SOUTH WEST REGIONAL MOCK EXAMINATION
GENERAL EDUCATION

THE TEACHERS' RESOURCE UNIT (TRU)

IN COLLABORATION WITH

THE REGIONAL INSPECTORATE OF PEDAGOGY FOR SCIENCE EDUCATION

AND

THE SOUTH-WEST ASSOCIATION OF MATHEMATICS TEACHERS (SWAMT)

FRIDAY, 25/03/2022 ORDINARY LEVEL

Subject Title	**Additional Mathematics**
Paper Number	**Paper 2**
Subject Code Number	**0575**

TWO AND A HALF HOURS

INSTRUCTIONS TO CANDIDATES:

Answer ALL the questions in SECTION A and ANY TWO questions from EITHER SECTION B OR SECTION C. DO NOT answer a combination of all three sections.

For your guidance, the approximate mark for each part of a question is indicated in brackets.

You are reminded of the necessity for good English and orderly presentation in your answers.

In calculations, you are advised to show all the steps in your working, giving your answer at each stage.

No marks will be awarded for answers without brief statements.

Electronic calculators and formulae booklets may be used.

Where necessary, take $g = 10m^{-2}$.

SECTION A : PURE MATHEMATICS

THIS SECTION IS COMPULSORY TO ALL CANDIDATES

(ANSWER ALL QUESTIONS)

1(i) When the polynomial $f(x) = x^3 + px^2 - 4x - 12$ is divided by $x - 1$, the remainder is -12.
   (a). Find the value of p. (2 marks)
   Given that with this value of p, x+3 is a factor of $f(x)$,
   (b). Show that $f(x) = (x+3)(x^2-4)$. Hence, factorise $f(x)$ completely. (2 marks)

(ii) The equation $x^2 - 3x + 1 = 0$ has roots α and β. Find the quadratic equation with integral coefficients whose roots are $\frac{\alpha-1}{\alpha}$ and $\frac{\beta-1}{\beta}$. (4 marks)

2(i) (a). In how many ways can a manager select a volleyball team of 4 left-handed and 2 right-handed players from a club of 7 left-handed and 5 right-handed players? (2 marks)
   (b). How many possible arrangements are there of the letters of the word ARRANGEMENT? (2 marks)

(ii) Find the coefficient of x^3, in the expansion of $(x - \frac{3}{x^2})^9$ in ascending powers of x. (4 marks)

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3. An engineer signed a one-year contract of work with a construction company stipulating that
-His starting salary would be 200,000 FCFA, with taxes.
-He would have a 5% increase in salary in the third month,
-Thereafter, the salary increase would come every second month following the last increase.
He started work on the 1st of June, 2019. Different from his bi-monthly salary increase, he got a 10% salary increase in the eighth month due to a promotion.
   (a). Copy and complete the table below, showing his monthly salary balance in the first ten months, given that he paid monthly taxes equal to 1,5% of his gross salary (6 marks)
   (b). Verify, correct to 2 d.p., the percentage of his total gross salary lost as taxes in this period. (2 marks)

S/N	MONTH / YEAR	GROSS SALARY (FCFA)	1.5% TAX ON GROSS (FCFA)	NET SALARY (FCFA)
1	JUNE, 2019	200,000	3,000	197,000
2	JULY, 2019	200,000	3,000	197,000
3	AUGUST, 2019			206,800
.	.	.	.	.
.	.	.	.	.
10				
	TOTAL			

In the table, give all amounts correct to the nearest hundred FCFA.

4(i) A binary operation ■ is defined over the set ℕ of natural numbers by $x■y = x + y - 4$.
   (a). Find the identity element. (2 marks)
   (b). Find the inverse of the element 9. (1 mark)
   (c). State, with a reason, whether (ℕ, ■) forms a group. (1 mark)

(ii) The sum of the first seven terms of an arithmetic progression is 24.5. Given that the sum of the terms from the eighth to the eleventh is 36, find the first term and the common difference of the progression.(5marks)

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5. An architect divided the cost of a building into units of 1 million FCFA. He had y units for raising of the whole structure and x units for all the finishing work. The owner of the building gave him the following conditions:
-The sum of the finishing costs and twice the raising costs (the owner's total cost function) must be at most 14 million FCFA.
-The difference, $2y - 3x$, must not exceed 2 million FCFA.
-The raising costs must be at least 4 million FCFA and the finishing costs at most 4 million FCFA.
   (a). Write down 4 inequalities which satisfy the owner's conditions. (3 marks)

(b). On graph paper, taking 2 cm for 1 unit on both axes, shade so as to leave unshaded the region satisfied by the four inequalities. (3 marks)

(c). Find the maximum and also the minimum possible total cost of the building. (2 marks)

6(i) Show that $\cot x - \tan x = 2\cot 2x$ (3 marks)

(ii) Given the function $f(x) = \sqrt{3}\sin 2x + \cos x$, where $0 \le x \le \frac{3\pi}{2}$,

(a). Copy and complete the following table: (3 marks)

$f(x) = \sqrt{3}\sin 2x + \cos x$										
x	0	$\frac{\pi}{6}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	$\frac{2\pi}{3}$	$\frac{5\pi}{6}$	π	$\frac{7\pi}{6}$	$\frac{4\pi}{3}$	$\frac{3\pi}{2}$
$f(x)$	1.0	1.7		0.0		−2.3			1.0	0.0

(b). Taking 2 cm to represent $\frac{\pi}{6}$ radians on the x-axis and 1 unit on the y-axis, draw the graph of $y = f(x)$. (2 marks)

(c). From your graph, estimate the minimum value of the function $f(x)$ (1 mark)

7. A straight line l_1 passes through the point $(2, -1)$ and is parallel to the vector AB, where the points A and B have coordinates $(-6,3)$ and $(-2,1)$, respectively. Another line is given as $l_2: r = 6i + j + t(-2i - 3j)$.

