ADDITIONAL MATHEMATICS 2
0575

CAMEROON GENERAL CERTIFICATE OF EDUCATION BOARD

General Certificate of Education Examination

JUNE 2020   **ORDINARY LEVEL**

Subject Title	**Additional Mathematics**
Paper No.	2
Subject Code No.	0575

Two and a half hours

Answer ALL QUESTIONS IN SECTION A and ANY TWO QUESTIONS FROM EITHER SECTION B or SECTION C. IN SECTIONS B AND C, ALL QUESTIONS CARRY EQUAL MARKS.

Candidates are expected to answer a combination of Section A **and** Section B OR Section A **and** Section C but **NOT** a combination of all three

All necessary working must be shown. No marks will be awarded for answers without brief statements showing how the answers have been obtained.

Electronic calculators may be used.

Where necessary take g as 10ms⁻².

Formulae Booklets may be used.

Turn Over

SECTION A: PURE MATHEMATICS

THIS SECTION IS COMPULSORY TO ALL CANDIDATES

(ANSWER ALL QUESTIONS)

1. (i) Given that $(x + 1)$ is a factor of $f(x)$, where $f(x) = 2x^3 + 3x^2 + kx + 2$

       (a) Find the value of k.   **(2 marks)**
       With this value of k,
       (b) Show that $f(x) = (x + 1)(2x^2 + x + 2)$.   **(2 marks)**

  (ii) Given also that α and β are the roots of the equation $x^2 + x + 2 = 0$.
       (a) Find the values of $\alpha + \beta$ and $\alpha\beta$.   **(1 mark)**
       Hence,
       (b) write down another quadratic equation with integral coefficients whose roots are $-\alpha$ and $-\beta$.   **(3 marks)**

2. (i) Find the number of permutations of the letters of the word **"INVOLVING"**   **(3 marks)**

  (ii) Find the numerical value of the term independent of x in the binomial expansion of $\left(x - \dfrac{1}{2x}\right)^{10}$.   **(5 marks)**

3. Yang takes a loan of 1,000,000FCFA from a credit union. The loan is to be paid in ten months in equal instalments with an interest rate of 1.5 % of what he owes for that month. The table below shows how the repayment of the loan is schedule for the first 3 months

Month	Capital	Repayment	Interest	Total amount paid back to the credit union
1	1000000	100000	15000	115000
2	900000	100000	13500	113500
3	800000	100000	12000	112000

Find,

       (a) the interest paid in the 10th month,   **(3 marks)**
       (b) the total interest paid for the 10 months   **(3 marks)**
       (c) the total amount of money paid back to the credit union.   **(2 marks)**

4. (i) The set, $S = \{a, b, c, d\}$ and the operation $*$ forms a group
       (a) Copy and complete the table.   **(3 marks)**

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

       From the table,
       (b) state the identity element,   **(1 mark)**
       (c) state the inverse of each element.   **(1 mark)**

  (ii) The linear transformation, T, is defined as $T: (x, y) \rightarrow (2x - y, -x + 2y)$.
       Find,
       (a) the image of the point $(5, -1)$ under the transformation T.   **(2 marks)**
       (b) the invariant line under the transformation T.   **(2 marks)**

Go on to the next page

5. A woman has 1,500FCFA only to buy x cups of beans and y cups of rice to prepare food for her house hold.

   (a) Given that a cup of beans costs 100FCFA and a cup of rice costs 50FCFA, show that $2x + y \leq 30$.

                            (2 marks)

   (b) Given that:

        -the quantity of beans is at least half the quantity of rice

        - the quantity of beans is at most twice the quantity of rice,

     write down two inequalities in terms of x and y that satisfy the conditions in (b).   **(2 marks)**

   (c) On a graph paper, taking 2 cm to represent 5 units on both axes shade, so as to leave unshaded, the region represented by these 3 inequalities.   **(2 marks)**

   (d) Given also that every member of the household has to consume $\frac{2}{3}$ of a cup of beans and a cup of rice, find the maximum number of people this woman can feed after preparing the meal.   **(2 marks)**

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6. (i) Solve, for θ, in the range $0° \leq \theta \leq 180°$, the equation $1 - 2\sin^2\theta = \cos\theta$.   **(3 marks)**

   (ii) The function $f(x) = \sqrt{3}\cos x - \sin x$, where, $0 \leq x \leq 2\pi$.

     (a) Copy and complete the table   **(3 marks)**

x	0	$\frac{\pi}{6}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	$\frac{2\pi}{3}$	$\frac{5\pi}{6}$	π	$\frac{7\pi}{6}$	$\frac{4\pi}{3}$	$\frac{3\pi}{2}$	$\frac{5\pi}{3}$	$\frac{11\pi}{6}$	2π
$f(x)$	1.7	1		-1	-1.7		-1.7		0	1		2	1.7

    Taking 1cm to represent $\frac{\pi}{6}$ radian units on the x-axis and 2cm to represent 1 unit on the y-axis,

   (b) draw the graph of $y = f(x)$.   **(2 marks)**

    From the graph or otherwise,

   (c) write down the maximum value of $f(x)$.   **(1 mark)**

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7. The points P and Q have position vectors $3i - 2j$ and $2i + j$ respectively.

   (a) Write down vector equation of the line l_1 passing through the points P and Q in the form $r = a + tb$, where t is a scalar.   **(2 marks)**

    Another line l_2, has vector equation $l_2 : r = 3i + 3j + s(i + 2j)$, where s is a scalar.

