B) = p$. Find p if they are
    (a) Mutually exclusive
    (b) Independent.

45. Let A be the independent events with P(A) = 0.3 and P(B) = 0.4. Find
    (a) $P(A \cap B)$ (b) $P(A \cup B)$
    (c) $P(A | B)$ (d) $P(B | A)$

46. If A and B are two events such that $P(A) = \frac{1}{4}$, $P(B) = \frac{1}{2}$ and $P(A \cap B) = \frac{1}{8}$, find P(not A and not B).

47. Events A and B are such that $P(A) = \frac{1}{2}$, $P(B) = \frac{7}{12}$ and P(not A or not B) = $\frac{1}{4}$, state whether A and B are independent?

48. Given two independent events A and B such that P(A) = 0.3, P(B) = 0.6, find
    (a) P(A and B)   (b) P(A and not B)
    (b) P(A or B)   (d) P(neither A nor B)

49. A die is tossed thrice. Find the probability of getting an odd number at least once.

50. Two balls are drawn at random with replacement from a box containing 10 black and 8 red balls. Find the probability that
    (a) Both balls are red.

(b) First ball is black and second is red.

(c) One of them is black and other is red.

51. One card is drawn at random from a well shuffled deck of 52 cards. In which of the following cases are the events E and F independent?

   (a) E : 'card drawn is a spade'.

       F : 'the card drawn is an ace'.

   (b) E : 'the card drawn is black'.

       F : 'the card drawn is a king'.

   (c) E : 'the card drawn is a king or queen'.

       F : 'the card drawn is a queen or jack'.

52. From a set of 100 cards numbered 1 to 100, one card is drawn at random. Find the probability that the number on the card is divisible by 6 or 8, but not by 24. **[2015]**

53. A can hit a target 4 times in 5 shots, B 3 times in 4 shots, and C 2 times in 3 shots. Calculate the probability that

   (a) A, B, C all may hit.

   (b) B, C may hit and A may lose.

   (c) Any two of A, B and C will hit the target.

   (d) None of them will hit the target.

54. An urn contains 4 red and 7 blue balls. Two balls are drawn at random with replacement. Find the probability of getting

   (a) 2 red balls   (b) 2 blue balls

   (c) One red and one blue ball.

   [CBSE 2007]

55. A speaks truth in 60% of the cases and B in 90% of the cases. In what percentage of cases are they likely to contradict each other in stating the same fact?

56. X is taking up subjects – Mathematics, Physics and Chemistry in the examination. His probabilities of getting grade A in these subjects are 0.2, 0.3 and 0.5 respectively. Find the probability that he gets

   (a) Grade A in all subjects.

   (b) Grade A in no subject.

   (c) Grade A in two subjects.

57. Out of 100 students, two sections of 40 and 60 formed. If you and your friend are among 100 students, what is the probability that:

   (a) You both enter the same section?

   (b) You both enter the same section?

58. A person has undertaken a construction job. The probabilities are 0.65 that there will be strike, 0.80 that the construction job will be completed on time if there is no strike, and 0.32 that the construction job will be completed on time if there is a strike. Determine the probability that the construction job will be completed on time.

59. One bag contains 4 yellow and 5 red balls. Another bag contains 6 yellow and 3 red balls. A ball is transferred from the first bag to the second bag and then a ball is drawn from the second bag. Find the probability that ball drawn is yellow.

60. An urn contains 5 red and 5 black balls. A ball is drawn at random, its colour is noted and is returned to the urn. Moreover, 2 additional balls of the colour drawn are put in the urn and then a ball is drawn at random. What is the probability that the second ball is red?

61. The bag A contains 8 white and 7 black balls while the bag B contains 5 white and 4 black balls. One ball is randomly picked up from the bag A and mixed up with the balls in bag B. Then a ball is randomly drawn out from it. Find the probability that ball drawn is white.

62. Bag I contains 3 red and 4 black balls while another bag II contains 5 red and 6 black balls. One ball is drawn at random from one of the bags and it is found to be red. Find the probability that it was drawn from bag II.

63. A bag contains 4 red and 4 black balls, another bag contains 2 red and 6 black balls. One of the two bags is selected at random and a ball is drawn from the bag which is found to be red. Find the probability that the ball is drawn from the first bag.

