UNIVERSITY OF BUEA

FACULTY OF ENGINEERING AND TECHNOLOGY

ENTRANCE EXAMINATION **September 2019**

MATHEMATICS

Time: 3 Hours

Answer all Questions.

Each Question has four suggested answers A, B, C, D. Select only one answer.

1. Given that $x > 0$, the value of x for which $log_4 x + log_4(6x + 10) = 1$ is
   - A $\frac{2}{3}$
   - B $\frac{1}{3}$
   - C $\frac{2}{5}$
   - D $\frac{3}{5}$

2. If $f(x)= x^3 - 2x - 1, f(-2)$
   - A 11
   - B -13
   - C -5
   - D -3

   $f(-2) = (-2)^3 - 2(-2) - 1$
   $= -8 + 4 - 1$

3. The period of the function $f(x) = 3\cos 5x$ is
   - A $\frac{2\pi}{5}$
   - B $\frac{5\pi}{2}$
   - C $\frac{2\pi}{3}$
   - D $\frac{3\pi}{5}$

   $3\cos 5x = 0$

4. $\frac{2x}{(x-3)(x-5)} \equiv$
   - A $\frac{3}{(x-3)} + \frac{5}{(x-5)}$
   - B $-\frac{3}{(x-3)} + \frac{5}{(x-5)}$
   - C $\frac{3}{(x-3)} - \frac{5}{(x-5)}$
   - D $-\frac{3}{(x-3)} - \frac{5}{(x-5)}$

5. An Arithmetic Progression has first term ln2 and common difference ln4. The sum of the first 4 terms of the progression is
   - A 16 ln4
   - B 16 ln2
   - C 10 ln4
   - D 8 ln2

   $U_1 = 2\ln 2$ $d = \ln 4$
   $S_n = \frac{n}{2}[2U_1 + nd]$
   $S_4 = 2[2\ln 2 + 2\ln 4]$
   $S_4 = 4\ln 2 + 4\ln 4$

6. If $x^2 + y^2 = 16x$, *then* $\frac{dy}{dx} =$
   - A $\frac{8+x}{y}$
   - B $\frac{8-x}{y}$
   - C $-\frac{8+x}{y}$
   - D $-\frac{8-x}{y}$

7. The radius of the circle with equation $x^2 + y^2 - 10x + 12y + 41 = 0$ is
   - A $5\sqrt{2}$
   - B $3\sqrt{5}$
   - C $2\sqrt{5}$
   - D $4\sqrt{5}$

8. $\int_0^1 e^{-x}\,dx =$
   - A $1 - e^{-1}$
   - B $-1 - e^{-1}$
   - C $e + e^{-1}$
   - D $-1 + e^{-1}$

9. The range of values of K for which the quadratic equation $x^2 + 2kx + (k + 6) = 0$ has real and distinct roots is
   - A $-2 < k < 3$
   - B $k < -2$ or $k > 3$
   - C $-2 \le k \le 3$
   - D $k \le -2$ *or* $k \ge 3$

10. A 3 x 3 matrix **M** is given by M=$\begin{pmatrix} x & 1 & x-1 \\ 2 & 1 & 0 \\ 1 & x & 0 \end{pmatrix}$. If the determinant of **M** is zero, then
    - A $2x^2 - 3x - 1 = 0$
    - B $2x^2 + 3x + 1 = 0$
    - C $x^2 - 3x + 1 = 0$
    - D $2x^2 - 3x + 1 = 0$

