UNIVERSITY OF BUEA

FACULTY OF ENGINEERING AND TECHNOLOGY

ENTRANCE EXAMINATION **October 2018**

MATHEMATICS

Time: 3 Hours

Answer all Questions

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

1. Given that

$$\frac{x}{(3-x)(4-x)} \equiv \frac{\mathrm{p}}{3-\mathrm{x}} + \frac{\mathrm{q}}{4-\mathrm{x}}$$

A p=3, q=4

B p=4, q= -3

C p=3. q= -4

D p= -3, q= -4

2. When the polynomial P(x), where

$$P(x) = ax^3 + 5x^2 + 2x$$

is divided by x-1 the remainder is 4. The value of the constant a is

A $\frac{-17}{7}$

B 3

C -3

D $\frac{-13}{7}$

3. The range of real values of x for which $\frac{x-3}{x+2} \leq 0$ *is*

A $x \leq -2$ *or* $x \geq 3$

B $-2 < x \leq 3$

C $x \leq -3$ *or* $x \geq 2$

D $-3 \leq x \leq 2$

4. The value of $\frac{1}{2} log_2 \sqrt{8}$ is

A $\frac{4}{3}$

B $\frac{1}{4}$

C $\frac{3}{2}$

D $\frac{3}{4}$

5. When $(3-2x)^{\frac{1}{2}}$ is expanded in ascending powers of x, *the range of values of* x for which the expansion is valid is

A $-\frac{3}{2} < x < \frac{2}{3}$

B $-\frac{2}{3} < x < \frac{3}{2}$

C $-\frac{3}{2} < x < \frac{3}{2}$

D $-\frac{2}{3} < x < \frac{2}{3}$

6. The sum of the first n terms of a sequence is given by

$$S_n = 3n^2 + n$$

An expression for the n^{th} term of the sequence is

A 2(5n – 3)

B 2(3n-1)

C 4(4n-3)

D 3n - 2

7. $\sum_{r=1}^{\infty} 15 \left(\frac{1}{4}\right)^r =$

A 5

B 4

C $\frac{5}{4}$

D $\frac{5}{2}$

8. The general solution of the equation $\sec(\theta + 30^o) = 2$ is

A $\theta = 360^o n \pm 30^o - 60^o$

B $\theta = 180^o n \pm 30^o - 60^o$

C $\theta = 360^o n \pm 60^o - 30^o$

D $\theta = 180^o n \pm 60^o - 30^o$

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9. $\dfrac{\sin 4\theta + \sin 2\theta}{\cos 4\theta + \cos 2\theta} \equiv$

A $\tan 3\theta$
B $\tan\theta$
C $\cot 3\theta$
D $\cot\theta$

10. The sine of the acute angle between the plane π *and the line* l, *where*
π: $x - y + z = 2$ and
l: $\frac{x-2}{2} = \frac{y+1}{2} = \frac{z}{1}$ is

A $\frac{1}{\sqrt{5}}$
B $\frac{1}{\sqrt{15}}$
C $\frac{1}{3\sqrt{3}}$
D $\frac{1}{\sqrt{3}}$

11. $\displaystyle\lim_{x \to 2} \frac{x^2 - x - 6}{(x+5)(x+2)}$ is

A $\frac{1}{3}$
B $-\frac{5}{3}$
C $-\frac{3}{5}$
D $-\frac{1}{3}$

12. Given that $y = (1 + 2x)^{\frac{1}{2}}$

$\frac{dy}{dx} =$

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

13. The general solution of the differential equation $\cos x \frac{dy}{dx} = y \sin x$ is

A $\ln y = \ln(\cos x) + k$
B $\ln y = \ln(\sin x) + k$
C $\ln y = -\ln(\sin x) + k$
D $\ln y = -\ln(\cos x) + k$

14. $\int \frac{3x}{1+x^2}\, dx =$

A $3\ln(1 + x^2) + k$
B $3\tan^{-1} x + k$
C $\frac{2}{3}\ln(1 + x^2) + k$
D $\frac{3}{2}\ln(1 + x^2) + k$

15. The vector equation of a straight line is
$r = 2i + j - 2k + t(3i + 2j + 6k)$
The direction cosines of the line are

A $[2, 1, -2]$
B $[3, 2, 6]$
C $\left[\frac{2}{3}, \frac{1}{3}, -\frac{2}{3}\right]$
D $\left[\frac{3}{7}, \frac{2}{7}, \frac{6}{7}\right]$

