



MATHS

BOOKS - NAGEEN PRAKASHAN ENGLISH

PROBABILITY

Solved Example Type

1. For two events A and B , $P(A) = \frac{7}{13}$, $P(B) = \frac{9}{13}$ and $P(A \cap B) = \frac{4}{13}$. Find the value of $P(A/B)$.



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2. If A and B are two events such that $P(A) = 0.4$, $P(B) = 0.8$ and $P(B/A) = 0.6$, then find:

(i) $P(A \cap B)$ (ii) $P(A \cup B)$ (iii) $P(A/B)$



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3. In one throw of a dice, the result is an even number. Find the probability that it is prime.



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4. There are two children in a family. Find the probability that both boys if it is known that:

(i) one of the children is a boy

(ii) Older child is a boy



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5. A dice is thrown twice and the sum of numbers appear to be 6. Find the probability of getting 4 on at least one throw.



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6. 20 cards whose number are from 1 to 20 are mixed after placing in a box. A card is drawn at random and it is found that the number on the card is greater than 11. Find the probability that the number on the card is an even number.

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7. Two integers are selected at random from the integers 1 to 11. If their sum is even find the probability that both integers are odd.

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8. If $P(A) = \frac{2}{5}$ and $P(B) = \frac{1}{3}$ and A and B are independent events, then find $P(A \cap B)$.

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9. If E and F are two independent events and $P(E) = \frac{1}{3}$, $P(F) = \frac{1}{4}$, then find $P(E \cup F)$.

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10. If A and B are two independent events and $P(A) = 0.2$, $P(B) = 0.3$, then find the values of the following:

- (i) $P(A \text{ and } B)$ (ii) $P(A \text{ and not } B)$
(iii) $P(A \text{ or } B)$ (iv) $P(\text{none of } A \text{ and } B)$

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11. There are 5 red and 7 white balls in a bag. Two balls are drawn one by one without replacement. Find the probability that first ball is red and second is white.

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12. A dice is thrown once. If E is the event of getting a multiple of 3 and F is the event of getting an even number, then find whether E and F are independent or not?

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13. There are 5 red, 4 black and 3 white balls in a bag. Three balls are drawn one by one without replacement find the probability that all three balls are red.

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14. Two cards are drawn one by one without replacement. Find the probability that both are hearts.

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15. A man A speaks truth in 70% of the cases while another man B speaks truth in 60% of the cases. Find the probability of an event in which they agree with one another.



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16. There are 3 white, 6 black balls in one bag and 6 white, 3 black balls in second bag. A bag is selected at random and a ball is drawn from it. Find the probability that the ball drawn is black.



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17. A man takes the contract of construction work. The probability is 0.30, if there will be no strike. The probability that the construct work will be completed on time are 0.8 and 0.3 in cases of no strike and in case strike respectively. Find the probability that the construction work will be completed in time.



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18. Two thirds of eth students in a class are boys and the rest girls. It is known that eh probability of a girl getting a first class is 0.25 and that of a boy getting a first class is 0.28. find the probability that a student chosen at random will get first class marks in the subject.

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19. A company has two plant 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.

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20. One bag A contains 4 red and 5 black balls. The other bag B contains 6 red and 3 black balls. A ball is taken from bag A and transferred to bag B. Now a ball is taken from bag B. Find the probability that the ball drawn is red.



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21. Find the mean and variance of the number of heads in the two tosses of a coin.



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



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23. There are 4 white and 5 red balls in a bag. Three balls are drawn with replacement. Find the probability distribution for number of red balls.

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24. A coin is tossed 5 times. If X is the number of heads observed, find the probability distribution of X .

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

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26. There are 5 questions in a multiple choice examination in which each question has 3 possible answers. Find the probability that a student gives 4 correct answers by guess only.



