

MOCK EXAMINATION 2021
FURTHER MATHEMATICS /

MATHEMATICS(ELECTIVE) **1**
Objective Test

DURATION $1\frac{1}{2}$ hours

Name.....

Index Number.....

ST JOHN'S SCHOOL, SEKONDI

FURTHER MATHEMATICS / MATHEMATICS (ELECTIVE) 1

OBJECTIVE TEST

JULY, 2021

[40 marks]

$1\frac{1}{2}$ hours

Do **not** open this booklet until you are told to do so. While waiting, read and observe the following instruction carefully. Write your **name** and **index number** in **ink** in the space provided above.

Answer all questions on your Objective Test sheet. Think carefully before you shade the answer space, erase completely any answer you will wish to change.

Do all your rough work on this question paper.

Mathematical tables may be used in any question. The use of non – programmable, silent and cordless calculator is allowed

Answer **all** the questions.

Each question is followed by four options lettered A to D. Find the **correct** option for **each** question and shade in **pencil**, on your answer sheet, the answer space which bears the same letter as the option you have chosen.

Give only **one** answer to **each** question.

Smart Learning Tools

1. If $\frac{8-3\sqrt{6}}{2\sqrt{3}+3\sqrt{2}} = p\sqrt{3} + q\sqrt{2}$, evaluate $(p + q)$.
 - A. $-\frac{10}{3}$
 - B. $-\frac{4}{3}$
 - C. $\frac{4}{3}$
 - D. $\frac{10}{3}$
2. A binary operation $*$ is defined by $x * y = 2x + xy$. Find $2 * 3$.
 - A. -10
 - B. -2
 - C. 2
 - D. 10
3. A function f is defined on the set $\mathbb{R}$, of real numbers by $f: x \rightarrow \frac{x}{2} + 11$. Find $f^{-1}(15)$.
 - A. -13.0
 - B. -4.5
 - C. 8.0
 - D. 18.5
4. The roots of quadratic equation are $(\sqrt{2} + 1)$ and $(\sqrt{2} - 1)$. Find its equation.
 - A. $x^2 - 12x + 2 = 0$
 - B. $x^2 + 2\sqrt{2}x + 1 = 0$
 - C. $x^2 - 24x + 5 = 0$
 - D. $x^2 - 2\sqrt{2}x + 2 = 0$
5. Find the remainder when $x^4 + 5x^3 + 5x - 6$ is divided by $(x + 1)$.
 - A. -5
 - B. 1
 - C. 3
 - D. 4
6. If $4\left(\frac{1}{2}\right)^{x-1} - \left(\frac{1}{2}\right)^{2-x} = 0$, find x .
 - A. $\frac{5}{2}$
 - B. 2
 - C. $\frac{3}{2}$
 - D. 1
7. If $\log_3 x = 3$, find $\log_x 81$.
 - A. 2
 - B. $\frac{4}{3}$
 - C. $\frac{2}{3}$
 - D. $\frac{1}{2}$
8. Calculate the coefficient of x^6 in the binomial expansion of $(x + y)^8$.
 - A. $8y^2$
 - B. $28y^2$
 - C. $56y^2$
 - D. $70y^2$

9. Solve $(4x - 7)(x + 3) \leq 0$.
- $-3 \leq x \leq \frac{7}{4}$
 - $-\frac{7}{4} \leq x \leq 3$
 - $\frac{7}{4} \leq x \leq 3$
 - $-3 \leq x \leq -\frac{7}{4}$
10. If the lines $3x - 4y - 12 = 0$ and $px + 6y + 9 = 0$ are parallel, find the value of the constant p .
- $-\frac{9}{2}$
 - $-\frac{2}{9}$
 - $\frac{2}{9}$
 - $\frac{9}{2}$
11. Find the radius of the circle $3x^2 + 3y^2 - 4x + 5y + 3 = 0$.
- $\frac{1}{2}$
 - $\frac{2}{3}$
 - $1\frac{1}{2}$
 - $\frac{\sqrt{5}}{6}$
12. The sum of the first five terms of a linear sequence (AP) is 35. If the first term is 3, find the common difference.
- 1
 - 2
 - 3
 - 4
13. Evaluate $\frac{\tan 60^\circ - \sin 45^\circ}{\cos 150^\circ}$, leaving your answer in surd form.
- $(6 - \sqrt{6})$
 - $(\sqrt{6} - \sqrt{6})$
 - $\frac{1}{3}(6 - \sqrt{6})$
 - $\frac{1}{3}(\sqrt{6} - 6)$
14. Given that $y = 12 - x + \frac{1}{x}$, find $\frac{dy}{dx}$.
- $1 + \frac{1}{x^2}$
 - $-(1 + \frac{1}{x^2})$
 - $\frac{1}{x^2 - 1}$
 - $\frac{12 - x}{x}$
15. Find the minimum value of $2x^2 - 8x + 3$.
- 7
 - 5
 - 2
 - 3

