

2023 MOCK FEBRUARY MATHEMATICS_1
OBJECTIVE TEST- FEBRUARY, 2023
SUBJECT: FURTHER MATHEMATICS/ELECTIVE MATHEMATICS

DURATION: 3 ¾ HOURS

Answer all questions from this section. Circle the correct option

1. Given that $f : x \rightarrow x^4 - 3x^2 - 7x + 11$, find $f(-1)$.
A. 2 B. 8 C. 14 D. 16
2. Find the remainder when $2x^3 + 3x^2 + 6x + 10$ is divided by $(x + 2)$.
A. -6 B. -3 C. 3 D. 6
3. If $f(x - 2)$ is a factor of $2x^2 - x^2 - 8x + 4$, find the other two factors.
A. $(x + 2)$ and $(x - 1)$ B. $(x - 2)$ and $(2x + 1)$
C. $(x - 2)$ and $(x + 1)$ D. $(x + 2)$ and $(2x - 1)$
4. Divide $3x^3 - x^2 - 4x + 1$ by $x^2 - 2$.
A. $3x + 1 + \frac{2x+1}{x^2-2}$ B. $3x + 1 + \frac{2x-1}{x^2-2}$ C. $3x - 1 + \frac{2x-1}{x^2-2}$ D. $3x - 1 + \frac{2x+1}{x^2-2}$
5. Which of the following is a factor of the polynomial $x^4 + 3x^2 - 17x + 6$?
A. $x + 3$ B. $x + 2$ C. $x - 2$ D. $x - 3$
6. Find the set of zeros of the polynomial $p(x) = x^3 - 2x^2 - x + 2$.
A. $\{0, 1, 2\}$ B. $\{-1, 0, 1\}$ C. $\{-1, 1, 2\}$ D. $\{-2, -1, 1\}$
7. If $\frac{3x+4}{x^2-3x+2} \equiv \frac{A}{(x-1)} + \frac{B}{(x-2)}$, find the value of $A + B$.
A. -3 B. 2 C. 3 D. 4
8. Which of the following is **not** a rational number?
A. 0 B. $\frac{1}{3}$ C. $\sqrt{3}$ D. 3
9. Given that $\frac{2x}{(x+6)(x+3)} \equiv \frac{P}{x+6} + \frac{Q}{x+3}$. Find P and Q
A. $P = 4$ and $Q = 2$ B. $P = 2$ and $Q = 4$
C. $P = 4$ and $Q = -2$ D. $P = -2$ and $Q = 4$
10. Given that $\frac{6x+m}{2x^2} \equiv \frac{4}{x+5} - \frac{2}{2x-5}$, find the value of m .
A. 20 B. 12 C. -10 D. -22
11. Express $\frac{x+2}{x^2-9} - \frac{3}{x-3}$ as a single fraction.
A. $\frac{-2x+11}{x^2-9}$ B. $\frac{-2x+9}{x^2-9}$ C. $\frac{-2x+7}{x^2-9}$ D. $\frac{-2x-7}{x^2-9}$
12. Find the coefficient of x^2 in the binomial expansion of $\left(x^2 + \frac{2}{x}\right)^4$
A. 4 B. 6 C. 12 D. 24
13. Determine the coefficient of the of x^3 in the expansion of $(1 - x)^6$.
A. -20 B. -10 C. 10 D. 20
14. Find the equation of the straight line with gradient 2 and passing through the point $P(0, 5)$.
A. $y = 2x - 5$ B. $y = 2x + 5$ C. $y = -2x - 5$ D. $y = -2x + 5$
15. Find the angle between the lines $2x - y = 4$ and $x - y = 3$.
A. $\tan^{-1}(-3)$ B. $\tan^{-1}(3)$ C. $\tan^{-1}\left(-\frac{1}{3}\right)$ D. $\tan^{-1}\left(\frac{1}{3}\right)$

Use the information below to solve questions 16-17

A circle has center $(-1, 3)$ and circumference 12π .