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



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Exercise 13 A

1. If A and B are two events such that $P(A) = 0.5$, $P(B) = 0.6$ and $P(A \cup B) = 0.8$, find $P(A/B)$ and $P(B/A)$.



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2. For two events A and B $P(A) = \frac{6}{13}$, $P(B) = \frac{5}{13}$ and $P(A \cup B) = \frac{7}{13}$. Find the values of following:

(i) $P(A \cap B)$ (ii) $P(A/B)$

(iii) $P(B/A)$

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3. For two events A and B $P(A) = 0.7$, $P(B) = 0.5$ and $P(A \cap B) = 0.3$

. Find the values of following:

(i) $P(A \cup B)$ (ii) $P(A/B)$

(iii) $P(\bar{A}/\bar{B})$ (iv) $P(\bar{B}/\bar{A})$

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4. In a throw of a dice a number divisible by 3 appears. Find the probability that it is an even number.

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5. If $P(A) = 0.3$, $P(B) = 0.6$ and $P(A/B) = 0.4$ then find:

(i) $P(A \cap B)$ (ii) $P(B/A)$



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6. A card is drawn from a well shuffled pack of 52 cards and it is found to be red. Find the probability that it is a king.



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7. In one toss of three coins, at least one head appears. Find the probability of getting three heads.



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8. A die is thrown three times. Events A and B are defined as follows: A:4 on the third throw, B:6 on the first and 5 on the second throw. Find the

probability of A given that B has already occurred.

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9. A family has two children. If one of them is boy, then the probability that other is also a boy, is

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10. 12 cards, numbered 1 to 12 are given. A card is drawn at random. It is known that the number on this card is greater than 6. Find the probability that it is odd.

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11. The sum of numbers on two throws of a dice is 8. Find the probability of getting 3 in at least one throw.

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12. It is known that the numbers getting in one throw of two dice are different. Find the probability of getting a sum of 6.



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13. In a school 25% students are failed in Mathematics, 15% in Physics and 5% students fail in both Mathematics and Physics. A student is selected at random.

- (i) If he is fail in Physics, find the probability that he is fail in Mathematics.
- (ii) If he is fail in Mathematics, find the probability that he is fail in Physics.
- (iii) Find the probability that he is fail either in Mathematics or in Physics.



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14. Two integers are selected at random from the integers 1 to 9. If their sum is even, then find the probability that both integers are odd.



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15. 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.



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Exercise 13 B

1. If A and B are independent events such that $P(A) = 0.4$ and $P(B) = 0.5$, then find $P(A \cap B)$.



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2. 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 i. mutually

exclusive, ii. independent.

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3. If A and B are independent events such that $P(A) = 0.3$ and $P(B) = 0.5$, then find the values of:

(i) $P(A \cap B)$ (ii) $P(A \cup B)$

(iii) $P(A/B)$ (iv) $P(B/A)$

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4. 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 $P(\text{not A and not B})$.

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



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6. A and B are two events such that $P(A) = \frac{3}{5}$, $P(B) = \frac{3}{10}$ and $P(A \cup B) = \frac{1}{2}$

Find whether A and B are independent or not.



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7. There are 10 black and 8 white balls in a bag. Two balls are drawn without replacement. Find the probability that:

- (i) both balls are black
- (ii) first ball is black and second is white
- (iii) one ball is black and other is white.



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8. A card is drawn from a well shuffled pack of 52 cards . In which of the following cases, the events E and F are independent events?

(i) $E =$ card drawn is heart.

$F =$ card drawn is a king.

(ii) $E =$ card drawn is red.

$F =$ card drawn is a king.



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9. The probabilities that A and b can solve a problem independently are

$\frac{1}{3}$ and $\frac{1}{4}$ respectively. If both try to solve the problem independently, find

the probability that:

(i) problem will be solved



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10. Three cards are drawn one by one without replacement from a well shuffled pack of 52 cards. Find the probability that the first two cards drawn are queen and third card drawn is a king.



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11. In three throws of a dice, find the probability of getting odd number at least in one throw.



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12. In a hostel 60% of the students read Hindi news paper, 40% read English newspaper and 20% read both Hindi and English newspapers. A student is selected at random.



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13. A speaks truth in 75% and B in 80% of the cases. In what percentage of cases are they likely to contradict each other in narrating the same incident?