64. Given three identical boxes I, II and III, each containing two coins. In box I, both coins are gold coins, in box II, both are silver coins and in the box III, there is one gold and one

silver coin. A person chooses a box at random and takes out a coin. If the coin is of gold, what is the probability that the other coin in the box is also of gold?

[CBSE 2011]

65. In a set of 10 coins, 2 coins are with heads on both the sides. A coin is selected at random from this set and tossed five times. If all the five times, the result was heads, find the probability that the selected coin had heads on both the sides. **[CBSE 2014]**

66. Suppose that the reliability of a HIV test is specified as follows:

Of people having HIV, 90% of the tests detect the disease but 10% go undetected. Of people free of HIV, 99% of the test are judged HIV – ve but 1% are diagnosed as showing HIV +ve. From a large population of which only 0.1% have HIV, one person is selected at random, given the HIV test, and the pathologists reports him/her as HIV +ve. What is the probability that the person actually has HIV?

67. In a factory which manufactures bolts, machines A, B and C manufacture respectively 25%, 35% and 40% of the bolts. Of their outputs 5, 4 and 2 percent are respectively defective bolts. A bolt is drawn at random from the product and is found to be defective. What is the probability that it is manufactured by the machine B?
[CBSE 2008]

68. A doctor is to visit a patient. From the past experience, it is known that the probabilities that he will come by train, bus, scooter or by other means of transport are respectively $\frac{3}{10}$, $\frac{1}{5}$, $\frac{1}{10}$ and $\frac{2}{5}$. The probabilities that he will be late are $\frac{1}{4}$, $\frac{1}{3}$ and $\frac{1}{12}$, if he comes by train, bus and scooter respectively, but if he comes by other means of transport, then he will not be late. When he arrives, he is late. What is the probability that he comes by train?

69. Of the students in a college, it is known that 60% reside in hostel and 40% are day scholars (not residing in hostel). Previous year results report that 30% of all students who reside in hostel attain A grade and 20% of day scholars attain A grade in their annual examination. At the end of the year, one student is chosen at random from the college and he has an A grade, what is the probability that the student is a hosteller?

70. 40% students of a college reside in hostel and the remaining reside outside. At the end of the year, 50% of the hostelers got A grade while from outside students. Only 30% got A grade in the examination. At the end of the year, a student of the college was chosen at random and was found to have gotten A grade. What is the probability that the selected student was a hosteler? **[2015]**

71. In answering a question on a multiple choice test, a student either knows the answer or guesses. Let $\frac{3}{4}$ be the probability that he knows the answer and $\frac{1}{4}$ be the probability that he guesses. Assuming that a student who guesses at the answer will be correct with probability $\frac{1}{4}$. What is the probability that the student knows the answer given that he answered it correctly?

72. A laboratory blood test is 99% effective in detecting a certain disease when it is in fact, present. However, the test also yields a false positive result for 0.5% of the healthy person tested (i.e. if a healthy person is tested, then, with probability 0.005, the test will imply he has the disease). If 0.1 percent of the population actually has the disease, what is the probability that a person has the disease given that his test result is positive?

73. There are three coins. One is a two headed coin (having head on both faces), another is a biased coin that comes up heads 75% of the time and third is an unbiased coin. One of the three coins is chosen at random and

tossed, it shows heads, what is the probability that it was the two headed coin? [CBSE 2009]

74. An insurance company insured 2000 scooter drivers, 4000 car drivers and 6000 truck drivers. The probabilities of an accident are 0.01, 0.03 and 0.15 respectively. One of the insured persons meets with an accident. What is the probability that he is a scooter driver? [CBSE 2000, 2002, 2008, 2012]

75. An insurance company insured 2000 scooter drivers, 4000 card drivers and 6000 truck drivers. The probabilities of an accident for them are 0.01, 0.03 and 0.15 respectively. One of the insured persons meets with an accident. What is the probability that he is a scooter driver or a car driver? [CBSE 2014]

76. A factory has two machines A and B. Past record shows that machine A produced 60% of the items of output and machine B produced 40% of the items. Further, 2% of the items produced by machine A and 1% produced by machine B were defective. All the items are put into one stock pile and then one item is chosen at random from this and is found to be defective. What is the probability that it was produced by machine B?

