THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
DIPLOMA IN EDUCATION EXAMINATION

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741 **MATHEMATICS**

Time: 3 Hours ***Monday, May 09, 2005 p.m.***

Instructions

1. This paper consists of sections A and B.
2. Answer ***all*** questions in section A and ***three (3)*** questions from section B.
3. Section A carries 49 marks and section B carries 51 marks.
4. Show your workings and answers clearly in both sections.
5. Graph papers, mathematical and statistical tables may be used.
6. Cellular phones are ***not*** allowed in the examination room.
7. Write your ***Examination Number*** on every page of your answer booklet(s).

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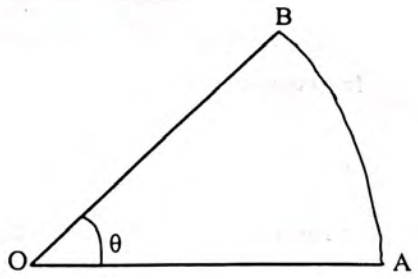
SECTION A (49 marks)

Answer **all** questions in this section.

1. Find the differential coefficient of $y = \sec^{-1}\left(\frac{x+1}{x-1}\right) + \sin^{-1}\left(\frac{x-1}{x+1}\right)$

2. Solve for x if $\sqrt{(2x-1)} - \sqrt{(x-1)} = 1$

3. The angle of a sector AOB shown in the diagram below is θ radius and the radius of the circle is r cm. The area of the sector is 10 cm^2 and its total perimeter is 13 cm. Find r and θ.



4. Simplify as far as possible.

$$\frac{\left(a^{2r-3}\, b^{-1-s}\, a^{s-r}\right)^{t} \cdot \left(ab^{-1}\right)t}{\left(a^{-rt+2t}\, b^{2t}\right)^{-1}}$$

5. (a) $\int \cos^2 x \sin^3 x \, dx.$

   (b) Express e^{i} in the form x + iy.

6. Solve the following linear systems by using determinants:

$$-2x_1 + 3x_2 - x_3 = 1$$
$$x_1 + 2x_2 - x_3 = 4$$
$$-2x_1 - x_2 + x_3 = -3$$

7. Show that $\tan^{-1}(\frac{1}{2}) + \tan^{-1}(\frac{1}{3}) = \frac{\pi}{4}$.

8. If $a + ib = \frac{1}{x+iy}$; show that $\left(a^2 + b^2\right)\left(x^2 + y^2\right) = 1$.

9. A box contains 20 fuses, of which 5 are defective. If 3 of the fuses are selected at random and removed from the box in succession without replacement, what is the probability that all three fuses are defective?

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10. Find the volume V of a triangular pyramid ABCD with vertices A(2, -1, 1); B(5, 5, 4); C(3, 2, -1); and D(4, 1, 3).

11. Determine the three geometric progression such that their sum is 52; given the condition that the sum of their product taken in pairs is 624.

12. If one root of the equation $8x^2 + qx + 27 = 0$ is the square of the other, find the value of q and hence rewrite the equation.

13. If $\log_{10} 2 = 0.3010300$ and $\log_{10} 3 = 0.4771213$, without using tables, find the values of

(a) $\log_{10} 50$ to 7 decimal places.

(b) $\log_{10} 13.5$ to 7 decimal places.

14. (a) If $p + q = 5$ and $p^2 + q^2 = 19$, find the value of pq and write the equation in x whose roots are p and q.

(b) A geometric series with common ratio 0.8 converges to the sum 250. Find the fourth term of the series.

15. (a) If $y = (\sin^{-1} x)^2$, show that $(1 - x^2)(dy/dx)^2 = 4y$.

(b) Find the equations of the tangent and normal to the curve $y = (1 - x)(2 + x)$ at the point where $x = 2$.

SECTION B (51 marks)

Answer **three (3)** questions from this section.

16. (a) If $Z + \frac{1}{Z} = -1$, prove that $Z^5 + \frac{1}{Z^5} = -1$ and find the value of $Z^{11} + \frac{1}{Z^{11}}$.

(a) Prove that $\cos^6 \theta = \frac{1}{32}(\cos 6\theta + 6\cos 4\theta + 15\cos \theta + 10)$.

17. (a) To estimate the time mean (μ) weight of all the automobiles that use a certain large packing garage; a statistician takes a random sample of size 100, obtaining a sample mean $\bar{x} = 2030$ kilograms and a sample standard deviation 216 kilograms. What is the 95 % confidence interval estimate for μ ?

(b) Two students were informed that they received standard deviation scores of 0.8 and – 0.4 respectively on a multiple choice examination in English language. If their marks were 88 and 64 respectively, find the mean and standard deviation of the examination.

18. (a) Find a general solution to the second order differential equation given by $XY'' = 2$.

(b) Solve for initial value problem:

$$(x^2 + 1)y' + (y^2 + 1) = 0 \quad \text{given} \quad y(0) = 1.$$

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(c) If $Z = \sin^{-1}\left(\frac{x - y}{x + y}\right)$, prove that $x\frac{\delta z}{\delta x} + y\frac{\delta z}{\delta y} = 0$.

19. (a) Evaluate the following :

$$I = \int_1^2 \int_0^3 \int_0^1 \left(p^2 + q^2 - r^2\right) dp.dq.dr.$$

(b) Using Wallis' formula, evaluate this equation: $I_6 = \int_0^{\frac{\pi}{2}} \sin^6 x \, dx$.

20. Find the local extrema for: $f(x, y) = x^3 + y^3 - 6xy$.

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