



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST YEAR THIRD SEMESTER EXAMINATION FOR

DIPLOMA IN BUILDING AND CIVIL ENGINEERING.

MATHEMATICS

DATE: 15/12/2020

TIME: 11.30-2.30 PM

INSTRUCTIONS

The paper consists of FIVE questions. Answer ALL.

ALL questions carry equal marks.

Show all your working

1. (a) Simplify (i) $\frac{\log 729 - 4\log 3 + 2\log 27}{\log 243 - \log 27 + \log 9}$ without using logarithm tables
(ii) $\frac{6x^2y^3 + 2xy^2}{6xy}$ (6 marks)
- (b) Solve the equations
 - i. $8x - 3y = -39$
 $7x + 6y = 9$
 - ii. $\frac{3}{x-2} = \frac{5}{3x+4}$
 - iii. $\log 2x^2 - \log x = \log 16 + \log x$ (10 marks)
- (c) Make b the subject of the formulae: $a = \frac{x-y}{\sqrt{(bd+cb)}}$ (4 marks)
2. (a) Given that $\mathbf{A} = P\mathbf{i} + b\mathbf{j} - 3\mathbf{k}$ and $\mathbf{B} = 4\mathbf{i} + 3\mathbf{j} - \mathbf{k}$ where P is a constant. Determine the value of P such that vectors $\mathbf{A}$ and $\mathbf{B}$ are perpendicular to each other. (4 marks)
- (b) Evaluate the middle term in the binomial expansion of $(2x + 3y)^8$ and its value when $x = \frac{1}{3}$ and $y = \frac{1}{2}$. (6 marks)
- (c) The sum of the 4th and 6th terms of a geometric series is 80. If the product of the 3rd and 5th term is 256, determine;

- i. first term
- ii. common ratio
- iii. sum of the first eight terms (10 marks)

3. (a) Prove the identity: $\frac{\sin\theta}{1+\cos\theta} + \frac{1+\cos\theta}{\sin\theta} = \frac{2}{\sin\theta}$ (4 marks)

(b) The probability of a concrete mixer is $\frac{1}{4}$, dumper $\frac{1}{7}$ and hoist $\frac{1}{8}$ respectively.

Determine the probability that:

- i. all machines breakdown;
- ii. two machines breakdown. (4 marks)

(c) **Table 1** shows the lengths in centimeters of 50 bars in a construction site.

Length (cm)	Frequency
34-36	2
37-39	6
40-42	12
43-45	14
46-48	10
49-51	5
52-54	1

Calculate

- i. Mean
- ii. Median (6 marks)

(d) Solve the equation $3\cos^2\theta + 10\sin\theta = 11$ (6 marks)

4. (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. $x = t^2 + 4$ and $y = t - 3$
- ii. $r = 5(1 + 2\cos\theta)$ (7 marks)

(c) A ship sails from A (40°N , 50°E) to B (40°N , 70°W). Taking $\pi = 3.14$ and the radius of the earth to be 6400 Km, calculate the distance from A to B giving the answer correct to five significant figures. (7 marks)

5. (a) Convert

- i. 1101101 to denary
- ii. 204 to binary (4 marks)

- (b) A minor segment is enclosed between a chord of length 14cm and a circle of diameter 20cm. determine the area of the segment. (5 marks)
- (c) Two ordinary unbiased dice are thrown. Determine the probability that the:
- i. sum of the two dice is 3;
 - ii. sum of the two dice exceeds 9;
 - iii. Two dice show the same number;
 - iv. Number on the two dice differ by more than 2. (11 marks)