16. Evaluate $\int_0^2 (x - 3)^2 dx$.

- A. $\frac{10}{3}$
- B. $\frac{16}{3}$
- C. $\frac{26}{3}$
- D. $\frac{32}{3}$

17. Find the unit vector in the direction of the resultant forces, $F_1(2\mathbf{i} - 3\mathbf{j})$, $F_2(\mathbf{i} + 2\mathbf{j})$ and $F_3(-2\mathbf{i} + 5\mathbf{j})$.

- A. $\frac{\sqrt{3}}{2}\mathbf{i} - \frac{\sqrt{3}}{3}\mathbf{j}$
- B. $\frac{\sqrt{3}}{3}\mathbf{i} - \frac{\sqrt{3}}{2}\mathbf{j}$
- C. $\frac{3}{5}\mathbf{i} + \frac{4}{5}\mathbf{j}$
- D. $\frac{3\sqrt{34}}{34}\mathbf{i} + \frac{5\sqrt{34}}{34}\mathbf{j}$

18. If $\mathbf{r} = (20N, 030^\circ)$ and $\mathbf{n} = (5N, 210^\circ)$, find $(\mathbf{r} + \mathbf{n})$.

- A. $(15N, 030^\circ)$
- B. $(15N, 240^\circ)$
- C. $(25N, 030^\circ)$
- D. $(25N, 240^\circ)$

19. If $\begin{vmatrix} 3 & x \\ 2 & x-2 \end{vmatrix} = -2$, find the value of x .

- A. 2
- B. 4
- C. 6
- D. 8

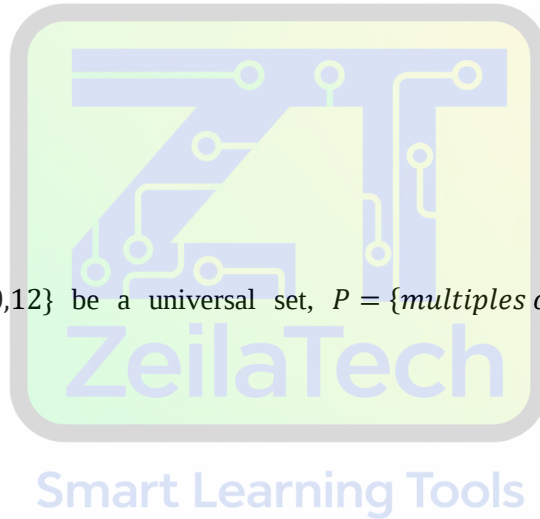
The table shows the distribution of the scores of group of students in a test. Use this information to questions 20 and 21.

