PROBABLITY

IMPORTANT FORMULAS

1. **Experiment:**

   An operation which can produce some well-defined outcomes is called an experiment.
2. **Random Experiment:**

   An experiment in which all possible outcomes are know and the exact output cannot be predicted in advance, is called a random experiment.
   Examples:

i. Rolling an unbiased dice.

ii. Tossing a fair coin.

iii. Drawing a card from a pack of well-shuffled cards.

iv. Picking up a ball of certain colour from a bag containing balls of different colours.
   Details:

v. When we throw a coin, then either a Head (H) or a Tail (T) appears.

vi. A dice is a solid cube, having 6 faces, marked 1, 2, 3, 4, 5, 6 respectively. When we throw a die, the outcome is the number that appears on its upper face.

vii. A pack of cards has 52 cards.
   It has 13 cards of each suit, name **Spades, Clubs, Hearts and Diamonds**.
   Cards of spades and clubs are **black cards**.
   Cards of hearts and diamonds are **red cards**.

   There are 4 honours of each unit.
   There are **Kings, Queens and Jacks**. These are all called **face cards**.
3. **Sample Space:**
   When we perform an experiment, then the set S of all possible outcomes is called the **sample space**.
   Examples:

1. In tossing a coin, S = {H, T}

2. If two coins are tossed, the S = {HH, HT, TH, TT}.

3. In rolling a dice, we have, S = {1, 2, 3, 4, 5, 6}.
4. **Event:**
   Any subset of a sample space is called an **event**.
5. **Probability of Occurrence of an Event:**

   Let S be the sample and let E be an event.

Then, $E \subseteq S$.

$\therefore$ $P(E) = \frac{n(E)}{n(S)}$.

6. **Results on Probability:**

. $P(S) = 1$

i. $0 \leq P(E) \leq 1$

ii. $P(\phi) = 0$

iii. For any events A and B we have : $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

iv. If A denotes (not-A), then P(A) = 1 - P(A).

1. Tickets numbered 1 to 20 are mixed up and then a ticket is drawn at random. What is the probability that the ticket drawn has a number which is a multiple of 3 or 5?

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

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

   C. $\frac{8}{15}$

   D. $\frac{9}{20}$

   Answer: Option **D**

   Explanation:

   Here, S = {1, 2, 3, 4, ..., 19, 20}.

   Let E = event of getting a multiple of 3 or 5 = {3, 6 , 9, 12, 15, 18, 5, 10, 20}.

   $\therefore$ $P(E) = \frac{n(E)}{n(S)} = \frac{9}{20}$.

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2. A bag contains 2 red, 3 green and 2 blue balls. Two balls are drawn at random. What is the probability that none of the balls drawn is blue?

   A. $\frac{10}{21}$

   B. $\frac{11}{21}$

   C. $\frac{2}{7}$

D. $\frac{5}{7}$

Answer: Option **A**

Explanation:

Total number of balls = (2 + 3 + 2) = 7.

Let S be the sample space.

Then, n(S) = Number of ways of drawing 2 balls out of 7

$= {}^7C_2$ `

$= \frac{(7 \times 6)}{(2 \times 1)}$

= 21.

Let E = Event of drawing 2 balls, none of which is blue.

$\therefore$ n(E) = Number of ways of drawing 2 balls out of (2 + 3) balls.

$= {}^5C_2$

$= \frac{(5 \times 4)}{(2 \times 1)}$

= 10.

$\therefore$ P(E) = $\frac{n(E)}{n(S)} = \frac{10}{21}$.

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3. In a box, there are 8 red, 7 blue and 6 green balls. One ball is picked up randomly. What is the probability that it is neither red nor green?

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

B. $\frac{3}{4}$

C. $\frac{7}{19}$

D. $\frac{8}{21}$

E. $\frac{9}{21}$

Answer: Option **A**
Explanation:

Total number of balls = (8 + 7 + 6) = 21.

Let E = event that the ball drawn is neither red nor green

= event that the ball drawn is blue.

$\therefore$ $n(E) = 7$.

$\therefore$ $P(E) = \frac{n(E)}{n(S)} = \frac{7}{21} = \frac{1}{3}$.

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4. What is the probability of getting a sum 9 from two throws of a dice?

A. $\frac{1}{6}$

B. $\frac{1}{8}$

C. $\frac{1}{9}$

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

Answer: Option **C**
Explanation:
In two throws of a dice, $n(S) = (6 \times 6) = 36$.

Let E = event of getting a sum ={(3, 6), (4, 5), (5, 4), (6, 3)}.

$\therefore$ $P(E) = \frac{n(E)}{n(S)} = \frac{4}{36} = \frac{1}{9}$.

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5. Three unbiased coins are tossed. What is the probability of getting at most two heads?

A. $\frac{3}{4}$

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

C. $\frac{3}{8}$

D. $\frac{7}{8}$

Answer: Option **D**
Explanation:

Here S = {TTT, TTH, THT, HTT, THH, HTH, HHT, HHH}

Let E = event of getting at most two heads.

Then E = {TTT, TTH, THT, HTT, THH, HTH, HHT}.

$\therefore\ P(E) = \frac{n(E)}{n(S)} = \frac{7}{8}$.

6. Two dice are thrown simultaneously. What is the probability of getting two numbers whose product is even?

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

   B. $\frac{3}{4}$

   C. $\frac{3}{8}$

   D. $\frac{5}{16}$

   Answer: Option **B**
   Explanation:
   In a simultaneous throw of two dice, we have $n(S) = (6 \times 6) = 36$.
   Then, E = {(1, 2), (1, 4), (1, 6), (2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6), (3, 2), (3, 4), (3, 6), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6), (5, 2), (5, 4), (5, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)}

   $\therefore\ n(E) = 27$.
   $\therefore\ P(E) = \frac{n(E)}{n(S)} = \frac{27}{36} = \frac{3}{4}$.