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14. The odds in favour of A whose age is 45 years will live upto 60 years are 7: 10. The odds against of B whose age is 50 years, will live upto 65 years are 3: 2. Find the probability that at least one will live upto next 15 years.



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15. In a company there are two vacancies. A man and his wife come for interview. The probability of selection of man is $\frac{1}{10}$ and his wife is $\frac{1}{8}$.

Find the probability that:

- (i) both will be selected
- (ii) only one will be selected
- (iii) none of them will be selected.



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16. A bag contains 50 tickets numbered 1, 2, 3, ..., 50 of which five are drawn at random and arranged in ascending order of magnitude $\{x_1$



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17. In a company there are two vacancies. A man and his wife come for interview. The probability of selection of man is $\frac{1}{10}$ and his wife is $\frac{1}{8}$.

Find the probability that:

- (i) both will be selected
- (ii) only one will be selected
- (iii) none of them will be selected.



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Exercise 13 C

1. There are 3 red and 2 black, 2 red and 3 black, 4 red and 1 black balls in three bags respectively. The probability of selecting each bag is same. A ball is drawn at random from one bag. Find the probability that it is black.



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2. Find the probability of drawing a one-rupee coin from a purse with two compartments one of which contains 3 fifty-paise coins and 2 one-rupee coins and other contains 2 fifty-paise coins and 3 one-rupee coins.



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3. A bag contains 4 white and 5 red balls. Second bag contains 6 white and 3 red balls. A ball is transferred from first bag to second and then a ball is drawn from the second bag. Find the probability that this ball drawn is red.



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4. One bag contains 5 white balls and 3 black balls and a second bag contains 2 white balls and 4 black balls. One ball drawn from the first bag and placed unseen in the second bag. What is the probability that a ball now drawn from second bag is black?



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5. A bag contains 3 black and 4 white balls. Second bag contains 5 black and 6 white balls. A ball is drawn at random from one of the bags and it is found to be black. What is the probability that this ball is drawn from second bag?

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6. In a bolt factory three machines A, B and C manufacture 25% , 35% and 40% of the total production respectively. Of their respective outputs, 5% , 4% and 2% are defective. A bolt is drawn at random from the total production and it is found to be defective. Find the probability that it was manufactured by machine C.

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7. 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 stockpile 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?



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8. 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 probability 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?



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9. Probability that A speaks truth is $\frac{4}{5}$. A coin is tossed A reports that a head appears. The probability that actually there was head is

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10. 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.

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11. 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 is a two headed coin.

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12. 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 these person being male? Assume that there are equal number of males and females.

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

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14. Suppose a girl throws a die. If she gets a 5 or 6, she tosses a coin 3 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?

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15. 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 corresponding probability is 0.3 if the second group wins. Find the probability that the new product introduced was by the second group.

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Exercise 13 D

1. Find the probability distribution for number of heads obtained in two tosses of a coin.

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2. Find the probability distribution for number of heads obtained in three tosses of a coin.

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

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4. Which of the following probability distribution does not exist for random variable? Give reason?

(i)	X	0	1	2
	$P(X)$	0.3	0.2	0.5

(ii)	X	0	1	2	3
	$P(X)$	0.1	0.3	-0.2	0.8

(iii)	X	-1	0	1	2
	$P(X)$	0.4	0.2	0.3	0.15



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5. The probability distribution for a random variable X is as follows:

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

Find:

(i) k (ii) $P(X < 3)$ (iii) $P(X > 6)$ (iv) $P(0 < X < 3)$



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

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

Find:

(i) k

(ii) the probability that you study exactly two hours,

(iii) the probability that you study at most two hours.



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7. Let X represent 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 ?



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



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9. There are 5 red and 2 black balls in a bag. Two balls are drawn at random. If X denotes the number of black balls, what are the possible values of X ?

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10. Find the probability of getting 5 at least once in there throws of a dice.

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11. Find the mean and variance of the number of heads in the two tosses of a coin.

