



MACHAKOS UNIVERSITY

University Examinations 2019/2020 Academic year

SCHOOL OF HEALTH SCIENCES

DEPARTMENT OF PUBLIC AND COMMUNITY HEALTH

SECOND YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (PUBLIC HEALTH)

HPH - 215: APPLIED TECHNICAL MATHEMATICS

DATE: 30/11/2020

TIME: 8:30 – 10:30 AM

INSTRUCTIONS

This paper consists of two sections A and B

SECTION A

Specific Instructions

- This section has one question
- The question is **COMPULSORY**
- The question is **30 marks**

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Simplify the complex expressions: (2 marks)

$$\frac{2+i}{2-i} - \frac{2-i}{2+i}$$

- b) Find out which term of the binomial expansion of the algebraic expression $\left(x^2 - \frac{1}{x^2}\right)^8$ equals to the number 70. (3 marks)

- c) Solve the exponential equation: (3 marks)

$$\left[\frac{1}{125}\right]^{-3x-1} = 25^{-x-1}$$

- d) Solve the quadratic equations : (4 marks)
- i) $2x^2 - 11x + 14 = 0$
 ii) $x^2 - 16x + 48 = 0$
- e) Solve the following radical expression: (3 marks)
- $$\sqrt{x-2} = \sqrt{2-\sqrt{x}}$$
- f) Solve the following logarithmic equation: (3 marks)
- $$\log_{16}x - \log_4x - \log_2x = 7$$
- g) Evaluate the given limit: (3 marks)
- $$\lim_{x \rightarrow 0} \frac{\cos 4x - 1}{x}$$
- h) Find the union $M \cup N$ of the sets M, N if $M = \{0, 2, 4, 6, 8\}$ and $N = \{2, 4, 5, 7, 8, 9\}$ (2 marks)
- i) Evaluate the indefinite integral for each of the following: (4 marks)
- i) $\int 12t^7 - t^2 - t \, dt$
 ii) $\int 10w^4 + 9w^3 + 7w \, dw$
- j) Negate the statement “You wear matching socks to the interview or you don’t get hired” (3 marks)

SECTION B:

Specific Instructions

- This Section has four (4) questions
- Answer any two (2) questions
- Each question is 20 marks

QUESTION TWO (20 MARKS)

- a) Find the intersections $A \cap B, A \cap C, B \cap C$, unions $A \cup B, A \cup C, B \cup C$ and differences $A - B, A - C, B - A, B - C, C - A, C - B$ of sets A, B, C if: (12 marks)

$$A = \{0, 2, 3, 5, 6, 7\}$$

$$B = \{1, 3, 4, 7, 8\}$$

$$C = \{-3, -1, 0, 2, 4, 5\}$$

- b) Use a Venn diagram to illustrate the relationship between the elements in the logic statement
 “ All ruffians are pirates and some ruffians are scoundrels” (8 marks)

QUESTION THREE (20 MARKS)

- a) Solve the following: (8 marks)
- We have 45 m^2 of material to build a box with a square base and no top. Determine the dimensions of the box that will maximize the enclosed volume.
 - We want to build a box whose base length is 6 times the base width and the box will enclose 50 cm^3 . The cost of the material of the sides is Kshs $300/\text{cm}^2$ and the cost of the top and bottom is Kshs. $1500/\text{cm}^2$. Determine the dimensions of the box that will minimize the cost.
- b) Find the given n^{th} term of the binomial expansion of following binomial expressions: (12 marks)

- 5^{th} term in $(a - b)^6$
- 3^{rd} term in $\left(\frac{1}{2} + \sqrt{2}\right)^5$
- 5^{th} term in $\left(x - \frac{1}{2}\sqrt{2}\right)^7$
- 9^{th} term in $\left(x^2 - \frac{1}{x}\right)^{12}$

QUESTION FOUR (20 MARKS)

- a) Consider the sets $A=\{0,1,2,3,4,5,6,7,8,9\}$, $B=\{1,4,6,7,10,14\}$, $C=\{3,5,6,7,9\}$, $D= \{0,2,4,6,8\}$. Find the sets : (10 marks)

- | | |
|--------------------------|------------------------|
| i) $A \cap C$ | vi) $A - C$ |
| ii) $B \cup D$ | vii) $C - B$ |
| iii) $(B \cap C) \cap D$ | viii) $(B \cup C) - D$ |
| iv) $A \cap (C \cup D)$ | ix) $D - (B \cap C)$ |
| v) $A - D$ | x) $(A - D) \cup C$ |

- b) The position of an object at any time t is given by $s(t)=3t^4-40t^3+126t^2-9$ (10 marks)
- Determine the velocity of the object at any time t .
 - Does the object ever stop changing?
 - When is the object moving to the right and when is the object moving to the left?

QUESTION FIVE (20 MARKS)

a) Use a truth table to determine whether:

i) $\sim(p \vee q)$ is equivalent to $\sim p \wedge \sim q$ (6 marks)

ii) $(p \vee \sim q) \vee (\sim p \wedge q)$ is a tautology (4 marks)

b) Evaluate each of the following integrals, if possible. If it is not possible clearly explain why it is not possible to evaluate the integral. (10 marks)

i) $\int_0^1 3(4x + x^4)(10x^2 + x^5 - 2)^6 dx$

ii) $\int_{\pi}^0 \sin(z) \cos^3(z) dz$

iii) $\int_1^5 \frac{2x^3 + x}{x^4 + x^2 + 1} - \frac{x}{x^2 - 4} dx$

iv) $\int_{-2}^1 (2 - z)^3 + \sin(\pi z) [3 + 2 \cos(\pi z)]^3 dz$