16. Determine the radius of the circle.
A. 12 B. 6 C. 2 D. 10
17. Find the equation of the circle
A. $6^2 = (x - 1)^2 + (y - 3)^2$ B. $6^2 = (x + 1)^2 + (y + 3)^2$

- C. $6^2 = (x + 1)^2 - (y - 3)^2$ D. $6^2 = (x + 1)^2 + (y - 3)^2$
18. $P(-2, 1)$ and $Q(-6, 2)$ are points in a plane. Find $|PQ|$
 A. $\sqrt{15}$ B. $\sqrt{16}$ C. $\sqrt{17}$ D. $\sqrt{18}$
19. A straight line passing through the point $(2, -1)$ is perpendicular to the line $2x + 3y - 1 = 0$. Find the equation of the straight line.
 A. $2x - 3y - 8 = 0$ B. $2y + 3x - 8 = 0$
 C. $2y - 3x + 8 = 0$ D. $2x - 3y - 1 = 0$
20. The gradient of a line passing through the point $M(6, 7)$ and $N(y, 8)$ is $\frac{1}{3}$. Find the value of y
 A. 12 B. 9 C. 6 D. -3
21. The midpoint of $M(4, -1)$ and $N(x, y)$ is $P(3, -4)$. Find the coordinates of N .
 A. $(-10, -7)$ B. $(-1, -3)$ C. $(2, -7)$ D. $(2, 3)$
22. Let $\mu = \{2, 4, 6, 8, 10, 12\}$ be the universal set, $P = \{\text{multiples of } 4\}$ and $Q = \{6, 8, 12\}$. Find $(P^1 \cap Q)$.
 A. $\{2, 6, 10\}$ B. $\{6, 8, 12\}$ C. $\{6\}$ D. $\{\}$
23. In a class of 25 students, 6 study French (F), 14 study Physics (P) and 3 study both French and Physics. Find $n(F^1 \cap P^1)$.
 A. 2 B. 3 C. 5 D. 8
24. If $(3 + 4\sqrt{3})(2 - a\sqrt{3}) = -18 + 2\sqrt{3}$, find the value of a .
 A. -4 B. -2 C. 2 D. 3
25. Evaluate $\frac{1-\sqrt{3}}{1+\sqrt{3}}$
 A. $-2 - \sqrt{3}$ B. $-2 + \sqrt{3}$ C. $-1 + \sqrt{3}$ D. $1 + \sqrt{3}$

Use the information below to answer Questions 26 and 27

The binary operation $*$ is defined on the set of rational numbers by $a * b = 2ab$.

26. Find the identity element.
 A. $\frac{1}{4}$ B. $\frac{1}{2}$ C. 2 D. 4
27. Find the rational number that has no inverse under $*$.
 A. 3 B. 2 C. 1 D. 0
28. A binary operation $\otimes$ is defined on the set of real numbers by $a \otimes b = a + b\sqrt{2}$. Find $(2 \otimes -3) \otimes 5$
 A. $2 + 5\sqrt{2}$ B. $2 + 2\sqrt{2}$ C. $2 - 3\sqrt{2}$ D. $-3 + 5\sqrt{2}$

Use the information below to answer Questions 29 to 30

The operation $*$ is defined on the set $A = (a, b, c)$ by the following table.

$*$	a	b	c
a	c	a	b
b	a	b	c
c	b	c	a

29. What is the identity element under $*$?
 A. a B. b C. c D. 0
30. What is the inverse of the element c under $*$?
 A. c B. a C. b D. 0
31. If $g(x) = 2x + 1$ and $h(x) = 3x - 2$, find $h \circ g(x)$.
 A. $6x + 1$ B. $6x + 3$ C. $6x + 4$ D. $6x + 5$