77. Two groups are competing for the position on the board of directors of a corporation. The probabilities that the first and the second groups will win are 0.6 and 0.4 respectively. Further, if the first group wins, the probability of introducing a new product is 0.7 and the corresponding probability is 0.3 if the second group wins. Find the probability that the new product introduced was by the second group.

78. Suppose a girl throws a die. If she gets a 5 or 6, she tosses a coin three times and notes the number of heads. If she gets 1, 2, 3 or 4, she tosses a coin once and notes whether a head or tail is obtained. If she obtained exactly one head, what is the probability that she threw 1, 2, 3 or 4 with the die? [CBSE 2012]

79. A manufacturer has three machine operators A, B and C. The first operator A produces 1% defective items, whereas the other two operators B and C produce 5% and 7% defective items respectively. A is on the job for 50% of the time, B is on the job for 30% of the time and C is on the job for 20% of the time. A defective item is produced. What is the probability that it was produced by A?

80. A card from a pack of 52 cards is lost. From the remaining cards of the pack, two cards are drawn and are found to be both diamonds. Find the probability of the lost card being a diamond.

81. A company has two plants to manufacture scooters, plant I manufactures 70% of the scooters and plant II manufactures 30%. At plant I, 80% of the scooters are rates as of standard quality and at plant II, 90% of the scooters are rated as of standard quality. A scooter is chosen at random and is found to be of standard quality. What is the probability that it has come from plant II? [CBSE 2000, 2004, 2005]

82. A card from a pack of 52 cards is lost. From the remaining cards of the pack, two cards are drawn and are found to be hearts. Find the probability of the missing card to be a heart. [CBSE 2000, 2010]

83. A card from a pack of 52 playing cards is lost. From the remaining cards of the pack three cards are drawn at random (without replacement) and are found to be all spades. Find the probability of the lost card being a spade. [CBSE 2014]

84. Bag I contains 3 red and 4 black balls and bag II contains 4 red and 5 black balls. One ball is transferred from bag I to bag II and then a ball is drawn from bag II. The ball so drawn is found to be red in colour. Find the probability that the transferred ball is black. [CBSE 2012]

98

85. Suppose that 5% of men and 0.25% of women have grey hair. A grey haired person is selected at random. What is the probability of this person being male? Assume that there are equal number of males and females. **[CBSE 2011]**

86. A bag contains 4 balls. Two balls are drawn at random and are found to be white. What is the probability that all the balls are white? **[CBSE 2010]**

87. Bag A contains 2 white and 3 red balls and a bag B contains 4 white and 5 red balls. One ball is drawn at random from one of the bags and it is found to be red. Find the probability that it was drawn from bag B.
[CBSE 2007, 2010, 2011]

88. A bag contains 1 white and 6 red balls, and a second bag contains 4 white and 3 red balls. One of the bags is picked up at random and a ball is randomly drawn from it, and is found to be white in colour. Find the probability that the drawn ball was from the first bag. **[CBSE 2005]**

89. The contents of urns I, II and III are as follows:
Urn I: 1 white, 2 black and 3 red balls.
Urn II: 2 white, 1 black and 1 red ball.
Urn III: 4 white, 5 black and 3 red balls.
One urn is chosen at random and two balls are drawn. They happen to be white and red. What is the probability that they come from urns I, II and III?

90. Three urns A, B and C contain 6 red and 4 white; 2 red and 6 white; and 1 red and 5 white balls respectively. An urn is chosen at random and a ball is drawn. If the ball drawn is found to be red, find the probability that the ball was drawn from urn A. **[CBSE 2004]**

91. Two groups are competing for the positions of the board of directors of a corporation. The probabilities that the first and the second groups will win are 0.6 and 0.4 respectively. Further, if the first group wins, the probability of introducing a new product is 0.7 and the conditional probability is 0.3 if the second group wins. Find the probability that the new product introduced was by the second group.
[CBSE 2009]

92. A factory has three machines X, Y and Z producing 1000, 2000 and 3000 bolts per day respectively. The machine X produces 1% defective bolts, Y produces 1.5% and Z produces 2% defective bolts. At the end of a day, a bolt is drawn at random and is found to be defective. What is the probability that this defective bolt has been produced by machine X?