Scores	1	2	3	4	5	6
Number of students	1	4	5	6	x	2

20. If the mean is 4, what is the value of x ?

- A. 3
- B. 4
- C. 6
- D. 12

21. If a pie chart is drawn for the distribution, what would be the sectorial angle for those who scored 4?
- A. 48°
 - B. 72°
 - C. 120°
 - D. 144°
22. How many three-digit number can be formed using the digit 1,2,3,4,5. If repetition is not allowed?
- A. 60
 - B. 80
 - C. 115
 - D. 125
23. Four fair coins are tossed. Find the probability of getting at least 2 tails.
- A. $\frac{5}{15}$
 - B. $\frac{3}{8}$
 - C. $\frac{5}{8}$
 - D. $\frac{11}{16}$
24. Let $\mu = \{2,4,6,8,10,12\}$ be a universal set, $P = \{\text{multiples of } 4\}$ and $Q = \{6,8,12\}$. Find $(P' \cap Q)$.
- A. $\{2,6,10\}$
 - B. $\{6,8,12\}$
 - C. $\{6\}$
 - D. $\{\}$
25. Simplify $(3 + 3\sqrt{3})(2 + 4\sqrt{3})$.
- A. $21 + 18\sqrt{3}$
 - B. $36 + 12\sqrt{3}$
 - C. $42 + 12\sqrt{3}$
 - D. $42 + 18\sqrt{3}$



26. If g and h are real value functions defined by $g: x \rightarrow x^2 + 1$ and $h: x \rightarrow 2x$, find $g\left(h\left(\frac{1}{4}\right)\right)$.
- A. $\frac{5}{4}$
B. $\frac{4}{5}$
C. $\frac{3}{4}$
D. $\frac{1}{16}$
27. If p and q are the roots of the equation $3x^2 - 16x + 2 = 0$, find the value of $p + q(1 + p)$.
- A. -14
B. $-\frac{14}{3}$
C. 6
D. 18
28. Given that $(x + 3y)$ is a factor of $x^2 - 2xy + py^2$, find the value of the constant p .
- A. -15
B. -5
C. 1
D. 12
29. $9^{2y-6} \times 27^6 = 3$, find the value of y .
- A. $\frac{5}{6}$
B. $-\frac{4}{5}$
C. $-\frac{5}{4}$
D. $-\frac{15}{4}$
30. If $x = \frac{1}{2}$ and $y = \frac{1}{3}$, find the value of the third term in the expansion of $(2x + 3y)^8$ in ascending powers of x .
- A. 16
B. 32
C. 56
D. 64

31. The gradient of the line passing through the points $M(6,7)$ and $N(y, 8)$ is $\frac{1}{3}$. Find the value of y .
- A. 12
B. 9
C. 6
D. -3
32. Find the equation of a circle whose center is at the point $(2,1)$ and passes through the point $(4, -3)$.
- A. $x^2 + y^2 + 4x - 2y - 15 = 0$.
B. $x^2 + y^2 - 4x - 2y - 15 = 0$.
C. $x^2 + y^2 - 2x - 4y - 27 = 0$.
D. $x^2 + y^2 - 2x + 4y - 27 = 0$.
33. The sum of the first four terms of a linear sequence (A.P) is 38. If the sum of the third and fourth terms is 29, find the common difference.
- A. 2
B. 4
C. 5
D. 10
34. If $\sin\theta = \frac{\sqrt{3}}{2}$ and $\cos\theta < 0$, find the value of θ where $0^\circ \leq \theta \leq 360^\circ$.
- A. 60°
B. 120°
C. 210°
D. 240°
35. The speed $V \text{ ms}^{-1}$ of a body moving in a straight line is given by $V = 24t - 3t^2$ at t seconds. Find the distance at ends of 3 seconds.
- A. 6m
B. 42m
C. 81m
D. 135m
36. If $|\mathbf{a}|=\sqrt{2}$, $|\mathbf{b}| = \sqrt{3}$, and the angle between $\mathbf{a}$ and $\mathbf{b}$ is 45° , find the scalar product of $\mathbf{a}$ and $\mathbf{b}$.
- A. 1
B. $\sqrt{2}$
C. $\sqrt{3}$
D. 2