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12. Two cards are drawn successively without replacement from a well shuffled deck of cards . Find the mean and standard variation of the

random variable X , where X is the number of aces .

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13. 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.

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14. There are 5 white and 4 red balls in a bag. Three balls are drawn one by one without replacement. Find the probability distribution for the number of white balls drawn.

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Exercise 13 E

1. A pair of dice is thrown 4 times. If getting a doublet is considered a success, find the probability of two successes.

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2. Suppose X has a binomial distribution $B\left(6, \frac{1}{2}\right)$. Show that $X = 3$ is the most likely outcome. (Hint: $P(x = 3)$ is the maximum among all $P(x_i)$, $x_i = 0, 1, 2, 3, 4, 5, 6$)

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

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

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5. A fair coin is tossed four times. Let X denote the number of heads occurring. Find the probability distribution, mean and variance of X .

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6. Find the probability distribution of doubles in three throws of two dice.

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7. If a fair coin is tossed 9 times, find the probability of (a) exactly six heads, (b) at least six heads, (c) at most six heads.

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8. 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?



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9. The probability that a student is not a swimmer is $\frac{1}{5}$. Then the probability that out of five students, four are swimmers is (A)

${}^5C_4 \left(\frac{4}{5}\right)^4 \frac{1}{5}$ (B) $\frac{\left(\frac{4}{5}\right)^{41}}{5}$ (C) ${}^5C_1 \frac{1}{5} \left(\frac{4}{5}\right)^4$ (D) None of these



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10. There are 10 defective bulbs in a group of 100 bulbs. If a sample of 8 bulbs are selected at random then find the probability that:

(i) in this sample 3 bulbs are defective and 5 are non-defective.

(ii) in this sample at least one bulb is defective.



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11. 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.



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12. A and B throw a dice alternately til any one gets a 6 on the and win the game. If A begins the game find the probabilities of winning the game.



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Exercise 13 F Multiple Choice Questions

1. If $P(A) = 0.4$, $P(B) = 0.8$, $P\left(\frac{B}{A}\right) = 0.6$. Find $P\left(\frac{A}{B}\right)$ and $(A \cup B)$.

A. 0.2

B. 0.3

C. 0.4

D. None of these

Answer: B



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2. 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?

A. $2/5$

B. $3/5$

C. $1/5$

D. $4/5$

Answer: A



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3. Events E and F are independent. Find

$P(F)$, if $P(E) = 0.35$ and $P(E \cup F) = 0.6$.

A. $3/13$

B. $4/13$

C. $6/13$

D. $5/13$

Answer: D



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

A. $P(A')P(B')$

B. $1 - P(A')P(B')$

C. $1 + P(A')P(B')$

D. None of these

Answer: B



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5. A speaks truth in 605 cases and B speaks truth in 70% cases. The probability that they will say the same thing while describing a single event is $\frac{2}{19}$ b. $\frac{3}{29}$ c. $\frac{17}{19}$ d. $\frac{4}{29}$

A. 0.42

B. 0.58

C. 0.54

D. 0.46

Answer: C



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6. In a class two third students are boys and remaining are girls. The probability of getting first class by a boy is 0.30 and the probability of getting first class by a girl is 0.24. The probability of getting first class by a randomly selected student is:

A. 0.28

B. 0.26

C. 0.24

D. None of these

Answer: A



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7. A bag contains 4 white and 5 black balls. Second bag contains 6 white and 7 black balls. A ball is transferred from first bag to second and then a

ball is drawn from the second bag. Find the probability that this ball drawn is black.

A. $\frac{29}{63}$

B. $\frac{34}{63}$

C. $\frac{7}{13}$

D. None of these

Answer: B



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8. The mean of getting tail two tosses of a coin is:

A. $\frac{1}{4}$

B. $\frac{1}{3}$

C. $\frac{1}{2}$

D. 1

Answer: D



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9. A coin is tossed 5 times. What is the probability of getting at least 3 heads.