93. Suppose we have four boxes A, B, C and D containing coloured marbles as given below:

Box	Marble colour		
	Red	White	Black
A	1	6	3
B	6	2	2
C	8	1	1
D	0	6	4

94. A company has two plants to manufacture bicycles. The first plant manufactures 60% of the bicycles and the second plant 40%. Out of that 80% of the bicycles are rated of standard quality at the first plant and 90% of standard quality at the second plant. A bicycle is picked up at random and found to be standard quality. Find the probability that it comes from the second plant.
[CBSE 2003]

95. A is known to speak truth 3 times out of 5 times. He throws a die and reports that it is 1. Find the probability that it is actually 1.
[CBSE 2004]

96. A man is known to speak truth 3 out of 4 times. He throws a die and reports that it is a six. Find the probability that it is actually a six**.** **[CBSE 2005, 2011]**

97. A speaks the truth 8 times out of 10 times. A die is tossed. He reports that it was 5. What is the probability that it was actually 5?
[CBSE 2004]

98. A factory has three machines A, B and C, which produce 100, 200 and 300 items of a particular type daily. The machines produce 2%, 3% and 5% defective items respectively. One day when the production was over, an item was picked up randomly and it was found to be defective. Find the probability that it was produced by machine A. **[CBSE 2004]**

99. For A, B and C the chances of being selected as the manager of a firm are in the ratio 4 : 1: 2 respectively. The respective probabilities for them to introduce a radical change in marketing strategy are 0.3, 0.8 and 0.5. If the change does take place, find the probability that it is due to the appointment of B or C. **[CBSE 2005]**

100. An insurance company insured 2000 scooter drivers and 3000 motorcycles. The probability of an accident involving a scooter is 0.01 and that of a motorcycle is 0.02. An insured vehicle met with an accident. Find the probability that the probability that the accidented vehicle was a motorcycle. **[CBSE 2005]**

101. Coloured balls are distributed in four boxes as shown in the following table:

Box	Colour			
	Black	White	Red	Blue
I	3	4	5	6
II	2	2	2	2
III	1	2	3	1
IV	4	3	1	5

A box is selected at random and then a ball is randomly drawn from the selected box. The colour of the ball is black, what is the probability that ball drawn is from the box III?

102. If a machine is correctly set up, it produces 90% acceptable items. If it is incorrectly set up, it produces only 40% acceptable items. Past experience shows that 80% of the set ups are correctly done. If after a certain set up, the machine produces 2 acceptable items, find the probability that the machine is correctly set up.

103. Assume that the chance of a patient having a heart attack is 40%. It is also assumed that a meditation and yoga course reduce the risk of heart attack by 30% and prescription of certain drug reduces its chances by 25%. At a time a patient can choose any one of the two options with equal probabilities. It is given that after going through one of the two options the patient selected at random suffers a heart attack. Find the probability that the patient followed a course of meditation and yoga. **[CBSE 2015]**

104. In a certain college, 4% of boys and 1% of girls are taller than 1.75 metres. Furthermore, 60% of the students in the college are girls. A student selected at random from the college is found to be taller than 1.75 metres. Find the probability that the selected student is girl. **[CBSE 2012]**

105. A person plays a game of tossing a coin thrice. For each head, he is given `2 by the organiser of the game and for each tail, he has to give `1.50 to the organiser. Let X denote the amount gained or lost by the person. Show that X is a random variable and exhibit it as a function on the sample space of the experiment.

106. A bag contains 2 white and 1 red balls. One ball is drawn at random and then put back in the box after noting its colour. The process is repeated again. If X denotes the number of red balls recorded in the two draws, describe X.

107. An urn contains 5 red and 2 black balls. Two balls are randomly drawn. Let X represents the number of black balls. What are the possible values of X? Is X a random variable?

108. Let X represents the difference between the number of heads and the number of tails

obtained when a coin is tossed 6 times. What are possible values of X?

