



**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**SCHOOL OF MATHEMATICS AND ACTUARIAL SCIENCE**

**UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF EDUCATION  
AND ACTUARIAL SCIENCE**

**SPECIAL RESIT 2020/2021 ACADEMIC YEAR**

**MAIN CAMPUS**

---

**COURSE CODE: SMA 3111**

**COURSE TITLE: MATHEMATICS I**

**EXAM VENUE: STREAM: HEALTHSCI, AGRI, ENGINEERING**

**DATE: EXAM SESSION:**

**TIME: 2.00 HOURS**

---

**Instructions:**

- 1. Answer question one (compulsory) and any other two questions.**
- 2. Candidates are advised not to write on the question paper.**
- 3. Candidates must hand in their answer booklets to the invigilator while in the examination room.**

**QUESTION ONE (30 marks)**

- a) Define the following terms as used in set theory and give example in each case.
- i) Cardinality of a set (2marks)
  - ii) Universal set (2marks)
- b) Solve the equation  $x^2 - 6x + 2 = 0$  by completing the square (4marks)
- c) i) How many committees of 5 people can be formed from a pool of 12 people (2marks)
- ii) Use Binomial theory to determine the expansion of  $(2a - 3b)^5$  (5marks)
- d) Prove the identity
- $$\frac{\cos \theta}{1 - \sin \theta} - \frac{1}{\cos \theta} = \tan \theta \quad (5\text{marks})$$
- e) Solve the equation  $\log(x^2 - 3) - \log x = \log 2$  (3marks)
- f) A geometric sequence has the first term as 3 and common ratio as 2, the sequence has eight terms. Find:
- i) The last term (2marks)
  - ii) The sum of the terms in the sequence (2marks)
- g) Solve  $\sin \theta = \frac{1}{2}$  for  $0 < \theta < 2\pi$  (3marks)

**QUESTION TWO (20 marks)**

- a) The following table shows the distribution of marks in percentages scored by a class of forty students in a promotion examination.

Marks	20-29	30-39	40-49	50-59	60-69	70-79	80-89
Runners	6	5	7	10	5	4	3

Use the data to compute

- i) mean (3marks)
  - ii) median (4marks)
  - iii) standard deviation from the above data (3marks)
- b) Given  $A = \{u, v, w, x\}$  and  $B = \{a, b, c\}$ . Let  $R$  be the following relation from  $A$  to  $B$ .  
 $R = \{(u, b), (u, c), (w, b), (x, a), (x, c)\}$
- i) Determine the arrow diagram of  $R$  (2marks)
  - ii) Find the inverse relation  $R^{-1}$  of  $R$  (2marks)
  - iii) Determine the domain and the range of  $R^{-1}$  (2marks)
- c) Given that  $A = \{a, b\}$  and  $B = \{x, y, z\}$  Show that the  $A \times B \neq B \times A$  (4 marks)

**QUESTION THREE (20 marks)**

- a) i) Three numbers are in arithmetic progression. Their sum is 15 and their product is 80. Determine the 3 numbers (6marks)
- ii) An oil company bores a hole 80 metres deep. Estimate the cost of boring if the cost is \$ 30 for the first metre with an increase in cost of \$ 2 per metre for each succeeding metre. (4marks)
- b) During the first semester in the Department of Mathematics, JOOUST University, 18 students took SMA 101, 25 took SMA102, 23 took SMA 103 and 9 took SMA 101 and SMA 102, 10 took SMA102 and SMA 103 and 6 took SMA 101 and SMA 103. If there were 50 students and 5 students did not take any of the three courses, with the aid of the Venn diagram find how many students took
- i) All 3 courses  
ii) Only SMA102  
iii) SMA 103 but not SMA 102  
iv) SMA 101 and SMA 103 but not SMA 102.
- (10marks)

**QUESTION FOUR (20 marks)**

- a) Find the power set of  $A = \{a, \{1,2\}\}$  (2marks)
- If  $\mathcal{U}$  is the universal set of all positive integers and  $P, Q, R$  are subsets such that  
 $P = \{x: x \text{ is a prime number}\}$   
 $Q = \{x: x \text{ is an even number}\}$   
 $R = \{x: 7 < x \leq 20\}$   
List the elements of:
- i)  $P \cap R$  (1mark)  
ii)  $Q^c \cap R$  (2marks)  
iii)  $P^c \cap (Q^c \cap R)$  (2marks)
- b) Draw the Venn diagram and shade the region corresponding to  $(A^c \cap B) \cap C^c$  (3marks)
- c) Solve the equation  $2\sin^2\theta = \cos\theta + 1$  for  $\theta$  in the range  $0^\circ \leq \theta \leq 360^\circ$  (5marks)
- d) Use the remainder theorem to evaluate  $f(x) = 6x^3 - 5x^2 - 4x - 17$  at  $x = 3$  (5marks)

**QUESTION FIVE (20 marks)**

- a) Show that the area  $A$  of an isosceles triangle whose equal sides are of length  $s$  and  $\theta$  is the angle between them is  $A = \frac{1}{2} s^2 \sin \theta$  (5 marks)
- b) Let  $f$  and  $g$  be the functions from the set of integers to the set of integers defined by  $f(x) = 2x^2 - 3$  and  $g(x) = 4x$ . Find
- i)  $(f \circ g)(x)$  (3marks)
- ii)  $(g \circ f)(x)$  (3marks)
- c) Find the inverse of  $f(x) = 2x - 3$  (3marks)
- a) Prove the following distributive law of set operations:
- $$F \cap (G \cup H) = (F \cap G) \cup (F \cap H) \quad (6 \text{ marks})$$