A. $11/32$

B. $21/32$

C. $5/32$

D. None of these

Answer: A



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10. The probability of any ship return safely to the port is $1/5$. Find the probability that the returning out of 5 ships, at least 3 ships returns

safely. It is given that returning ships are independently.

A. $256 / 625$

B. $369 / 625$

C. $248 / 625$

D. None of these

Answer: D



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Exercise 13 G Questions For Competitive Examinations

1. A lottery consists 3 prize tickets and 6 blank tickets. A choose three tickets from this lottery . Another lottery there are 1 prize ticket and 2 blank tickets. B choose one ticket from this lottery. Find the ratio in favour of A and B.

A. 7: 16

B. 16:7

C. 16:9

D. 1:28

Answer: D



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2. There are 10% rotten eggs in a sample. 10 eggs are drawn one by one with replacement. Find the probability that at least one egg is rotten in a sample of 10 eggs.

A. $\left(\frac{9}{10}\right)^{10}$

B. $1 - \left(\frac{9}{10}\right)^{10}$

C. $\left(\frac{1}{10}\right)^{10}$

D. None of these

Answer: B



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3. Two integers are selected at random from integers 1 through 11. If the sum is even, find the probability that both the numbers are odd.

A. $1/5$

B. $2/5$

C. $3/5$

D. $4/5$

Answer: C



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4. A bag contains 50 tickets numbered 1, 2, 3, ..., 50 of which five are drawn at random and arranged in ascending order of magnitude x_1

A. $\frac{653}{15134}$

B. $\frac{949}{15134}$

C. $\frac{551}{15134}$

D. None of these

Answer: C



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5. 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.

A. $\frac{11}{50}$

B. $\frac{17}{50}$

C. $\frac{33}{50}$

D. $\frac{39}{50}$

Answer: A



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6. A man is known to speak truth 3 out of 4 times. He throws a die and report that it is a 6. Find the probability that it is actually 6.

A. $1/8$

B. $7/8$

C. $5/8$

D. $3/8$

Answer: D



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7. Two cards are drawn from 52 playing cards without replacement. The variance of the number of ace is

A. $\frac{400}{2873}$

B. $\frac{600}{2873}$

C. $\frac{200}{2873}$

D. None of these

Answer: A



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8. Let A and B be two events such that $P(\overline{A \cup B}) = 1/6$, $P(A \cap B) = 1/4$ and $P(\overline{A}) = 1/4$ where \overline{A} stands for complement of event A. Then events A and B are

A. $1/4$

B. $1/3$

C. $1/2$

D. $1/6$

Answer: B



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9. 13. If A and B are two events such that $P(A) = \frac{1}{2}$ and $P(B) = \frac{2}{3}$, then

A. $1/6$

B. $1/3$

C. $2/3$

D. $1/2$

Answer: B



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10. A pair of unbiased die is thrown 3 times independently. The probability of getting the sum of number 9 two times is:

A. $5/243$

B. $7/243$

C. $8/243$

D. $10/243$

Answer: C

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Exercise 13 1

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

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2. Compute $P(A | B)$. if $P(B) = 0.5$ and $P(A \cap B) = 0.32$

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3. If $P(A) = 0.8$, $P(B) = 0.5$ and $P(B | A) = 0.4$, find (i) $P(A \cap B)$
(ii) $P(A | B)$ (iii) $P(A \cup B)$

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

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5. If $P(A) = \frac{6}{11}$, $P(B) = \frac{5}{11}$ and $P(A \cup B) = \frac{7}{11}$, find (i) $P(A \cap B)$
(ii) $P(A | B)$ (iii) $P(B | A)$

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6. A coin is tossed three times. Find $P(A/B)$ in each of the following:
 $A =$ Heads on third toss, $B =$ Heads on first two tosses
 $A =$ At least two heads, $B =$ At most two heads
 $A =$ At most two tails, $B =$ At least one tail.