109. The random variable X has a probability distribution P(X) of the following form, where k is some number:

$$P(X)=\begin{cases} k, & \text{if } x=0 \\ 2k, & \text{if } x=1 \\ 3k, & \text{if } x=2 \\ 0 & \text{otherwise} \end{cases}$$

(a) Determine the value of k.

(b) Find $P(X < 2)$, $P(X \leq 2)$, $P(X \geq 2)$.

110. Two cards are drawn successively with replacement from a well shuffled deck of 52 cards. Find the probability distribution of the number of aces.

111. Find the probability distribution of number of doublets in three throws of a pair of dice.

112. Let X denotes the number of hours you study during a randomly selected school day. The probability that X can take the values x, has the following form, where k is some unknown constant.

$$P(X)=(x)=\begin{cases} 0.1, & \text{if } x=0 \\ kx, & \text{if } x=1\,or\,2 \\ k(5-x), & \text{if } x=3\,or\,4 \\ 0 & \text{otherwise} \end{cases}$$

(a) Find the value of k.

(b) What is the probability that you study at least two hours? Exactly two hours? At most two hours?

113. Find the probability of
   (a) Number of heads in two tosses of a coin.
   (b) Number of tails in the simultaneous tosses of three coins.
   (c) Number of heads in four tosses of a coin.

114. A fair die is tossed twice. If the number appearing on the top is less than 3, it is success. Find the probability distribution of number of successes.

[CBSE 2004]

115. From a lot of 30 bulbs, which includes 6 defectives, a sample of 4 bulbs is drawn at random with replacement. Find the

probability distribution of the number of defective bulbs. **[CBSE 2004]**

116. From a lot of 15 bulbs which include 5 defectives, a sample of 4 bulbs is drawn one by one with replacement. Find the probability distribution of number of defective bulbs. Hence find the mean of the distribution. **[CBSE 2014]**

117. From a lot of 10 bulbs, which includes 3 defectives, a sample of 2 bulbs is drawn at random. Find the probability distribution of the number of defective bulbs.

[CBSE 2010]

118. A box contains 13 bulbs, out of which 5 are defective. 3 bulbs are randomly drawn, one by one without replacement, from the box. Find the probability distribution of the number of defective bulbs. **[CBSE 2005]**

119. A coin is biased so that the head is 3 times as likely to occur as tail. If the coin is tossed twice, find the probability distribution of number of tails.

120. A random variable X has the following probability distribution:

X	0	1	2	3	4	5	6	7
P(X)	0	K	2k	2k	3k	k^2	$2k^2$	$7k^2+k$

Determine
(a) k   (b) $P(X < 6)$
(c) $P(X \geq 6)$ (d) $P(0 < X < 5)$

[CBSE 2011]

121. Two dice are thrown simultaneously. If X denotes the number of sixes, find the expectation of X.

122. A and B throw a die alternatively till one of them gets a number greater than four and wins the game. If A starts the game, what is the probability of B winning? **[CBSE 2015]**

123. Three cards are drawn from a pack of 52 playing cards. Find the probability distribution of the number of aces.

[CBSE 2001]

124. Two cards are drawn successively with replacement from a well shuffled pack of 52 playing cards. Find the probability distribution of the number of aces.

[CBSE 2011]

125. Two cards are drawn successively with replacement from a well shuffled pack of 52 playing cards. Find the probability distribution of the number of kings.

[CBSE 2012]

126. Two cards are drawn successively without replacement from a well shuffled pack of 52 playing cards. Find the probability distribution of the number of aces. **[CBSE 2011]**

127. Three cards one drawn at random (without replacement) from a well shuffled pack of 52 playing cards. Find the probability distribution of number of red cards. Hence find the mean of the distribution. **[CBSE 2014]**

128. Two the numbers are selected at random (without replacement) from first six positive integers. Let x denote the larger of the two numbers obtained. Find the probability distribution of x. Find the mean and variance of this distribution. **[2015]**

129. Four bad oranges are mixed accidently with 16 good oranges. Find the probability distribution of the number of bad oranges in a draw of two oranges.

130. In a game, a man wins a rupee for a six and loses a rupee for any other number when a fair die is thrown. The man decided to throw a die thrice but to quit as and when he gets a six. Find the expected value of the amount he wins/loses.