11. The argument of the complex number z, where $z = \frac{1+i}{1-i}$ is

A $\frac{\pi}{4}$

B $\frac{\pi}{3}$

C $\frac{\pi}{2}$

D $\frac{\pi}{6}$

$z = \frac{1+i}{1-i} \times \frac{1+i}{1+i}$

$z = \frac{1+i+i-1}{1+i-i+1} = \frac{2i}{2}$

12. A function y satisfies the differential equation $y\frac{dy}{dx} = x$. If y=1 when x=0, then

A y^2=1+x^2

B y^2=1 - x^2

C y^2= -1+x^2

D y^2= -1 - x^2

13. Given that x^2+-4x-1≡ $(x+B)^2 + C$, the values of the constants B and C respectively are

A 2 and 5

B -2 and 5

C 2 and -5

D -2 and -5

$\Delta = b^2 - 4ac$

$= 16 - 4(1)(-1)$

$\Delta = 20$

14. $\lim_{x\to 3}\left(\frac{x-3}{x^2-2x-3}\right)$ =

A 0

B $\frac{1}{3}$

C ∞

D $\frac{1}{4}$

15. $\frac{\cos 2x}{\cos x - \sin x}$

A $\sin x - \cos x$

B $\cos x + \sin x$

C $2\cos x + \sin x$

D $\cos x - 2\sin x$

$\sin^2 x = \frac{1}{2}(1 + \cos 2x)$

$\sin^2 x = 1 - \cos^2 x$

$2\sin^2 x = 1 + \cos 2x$

16. $\int_0^2 \frac{2x}{1+2x^2}\,dx$ =

A $ln9$

B ln81

C ln $(\sqrt{3})$

D ln3

$(\sin x - \cos x)(\sin x + \cos x)$

17. Two vectors **a** and **b** are given as $a = i + 2j + k$ and $b = 3i + j + 2k$

The vector product $a \times$ b is

A $3i - j - 5k$

B $3i + j - 5k$

C $3i + j + 5k$

D $3i - 5j + 5k$

18. The equations of the asymptotes of the graph of the curve $y = \frac{x-2}{x^2-4x+3}$ are

A $x = 1,\ x = -3,\ y = 1$

B $x = -1,\ x = 3,\ y = 0$

C $x = 1,\ x = 3,\ y = 0$

D $x = 1,\ x = 3,\ y = 1$

$\Delta = 16 - 4(1)(3)$

$\Delta = 4$

19. If $\sin(x+y) = x, then\ \frac{dy}{dx} =$

A $\frac{1-\cos(x+y)}{\cos(x+y)}$

B $\frac{1+\cos(x+y)}{\cos(x+y)}$

C $\frac{\cos(x+y)+2}{\cos(x+y)}$

D $\frac{\cos(x+y)-1}{\cos(x+y)}$

20. If $z = \frac{1+2i}{3-4i} = a + bi, then$

A $z = -\frac{1}{5} + \frac{2}{5}i$

B $z = -\frac{2}{5} + \frac{1}{5}i$

C $z = -\frac{1}{5} - \frac{2}{5}i$

D $z = -\frac{1}{5} - \frac{2}{5}i$

$\frac{1+2i}{3-4i} \times \frac{3+4i}{3+4i}$

21. Given that $\begin{vmatrix} 1 & 2 & -2 \\ 2 & 1 & 3 \\ 3 & 2 & -4 \end{vmatrix} = d,\ then$

$\begin{vmatrix} 1 & 6 & -8 \\ 2 & 3 & 12 \\ 3 & 6 & -16 \end{vmatrix}$ =

A 7d

B 72d

C 12d

D $12d^2$

22. When the polynomial function $x^3 + 2x^2 + \beta x - 3$ is divided by x − 2 and x+1, the remainders are the same. The value of the constant β is

A -5

B 15

C 18

D -6

23. α and β are the roots of a quadratic such that

α + β = 2 and αβ = $\frac{1}{2}$. The value of $\alpha^2 + \beta^2$

A $\frac{7}{2}$

B 3

C 2

D $\frac{9}{2}$

24 The equation $\cos x + \sqrt{3}\ \sin x = 1$

is equivalent to

A $2\sin(x + \frac{\pi}{6}) = 1$

B $2\sin(x + \frac{\pi}{3}) = 1$

C $2\cos(x - \frac{\pi}{6}) = 1$

D $2\cos(x - \frac{\pi}{3}) = 1$

25. Given that $\tan x = \frac{2}{3}$, $\tan 2x =$

A $\frac{12}{5}$

B $\frac{4}{3}$

C $\frac{12}{13}$

D $\frac{4}{9}$

26. The vector v, where $|v| = 28$,

Is in the direction of the vector

$2i + 3j - 6k$.