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7. Two coins are tossed once. $P(E/F)$ in each of the following: E = Tail appears on one coin, F = one coin shows head E = No tail appears, F = No head appears,



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8. Determine $P(E|F)$ in : A die is thrown three times, E : 4 appears on the third toss, F : 6 and 5 appears respectively on first two tosses. Determine $P(E|F)$



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9. Determine $P(E|F)$ in : Mother father and son line up at random for a family picture E : son on one end. F : father in middle



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10. 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 a 5.

(b) Find the conditional probability of obtaining the sum 8? given that the red die resulted in a number less than 4.



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11. A fair die is rolled. Consider events $E = \{1, 3, 5\}$, $F = \{2, 3\}$ and $G = \{2, 3, 4, 5\}$ Find (i) $P(E | F)$ and $P(F | E)$ (ii) $P(E | G)$ and $P(G | E)$ (iii) $P((E \cup F) | G)$ and $P((E \cap F) | G)$



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12. Assume that each child born 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 i. the youngest is a girl, ii. at least one is a girl?



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13. An instructor has a test bank consisting of 300 easy True/False questions, 200 difficult True/False questions, 500 easy multiple choice questions (MCQ) and 400 difficult multiple choice questions. If a question is selected at random from the test bank, what is the probability that it will be an easy question given that it is a multiple choice question.

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14. 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.

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15. 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 as three.



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16. In each of the Exercises choose the correct answer: If $P(A) = \frac{1}{2}$, $P(B) = 0$, then $P(A | B)$ is

A. 0

B. $\frac{1}{2}$

C. not defined

D. 1

Answer: C



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17. If A and B are two events such that $A \cap B \neq \phi$, $P\left(\frac{A}{B}\right) = P\left(\frac{B}{A}\right)$.

Then,

A. $A \subset B$ but $A \neq B$

B. $A = B$

C. $A \cap B = \phi$

D. $P(A) = P(B)$

Answer: B::D



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Exercise 13 2

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



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2. 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.

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3. 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.

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4. 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.

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5. 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?



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6. 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?



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7. 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 i. mutually exclusive, ii. independent.



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8. Let A and B be independent events with $P(A) = 0.3$ and $P(B) = 0.4$

Find (i) $P(A \cap B)$ (ii) $P(A \cup B)$ (iii) $P(A | B)$ (iv) $P(B | A)$

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9. 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 $P(\text{not A and not B})$.

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10. Events A and B are such that $P(A) = 1/2$, $P(B) = 7/12$, and $P(\text{not A or not B}) = 1/4$. State whether A and B are independent?

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11. Given two independent events A and B such that $P(A) = 0.3$, $P(B) = 0.6$. Find (i) $P(A \text{ and } B)$ (ii) $P(A \text{ and not } B)$ (iii) $P(A \text{ or } B)$ (iv)

P(neither A nor B)



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



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13. Two balls are drawn at random with replacement from a box containing 10 black and 8 red balls. Find the probability that i. both balls are red, ii. first ball is black and second is red, iii. One of them is black and other is red.



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14. 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 (i) the problem is solved (ii) exactly one of them solves the problem.

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15. 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? (i) E : the card drawn is a spade F : the card drawn is an ace (ii) E : the card drawn is black F : the card drawn is a king

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16. In a hostel 60% of the students read Hindi news paper, 40% read English newspaper and 20% read both Hindi and English newspapers. A student is selected at random.

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17. The probability of obtaining an even prime number on each die, when a pair of dice is rolled is

A. 0

B. $\frac{1}{3}$

C. $\frac{1}{12}$

D. $\frac{1}{36}$

Answer: A



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18. Two events A and B will be independent, if(A) A and B are mutually exclusive(B) $P(A' \cap B') = [1 - P(A)][1 - P(B)]$ (C) $P(A) = P(B)$ (D) $P(A) + P(B) = 1$

A. A and B are mutually exclusive

B. $P(A' \cap B') = [1 - P(A)][1 - P(B)]$

C. $P(A) = P(B)$

D. $P(A) + P(B) = 1$

Answer: A



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Exercise 13 3

1. 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?



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2. 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

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3. Of the students in a college, it is known that 60% reside in hostel and 40% 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 hosteler?