32. Given that $f : x \rightarrow x^2 - 6x + 5$ and $g : x \rightarrow x - 2, x \in \mathbf{R}$, find $f \circ g(4)$
 A. 3 B. 1 C. -3 D. -5
33. Resolve $\frac{3x-1}{(x-2)^2}, x \neq 2$ into a partial fraction.
 A. $\frac{3}{(x-2)} - \frac{7}{(x-2)^2}$ B. $\frac{3}{(x-2)^2} - \frac{7}{(x-2)}$ C. $\frac{3}{(x-2)} - \frac{5}{(x-2)^2}$ D. $\frac{3}{(x-2)^2} - \frac{7}{(x-2)}$
34. If $(x - A)^2 + B \equiv x^2 - 10x + 29$, find the value of $(A + B)$.
 A. -9 B. -1 C. 8 D. 9
35. Given that $\frac{2x}{(x+6)(x+3)} \equiv \frac{P}{x+6} + \frac{Q}{x+3}$, find (P, Q) .
 A. (4, 2) B. (2, 4) C. (4, -2) D. (-2, 4)
36. If $f(x - 2) = x^3 - 4x^2 + 3x + 2$, find $f(-1)$.
 A. 14 B. 2 C. 0 D. -6
37. Factorize completely $4x^3 + 8x^2 - x - 2$.
 A. $(x - 2)(2x + 1)(x - 1)$ B. $(x - 2)(4x^2 - 1)$
 C. $(x + 2)(x - 2)(x + 1)$ D. $(x + 2)(2x + 1)(2x - 1)$
38. If $f(x - 1) = 3x^3 - 2x - 1$, find $f(3)$
 A. 19 B. 74 C. 183 D. 189
39. Find the coefficient of x^3 in the binomial expansion of $(2 + 3x)^4$.
 A. 216 B. 81 C. 27 D. 8
40. If $(x + 1)$ is a factor of the polynomial $f(x) = x^3 - px^2 + x + 6$, find the value of p .
 A. -8 B. -4 C. 4 D. 8
41. Given the general equation of a circle $x^2 + y^2 + 2gx + 2fy + c = 0$, what is the nature of the equation $x^2 + y^2 = 4$?
 A. It is perpendicular to the general equation B. The center of the equation is at the origin
 C. The center is parallel to the radius D. The equation is symmetrical
42. A function f is defined by $f : x \rightarrow \frac{3x+1}{2}$, find $f^{-1}(x)$
 A. $\frac{2x-1}{3}$ B. $\frac{2x+1}{3}$ C. $\frac{2(x-1)}{3}$ D. $\frac{x-2}{3}$
43. Find the equation of the line which passes through the point (1, 3) and which is perpendicular to the line $2y - 3x + 1 = 0$
 A. $2y + 3x - 9 = 0$ B. $2y - 3x - 9 = 0$
 C. $3y + 2x - 11 = 0$ D. $2y + 3x - 3 = 0$
44. Find the gradient of the tangent to the curve $y = x^3 - 2x + 1$ at the point $(-1, 2)$
 A. -1 B. 1 C. 5 D. 10
45. An equation of the circle of radius $\sqrt{7}$ with center at the origin is
 A. $x^2 - y^2 = \sqrt{7}$ B. $x^2 - y^2 = 7$ C. $x^2 + y^2 = \sqrt{7}$ D. $x^2 + y^2 = 7$
 The equation of a circle is $x^2 + y^2 + 2x - 6y = 15$
Use the information to answer questions 6-7
46. What is the center of the equation?
 A. $(-1, 3)$ B. $(3, -1)$ C. $(-3, 1)$ D. $(-3, -1)$
47. Determine the radius of the equation
 A. 25units B. 15units C. 5units D. 2units
48. Find the standard equation of a circle whose center is $(-1, -3)$ and radius 2.
 A. $(x - 1)^2 + (y - 3)^2 = 2^2$ B. $(x + 1)^2 + (y + 3)^2 = 2^2$
 C. $(x - 1)^2 + (y - 3)^2 = 4$ D. $(x + 1)^2 + (y + 3)^2 = 4^2$
49. If $|AB|$ is perpendicular $|CD|$, find the gradient of $|CD|$, find the gradient of $|CD|$, when $m_{AB} = -4$
 A. -4 B. $-\frac{1}{4}$ C. 4 D. $\frac{1}{4}$
50. Solve the equation $\sin(3\theta - 30^\circ) = \cos 60^\circ$

