REPUBLIQUE DU CAMEROUN
Paix-Travail-Patrie

MINISTERE DES ENSEIGNEMENTS SECONDAIRES

CELLULE D'APPUI A L'ACTION PEDAGOGIQUE
ANTENNE RÉGIONALE DU NORD OUEST

BP 2183 MANKON BAMENDA
TEL 233 362 209
Email : trubamenda@yahoo.co.uk

REPUBLIC OF CAMEROON
Peace-Work-Fatherland

MINISTRY OF SECONDARY EDUCATION

TEACHERS' RESOURCE UNIT
REGIONAL BRANCH FOR THE NORTH WEST

P.O. BOX: 2183 MANKON BAMENDA
TEL 233 362 209
Email : trubamenda@yahoo.co.uk

TEACHERS' RESOURCE UNIT TRU-RIP-STA MOCK EXAMS NORTH WEST REGION

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MARCH 2022

The Teachers' Resource Unit and the Regional Inspectorate of Pedagogy in collaboration with MTA	SUBJECT CODE NUMBER 0765	PAPER NUMBER 2
GENERAL CERTIFICATE OF EDUCATION REGIONAL MOCK EXAMINATION	SUBJECT TITLE MATHEMATICS WITH MECHANICS	
ADVANCED LEVEL		

Time Allowed: THREE hours

INSTRUCTIONS TO CANDIDATES

Mobile phones are **NOT ALLOWED** in the examination room.

Full marks may be obtained for answers to ALL questions.

Mathematical Formulae Booklets published by The GCE Board are allowed.

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

Start each question on a fresh page.

1. The polynomial $p(x) = 2x^3 + px^2 - qx + 6$ where p and q are constants leaves a remainder of -4 when divided by $(x-1)$. Given that $(2x-1)$ is a factor of $p(x)$,
   (a) find the values of the constants p and q.
   (b) factorize $p(x)$ completely.
   (c) solve the equation $p(x) = 0$.

(5, 3, 3) marks

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2. (i) Show that $\log_3 x = \log_{27} x^3$.

   (ii) Find real values of x for which $3^x - 7 = 18(3^{-x})$.

   (iii) Determine the range of values of x for which the expansion of $\sqrt{\frac{(2-x)}{x-1}}$ is valid.

(2, 4, 4)marks

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3. (i) Given that $= \frac{5x^2-10x+5}{(x-1)^2}, x \neq 1$ show that $\frac{dy}{dx} = \frac{k}{(x-1)^3}$ where k is a constant.

   (ii) The function f is defined on the set $\mathbb{R}$, of real numbers by $f(x) = x^3 + 3x^2 + 4x - 12$.
   (a) Show that $f(x) = 0$ has a root between 0 and 2.
   (b) Show also that if $f(x) = 0$, then $x = \sqrt{\frac{4(3-x)}{3+x}}, x \neq -3$.

(4, 5) marks

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4. (i) The functions g and h are defined as shown below
   $g: x \to \frac{1}{x+3}, x \in \mathbb{R}, x \neq -3$
   $h: x \to \frac{x+1}{x-2}, x \in \mathbb{R}, x \neq 2$.
   (a) Find $g \circ h$ stating its domain.
   Show that $h(x)$ is not surjective.
   (ii) let P: John is sick and Q: John will play the game
   write in ordinary English the following logical statements
   (a) $\sim P \wedge Q$ (1mark)
   (b) $\sim P \to Q$ (1 mark)
   (c) Draw a truth table for the statement $\sim P \vee \sim Q$ (2 marks)

(7, 4) marks

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5. (i) Given that $f(\theta) \equiv \sqrt{3}\cos\theta - \sin\theta$,
   (a) Write $f(\theta)$ in the form $R\cos(\theta + \alpha)$, where R, is a positive real number and α an acute angle
   (b) Hence find the general solution of the equation $f(\theta) = \sqrt{3}$