131. A class has 15 students whose ages are 14, 17, 15, 14, 21, 17, 19, 20, 16, 18, 20, 17, 16, 19 and 20 years. One student is selected in such a manner that each has the same chance of being chosen and the age X of the selected student is recorded. What is the probability distribution of the random variable X? Find mean, variance and standard deviation of X.

132. Two numbers are selected at random (without replacement) from the first six positive integers. Let X denotes the larger of the two numbers obtained. Find E(X).

133. Find the variance of the number obtained on a throw of an unbiased die.

134. Let a pair of dice be thrown and the random variable X be the sum of the numbers that appear on the two dice. Find the mean or expectation of X.

135. Two cards are drawn simultaneously (or successively without replacement) from a well shuffled pack of 52 playing cards. Find the mean, variance and standard deviation of the number of kings.

[CBSE 2008]

136. Two cards are drawn successively without replacement from a well shuffled deck of 52 cards. Compute the variance of the number of aces. **[CBSE 2010]**

137. Two cards are drawn successively with replacement from a well shuffled deck of 52 cards. Compute the mean and standard deviation of the number of aces.

[CBSE 2012]

138. Find the mean number of heads in three tosses of a fair coin.

139. Find the mean, variance and standard deviation of the number of heads in a simultaneous toss of three coins.

[CBSE 2007]

140. Let X denotes the sum of the numbers obtained when two fair dice are rolled. Find the variance and standard deviation of X.

141. In a meeting, 70% of the members favour and 30% oppose a certain proposal. A member is selected at random and we take X = 0, if he opposed, and X = 1, if he is in favour. Find E(X) and Var(X).

142. Find the probability distribution of the number of successes in two tosses of a die, where a success is defined as
(a) Number greater than 4.
(b) Six appears on at least one die.
Also, find the mean and variance of the distribution.

143. If a fair coin is tossed 10 times, find the probability of
(a) Exactly six heads.

(b) At least six heads.

(c) At most six heads.

144. A die is thrown 6 times. If 'getting an odd number' is a success, what is the probability of

(a) 5 successes?   (b) at least 5 successes?

(c) At most 5 successes?

145. A pair of dice is thrown 7 times. If getting a total of 7 is considered a success, what is the probability of

(a) No success?

(b) 6 successes?

(c) At least 6 successes?

(d) At most 6 successes?   **[CBSE 2004]**

146. A pair of dice is thrown 4 times. If getting a doublet is considered a success, find the probability of two successes and hence find its mean.

[CBSE 2012]

147. Find the probability distribution of the number of doublets in 4 throws of a pair of dice and hence find its mean.

[CBSE 2008, 2010, 2012]

148. Find the probability distribution of the number of sixes in three tosses of a die.

[CBSE 2007C]

149. Ten eggs are drawn successively with replacement from a lot containing 10% defective eggs. Find the probability that there is at least one defective egg.

150. There are 5% defective items in a large bulk of items. What is the probability that a sample of 10 items will include not more than one defective item?

151. Five cards are drawn successively with replacement from a well – shuffled deck of 52 cards. What is the probability that

(a) All the five cards are spades?

(b) Only 3 cards are spades?

(c) None is a spade?

152. The probability that a bulb produced by a factory will fuse after 150 days of use is 0.05. Find the probability that out of 5 such bulbs

(a) None

(b) Not more than one.

(c) More than one.

(d) At least one.

153. A bag consists of 10 balls each marked with one of the digits 0 to 9. If four balls are drawn successively with replacement from the bag, what is the probability that none is marked with the digit 0?

154. In an examination, 20 questions of true – false type are asked. Suppose a student tosses a fair coin to determine his answer to each question. If the coin falls heads, he answers 'true'; if it falls tails, he answers 'false'. Find the probability that he answers at least 12 questions correctly.

155. Suppose X has a binomial distribution $B\left(6, \frac{1}{2}\right)$. Show that X = 3 is the most likely outcome.

156. On a multiple choice examination with three possible answers for each of the five questions, what is the probability that a candidate would get four or more correct answers just by guessing?   **[CBSE 2010]**

157. A person buys a lottery ticket in 50 lotteries, in each of which his chance of winning a prize is $\frac{1}{100}$. What is the probability that he will win a prize

(a) At least once?