16. Given the parametric equations
$x = 27 + \sin 2t$ *and* $y = 2 - \cos 2t$
Where t is the parameter,
$\frac{dy}{dx} =$

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

17. $\frac{1-i}{1-2i} =$

A $\frac{3}{5} + \frac{1}{5}i$
B $-\frac{1}{5} + \frac{1}{5}i$
C $-\frac{3}{5} + -\frac{1}{5}i$
D $1 + \frac{2}{3}i$

18. Given that $y = x\ln(3x^2)$, *the value of* $\frac{dy}{dx}$ *when* $x = 1$ *is*

A 3
B ln 3
C 1 + ln 3
D 2 + ln 3

19. The modulus of the complex number $\frac{1+\sqrt{3}\,i}{1+i}$ is

A 2

B $\sqrt{3}$

C $\frac{2}{\sqrt{2}}$

D $\frac{1}{\sqrt{2}}$

20. The complex number $\left(\cos\frac{\pi}{27} + i\sin\frac{\pi}{27}\right)^9$ Can be expressed in the form a+bi, where a and b are real numbers, as

A $-\frac{1}{2} + \frac{\sqrt{3}}{2}$i

B $\frac{1}{2} + \frac{\sqrt{3}}{2}$i

C $-\frac{1}{2} - \frac{\sqrt{3}}{2}$i

D $\frac{1}{2} + \frac{\sqrt{3}}{2}$i

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) = $ [illegible] $+ x^2 - 13x + 6$ is divided by $2x-1$, the remainder is

A 1[illegible]

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. $\lim\limits_{x\to\pi}\frac{\sin 2x}{\sin x}=$
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
Y	0.3	0.8	1.4	2.1	3.0

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 $-\frac{3}{2}$

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

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

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. $\int \frac{x}{1+x^2} dx =$

A $\ln(1+x^2) + c$
B $\frac{1}{2}\ln(1+x^2) + c$
C $\frac{1}{2}\tan^{-1} x + c$
D $\tan^{-1} x + c$

52. The general solution of the equation $\tan(2x + \frac{\pi}{3}) = \frac{1}{\sqrt{3}}$ is

A $2x = n\pi - \frac{\pi}{6}$
B $2x = n\pi + \frac{\pi}{3}$
C $2x = n\pi + \frac{\pi}{6}$
D $2x = n\pi - \frac{\pi}{3}$

53. Given the vectors **a** and **b**, where **a=2i-2j+2k** and **b= 3i-j+2k** are coplanar vectors, **a x b=**

A **-2i-2j+4k**
B **-2i+2j-4k**
C **-2i+2j+4k**
D **2i-2j-4k**

54. Given

$n \in N^*$ *such that* $u_n = 1 - \frac{1}{n}$, *the sequence* (u_n) *is*

A Strictly monotonic increasing
B not bounded below
C Strictly monotonic decreasing
D tends to infinity as $n \to \infty$

55. The function $f: R \to R$, *where* $f: x \to x - \frac{1}{3}x^3$ accepts the following ranges of values of x

A decreases for $x \le -1$, increases for $-1 < x < 1$, decreases for $x \ge 1$
B increases for $x < 1$, decreases for $-1 < x < 1$, increases for $x \ge 1$
C increases for $x \le 1$, decreases for $x > 1$
D decreases for $x \le 1$, increases for $x > 1$

56. The complex number $1 + \sqrt{3}\,i$ can be expressed in exponential form

A $2e^{\frac{\pi}{6}i}$
B $2e^{-\frac{\pi}{6}i}$
C $2e^{-\frac{\pi}{3}i}$
D $2e^{\frac{\pi}{3}i}$

57. $(\cos 4\theta + i\sin 4\theta)^2(\cos 3\theta + i\sin 3\theta) =$

A $\cos 5\theta + i\sin 5\theta$
B $\cos 11\theta + i\sin 11\theta$
C $\cos 3\theta + i\sin 3\theta$
D $\cos 19\theta + i\sin 19\theta$

58. An iterative formula is given by $X_{n+1} = \frac{X_n^3 + 1}{5}$. Given that $X_1 = 0$, $X_3 =$

A 0.2
B 0.2016
C 0.208
D 2.016

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59. Given the matrix A, where $A=\begin{pmatrix}2 & 8 & 9\\ 0 & -1 & -3\\ 0 & 2 & 1\end{pmatrix}$.