   (ii) Given that $\tan^{-1} 5 = x$ and $\tan^{-1} 7 = y$, show that $y - x = \tan^{-1}\frac{1}{18}$

(6, 3) marks

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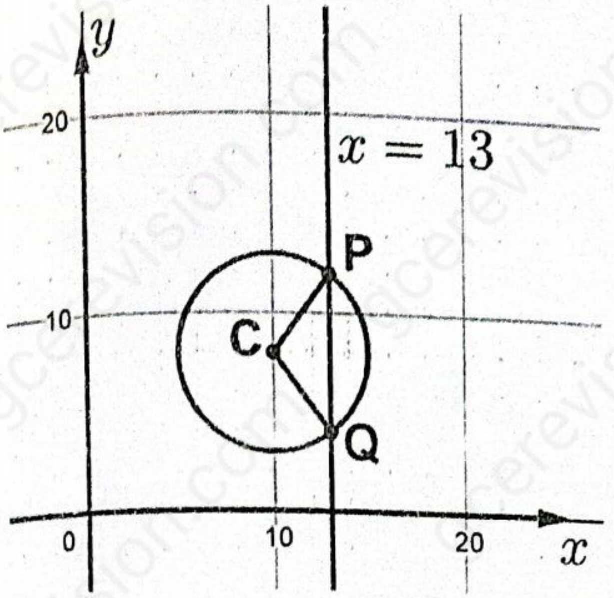
6. (i) (a) Express $f(x) = \frac{2x+1}{x^2-1}$ in partial fractions.

   (b) Hence show that $\int_2^3 f(x)dx = \frac{1}{2}\ln\left(\frac{32}{3}\right)$

   (ii) find the equation of a curve which passes through the point $(2, -2)$ and satisfies the differential equation $(-1+x)\frac{dy}{dx} = -y + 1$. Hence sketch this curve

(6, 6)marks

7. The diagram shows a circle with equation $x^2 + y^2 - 20x - 16y + 139 = 0$, center C and radius r.



(a) Find the coordinates of C.
(b) Show that $r = 5$ units

The line with equation $x = 13$ crosses the circle at two different points P and Q as shown on the diagram.
(c) Find the y coordinate of P and the y coordinate of Q

A tangent to the circle from the Origin, touches the circle at a point X.
(d) Find the length of OX, expressing your answer in surd form

(2, 2, 3, 3) marks

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8. (i) The complex number z is such that $\frac{3z+1}{z-1} = 1 - 2i\sqrt{3}$.
Express (a) z in the form $x + iy$ where x and y are real numbers.
(b) z^2 in the form $r(\cos\theta + i\sin\theta)$.
(ii) Find the Cartesian equation of the locus represented by the equation $2|z + i| = |z - 3i|$.

(7, 3) marks

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9. (i) Two lines r_1 and r_2 are given by the equations:
$\mathbf{r_1} = i - 2j + k + \mu(-j + 2k)$
$\mathbf{r_2} = -i - 3j - 3k + \beta(i + j + k)$
(a) Show that $\mathbf{r_1}$ and $\mathbf{r_2}$ intersect and find the position vector of their common point.
(b) Find the cosine of the acute angle between $\mathbf{r_1}$ and $\mathbf{r_2}$.

(ii) Prove by mathematical induction that for any positive integer n, $3^{2n} - 1$ is even.

(5, 2, 5) marks

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10. Let $P = \begin{pmatrix} 1 & -1 & 1 \\ 2 & -1 & -4 \\ 3 & -2 & -2 \end{pmatrix}$
(a) Show that P has an inverse.
(b) Find the inverse of P.
(c) Hence find the point of intersection of the lines
$x - y + z = 4$
$2x - y - 4z = 3$
$3x - 2y - 2z = 2$.
(d) Find the point R whose image under the transformation represented by P is $(-1, 0, 2)$.

(2,3,3,2)marks