2501/203 2508/203
2502/203 2509/203
2503/203
ENGINEERING MATHEMATICS II
June/July 2019
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN MECHANICAL ENGINEERING
(PRODUCTION OPTION)
(PLANT OPTION)
DIPLOMA IN AUTOMOTIVE ENGINEERING
DIPLOMA IN WELDING AND FABRICATION
DIPLOMA IN CONSTRUCTION PLANT ENGINEERING

MODULE II

ENGINEERING MATHEMATICS II

Abeja

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Mathematical tables/Non-programmable scientific calculator.
*This paper consists of **EIGHT** questions.*
*Answer any **FIVE** questions.*
All questions carry equal marks.
Maximum marks for each part of a question are as indicated.
Candidates should answer the questions in English.

This paper consists of 5 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

Turn over

(b) (i) Figure 1 shows a system of forces acting at a point on a body.

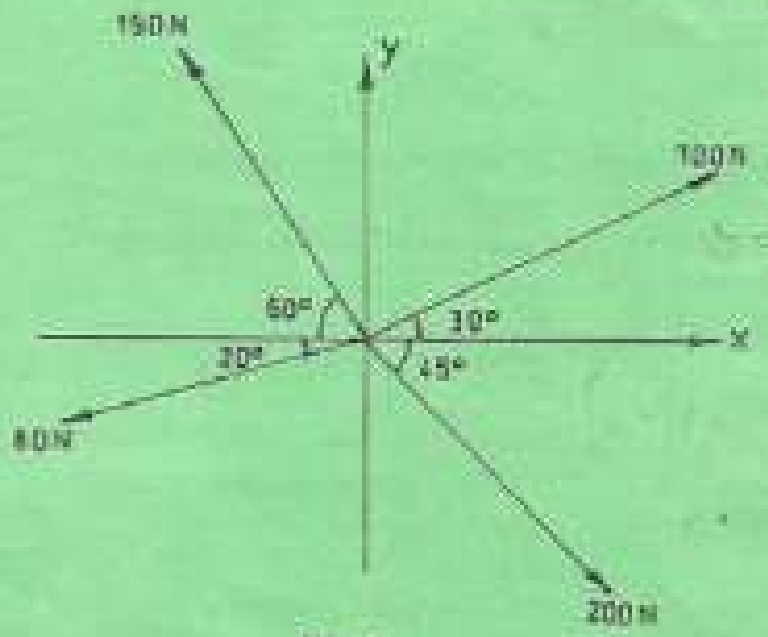

Fig. 1

Use the method of resolution of vectors to determine the:

(i) magnitude of the resultant force;
(ii) direction of the resultant force.

(12 marks)

4. (a) A regular pyramid stands on a rectangular base of sides 7 cm by 24 cm. The height of the vertex above the base is 20 cm. Calculate the

(i) surface area of the solid;
(ii) volume of the pyramid.

(10 marks)

(b) Use Simpson's rule with 6 intervals to evaluate $\int_{0.2}^{1.4} \frac{x\,dx}{\sqrt{1+x^3}}$. (10 marks)

5. (a) Determine $\int \frac{(x^2-3)\,dx}{(x+1)(x^2+1)}$. (9 marks)

(b) Determine the volume generated when the area enclosed between the curve $y = x^2$ and the line $y = 6 - x$ is rotated about the x-axis through 360°.

(11 marks)

1. (a) A continuous random variable has a probability density function defined by

$$f(t) = \begin{cases} \frac{k^2}{7}e^{-kt} & t > 0 \\ 0 & \text{elsewhere} \end{cases}$$ where k is a positive constant.

Determine the:

(i) value of k;
(ii) mean;
(iii) variance;
(iv) median

(14 marks)

(b) In a binomial experiment of 11 trials. The variance was found to be 1.76. If the probability of success in the experiment does not exceed 30%, determine the probability of obtaining at most two successes. (6 marks)

2. (a) Given that $(t-2)$, $(2t-6)$ and $(4t-8)$ form the first three terms of an arithmetic progression, determine the:

(i) value of t;
(ii) sum of the first twenty terms.

(7 marks)

(b) A carpenter stacks $(8k + 15)$ logs of timber in such a way that there are k layers with 10 logs in the top layer. Each layer below contains one log more that the one immediately above. Calculate the number of logs. (8 marks)

(c) One third of the air in a tank is removed with each stroke of a pump. If the volume of the air remaining in the tank follows a geometric progression, determine the

(i) fraction of original volume that remains after four strokes.

(ii) sum of the first 10 terms of the progression.

(5 marks)

3. (a) Points P(10, 5) and Q(30, 5) are in a Cartesian plane. Point T divides PQ in ratio 2:3. Determine the:

(i) position vector of T;
(ii) coordinates of T.

(8 marks)

6. (a) Given the function $f(x, y) = \sin(x^2 + y^2)$, and that $x = 3t, y = \frac{1}{1+t^2}$ determine the value of $\frac{df}{dt}$ at $t = 1$.

(10 marks)

(b) The transmission of power by belts on pulleys is given by $P = \frac{2\pi RNT}{60}$.

Determine the percentage change in P when T is increased by 3%, R increased by 1% and N reduced by 2%.

(10 marks)

7. (a) Given that $y = x \ln x$, determine $\frac{dy}{dx}$ (4 marks)

(b) Given the function $y = x^2 e^{3x}$, determine the:

(i) equation of the tangent at the point where $x = 2$;

(ii) stationary points and their nature.

(16 marks)

8. (a) (i) Use Maclaurin's theorem to determine the series expansion of $\ln(1 + x)$ as far as the term in x^3.

(ii) Use the result in (i) to evaluate $\int_0^1 \ln(1 + x)\,dx$. (11 marks)

(b) Determine Taylor's series for the function $f(a + h) = \sin(a + h)$ as far as the term h^2. Hence evaluate $\sin 46°$, giving the answer correct to five decimal places.

(9 marks)