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4. 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 ans

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5. A laboratory blood test is 99% effective in detecting a certain disease when its infection is 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% of the population actually has the disease, what is the probability that a person has the disease given that his test result is positive?

[!\[\]\(919a2cb85b99741a73c0c31a427236a8_img.jpg\) Watch Video Solution](#)

6. There are three coins, one is a two headed coin (having head on both the faces), another is a biased coin that comes up heads 75% of the time and the third is an unbiased coin. One of the three coins is chosen at random and tossed. If it shows head. What is probability that it was two headed coin ?

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7. An insurance company insured 2000 scooter drivers, 4000 car 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?

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8. 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 stockpile 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?

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9. 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 corresponding probability is 0.3 if the second group wins. Find the probability that the new product introduced was by the second group.



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10. 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?



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11. 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?

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12. 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.

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13. Probability that A speaks truth is $\frac{4}{5}$. A coin is tossed A reports that a head appears. The probability that actually there was head is

A. $\frac{4}{5}$

B. $\frac{1}{2}$

C. $\frac{1}{5}$

D. $\frac{2}{5}$

Answer: A



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14. If A and B are two events such that $A \subset B$ and $P(B) \neq 0$, then which of the following is correct?

(A) $P(A | B) = \frac{P(B)}{P(A)}$ (B) $P(A | B) < P(A)$ (C) $P(A | B) \geq P(B)$ (D)

none of these

A. $P(A/B) = \frac{P(B)}{P(A)}$

B. $P(A/B) < P(A)$

C. $P(A/B) \geq P(A)$

D. None of these

Answer: C

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Exercise 13 4

1. State which of the following are not the probability distributions of a random variable. Give reasons for your answer.

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

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3. Let X represent 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 ?



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4. Find the probability distribution of (i) number of heads in two tosses of a coin. (ii) number of tails in the simultaneous tosses of three coins. (iii) number of heads in four tosses of a coin.



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5. Find the probability distribution of the number of successes in two tosses of a die, where a success is defined as (i) number greater than 4 (ii) six appears on at least one die



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6. From a lot of 30 bulbs which include 6 defectives, a sample of 4 bulbs is drawn at random with replacement. Find the probability distribution of the number of defective bulbs.

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7. 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.

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8. 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 :

(i) k

(ii) $P(X < 3)$

(iii) $P(X > 6)$

(iv) $P(0 < X < 3)$

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

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

(i) Determine the value of k (ii) Find

$P(X < 2), P(X \leq 2), P(X \geq 2)$

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

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

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

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

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14. 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.



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15. 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 $\text{Var}(X)$.



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16. The mean of the numbers obtained on throwing a die having written 1 on three faces, 2 on two faces and 5 on one face is

A. 1

B. 2

C. 5

D. $\frac{8}{5}$

Answer: B



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17. Suppose that two cards are drawn at random from a deck of cards. Let X be the number of aces obtained. Then the value of $E(X)$ is



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Exercise 13 5

1. A die is thrown 6 times. If "getting an even number" is a success, what is the probability of (i) 5 successes? (ii) at least 5 successes? (iii) at most 5 successes?



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2. A pair of dice is thrown 5 times. If getting a doublet is considered a success, find the probability of 2 success.



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3. 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?



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4. Five cards are drawn successively with replacement from a well-shuffled deck of 52 cards. What is the probability that (i) all the five cards are spades? (ii) only 3 cards are spades? (iii) none is a spade?



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5. 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 (i) none (ii) not more than one (iii) more than one (iv) at least one will fuse after 150 days of use.



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6. 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?



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7. 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 gives at least two correct answers



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8. Suppose X has a binomial distribution $B\left(6, \frac{1}{2}\right)$. Show that $X = 3$ is the most likely outcome. (Hint: $P(x = 3)$ is the maximum among all $P(x_i)$, $x_i = 0, 1, 2, 3, 4, 5, 6$)

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9. On a multiple choice examination with three possible answers (out of which only one is correct) for each of the five questions, what is the probability that a candidate would get four or more correct answers just by guessing?