V =

A 14i + 21j -42k

B 8i + 12j -24k

C 26i + 25j -22k

D $14i + \frac{28}{3}j - \frac{14}{3}k$

27. The vector perpendicular to both

3i -6j -4k and -3i + 2j + 2k is

A - 4i +6j +12 k

B - 4i +6j - 12k

C 4i -6j - 12k

D - 2i + 3j + 6k

28. Given that $f(x) = x^2 \ln(x - 2)$

$f'(3) =$

A 9

B 6

C 6ln5 – 9

D - 9

29. $\int_0^{\frac{\pi}{4}} \tan x \, dx =$

A $\frac{1}{2}\ ln2$

B $-\frac{1}{2}\ ln2$

C $\frac{1}{2}\ ln2\ - 1$

D $-\frac{1}{2}\ ln2\ - 1$

30. The curve $y = \frac{x^2}{x-1}$ cannot lie between y=0 and y=4. There is a local maximum of the curve at the point

A (0, 0)

B (0, 4)

C (2, 4)

D (2, 0)

31. The solution of the differential equation $y\frac{dy}{dx} = 2x$, given that y=1 and x=1 is

A $x^2 = y^2 - 2$

B $2x^2 = y^2 - 1$

C $x = 2y^2 - 1$

D $y^2 = 2x^2 - 1$

32. The line segment PQ, where P is the point(7,7) and Q the point(-1,3), is the diameter of a circle. The equation of the circle is

A $(x-7)(x+1)+(y-7)(y-3)=0$

B $(x-7)(x-1)+(y-7)(y-3)=0$

C $(x+7)(x-1)+(y+7)(y+3)=0$

D $(x+7)(x+1)+(y-7)(y+3)=0$

33. When $f(x) = 2x^3 + x^2 - 13x + 6$ is divided by $2x - 1$, the remainder is

A 13

B 52

C $\frac{1}{2}$

D 0

34. The range of values of x for which $|x-4| \le 2$ is

A $x \le 6$

B $x \le 2$ or $x \ge 6$

C $2 \le x \le 6$

D $x \ge 2$

35. Which of the following statements is TRUE?

A If $x^2 = y^2$, then $x = y$

B If f(a)=0 then x+a is a factor of f(x)

C If f(x) has a maximum value at x=a then $f''(a) > 0$

D Let $m, n \in Z$, the set of integers. If m and n are both odd, then m+n is even

36. Given that $f(x) = \begin{vmatrix} x & x^2 & x^3 \\ 1 & 2x & 3x^2 \\ 0 & 2 & 6x \end{vmatrix}$, $f'(x) =$

A 12

B $6x^2$

C 6x

D $42x^2$

37. Given that x is a periodic function of period 4 and that

$f(x) = \{x^2,\ 0 \le x < 2\ ;\ x+2,\ 2 \le x < 4$

then f(9)=

A 1

B 81

C 11

D 7

38. The volume generated when the area of the finite region enclosed by the x-axis and the curve $y = x - x^2$ is rotated completely about the x-axis is

A $\pi\int_0^1 (x-x^2)^2\,dx$

B $\pi\int_0^2 (x-x^2)^2\,dx$

C $2\pi\int_{-1}^1 (x-x^2)^2\,dx$

D $2\pi\int_{-1}^0 (x-x^2)^2\,dx$

39. Two consecutive integers between which a root of the equation $x^3+x-16=10$ lies are

A 1 and 2
B 2 and 3
C 3 and 4
D 4 and 5

40. The vectors a and b are such that $|a|=3, |b|=5, and\ a.b=-14\ then\ |a-b|=$

A 62
B $\sqrt{62}$
C 44
D $\sqrt{44}$

41. The sum of the first n terms of a series is given by $S_n=5n^2+2n$. The n^{th} term of the series is

A 10n + 7
B 10n − 3
C 10n + 3
D 10n − 7

42. The expansion of $(2+3x)^{-1}$ is valid when

A $-\frac{2}{3}<x<\frac{2}{3}$
B $-\frac{1}{3}\le x\le\frac{1}{3}$
C $-\frac{1}{3}<x<\frac{1}{3}$
D $-\frac{3}{2}<x<\frac{3}{2}$