(b) Exactly once?

(c) At least twice?

158. Find the probability of getting 5 exactly twice in 7 throws of a die.

159. Find the probability of throwing at most 2 sixes in 6 throws of a single die.

160. It is known that 10% of certain articles manufactured are defective. What is the probability that in a random sample of 12 such articles, 9 are defective?

161. Find the mean of the binomial distribution $B\left(4, \frac{1}{3}\right)$.

162. The probability of a shooter hitting a target is $\dfrac{3}{4}$. How much minimum number of times must he/she fire so that the probability of hitting the target at least once is more than 0.99?

163. Suppose that 90% of people are right – handed. What is the probability that at most 6 of a random sample of 10 people are right – handed?

164. An urn contains 25 balls of which 10 balls bear a mark 'X' and the remaining 15 bear a mark 'Y'. A ball is drawn at random from the urn, its mark is noted down and it is replaced. If 6 balls are drawn in this way, find the probability that
(a) All will bear 'X' mark.
(b) Not more than 2 will bear 'Y' mark.
(c) At least one ball will bear 'Y mark.
(d) The number of balls with 'X' marks and 'Y' mark will be equal.

165. In a hurdle race, a player has to cross 10 hurdles. The probability that he will clear each hurdle is $\dfrac{5}{6}$. What is the probability that he will knock down fewer than 2 hurdles?

166. A die is thrown again and again until three sixes are obtained. Find the probability of obtaining the third six in the sixth throw of the die. **[CBSE 2009]**

167. An experiment succeeds twice as often as it fails. Find the probability that in the next six trials, there will be at least 4 successes.

168. An unbiased coin is tossed 8 times. Find, by using binomial distribution, the probability of getting at least 6 heads.

169. Six coins are tossed simultaneously. Find the probability of getting
(a) 3 heads   (b) no heads
(c) At least one head   **[CBSE 2003]**

170. The probability that a student entering a university will graduate is 0.4. Find the probability that out of 3 students of the university:
(a) None will graduate.
(b) Only one will graduate.
(c) All will graduate.   **[CBSE 2005]**

171. How many times must a man toss a fair coin so that the probability of having at least one head is more than 80%?
                [CBSE 2012]

172. Six balls are drawn successively from an urn containing 7 red and 9 black balls. Tell whether or not the trials of drawing balls are Bernoulli trials when after each draw the ball drawn is
(a) Replaced   (b) Not replaced in the urn

173. The mean and variance of a binomial distribution are 4 and 4/3 respectively, find $P(X \geq 1)$.   **[CBSE 2004, 2005]**

174. The mean and variance of a binomial distribution are $\dfrac{4}{3}$ and $\dfrac{8}{9}$ respectively, find $P(X \geq 1)$.   **[CBSE 2004]**

175. If a random variable X follows binomial distribution with mean 3 and variance $\dfrac{3}{2}$, find $P(X \leq 5)$.

176. If X follows binomial distribution with mean 4 and variance 2, find $P(X \geq 5)$.

177. If the sum of the mean and variance of a binomial distribution for 5 trials is 1.8, find the distribution.   **[CBSE 2004]**

178. If the sum of the mean and variance of a binomial distribution for 6 trials is $\dfrac{10}{3}$, find the distribution.   **[CBSE 2004]**

179. If two dice are rolled 12 times, obtain the mean and variance of the distribution of successes, if getting a total greater than 4 is considered a success.   **[CBSE 2002C]**

180. A and B throw a die alternatively till one of them gets a '6' and wins the game. Find their respective probabilities of wining, if A starts first.

181. How many times must a man toss a fair coin so that the probability of having at least one head is more than 90%?

182. How many times must a fair coin be tossed so that the probability of getting at least one head is more than 80%?

[CBSE 2015]

183. If each element of a second order determinant is either zero or one, what is the probability that the value of the determinant is positive?

184. An electronic assembly consists of two subsystems, say, A and B. From previous testing procedures, the following probabilities are assumed to be known:
P(A fails) = 0.2, P(B fails alone) = 0.15,
P(A and B fail) = 0.15
Evaluate the following probabilities
(a) P(A fails | B has failed)
(b) P(A fails alone).