- A. 10° B. 45° C. 60° D. 20°

51. Find the value of θ if $\tan \theta = \frac{5}{12}$, $0 < \theta < 90^\circ$

- A. 22.6 B. 0.416 C. 67.4 D. 90°

52. If $\cos^2 \theta + \sin^2 \theta = 1$, determine an expression for $\cos \theta$

- A. $\sqrt{1 - \sin^2 \theta}$ B. $\sqrt{1 + \sin^2 \theta}$ C. $\sqrt{\sin^2 \theta + 1}$ D. $\sqrt{1 - \cos^2 \theta}$

The equation of a circle is $x^2 + y^2 + 2x - 6y = 15$

Use the information to answer questions 19-20

53. Find the coordinates of the center.

- A. $(-1, 3)$ B. $(1, -3)$ C. $(-1, -3)$ D. $(1, 3)$

54. What is the radius of the circle?

- A. $\sqrt{2}$ B. $\sqrt{7}$ C. 5 D. 25

55. Which of the following represent an equation of the straight line passing through the point $P(4, 5)$ and perpendicular to the line $y = -\frac{2}{3}x - 1$.

- A. $y = \frac{3}{2}x + 7$ B. $y = \frac{3}{2}x - 7$ C. $y = -\frac{3}{2}x - 1$ D. $y = \frac{3}{2}x - 1$

56. What is the slope of the tangent to the curve $y = -\frac{27}{x}$ at the point $(3, 9)$?

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

57. Given that $f : x \rightarrow x^4 - 3x^2 - 7x + 11$, find $f(-1)$.

- A. 2 B. 8 C. 14 D. 16

58. Find the equation of the straight line with gradient 2 and passing through the point $P(0, 5)$.

- A. $y = 2x - 5$ B. $y = 2x + 5$ C. $y = -2x - 5$ D. $y = -2x + 5$

59. Find the angle between the lines $2x - y = 4$ and $x - y = 3$.

- A. $\tan^{-1}(-3)$ B. $\tan^{-1}(3)$ C. $\tan^{-1}\left(-\frac{1}{3}\right)$ D. $\tan^{-1}\left(\frac{1}{3}\right)$

Use the information below to solve questions 26-27

A circle has center $(-1, 3)$ and circumference 12π .

60. Determine the radius of the circle.

- A. 12 B. 6 C. 2 D. 10

61. In a class of 25 students, 6 study subject A and 14 study subject B and three study both A and B. Find $n(A' \cap B')$

- A. 8 B. 5 C. 3 D. 2

62. A binary operation Δ is defined on the set R of real numbers by $a \Delta b = \frac{1}{2}ab$. Find the identity element under Δ .

- A. 0 B. $\frac{1}{2}$ C. 2 D. 1

63. If $P = \{n^2 + 1 : n = 0, 2, 3\}$ and $Q = \{n + 1 : n = 2, 3, 5\}$ Find $P \cap Q$.

- A. $\{ \}$ B. $\{1, 3\}$ C. $\{4, 6\}$ D. $\{5, 10\}$

64. The polynomial $f(x) = 2x^3 - 4x^2 + x - 7$ is divided by $x - 1$. Find the remainder

- A. -14 B. -8 C. 0 D. 14

65. Express $\frac{2}{3 - \sqrt{7}}$ in the form $a + \sqrt{b}$, where a and b are constants.

- A. $6 - \sqrt{7}$ B. $3 - \sqrt{7}$ C. $3 + \sqrt{7}$ D. $3 + 2\sqrt{7}$

66. $\sin \theta = \frac{8}{17}$ and θ is obtuse find the value of $\frac{1}{\cos \theta + 1}$

