



MACHAKOS UNIVERSITY

University Examinations for 2020/2021

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST YEAR FIRST SEMESTER EXAMINATION FOR

DIPLOMA IN BUILDING AND CIVIL ENGINEERING

DIPLOMA IN ELECTRICAL ENGINEERING

DIPLOMA IN MECHANICAL ENGINEERING

DIPLOMA IN AUTOMOTIVE ENGINEERING

2601/106/M: ENGINEERING MATHEMATICS 1

DATE: 31/8/2021

TIME: 11:30 – 2:30 PM

INSTRUCTIONS:

Answer **ALL** questions

Each question carries **20** marks

1. a) Simplify

$$\frac{(16a^2)^{\frac{1}{2}} \times (36a^4)^{\frac{1}{2}}}{2a^{\frac{1}{2}} \times 5a^{\frac{3}{2}} \times 8a^{\frac{9}{4}}} \quad (4 \text{ marks})$$

b) Solve

$$\frac{2}{3x-1} + \frac{1}{x+2} = 5 \quad (5 \text{ marks})$$

c) Solve for θ between $0 \leq \theta \leq 360^\circ$

$$\sin(2\theta + 30^\circ) = 0.8 \quad (3 \text{ marks})$$

d) A triangle has the longest side equivalent to $2x$ and the other sides are $2x - 4$ and

$x + 3$ respectively calculate the dimensions of the triangle. (8 marks)

2. a) Solve for x
- $$(4)^{4x}(2)^{-5x} = 64 \quad (3 \text{ marks})$$
- b) In a triangle ABC line $AB = 8.9\text{cm}$ $bc = 11.5\text{cm}$ and angle $\angle ABC = 117.4^\circ$
- Solve the triangle. Calculate the area of the triangle and the radius of the circumcircle. (5 marks)
- c) i) Solve the equation $8\sin^2\theta = 7 - 2\cos\theta$ (4 marks)
- ii) From a point P, 80m from the foot of a vertical tower, the angle of elevation of its top is 60° . Calculate the height of the tower. What is the angle of depression from the top of the tower. (5 marks)
- d) Show that
- $$\frac{\sin\theta}{1+\cos\theta} + \frac{1+\cos\theta}{\sin\theta} = \frac{2}{\sin\theta} \quad (3 \text{ marks})$$
3. a) By expansion determine possible values of R and α in order that
- $$5\sin x + 12\cos x$$
- may be expressed as $R\cos(x + \alpha)$ (6 marks)
- b) Obtain the values of x for the equation $4x^2 - 6x + 1 = 0$ using completing of squares method. (6 marks)
- c) Reduce $10\sin(x + 35^\circ) + 20\cos(x - 47^\circ)$ to the form $p\sin x + q\cos x$ stating the values of p and q to 2 decimal places (3 marks)
- d) Simplify
- $$\frac{3\log\sqrt{2} + \log 24 - \log 3}{\frac{13}{2}\log 64 - \log 128^{-1}} \quad (5 \text{ marks})$$
4. a) Draw the graph of $y = x^2 + x - 6$ for $-4 \leq x \leq 4$. Hence solve the equations
- i. $x^2 + x - 6 = 0$
- ii. $x^2 + x - 4 = 0$
- iii. $x^2 + 2x - 4 = 0$ (10 marks)
- b) The equation of a certain system satisfies the equation $F = ax + b$ where a and b are constants. If $x = 24$ when $F = 84$ and $x = 15$ when $F = -105$. Calculate the values of a and b . (4 marks)
- c) Use elimination method to solve the simultaneous equations
- $$\begin{aligned} 2x + 5y + 7z &= 3 \\ 5x + y + 3 &= 2 \\ 3x - 2y - 10z &= 17 \end{aligned} \quad (6 \text{ marks})$$

5. a) Given that $\sin A = \frac{4}{5}$ $\cos B = \frac{5}{13}$ and that both A and B are acute angles, determine without using tables or calculators
- i) $\sin(A + B)$
- ii) $\cos(A + B)$ (6 marks)
- b) Obtain the values of $\tan A$ given that $\tan(A - 45^\circ) = \frac{1}{3}$ (4 marks)
- c) Show that
- $$\frac{\sin \theta}{1 + \cos \theta} + \frac{1 - \cos \theta}{\sin \theta} = \frac{2}{\sin \theta}$$
- (4 marks)
- d) Solve the equation $3 \cos \theta = 4 \tan \theta$ (6 marks)