(a) Find a vector equation of l_1 in the form $\boldsymbol{r} = \boldsymbol{a} + \lambda\boldsymbol{d}$, where λ is a scalar. (2 marks)

(b) Find the position vector of the point of intersection of the lines l_1 and l_2. (4 marks)

(c). Find, correct to 3 s.f., the angle between the lines l_1 and l_2. (2 marks)

8(i) Given that $f(x) = \frac{3x^2}{1-x^2}$, find $f'(-2)$. (4 marks)

(ii) Evaluate $\int_0^{\frac{\pi}{4}}(2x + \cos 2x)dx$, leaving your answer in terms of π. (4 marks)

SECTION B: MECHANICS.
IF THIS SECTION IS CHOSEN, THEN SECTION C MAY NOT BE CHOSEN.
(ANSWER ANY TWO QUESTIONS

9(i) The position vectors of two particles P and Q at time t seconds are given by $(t^2 i + 2tj)m$ and $(t^3 i - 3tj)m$, respectively.

(a). Calculate the distance between P and Q when $t = 2$. (3 marks)

(b). Find the velocity of P relative to Q when $t = 2$. (4 marks)

(ii) A particle, K, of mass 3kg, moving with a speed of $30m^{-s}$, hits another particle, L, of mass 5kg, moving in the same direction with speed $10m^{-s}$. The speed of K is reduced to $20m^{-s}$ by this collision. Calculate:

(c). The speed of L after the collision. (5 marks)

(d). The impulse on particle K after the collision. (2 marks)

(e). The loss in kinetic energy. (3 marks)

10(i) Two particles of masses 6 kg and 10 kg are connected by a light inextensible string which passes over a smooth, fixed pulley. Find:

(a). The acceleration of the system. (4 marks)

(b). The tension in the string. (1 mark)

(c). The reaction on the pulley. (2 marks)

(ii) Given that the forces $F_1 = (4i + 3j)$ N, $F_2 = (ci - 5j)$ N, $F_3 = (3i + kj)$ N and $F_4 = (5i + j)$ N have a resultant force equal to $(14i + 5j)$ N,

(d). Find the values of the constants c and k. (4marks)

A fifth force, F_5, is added to the system and equilibrium is established.

(e). Find the magnitude and the direction, to the nearest degree, of the fifth force. (6marks)

11(i) The radius, r, of a sphere is increasing at the rate of $\frac{3}{4\pi r^2}$ cms^{-1} at the instant when its radius is $12cm$. (Area of sphere, $A = 4\pi r^2$).

(a). Calculate the value of $\frac{dA}{dr}$. (3 marks)

(b). Calculate the rate of change of the area of the sphere. (3 marks)

(ii) The area bounded by the line $y = 3x + 2$, the $x - axis$ and the ordinates $x = 0$ and $x = 1$, is rotated completely through one complete revolution about the $x - axis$. Calculate the volume of the solid generated. (6 marks)

(iii) A car of mass 450 kg is moving along a level road against a constant resistance of $200N$. The engine of the car is working at $20kw$. Calculate the acceleration of the car when its speed is $20m/s$. (5 marks)

SECTION C: STATISICS AND PROBABILITY
IF THIS SECTION IS CHOSEN, THEN SECCTION B MAY NOT BE CHOSEN.
(ANSWER ANY TWO QUESTIONS)

12(i) The points scored by 80 persons in a competition are distributed as follows:

Points (x)	05-09	10-14	15-19	20-24	25-29	30-34	35-39	40-44
Number of Persons (f)	4	8	12	17	21	10	5	3

(a). Draw a histogram of this distribution. (5 marks)

From the histogram, or otherwise,

(b). find the modal number of points scored in the competition. (3 marks)

(ii) Find the mean and the standard deviation of the distribution. (9 marks)

13(i) Events A and B are such that $P(A) = \frac{1}{5}$, $P(B) = \frac{1}{4}$ and $P(A \cup B) = \frac{1}{3}$. Find:

(a). P(A∩B) (3 marks)

(b). P(A∩B') (3 marks)

(c). P(A'∩B') (2 marks)

(ii) A black bag and a white bag each contain a number of apples of the same size. The black bag contains 5 red and 7 green apples while the white bag contains 8 red and 4 green apples. An apple is taken at random from any of the bags.

(d). Draw a tree diagram to illustrate all the possible events. (3 marks)

(e). Find the probability that the apple taken is green. (3 marks)

(f). A red apple is taken. Find the probability that it came from the black bag (3 marks)

14(i) A discrete random variable, X, has probability mass function, p, given by

$$p(x) = \begin{cases} k(x+1), & x = 0, 1, 2, \\ k(7 - x), & x = 3, 4, \\ 0, & otherwise. \end{cases}$$

(a). Copy and complete the following table: (2 marks)

X	0	1	2	3	4
$P(X = x)$		2k			3k

(b). Find the value of the constant k. (2 marks)

(c). Find the mean and the variance of X. (5 marks)

(ii) The random variable Y is such that $Y \sim Bin(5, p)$, with mean $E(Y) = \frac{1}{2}$.

(d). Find the value of p and the standard deviation, in surd form, of Y. (5 marks)

(e). Evaluate, correct to 3 significant figures, $P(Y = 2)$. (3 marks)