37. Two forces $\mathbf{F}_1 = (5N, 030^\circ)$ and $\mathbf{F}_2 = (20N, 300^\circ)$ acts on a body of mass 4kg placed on a smooth horizontal table. Find in ms^{-2} , the acceleration of the body.
- A. 1.17
B. 1.92
C. 7.50
D. 13.46
38. Find the matrix of the transformation when a point is reflected in the line $y = x$.
- A. $\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$
B. $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$
C. $\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$
D. $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$
39. The of best fit in a scatter diagram passes through the points $(2, -3)$ and $(10, 9)$ in the $x - y$ plane. What will be the predicted value for y when $x = 4$?
- A. -3
B. 0
C. 3
D. 6
40. Given that $\overrightarrow{PQ} = \begin{pmatrix} 2 \\ 1 \end{pmatrix}$ and $\overrightarrow{PR} = \begin{pmatrix} -1 \\ 5 \end{pmatrix}$. Find $\overrightarrow{QR}$.
- A. $\begin{pmatrix} -3 \\ 4 \end{pmatrix}$
B. $\begin{pmatrix} -3 \\ 6 \end{pmatrix}$
C. $\begin{pmatrix} 3 \\ 4 \end{pmatrix}$
D. $\begin{pmatrix} 3 \\ 6 \end{pmatrix}$

GOOD LUCK

MOCK EXAMINATION 2021

FURTHER MATHEMATICS/

MATHEMATICS(ELECTIVE) **2**

DURATION $2\frac{1}{2}$ hours

Name.....

Index Number.....

ST JOHN'S SCHOOL, SEKONDI

FURTHER MATHEMATICS / MATHEMATICS (ELECTIVE) 1

JULY, 2021

[100 marks]

$2\frac{1}{2}$ hours

Write your **name** and **index number** in **ink** in the space provided above.

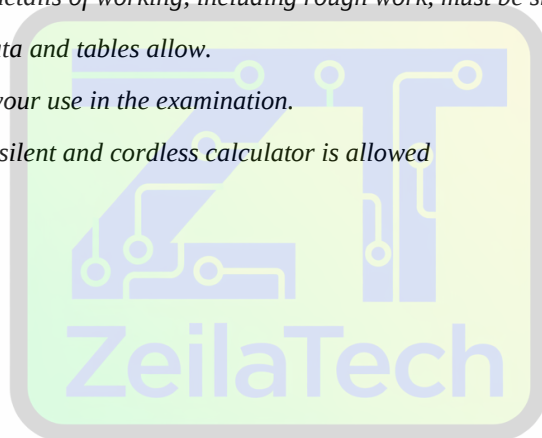
Answer **twelve** questions in all. **All the eight** questions in **section A** and **four questions** from **section B** with at least **one** question from each part.

In each question, all necessary details of working, including rough work, must be shown with the answer.

Give answer as accurately as data and tables allow.

Graph papers are provided for your use in the examination.

The use of non- programmable, silent and cordless calculator is allowed



Smart Learning Tools

Section A

[48 marks]

Answer all questions in this section

All questions carry equal marks

- The binary operations $*$ and Δ are defined on the set R , of real numbers by $a * b = 2a + ab$ and $x \Delta y = x + y - xy$ respectively where $a, b, x, y \in R$.
 - Determine whether or not Δ is commutative.
 - Evaluate $(3 * 2) \Delta (5 \Delta 3)$.
- Given that $\log 2x + 2 \log(y + 1) = \log(x + 1)$.
 - Express y in terms of x .
 - Determine the value of y , if $x = 8$.
- The gradient of a curve at any point (x, y) is given by $2(x - 3)$. Find:
 - the equation of the curve if it passes through the point $(3, 1)$.
 - the equation of the normal at the point.
- By writing $12x^2 - 6x + 1$ in the form $p(x + m)^2 + n$. Find the value of the constant p, m and n . Hence find the minimum value of $y = 12x^2 - 6x + 1$.
- Five odd and four even numbers are to be $1, 2, 3, 4, \dots, 15$. How many ways can this be done?
- The below shows the distribution of marks scored by 20 candidates in a Mathematics test.

Marks	1-5	6-10	11-15	16-20	21-30
Frequency	3	4	7	2	4

Draw a histogram for the distribution.

- Given that the angle between $\mathbf{p} = 4\mathbf{i} + 3\mathbf{j}$ and $\mathbf{q} = -2\mathbf{i} + m\mathbf{j}$ is $\cos^{-1}(-\frac{4}{5})$, find the constant m .
- A stone is dropped from the top of a building 30m high. Find correct to one decimal place,
 - the time it takes to reach the ground.
 - the velocity with which it hits the ground [Take $g = 9.8m^{-2}$].

