



MACHAKOS UNIVERSITY

University Examinations 2019/2020

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS, STATISTICS AND ACTUARIAL SCIENCE

FIRST YEAR SECOND SEMESTER EXAMINATION FOR

DIPLOMA IN BUILDING AND CIVIL ENGINEERING (TVET)

2705/102: MATHEMATICS

DATE: 24/3/2020

TIME: 11.30-2.30 PM

INSTRUCTIONS:

The paper consists of SEVEN questions. Answer any FIVE questions.

ALL questions carry equal marks.

Show all your working

1. a) Simplify the expressions
- i) $\frac{3x^2y^3+2xy^2}{6xy}$ (3 marks)
- ii) $\frac{\log 625 - \log 25 + \frac{1}{2}\log 5}{\log 125 + \log 625 + -\frac{1}{2}\log 25}$ (3 marks)
- b) Solve the following equations
- i. $\log 2x^3 - \log x = \log 16 + \log x$ (5 marks)
- ii. $\frac{3}{x-2} = \frac{5}{3x+4}$ (3 marks)
- iii. $\log(x-2) + \log(x+1) = 2\log(x+2)$ (3 marks)
- iv. $3^{2x-1} = 5^{x+2}$ (3 marks)
2. a) Determine graphically the values of x and y which simultaneously satisfy the equations $y = 2x^2 - 3x - 4$
 $y = 2 - 4x$ (6 marks)
- b) Solve the equations
- i. $3\cos^2 \theta + 10\sin \theta = 11$ for $0 \leq \theta \leq 360^\circ$ (6 marks)

- ii. $2\sec^2 \theta = 3(3 - \tan \theta)$ for $0 \leq \theta \leq 360^\circ$ (8 marks)
3. a) Solve the simultaneous equations
 $8x - 3y = -39$
 $7x + 6y = 9$ (6 marks)
- b) Given that $\sin A = \frac{12}{13}$ and $\cos B = \frac{4}{5}$ where A is obtuse and B is acute, determine the values of ;
- i) $\sin(A - B)$
ii) $\tan(A + B)$ (6 marks)
- c) Prove the identities:
- i) $\frac{1 - \cos \theta}{\sin \theta} + \frac{\sin \theta}{1 - \cos \theta} = 2 \operatorname{cosec} \theta$
ii) $\tan 3x = \frac{3 \tan x - \tan^3 x}{1 - 3 \tan^2 x}$ (8 marks)
4. a) Find the
- i) Cartesian coordinates of the point whose polar coordinates are $(5, 5.26 \text{ rad})$
ii) Polar coordinates of the point whose Cartesian coordinates are $(-5, -9)$ (10 marks)
- b) The sum of the 4th and 6th term of the geometric series is 80. If the product of the 3rd and the 5th term is 256, determine
- i. first term
ii. common ratio
iii. sum of the first eight terms (10 marks)
5. a) Express in polar co-ordinates the position :
- i. $P_1(3, 4)$
ii. $P_2(-5, -8)$ (6 marks)
- b) obtain the Cartesian equations of;
- i. $r = 5(1 + 2 \cos \theta)$
ii. $r = a \tan \theta$ (7 marks)
- c) Find the cartesian equations of the loci;
- i. $x = t^2 + 4$ and $y = t - 3$
ii. $x = 5 \cos \theta$ and $y = 4 \sin \theta$ (7 marks)
6. a) The second term of an arithmetical progression is 15 and the fifth term is 21. Determine the :

- i. Common difference
 - ii. First term
 - iii. The sum of the first ten terms (7 marks)
 - b) Find the difference between the sums of the first ten terms of the arithmetical progression whose first terms are 12 and 8, and whose common differences are 2 and 3 respectively. (5 marks)
 - c) Given the first, third and sixth terms of an arithmetical progression are in geometrical progression, find the common ratio of the geometric progression. (8 marks)
- 7.
- a)
 - i) Find the sum of the integers between 1 and 100
 - ii) Determine the sum of the first six terms of the geometrical progression
 $5 + 15 + 45 + \dots$ (12 marks)
 - b) A sum of Ksh 4000 is deposited in a bank account at a simple interest rate of 3% per annum. Determine, using AP's and GP's, the:
 - i. Amount after ten years;
 - ii. Number of years required for the amount in (i) to be realized at compound Interest rate of 2% per annum (8 marks)