This is a multiple choice test. For each question, 3 candidate answers are provided. Only one answer is correct. Please put a cross (‘X’) near the answer which you think to be correct.

1. Consider the function \( f(x) = 1 + x^2 \). What is the derivative of \( f \) at \( x \)?
   
   [ ]: \( 2x \)
   
   [ ]: 2
   
   [ ]: \( x \)

2. Consider the function \( f(x) = 2^x - 3 + 1 \). What is the value of \( f \) at \( x = 3 \)?
   
   [ ]: 2
   
   [ ]: 6
   
   [ ]: 3

3. Consider the function \( f(x) = \frac{1}{x} \). What is the limit of \( f(x) \) as \( x \) goes to \( \infty \)?
   
   [ ]: 0
   
   [ ]: \( \infty \)
   
   [ ]: the limit does not exist

4. Consider the function \( f(x) = \log x \). What is the limit of \( f(x) \) as \( x \) goes to \( +\infty \)?
   
   [ ]: 0
   
   [ ]: \( +\infty \)
   
   [ ]: the limit does not exist

5. The function \( f(x) = \frac{1}{2^x} \) can also be written as
   
   [ ]: \( 2^{-x} \)
   
   [ ]: \( 2^{\frac{1}{x}} \)
   
   [ ]: \( \frac{x}{2} \)
6. Consider the 2nd order polynomial \( p(x) = ax^2 + bx + c \), where \( a, b, c \) are some real numbers. The formula for the roots of \( p \) is

\[
\begin{align*}
[1]: & \quad x = \frac{b \pm \sqrt{b^2 - 4ac}}{2a} \\
[2]: & \quad x = \frac{b \pm \sqrt{b^2 - 4ac}}{2a} \\
[3]: & \quad x = \frac{b \pm \sqrt{b^2 - 4ac}}{2a}
\end{align*}
\]

7. Which of the following polynomials has two real zeros?

\[
\begin{align*}
[1]: & \quad x^2 + 2x + 1 \\
[2]: & \quad x^2 - 3x + 2 \\
[3]: & \quad x^2 + x + 1
\end{align*}
\]

8. Consider the linear system of equations:

\[
\begin{align*}
x + y & = 1 \\
x - y & = 0
\end{align*}
\]

The solution to the above system of equations is

\[
\begin{align*}
[1]: & \quad x = 1, \ y = 0 \\
[2]: & \quad x = 1, \ y = 1 \\
[3]: & \quad x = 0.5, \ y = 0.5
\end{align*}
\]

9. What is the result of the following computation \( 2^2 + 2^3 \)?

\[
\begin{align*}
[1]: & \quad 2^5 \\
[2]: & \quad 3 \cdot 2^2 \\
[3]: & \quad 2^6
\end{align*}
\]

10. Consider the matrix

\[
A = \begin{bmatrix} 1 & 2 \\ 1 & -1 \end{bmatrix}
\]

This matrix is

\[
\begin{align*}
[1]: & \quad \text{symmetric} \\
[2]: & \quad \text{invertible} \\
[3]: & \quad \text{singular}
\end{align*}
\]
11. The determinant of matrix $A$ defined in the previous question is:

- $[ ]: -3$
- $[ ]: 0$
- $[ ]: -1$

12. The matrix product between an $n \times k$ matrix and a $k \times \ell$ matrix is a

- $[ ]: n \times \ell$ matrix
- $[ ]: k \times k$ matrix
- $[ ]: k \times \ell$ matrix

13. The identity matrix

- $[ ]: $ has all its elements equal to $1$
- $[ ]: $ has determinant equal to $-1$
- $[ ]: $ is the diagonal matrix with all diagonal elements equal to $1$

14. The scalar product between the vectors $(0, 1)$ and $(-2, 0)$ is

- $[ ]: 0$
- $[ ]: 1$
- $[ ]: -1$

15. (NOTE: In this and the next two questions $A$, $B$ and $C$ are Boolean variables taking values $0$ or $1$ (where ‘0’ means ‘FALSE’ and ‘1’ means ‘TRUE’). Let “−”, “·” and “+” be the standards operators denoting negation, intersection and union respectively.)

What is the result of the Boolean formula $(A + \bar{B}) \cdot C$ when $A = 1$, $B = 0$ and $C = 1$?

- $[ ]: 1$
- $[ ]: 0$
- $[ ]: 2$

16. The result of the Boolean formula $A + \bar{A}$

- $[ ]: $ is always equal to $1$
- $[ ]: $ always equal to $0$
17. What is the result of the Boolean formula $A \cdot B$ when $A = B = 0$?

[ ]: 0
[ ]: 1
[ ]: The above formula is not well defined

18. What is the binary representation of the decimal number 7?

[ ]: 100
[ ]: 101
[ ]: 111

19. Consider the sets of integer numbers $\{-3, -2, -1, 0\}$ and $\{0, 1, 2, 3\}$. The union of these two sets is:

[ ]: the set $\{0\}$
[ ]: the set $\{-3, -2, -1, 0, 1, 2, 3\}$
[ ]: equal to 0

20. Consider again the two previous sets. Their intersection is

[ ]: the set $\{0\}$
[ ]: the set $\{-3, -2, -1, 0, 1, 2, 3\}$
[ ]: equal to 0