Section B

[52 marks]

Answer **four** questions only from this section with **at least one** question from each part.
All questions carry **each** marks.

PART I

Pure Mathematics

9. The gradient of curve which passes through the point $(2,0)$ is given by $3x^2 - 4x - 4$. Find the
- equation of the curve
 - coordinates of the
 - turning points
 - minimum point.
10. Two linear transformation **P** and **Q** are given by **P**: $(x, y) \rightarrow (3x - 2y, x - 5y)$, **Q**: $(x, y) \rightarrow (-2x + y, 3x - y)$.
- Write down the matrices **P** and **Q**.
 - Find the matrix **R**, $PQ + R = P + Q$
 - Find the image of the point $(3,4)$ under the transformation $2P + 3Q$.
11. a. Evaluate $\int_1^3 \frac{x^3 + x^2 + 3}{x^2} dx$.
- Sketch the graph of $y = (1 - 3x)(x + 2)$.
 - Calculate the area of the region bounded by the curve and the x-axis.

PART II

Statistics and Probability

12. The following table shows the marks obtained by some students in the two papers of a subject.

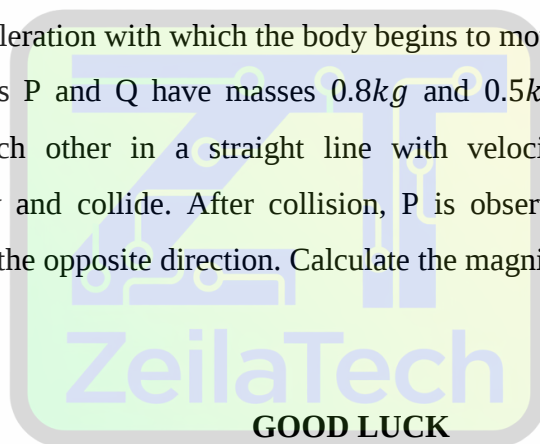
Paper 1(x)	51	45	23	47	18	31	27	30	21	23
Paper 2(y)	41	38	11	28	12	14	14	17	15	17

- Plot a scatter diagram to represent the information.
 - Find $\bar{x}$, the mean of x and $\bar{y}$, the mean of y .
 - Draw the line of best fit to pass through $(\bar{x}, \bar{y})$.
 - From your graph determine
 - the relation between x and y
 - the value of y when x is 25.
13. a. A student must answer 4 out of 7 questions in an examination.
- How many choices has he?
 - If he must answer the first two questions, how many choices has he?
- b) A fair die is thrown five times. Calculate, correct to three decimal places, the probability of obtaining
- at least 3 sixes
 - exactly 2 sixes.

PART III

Vectors and Mechanics

14. a) $\overrightarrow{PQ} = \begin{pmatrix} a \\ b \end{pmatrix}$ and $\overrightarrow{RQ} = \begin{pmatrix} c \\ d \end{pmatrix}$, express $\overrightarrow{PR}$ as a column vector.
- b) The position vectors of points A, B, C and D are $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$, $\begin{pmatrix} 10 \\ 4 \end{pmatrix}$, $\begin{pmatrix} 3 \\ 12 \end{pmatrix}$ and $\begin{pmatrix} 4 \\ 0 \end{pmatrix}$ respectively.
- Show that $\overrightarrow{AB}$ is perpendicular to $\overrightarrow{CD}$.
 - Calculate, correct to the nearest degree, $\angle ADB$.
15. a) Three forces $F_1(2N, 060^\circ)$, $F_2(4.5N, 180^\circ)$, $F_3(5N, 300^\circ)$ act on a body of mass 2kg initially at rest. Find
- the magnitude and direction of the resultant force.
 - the acceleration with which the body begins to move.
- b) Two objects P and Q have masses $0.8kg$ and $0.5kg$ respectively. They move towards each other in a straight line with velocities $2ms^{-1}$ and $3.4ms^{-1}$ respectively and collide. After collision, P is observed to have a velocity of $1.5ms^{-1}$ in the opposite direction. Calculate the magnitude of the velocity of Q.



Smart Learning Tools