**JOMO KENYATTA UNIVERSITY**

**OF**

**AGRICULTURE AND TECHNOLOGY**

**UNIVERSITY EXAMINATION 2017/2018 ACADEMIC YEAR**

*FIRST YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR*

*OF SCIENCE IN ACTUARIAL SCIENCE*

**STA 2101 ALGEBRA FOR STATISTICS AND FINANCE**

**DATE: JANUARY, 2018 TIME** 2 HOURS

**Instructions**

1. Answers question **one** and any other **two** questions.
2. Strictly submit this question paper together with the answer booklet

**QUESTION ONE (30 MARKS)**

a) A star’s diameter D (as a multiple of the sun’s diameter) varies directly with the square root of the star’s luminosity (as a multiple of the sun’s luminosity) and inversely with the square of the star’s temperature T(in kelvins).

i) Write an equation relating D,L ,T and a constant k. (1 mark)

ii) The luminosity of Polaris is 10,000 times the luminosity of the sun. The surface temperature of Polaris is about 5800 kelvins. Using k=33,640,000, find how the diameter of Polaris compares with the diameter of the sun.

iii) The sun’s diameter is 1,390,000 kilometers. What is the diameter of Polaris? (1 mark)

 b) Use the inverse method or Crammer’s rule to solve the system 2x-3y=7 4x+3y=5 (5 marks)

c) Given that f(x)=2+3x-x2 and g(x)=2x-1 evaluate f o g(x) and g o f(3) (3 marks)

d) Write the cubic function whose graph is shown below

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

e) Factor the polynomial P=x3-2x2-9x+18 by grouping hence or otherwise find the roots of x3-2x2-9x+18=0 (3 marks)

f) Identify the horizontal and vertical asymptotes of the graph of the function y=(21/x-2 )+3. Graph the function (3 marks)

g) The limiting sum of a geometric progression is 3 and the sum of the first two terms is 8/3. Find the first term and the common ratio. (4 marks)

h) A shoe store gives a discount of between 10 to 25 percent on all sales. Let x be the regular footwear price and Y be the discount or sale price

1. Write a system of inequalities for the regular footwear prices and possible sale prices. (2marks)
2. Graph the system you have written in part I above. Use your graph to estimate the range of possible sale prices for shoes that are regularly priced at $65 (4 marks)

**QUESTION TWO (30 MARKS)**

1. The average number of phone calls per day between two cities © varies jointly as the product of the populations of the cities (P), and inversely as the square of the distance between the two cities (D). The population of Charlotte is about 1,500,000 and the population of Nashville is about 1,200,000,and the distance between the two cities is about 400 mile. The average number of calls between the two cites is about 200,000
2. Find the proportionality constant k and write the equation of variation.(2 marks)
3. The average number of daily phone calls between Charlotte and Indianapolis (which has a population of 1,700,000) is 134,000. Find the distance between the two. (2marks)

b) Given A= -1 4 and B= 2 -3, find the determinant of 2A+3B (2 marks)

 3 0 5 -6

c) Solve the system of non- linear equations x2-y=-1 by substitution method (4 marks)

 4x-y=-1

d) The first row of a concert hall has 25 seats, and each row after the first row has two more seats than the row before it. There are 32 rows of seats.

1. What is the total number of seats in the concert hall? (2 marks)
2. Suppose each seat in rows on through 11 costs $24, each seat in rows 12 through 22 costs $18, and each seat in rows 23 through 32 costs $12. How much money does the concert hall take in for a sold-out event? (5 marks)

c)A union contract specifies that each workers will receive a 5% pay increase each year for the next 30 years. One worker is paid $20,000 the first year. What is this person’s total lifetime salary over the 30- year period? (3 marks)

**QUESTION THREE (20 MARKS)**

1. Show that the functions f(x)=2x3-1 ;and g(x)=$\sqrt[3]{1/2(x+1)}$ are inverse of each other. (4 marks)
2. Find the polynomial function of degree 3 whose zeros are 1/3,3 and -3. Also graph the function f(x)=3x4-4x3 (5 marks)
3. The table below shows the population y (in millions) and the population rank x for nine cities in Argentina in 1999.
4. Draw a scatter plot of *ln* y versus *ln* x. Is a power model a good fit for the original data?(4 marks)
5. Find a power model for the original data. Estimate the population of the city Vicente Lopez, which has a population rank of 20 (2 marks)

|  |  |  |
| --- | --- | --- |
| City | Rank x | Population(millions),y |
| Cordoba | 2 | 1.21 |
| La Matanza | 3 | 1.12 |
| Mendoza | 4 | 1.11 |
| La plata | 5 | 0.77 |
| Moron | 6 | 0.64 |
| San Miguel de Tucuman | 7 | 0.64 |
|  Tucuman | 8 | 0.62 |
| Lomas de Zamoras  | 9 | 0.57 |
| Mar de Plata | 10 | 0.51 |

d) The approximate number of fruit flies in an exponential population after t hours is given by Q (t)=20e0.003t t≥0

i) Find the initial number of fruit flies in the population and the population of fruit flies after 72hours (2 marks)

ii) Sketch the graph of Q (t) (2 marks)

**QUESTION FOUR (20 MARKS)**

1. Find the radius and the center of the circle described by the equation x2+y2-(6/5)x-(4/5)y-131/25=0 (3 marks)
2. Determine the vertex, focus and the axis of symmetry of the parabola given by y=-2x2+8x-11 hence graph the parabola. (5 marks)
3. Sketch and describe the graph given by the equation 4x2+9y2-16x-54y+61=0 (7 marks)
4. Sketch and describe the graph of the hyperbola 16(x+3)2-4(y-2)2=64 (5 marks)