The Determinant of A^T,
the transpose of A, is

A -14
B 14
C -10
D 10

60. The image of the line y=2x under the transformation matrix $\begin{pmatrix}2 & 1\\ 1 & 3\end{pmatrix}$ is the line

A 7x – 4y = 0
B 7x +4y = 0
C 4x – 7y = 0
D 4x+7y=0

61. The equations

$$2x-3y+4z=1$$
$$3x-y \quad\quad =2$$
$$x+2y-4z=1$$

A are linearly independent
B are straight lines
C are linearly dependent
D have a unique solution

62. $\lim_{x\to 3}\left(\frac{x^2-9}{x-3}\right)$

A 0
B -3
C ∞
D 6

63 Given that $y^3 + x^2y - x^3 = 3$, $\frac{dy}{dx} =$

A $\frac{x(2y-3x)}{x^2+3y^2}$

B $\frac{x(3x-2y)}{x^2+3y}$

C $\frac{x(3x-2y)}{x^2+3y^2}$

D $\frac{3x-2y}{x+3y^2}$

64 $\int \frac{x+2}{x+3}\,dx =$

A $2x - \ln(x+3) + K$
B $x - \ln(x+3) + K$
C $\ln(x+3) - x + K$
D $x + \ln(x+3) + K$

65. Given that $(1+i)z - 3 + i = 0$, the value of z in the form $a + bi$,
where a and b $\in \mathbb{R}$, is

A $-1-2i$
B $-1+2i$
C $1+2i$
D $1-2i$

66. If a complex number z has modulus 2 and argument $\frac{\pi}{6}$, then

A $z=1+\sqrt{3}\,i$
B $z=\sqrt{3}-i$
C $z=\sqrt{3}+i$
D $z=1-\sqrt{3}\,i$

67. $e^{-\frac{\pi}{2}i} =$

A $\cos\frac{\pi}{2} - i\sin\frac{\pi}{2}$

B $-\cos\frac{\pi}{2} - i\sin\frac{\pi}{2}$

C $\cos\frac{\pi}{2} + i\sin\frac{\pi}{2}$

D $\frac{1}{2}[\cos(-\pi) - i\sin(-\pi)]$

68. The solution of the differential equation

$(1+x^2)\frac{dy}{dx} = 1$ is

A $\tan^{-1}(\frac{x}{2}) + k$
B $\tan^{-1}(x) + k$
C $\cot^{-1}(\frac{x}{2}) + k$
D $\cot^{-1}(x) + k$

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69. Given that $r_1 = i + 2j + 3k + \lambda(4i - j + mk)$ and $r_2 = 3i + 2j - k + \mu(i + j - k)$ are two perpendicular lines, the value of m is

A 3
B -3
C 1
D -1

70. Given that $\sqrt{3}\cos x + \sin x \equiv R\cos(x - \theta)$, where R>0 and $0 < \theta < \frac{\pi}{2}$, the values of R and $\tan\theta$ *respectively are* :

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

71. $\cos 7\theta + i\sin 7\theta =$

A $7(\cos\theta + i\sin\theta)$
B $7(\cos\theta - i\sin\theta)$
C $(\cos\theta + i\sin\theta)^7$
D $\cos 2\theta\cos 5\theta + i\sin 2\theta\sin 5\theta$

72. The sum of the roots of the equation $3x^2 + kx - 15 = 0$ *is* 2. The value of the constant K is

A 6
B -6
C 30
D -30

73. Which of the following binary relations defined on Z, the set of integers, is not transitive?

A $aRb \Leftrightarrow a$ *is a factor of* b
B $aRb \Leftrightarrow a$ *is a greater than* b
C $aRb \Leftrightarrow a + b$ *is odd*
D $aRb \Leftrightarrow a + b$ *is even*

74. The functions f and g are defined on R by $f : x \to 2x - 1$ *and* $fg : x \to x - 2$

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

75. A linear relationship involving the variables x and y is $\ln y = nx + \ln a$, where a and n are constants. The relationship between x and y is also

A $y = an^x$
B $y = ae^{nx}$
C $y = ax^n$
D $y = ne^{ax}$

76. The gradient of the tangent to the curve $y = 2e^{2x} - 3e^{-x}$ at the point where x=0 is

A 5
B 7
C -1
D -5

77. The function f is defined on the set of real numbers R by $f(x) = \frac{k + 3x}{2 + x}, x \neq -2, 0.$
The value of the constant K for which f is an even function is

A 6
B 3
C 2
D 5

78. 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)

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79. 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 $4^x = 13y$

80. 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 $\frac{18}{11}$