    Find,

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

   (c) the cosine of the angle between the lines l_1 and l_2.   **(2 marks)**

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8. (i) Find the equation of the tangent to the curve $y = 3x^2 - x^3$ at the point $(1, 2)$.   **(4 marks)**

   (ii) Evaluate $\int_0^\pi (2x - \cos 2x)\, dx$ **(4 marks)**

SECTION B: MECHANICS

IF THIS SECTION IS CHOSEN, THEN SECTION C MAY NOT BE CHOSEN

(ANSWER ANY TWO QUESTIONS)

9. (i) A car accelerates at $2ms^{-2}$ uniformly from rest for 3 seconds.

     (a) Find the speed of the car at this instant.   **(2 marks)**

    It maintains this speed for the next 5 seconds and then decelerates uniformly to rest for the next 3 seconds.

     (b) Draw a velocity-time graph to illustrate the motion of the car.   **(2 marks)**

     From the graph or otherwise,

     (c) find the total distance travelled by the car.   **(2 marks)**

   (ii) A particle, P, of mass 3kg is connected by a light inextensible string, which passes over a smooth fixed pulley to a particle Q of mass 4 kg, hanging freely. The string is held taut and the particles are released from rest.

    Find:

     (a) the common acceleration of the particles,   **(3 marks)**

     (b) the tension in the string,   **(2 marks)**

     (c) the force exerted on the pulley.   **(1 mark)**

(iii) A particle, P of mass 3 kg moves on a straight line with speed $4ms^{-1}$ and collides with a stationary particle Q, of mass 2kg. After collision P moves with speed $2ms^{-1}$. Find,

    (a) the speed of Q after collision, **(2 marks)**

    (b) the loss in kinetic energy. **(3 marks)**

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10. (i) The rate of change of the volume of a sphere is $48\pi\ cm^3s^{-1}$ at the instant when the radius is $6\ cm$. Find:

    (a) the rate of change of the radius of the sphere. **(3 marks)**

    (b) the rate of change of the surface area of the sphere. **(2 marks)**

$$\left[\text{\textit{The volume of a sphere}},\ V = \frac{4}{3}\pi r^3\ \text{\textit{and the surface area of a sphere}},\ A = 4\pi r^2\right]$$

(ii) The area bounded by the curve $y^2 = x^2$, the x-axis and the ordinates $x = 0$ and $x = 2$ is rotated completely about the x-axis. Find volume of the solid generated. **(6 marks)**

(iii) The position vector of the centre of gravity of three particles of mass mkg, nkg and $7kg$ which are at the points with position vectors $i - 2j$, $i + 5j$ and $2i - 3j$ respectively is $\frac{3}{2}i$.

Given that m and n are constants, find the values of m and n. **(6 marks)**

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11. (i) A uniform rod AD of length $4m$ is suspended horizontally by two vertical strings attached at A and D, the ends of the rod. The rod weighs $100\ N$ and a weight of $100\ N$ is also attached on the rod $1m$ from A.

Given that the system is at equilibrium,

    (a) draw a diagram showing all the forces acting on the rod. **(3 marks)**
    Hence or otherwise,

    (b) find the tensions in the strings. **(6 marks)**

(ii) A crane lifts a block of mass $10kg$ which is at rest from a horizontal ground vertically upward, to a height of $20m$. Find:

    (a) the time taken to lift the block,

    (b) the work done against gravity by the crane, **(3 marks)**

    (c) the power generated by the crane. **(3 marks)**

    (2 marks)

SECTION C: STATISTICS AND PROBABILITY

(IF THIS SECTION IS CHOSEN, THEN SECTION B MAY NOT BE CHOSEN)
IF THIS SECTION IS CHOOSEN, THEN ANSWER ANY TWO QUESTIONS

12. The marks scored by 60 students in an examination are distributed as follows:

Marks (x)	1- 5	6 -10	11-15	16-20	21-25	26-30	31-35	36 - 40
Number of students (f)	3	5	8	14	12	9	5	4

  (i) (a) Draw a histogram of this distribution. **(5 marks)**
      From the histogram or otherwise,
    (b) find the mode of the distribution. **(3 marks)**

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

Go on to the next page

13. (i) A discrete random variable, X, has probability mass function , p, defined by

$$p(x) = \begin{cases} k(x-1), for \ x = 1,2,3,4 \\ 0, \quad elsewhere \end{cases}$$

where, k, is a constant.

(a) Copy and complete the distribution table. **(2 marks)**

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

Find :

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

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

(ii) In a basket of mangoes, one out of every two mangoes is rotten. Five mangoes are drawn at random from the basket one after the other. Using the binomial distribution or otherwise, find the probability that:

(a) all the mangoes chosen are rotten, **(3 marks)**

(b) less than two mangoes are rotten. **(2 marks)**

(c) Find the mean and variance of the distribution . **(3 marks)**

14. (i) Two events A and B are such that $P(A) = \frac{8}{15}$, $P(B) = \frac{2}{3}$ and $P(A \cap B) = \frac{1}{5}$.

Find:

(a) $P(A \cup B)$, **(3 marks)**

(b) $P(A' \cap B)$, **(2 marks)**

(c) $P(A'/B)$. **(3 marks)**

(ii) In a given class, 40% of the students are boys and 60% are girls. Given that 20% of the boys and 30% of the girls are short sighted. A student X is chosen at random from the class. By drawing a tree diagram or otherwise, find the probability that:

(a) X is short sighted, **(3 marks)**

(b) X is a girl or short sighted, **(3 marks)**

(c) X is a boy given that he is short sighted. **(3 marks)**