Bayes Formula:

Two Variables:  
\[ P(A \mid D) = \frac{P(A) P(D \mid A)}{P(A) P(D \mid A) + P(B) P(D \mid B)} \]

Three Variables:  
\[ P(A \mid D) = \frac{P(A) P(D \mid A)}{P(A) P(D \mid A) + P(B) P(D \mid B) + P(C) P(D \mid C)} \]

(1) In how many ways can you rearrange the letters in BANANA?  
(a) 5 \times 4 \times 3  
(b) 6!  
(c) C(6, 3)  
(d) P(6, 3)  
(e) NOTA

(2) A Sudoku row consists of a sequence of nine numbers, ranging between 1 and 9, where no digit is used twice. How many possible Sudoku rows are there?  
(a) 10^9  
(b) 9^9  
(c) 9!  
(d) 999,999,999  
(e) NOTA

(3) True or False? Consider the following two statements:

I. \( A \cup (B \cap C) = (A \cap B) \cup (A \cap C) \)  
II. \( (A \cap B)^c = A^c \cap B^c \)

(a) both I and II are true  
(b) I is true, II is false  
(c) I is false, II is true  
(d) both I and II are false
(4) There are 90 people at a party. Forty are liars, 20 are lawyers, and 15 are both. If \( A \) is the set of liars and \( B \) is the set of lawyers at the party, find \( n(A \cap B^c) \)
(a) 60    (b) 45    (c) 25    (d) 5    (e) NOTA

(5) There are four types of small molecules used in genetic coding, represented by their names: adenine (A), cytosine (C), guanine (G), and thymine (T). How many groupings of five molecules are possible?
(a) \( 4^5 \)    (b) \( 5^4 \)    (c) \( P(5, 4) \)    (d) \( \frac{5!}{4} \)    (e) NOTA

(6) Which of the following statement(s) are true if \( A \) and \( B \) are mutually exclusive events?
(a) \( P(A \cap B) = P(A)P(B) \)
(b) \( P(A \mid B) = P(B) \)
(c) \( P(B \mid A) = P(A) \)
(d) (a)–(c) are correct
(e) \( P(A \cap B) = 0 \)

(7) Which of the eight regions 1–8 in the following Venn diagram together comprise the set \( (A \cap B) \cup C^c \)?
(a) 2, 3, 7
(b) 1, 2, 3, 5
(c) 2, 3, 8
(d) 1, 2, 5, 8
(e) 1, 2, 3, 5, 8
(8) Hercule Poirot, a detective, suspect the butler of murder. He is 60% sure that the butler is guilty. He then discovers that the murder was committed by a left-handed person and that the butler is left-handed. If 10% of all people are left-handed, how does the probability that the butler is guilty change?

\[(a) \frac{(0.6)(0.9)}{(0.6)(0.9) + (0.4)(0.1)}\]
\[(b) \frac{(0.6)(1.0)}{(0.6)(1.0) + (0.4)(0.1)}\]
\[(c) \frac{(0.6)(0.9) + (0.4)(0.1)}{0.6 + (0.4)(0.1)}\]
\[(d) \frac{0.6 + (0.4)(0.1)}{0.6 + (0.4)(0.1)}\]
\[(e) \text{NOTA}\]

(9) A card is drawn from a well-shuffled deck of 52 cards. What is the probability that the card is an ace or a club?

\[(a) 1 - \frac{39}{52} = \frac{12}{13}\]
\[(b) \frac{1}{4} + \frac{1}{13}\]
\[(c) \frac{15}{52}\]
\[(d) \frac{16}{52}\]
\[(e) \text{NOTA}\]

(10) Two boxes each contain the numbers 1, 2, and 3. A number \(x\) is chosen from the first box and a number \(y\) is chosen from the second box. What is the probability that \(x + y\) is even?

\[(a) \frac{1}{2}\]
\[(b) \frac{5}{9}\]
\[(c) \frac{4}{9}\]
\[(d) \frac{1}{3}\]
\[(e) \text{NOTA}\]

(11) An urn contains seven red and three green balls.
A second urn contains five red and five green balls.
A ball is selected at random from the first urn and placed in the second.
Then a ball is selected at random from the second urn.
What is the probability of drawing a green ball the first time and a red ball the second time?

\[(a) \frac{3}{22}\]
\[(b) \frac{3}{20}\]
\[(c) \frac{7}{22}\]
\[(d) \frac{7}{20}\]
\[(e) \text{NOTA}\]
(12) To gain access to her account, a customer using an automatic teller machine (ATM) must enter a four-digit code. If repetition of the same four digits (for example, 2222 or 5555) is not allowed, how many possible codes are there?

(a) $10^4$  (b) $P(10, 4)$  (c) $C(10, 4)$  (d) 9000  (e) 9990

(13) Events $E$ and $F$ occur with the probabilities:

$P(E) = 0.6$  $P(F) = 0.3$  $P(E \cap F) = 0.2$

Compute $P(E \cup F)$ and $P(E \mid F)$ and

(a) $P(E \cup F) = .9$,  $P(E \mid F) = 2/3$
(b) $P(E \cup F) = .7$,  $P(E \mid F) = 2/3$
(c) $P(E \cup F) = .9$,  $P(E \mid F) = 1/2$
(d) $P(E \cup F) = .7$,  $P(E \mid F) = 1/2$
(e) NOTA

(14) True or False? Consider the following two statements:

I. A person participates in a weekly office pool in which she has a one chance in ten of winning the purse. If she participates for 5 weeks in a row, the probability of winning at least one purse is $5/10$.

II. If $A$ is a subset of $B$, then $P(A) \leq P(B)$.

(a) both I and II are true
(b) I is true, II is false
(c) I is false, II is true
(d) both I and II are false

(15) There is a 15% chance that if you speed through the town of Malta, then your speed will be recorded by radar and you will be given a citation. If you speed through Malta 5 days in a row, what is the probability that you will receive exactly two citations?

(a) $C(5, 2)(.15)^2$
(b) $C(5, 2)(.15)^2(.85)^3$
(c) $(.15)^2(.85^3)$
(d) $C(5, 2)(.15)^3(.85)^2$
(e) NOTA