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7. In a class, there are 15 boys and 10 girls. Three students are selected at random. The probability that 1 girl and 2 boys are selected, is:

   A. $\frac{21}{46}$

   B. $\frac{25}{117}$

   C. $\frac{1}{50}$

   D. $\frac{3}{25}$

   Answer: Option **A**

Explanation:

Let S be the sample space and E be the event of selecting 1 girl and 2 boys.

Then, $n(S)$ = Number ways of selecting 3 students out of 25

$= {}^{25}C_3$ `

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

= 2300.

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

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

= 1050.

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

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8. In a lottery, there are 10 prizes and 25 blanks. A lottery is drawn at random. What is the probability of getting a prize?

A. $\frac{1}{10}$

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

C. $\frac{2}{7}$

D. $\frac{5}{7}$

Answer: Option **C**

Explanation:

P (getting a prize) $= \frac{10}{(10 + 25)} = \frac{10}{35} = \frac{2}{7}.$

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9. From a pack of 52 cards, two cards are drawn together at random. What is the probability of both the cards being kings?

A. $\frac{1}{15}$

B. $\frac{25}{57}$

C. $\frac{35}{256}$

D. $\frac{1}{221}$

Answer: Option **D**
Explanation:

Let S be the sample space.

Then, $n(S) = {}^{52}C_2 = \frac{(52 \times 51)}{(2 \times 1)} = 1326$.

Let E = event of getting 2 kings out of 4.

$\therefore\ n(E) = {}^{4}C_2 = \frac{(4 \times 3)}{(2 \times 1)} = 6$.

$\therefore\ P(E) = \frac{n(E)}{n(S)} = \frac{6}{1326} = \frac{1}{221}$.

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10. Two dice are tossed. The probability that the total score is a prime number is:

A. $\frac{1}{6}$

B. $\frac{5}{12}$

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

D. $\frac{7}{9}$

Answer: Option **B**
Explanation:
Clearly, $n(S) = (6 \times 6) = 36$.

Let E = Event that the sum is a prime number.

Then E = { (1, 1), (1, 2), (1, 4), (1, 6), (2, 1), (2, 3), (2, 5), (3, 2), (3, 4), (4, 1), (4, 3), (5, 2), (5, 6), (6, 1), (6, 5) }

$\therefore\ n(E) = 15$.

$\therefore$ P(E) = $\frac{n(E)}{n(S)} = \frac{15}{36} = \frac{5}{12}$.

11. A card is drawn from a pack of 52 cards. The probability of getting a queen of club or a king of heart is:

A. $\frac{1}{13}$

B. $\frac{2}{13}$

C. $\frac{1}{26}$

D. $\frac{1}{52}$

Answer: Option **C**
Explanation:
Here, $n(S) = 52$.

Let E = event of getting a queen of club or a king of heart.

Then, $n(E) = 2$.
$\therefore$ P(E) = $\frac{n(E)}{n(S)} = \frac{2}{52} = \frac{1}{26}$.

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12. A bag contains 4 white, 5 red and 6 blue balls. Three balls are drawn at random from the bag. The probability that all of them are red, is:

A. $\frac{1}{22}$

B. $\frac{3}{22}$

C. $\frac{2}{91}$

D. $\frac{2}{77}$

Answer: Option **C**
Explanation:

Let S be the sample space.

Then, $n(S)$ = number of ways of drawing 3 balls out of 15

$= {}^{15}C_3$

$= \dfrac{(15 \times 14 \times 13)}{(3 \times 2 \times 1)}$

$= 455.$

Let E = event of getting all the 3 red balls.

$\therefore\ n(E) = {}^{5}C_3 = {}^{5}C_2 = \dfrac{(5 \times 4)}{(2 \times 1)} = 10.$

$\therefore\ P(E) = \dfrac{n(E)}{n(S)} = \dfrac{10}{455} = \dfrac{2}{91}.$

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13. Two cards are drawn together from a pack of 52 cards. The probability that one is a spade and one is a heart, is:

A. $\dfrac{3}{20}$

B. $\dfrac{29}{34}$

C. $\dfrac{47}{100}$

D. $\dfrac{13}{102}$

Answer: Option **D**

Explanation:

Let S be the sample space.

Then, $n(S) = {}^{52}C_2 = \dfrac{(52 \times 51)}{(2 \times 1)} = 1326.$

Let E = event of getting 1 spade and 1 heart.

$\therefore\ n(E)$ = number of ways of choosing 1 spade out of 13 and 1 heart out of 13

$= ({}^{13}C_1 \times {}^{13}C_1)$

$= (13 \times 13)$

$= 169.$

$\therefore\ P(E) = \dfrac{n(E)}{n(S)} = \dfrac{169}{1326} = \dfrac{13}{102}.$

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14. One card is drawn at random from a pack of 52 cards. What is the probability that the card drawn is a face card (Jack, Queen and King only)?

A. $\frac{1}{13}$

B. $\frac{3}{13}$

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

D. $\frac{9}{52}$

Answer: Option **B**
Explanation:

Clearly, there are 52 cards, out of which there are 12 face cards.

$\therefore$ P (getting a face card) = $\frac{12}{52} = \frac{3}{13}$.

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15. A bag contains 6 black and 8 white balls. One ball is drawn at random. What is the probability that the ball drawn is white?

A. $\frac{3}{4}$

B. $\frac{4}{7}$

C. $\frac{1}{8}$

D. $\frac{3}{7}$

Answer: Option **B**
Explanation:

Let number of balls = (6 + 8) = 14.

Number of white balls = 8.

P (drawing a white ball) = $\frac{8}{14} = \frac{4}{7}$.