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10. 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?

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



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



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13. 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?



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14. In a box containing 100 bulbs, 10 bulbs are defective. Probability that out of a sample of 5 bulbs, none is defective, is

A. 10^{-1}

B. $\left(\frac{1}{2}\right)^5$

C. $\left(\frac{9}{10}\right)^5$

D. $\frac{9}{10}$

Answer: A



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15. The probability that a student is not a swimmer is $\frac{1}{5}$. Then the probability that out of five students, four are swimmers is (A)

${}^5C_4 \left(\frac{4}{5}\right)^4 \frac{1}{5}$ (B) $\frac{\left(\frac{4}{5}\right)^{41}}{5}$ (C) ${}^5C_1 \frac{1}{5} \left(\frac{4}{5}\right)^4$ (D) None of these

A. ${}^5C_4 \left(\frac{4}{5}\right)^4 \frac{1}{5}$

B. $\left(\frac{4}{5}\right)^4 \frac{1}{5}$

C. ${}^5C_1 \frac{1}{5} \left(\frac{4}{5}\right)^4$

D. None of these

Answer: A

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Miscellaneous Exercise

1. A and B are two events such that $P(A) \neq 0$. Find $P(B | A)$, if (i) A is a subset of B (ii) $A \cap B = \varnothing$

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2. A couple has two children. Find the probability that both the children are (i) males, if it is known that at least one of the children is male. (ii) females, if it is known that the elder child is a female.



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3. 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 these person being male? Assume that there are equal number of males and females.



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4. 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 ?



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5. An urn contains 25 balls of which 10 balls are red and the remaining green. A ball is drawn at random from the urn the colour is noted and the ball is replaced. If 6 balls are drawn in this way, find the probability that :

(i) All the balls are red.

(ii) Number of red balls and green balls are equal.

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

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7. 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.

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8. If a leap year is selected at random, what is the chance that it will contain 53 Tuesdays?

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9. An experiment succeeds twice as often as it fails. Then find the probability that in the next 6 trials, there will be at least 4 successes.

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

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11. 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.

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12. Suppose we have four boxes A,B,C and D containing coloured marbles as given below : One of the boxes has been selected at random and a single marble is drawn from it. If the marble is red, what is the probability that it was drawn from box A? bo



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13. Assume that the chances 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 ch



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14. 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? (Assuming that the individual entries of eth determinant are chosen independently, each value being assumed with probability 1/2).



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15. An electronic assembly consists of two sub-systems say A and B. From previous testing procedures, the following probabilities are assumed to be known.

$$P(A \text{ fails}) = 0.2, P(B \text{ fails alone}) = 0.15, P(A \text{ and } B \text{ fail}) = 0.15.$$

Evaluate the following probabilities: $P(A \text{ fails} / B \text{ has failed})$ (ii)

$$P(A \text{ fails alone})$$



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16. Bag 1 contains 3 red and 4 black balls and Bag II contains 4 red and 5 black balls. One ball is transferred from Bag 1 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.



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17. If A and B are two events such that $P(A) \neq 0$ and $P(B/A) = 1$ then

A. $A \subset B$ but $A \neq B$

B. $B \subset A$

C. $B = \phi$

D. $A = \phi$

Answer: A



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18. If $P(A|B) > P(A)$, then which of the following is correct: (A)

$P(B|A) < P(B)$

A. $P(B/A) < P(B)$

B. $P(A \cap B) < P(A) \cdot P(B)$

C. $P(B/A) > P(B)$

$$D. P(B/A) = P(B)$$

Answer: A



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19. If A and B are any two events such that $P(A) + P(B) - P(A \text{ and } B) = P(A)$? then (A) $P(B | A) = 1$ (B) $P(A | B) = 1$ (C) $P(B | A) = 0$ (D) $P(A | B) = 0$

A. $P(B/A) = 1$

B. $P(A/B) = 1$

C. $P(B/A) = 0$

D. $P(A/B) = 0$

Answer: A



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