- A. $-\frac{15}{17}$ B. $-\frac{2}{17}$ C. $\frac{8}{15}$ D. $\frac{17}{32}$

67. A function f is defined by $f : x \rightarrow \frac{3x+1}{2}$, Find f^{-1}

- A. $\frac{2x-1}{2}$ B. $2x - \frac{3}{x^4}$ C. $2x + \frac{3}{x^4}$ D. $2x + \frac{3}{x^2}$
68. If $(3 + 4\sqrt{3})(2 - a\sqrt{3}) = -18 + 2\sqrt{3}$, find the value of a .
1) -4 B. -2 C. 2 D. 3
69. Given that $2 \log_y x = 3$, find the relation involving x and y
A. $y^3 = x^2$ B. $y^3 = x$ C. $y^2 = x^3$ D. $y = x^3$
70. Find the equation of the line which passes through the point (1,3) and which is perpendicular to the line $2y - 3x + 1 = 0$
A. $2y + 3x - 9 = 0$ B. $2y - 3x - 9 = 0$ C. $3y + 2x - 11 = 0$ D. $2y + 3x - 3 = 0$
71. V and P are related by $V = aP^n$, where a and b are constants. Find the gradient of the straight line obtained from it.
A. $\log a$ B. $\log n$ C. a D. n
72. Given that $f: x \rightarrow x^4 - 3x^2 - 7x + 11$, find $f(-1)$
A. 2 B. 8 C. 14 D. 16
73. Two functions f and g are defined by $f \rightarrow x + 3$ and $g: \rightarrow x^2 - 1$. Find gof
A. $x^2 + 2$ B. $x^2 + 3$ C. $x^2 + 3x + 8$ D. $x^2 + 6x + 8$
74. Find the value of $\log_3 27 + \log_4 16 - \log_8 64$
A. 5 B. 4 C. 3 D. 2
75. Solve the equation $x^{\frac{2}{3}} - x^{\frac{1}{3}} - 6 = 0, x > 0$
A. 27 B. 9 C. 8 D. 3
76. $R(-3,1)$ and $S(-1,3)$ are two points on a circle. If RS is a diameter, find the equation of the circle.
A. $x^2 + y^2 - 4x + 4y - 6 = 0$ B. $x^2 + y^2 - 4x - 4y + 6 = 0$ C. $x^2 + y^2 + 4x - 4y + 6 = 0$ D. $x^2 + y^2 + 6x - 4y + 8 = 0$
77. If $f(x) = -2x^3 + qx + 2$, where q is a constant and $f(-1) = 2$, find q .
A. -1 B. -2 C. 2 D.
78. Given that $x = 2 + 3\sqrt{2}$ and $y = -1 + 5\sqrt{2}$, find $x^2 - y^2$
A. $-29 + 22\sqrt{2}$ B. $29 + 22\sqrt{2}$ C. 73 D. $3 - 2\sqrt{2}$
- Use the information below to answer questions 79 and 80
- Given that $f(x) = 3\cos x + 2\sin x$, where $0^\circ \leq x \leq 360^\circ$
79. What is the maximum value of $f(x)$?
A. 5 B. $\sqrt{14}$ C. $\sqrt{5}$ D. $\sqrt{13}$
80. For what value of x is $f(x)$ maximum?
A. 33.7° B. 56.3° C. 213.7° D. 236.3°
81. Factorize the expression $(x + y - 1)^2 - (x - y + 1)^2$
A. $2x(2y - 1)$ B. $2y(2x - 1)$ C. $4y(x - 1)$ D. $4x(y - 1)$
82. If $\tan x = \frac{1}{3}$, find $\cos x$
A. $0.3\sqrt{10}$ B. $0.1\sqrt{10}$ C. $\frac{\sqrt{3}}{10}$ D. $\frac{1}{10}$
83. Determine the equation of axis of symmetry of the curve $y = x^2 + 6x - 12$
A. $y = 2x + 6$ B. $x = -6$ C. $x = -3$ D. $y = 6x - 12$
84. Find the inverse g^{-1} of the function $g: x \rightarrow \frac{2}{x} - 5, x \neq 0, x \in R$
A. $g^{-1}(x) = \frac{2}{5-x}$ B. $g^{-1}(x) = \frac{2}{5+x}$ C. $g^{-1}(x) = \frac{x}{2} - \frac{1}{5}$ D. $g^{-1}(x) = \frac{5+x}{2}$
85. Find the minimum value of the function $f(x) = x^2 - x - 6$
A. $-6\frac{1}{4}$ B. -6 C. $-5\frac{3}{4}$ D. $-\frac{1}{2}$
86. Find the value of k for which the equation $x^2 - kx + 4$ has equal roots
A. ± 1 B. ± 2 C. ± 3 D. ± 4
87. The coefficient of x^3 in the binomial expansion of $(p + 3x)^4$ is 54. Find the value of p .