43. The Cartesian equation of the curve with parametric equation $x=1+t^2$, $y=2t$, where t is a parameter, is

A $y^2=4(x-4)$
B $y^2=4(x-1)$
C $y^2=4(x+4)$
D $y^2=4(1-x)$

44. $\lim_{x\to\pi}\frac{\sin 2x}{\sin x}=$

A -1
B 2
C 0
D -2

45. $1+\frac{1}{2}+\frac{1}{2^2}+\frac{1}{2^3}+=$

A $\frac{31}{16}$
B $\frac{1}{2}$
C 7
D 2

46. The asymptotes of the curve $y=\frac{(x-5)^2}{(x+5)(x-3)}$ are

A x=3, x=-5, y=5
B x=-3, x=-5, y=-5
C x=3, x=-5, y=1
D x=3, x= -5, y=-1

47. The values of y corresponding to the values of x are given in the table below.

X	6	9	12	15	18	21
Y	0.3	0.8	1.4	2.1	3.0	4.3

Using the trapezoid rule, the approximate value for $\int_6^{21} y\,dx$ is

A 9.6
B 35.7
C 28.9
D 28.8

48. The gradient of the implicit function to the curve $x^2+y^2=13$ at the point(2,-3) is

A $-\frac{2}{3}$
B $\frac{3}{2}$
C $\frac{2}{3}$
D $-\frac{3}{2}$

49. $\sin 50^\circ + \sin 40^\circ =$

A $\sqrt{2}\cos 5^\circ$
B $2\cos 10^\circ$
C $2\cos 5^\circ$
D $\sqrt{2}\cos 10^\circ$

50. The value of the constant λ, for which the plane $\lambda x - 3y + 4z = 5$ and the line $r = i - 2j - 3k + t(2i + 6j + 3k)$ are parallel is

A 6
B 3
C 4
D 5

51. A point P divides the line segment joining the points M(4, 1) and N(7, 7) internally in the ratio 2:1. The coordinates of P are

A (5, 6)
B (5, 5)
C (6, 3)
D (6, 5)

52. If $4\log_{10} x - \log_{10} y = \log_{10} 13$ *then*

A $x^4 y = 13$
B $4x = 13y$
C $x^4 = 13y$
D $4^x = 13y$

53. A first approximation to the real root of the equation $x^3 + x^2 - 5x - 1 = 0$ *is* 2. A second approximation to the root of the equation, using the Newton-Raphson's method, is

A $\frac{21}{11}$
B $\frac{23}{11}$
C $\frac{19}{11}$
D $\frac{18}{11}$

54. Given the complex number z, where $z = -\sqrt{3} - i$, the modulus-argument form for z is

A $2(\cos\frac{\pi}{6} - i\sin\frac{\pi}{6})$
B $2(\cos\frac{5\pi}{6} - i\sin\frac{5\pi}{6})$
C $2(\cos\frac{\pi}{6} + i\sin\frac{\pi}{6})$
D $2(\cos\frac{5\pi}{6} - i\sin\frac{5\pi}{6})$

55. Given that $\sqrt{3}\cos x = \cos(\frac{\pi}{6} - x)$, $\tan x =$

A $\sqrt{3}$
B $\frac{1}{\sqrt{3}}$
C 1
D $\frac{\sqrt{3}}{2}$

56. $\int e^{3x}\,dx =$

A $\frac{1}{3x+1}e^{3x+1} + k$
B $3e^{3x} + k$
C $e^{3x} + k$
D $\frac{1}{3}e^{3x} + k$

57. Given the parametric equations
$x = 2t + \sin 2t$ *and* $y = 1 - \cos 2t$
where t is a parameter, $\frac{dy}{dx} =$

A $-\tan t$
B $\cot t$
C $\frac{-\sin 2t}{1+\cos 2t}$
D $\frac{\sin 2t}{1+\cos 2t}$

58. The curve $y = (x+2)^2$ has a minimum point at

A (0, 4)
B (4, 0)
C (0, -2)
D (-2, 0)

59. The number of selections of 3 students from a class of 7 students for a party in which the class prefect must attend is.

A $1x\ {}^6C_3$
B $1+\ {}^6C_3$
C $1x\ {}^6C_2$
D $1+\ {}^6C_2$

60. Given that x-c is a factor of f(x), where $f(x) = 2x^3 - cx^2 + +c(1-c)x - (6+c)$, the value of the constant c is

A 2 or -3
B -2 or 3
C -2 or -3
D 2 or 3

61. Given the differential equation $\cos x\frac{dy}{dx} = y\sin x$, then

A $y = \ln(\sec\ x) + K$
B $\ln y = \ln(\sec\ x) + K$
C $y = \sec\ x + K$
D $\ln y = \sec\ x + K$

62. $\sum_{r=1}^{n+1}(r-1) =$

A $\frac{1}{2}n(n+1)-(n+1)$
B $\frac{1}{2}n(n+1)(n+2)-n$
C $\frac{1}{2}n(n+1)$
D $\frac{1}{2}n(n+2)-(n+1)$

63. $\lim_{x\to 0}\left(\frac{\sin 2x - \sin x}{\sin x}\right) =$

A 0
B -3
C 2
D 1

64. Given that $\frac{d}{dx}(3x^3e^{2x}) = 3x^2(a+bx)e^{2x}$

A a=9, b=6
B a=6, b=9
C a=2, b=3
D a=3, b=2

65. The number of arrangements of the letters of the word MINIMUM is

A $\frac{7!}{2!3!}$
B 7!x3!x2!
C 7!
D $\frac{5!}{2!3!}$

66. If $\frac{2}{x-2} + \frac{3}{x+1} = \frac{ax+b}{(x-2)(x+1)}$ then the values of the real constants a and b are respectively

A 5, 4
B 5, -4
C -5, 4
D -5, -4

67. The roots of the quadratic equation $cx^2 - 3x - c = 0$ are

A $\frac{3 \pm \sqrt{9-4c^2}}{2c}$
B $\frac{3 \pm \sqrt{9+4c}}{2c}$
C $\frac{3 \pm \sqrt{9+4c^2}}{2c}$
D $\frac{3 \pm \sqrt{9-4c}}{2c}$

68. Given that $x \in R$ *and that* $x > 0$, the root of the equation $\log 2 + \log(2x^2 + 2x - 1) = 0$ is

A $\frac{3}{2}$
B $\frac{2}{3}$
C $\frac{1}{4}$
D $\frac{1}{2}$

69. The diameters of two concentric circles are 10m and 6m. The area of the region between the two circles is

A 16π
B 64π
C 4π
D 9π

70. The parametric equations of a curve are $1-x=\tan\theta, \quad y=\sec\theta$.
The Cartesian equation of this curve is

A $x^2-y^2+2x+2=0$
B $x^2-y^2+2x-2=0$
C $x^2-y^2-2x+2=0$
D $x+y^2-2x+2=0$

71. $n!+(n-1)!+(n-2)!=$

A $n^2(n-1)!$
B $n^2(n-2)!$
C $n(n-2)!$
D $n(n-1)!$

72. The center of the circle $x^2+y^2-x+\frac{1}{2}y-\frac{1}{4}=0$ is

A $(\frac{1}{2},\frac{1}{4})$
B (2, -1)
C $(-\frac{1}{2},-\frac{1}{4})$
D $(\frac{1}{2},-\frac{1}{4})$

73. The general solution of the equation $\sin 2x=\frac{\sqrt{3}}{2}$ is

A $\frac{\pi}{6}[3n+(-1)^n]$
B $\frac{\pi}{2}[6n+(-1)^n]$
C $\frac{\pi}{6}[2n+(-1)^n]$
D $\frac{\pi}{3}[3n+(-1)^n]$

74. If $y=\ln(\frac{x+1}{2x})$, *then* $\frac{dy}{dx}$ *is*

A $\frac{2x}{1+x}$
B $\frac{1}{x+1}-\frac{1}{x}$
C $\frac{1}{x+1}+\frac{1}{2x}$
D $\frac{1}{x+1}-\frac{1}{2x}$

75. $\int_1^2 3e^{\ln x^2}dx=$

A 6 ln2
B $\frac{3}{\ln 4}$
C 8
D 7

76. The general solution of the differential equation $(x-3)\frac{dy}{dx}=y$ is

A $y=\frac{x^2}{2}-3x+K$
B $y=Ke^{x-3}$
C y=K(x-3)
D y=(x-3)+K

77. The statement $x-3>\frac{x-4}{x}, \; x\in R$ is equivalent to

A $\frac{x^2-4x+4}{x}>0$
B $x^2-4x+4>0$
C $\frac{x^2-4x-4}{x}>0$
D $x^2-2x-4>0$

78. Given that -2, K, 5 are three consecutive terms of an arithmetic progression, then the common difference is

A $\frac{3}{2}$
B $\frac{7}{2}$
C 7
D 3

79. The set of values of x for which the geometric series $\sum_{r=0}^{\infty}(x-1)^r$ is convergent is

A 0< x < 2
B -1 < x <1
C -2 < x <1
D $0 \le x \le 2$

80. The partial fractions corresponding to $\frac{2x+7}{x^2+5x+6}$ are

A $\frac{3}{x+2}-\frac{1}{x+3}$
B $-\frac{3}{x+2}+\frac{1}{x+3}$
C $-\frac{3}{x+2}-\frac{1}{x+3}$
D $\frac{3}{x+2}+\frac{1}{x+3}$