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

88. Find the set of zeros of the polynomial $p(x) = x^3 - 2x^2 - x + 2$

- A. $\{0,1,2\}$ B. $\{-10,1\}$ C. $\{-1,1,2\}$ D. $\{-2,-1,1\}$

89. If $\sin A = \frac{4}{5}$ and $\cos B = \frac{12}{13}$ find the value of $\sin(A - B)$

- A. $\frac{33}{65}$ B. $\frac{63}{65}$ C. $\frac{65}{63}$ D. $\frac{65}{33}$

90. Express $\frac{2}{x-1} - \frac{1}{2(x+1)}$ as single fraction.

- A. $\frac{3x-5}{x^2-1}$ B. $\frac{x+1}{2(x^2-1)}$ C. $\frac{3x-5}{2(x^2-1)}$ D. $\frac{3x+5}{2(x^2-1)}$

91. Find the set of values of x for which $\frac{x^2-2x-35}{(x+2)(2x+1)} = 0$

- A. $\{7,-5\}$ B. $\{7,5\}$ C. $\{5,-7\}$ D. $\{2,-\frac{1}{2}\}$

92. If $(3 + 4\sqrt{3})(2 - a\sqrt{3}) = -18 + 2\sqrt{3}$, find the value of a .

- A. -4 B. -2 C. 2 D. 3

93. Given that $\tan x = 1$, find the value of $\cos 2x$

- A. $\frac{1}{2}$ B. $\frac{2}{\sqrt{2}}$ C. $\frac{1}{\sqrt{2}}$ D. 0

94. If $f(x-1) = 3x^2 - 2x - 1$, find $f(3)$

- A. 19 B. 74 C. 185 D. 189

95. ABC is a triangle, $|AB|=8\text{cm}$, $|BC|=7\text{cm}$, angle $ABC=36^\circ$, find $|AC|$, correct to one decimal place.

- A. 4.7cm B. 14.3cm C. 15.0cm D. 22.4cm

96. Solve the equation $2\cos^2\theta - \cos\theta = 0$, where $0 < \theta < 90^\circ$

Use the information to answer questions 36 and 37.

Given the equation of the circle, $2x^2 + 2y^2 + 6x - 2y + 12 = 0$,

97. Find the centre of the circle

- A. $(-6,2)$ B. $(-3,-2)$ C. $(-3,2)$ D. $(3,-2)$

98. Determine the radius of the circle

- A. 12 B. $\sqrt{7}$ C. $\sqrt{13}$ D. 7

99. If -1 is one of the roots of the equation $3x^2 - 2(k-2)x - 1 = 0$, find the value of k

- A. 0 B. 1 C. 3 D. 4

100. If $\cos^2\theta + 3\sin\theta = 1$, find the value of θ , where $0^\circ \leq \theta \leq 360^\circ$.

- A. 0° and 180° B. 45° and 90° C. 60° and 120° D. 60° and 75°