**THE OPEN UNIVERSITY OF SRI LANKA**
**Faculty of Engineering Technology**
**Department of Mathematics & Philosophy of Engineering**

**Bachelor of Industrial Studies**

079

**Final Examination (2022/2023)**
**MHZ3458 Mathematics for Agriculture**

**Date: 8th February 2024 (Thursday)** **Time: 0930 hrs. –1230 hrs.**

*Instructions:*

- *Answer **five (05)** questions only.*
- *Number of pages in the paper is four (04).*
- *All the symbols are in standard notation unless they are defined.*
- *Each question carries 20 marks.*

1. Information on the types of fruits bought by 54 customers from a fruit stall on a certain day is as follows. 23 bought Pineapple, 17 bought Papaya and 25 bought Mango. Pineapple and Papaya was bought by 13 customers. Pineapple and Mango was bought by 18 customers. 11 customers bought Papaya and Mango. 9 customers bought all three types of fruits.
    a. Draw a Venn diagram to represent the given information.
    b. How many customers bought at least one type of fruit from the three types?
    c. How many customers did not buy any of the three types of fruit?
    d. How many customers bought only Papaya?

2.
    a. Simplify the following expressions.
        i. $-2x^3 - x^2 - 3x + 2 - (x^3 - x + 1)$
        ii. $(4a^{-2} \div 9x^2)^{-1/2}$
    b. Determine the value of $x$ by solving the following equation.
    $$\log(6x - 42) - \log 6 = \log 9$$
    c. In a certain year the university issues 266 books for the students registered for the courses, Mathematics and Science. The number of students registered for Mathematics is 6 times the number of students registered for Science. Each student is issued only one book per course.
        i. Formulate a system of simultaneous equations with $x$ representing the number of students registered for Mathematics and $y$ representing the number of students registered for Science.
        ii. By solving the system of simultaneous equations, find the number of students registered for each course.

3.

a. How many multiples of 9 lie between 10 and 500?
b. In an arithmetic series $1^{st}$ term is 25 and $13^{th}$ term is $-11$. Find the common difference and $20^{th}$ term.

(In order to assist with the calculations you may select from formulas given by $T_n = a + (n-1)d, S_n = \frac{n}{2}[2a + (n-1)d], T_n = ar^{n-1}, S_n = \frac{a(r^n-1)}{r-1}\Big\} \; r \neq 1$)

4.

a. Draw the graph of the function given by $y = x^2 - 6x + 8$ within the interval $-1 \leq x \leq 7$
b. Using the graph in part $(a)$,
   i. Find the axis of symmetry of the graph.
   ii. Determine the roots of the equation $y = 0$.
   iii. Determine the values of $x$ such that $y \leq 8$.

5. $AB$ is a vertical post erected on a flat ground. Two points $C$ and $D$ are on the flat ground and on opposite sides of the post $AB$. Two wires $50\ m$ and $40\ m$ long are drawn from points $C$ and $D$ respectively and fixed to the top of the post $B$. The post $AB$ is in line with points $C$ and $D$ and wires are taut. Given that $A\hat{D}B = 43°\ 15'$.
   i. Draw a sketch of the above description.
   ii. Determine the height of the post $AB$
   iii. Find the value of the angle $A\hat{C}B$ using trigonometric ratios.

6.

a. Evaluate the following limit.

$$\lim_{x \to \frac{2}{3}} \left( \frac{9x^2 - 4}{3x - 2} \right).$$

b. Differentiate the following function with respect to $x$.

$$y = \sqrt{x^3 - 3x + 2}$$

c. A coconut farmer's total **Revenue** $R(x)$ and the **Cost of production** $C(x)$ in rupees are given by the following functions, where $x$ is the number of coconuts produced.

$$C(x) = 0.021\, x^2 + 200$$

$$R(x) = 546x - 0.07x^2$$

If the $\boldsymbol{Profit = Revenue - Cost}$, then find the number of coconuts to be produced to maximize the profit.

7.

a. Let

$$f(x) = \frac{1}{x^2 + 6x - 7}.$$

i. Find the partial fractions of $f(x)$.

ii. Hence, find the indefinite integral.

$$\int f(x)dx$$

b. Find the area of the region bounded by the curves $1 + 4x - x^2$, $y = 0$, $x = 0$ and $x = 3$.

8.

a. Let $A = \begin{bmatrix} a & 7 \\ 2 & 4 \end{bmatrix}$ $B = \begin{bmatrix} 1 & b \\ -3 & 5 \end{bmatrix}$. $C = \begin{bmatrix} 2 & c \\ -218 & -2 \end{bmatrix}$

If $AB = C^T$, then determine the values of $a, b, c$.

b.

i. Find the value of the determinant of the matrix $D$, where $D = \begin{bmatrix} 1 & 3 \\ 2 & -6 \end{bmatrix}$.

ii. Hence or otherwise find the inverse of matrix $D$.

## ස්වභාවික සයින

## இயற்கைச் சைன்கள்

## NATURAL SINES

| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | | මධ්‍යන්‍ය අන්තරය<br>இடை வித்தியாசங்கள்<br>Mean Differences | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 1′ | 2′ | 3′ | 4′ | 5′ | 6′ | 7′ | 8′ | 9′ |
| 0 | 0.0000 | 0.0029 | 0.0058 | 0.0087 | 0.0116 | 0.0145 | 0.0175 | 89 | 3 | 6 | 9 | 12 | 15 | 17 | 20 | 23 | 26 |
| 1 | .0175 | .0204 | .0233 | .0262 | .0291 | .0320 | .0349 | 88 | 3 | 6 | 9 | 12 | 15 | 17 | 20 | 23 | 26 |
| 2 | .0349 | .0378 | .0407 | .0436 | .0465 | .0494 | .0523 | 87 | 3 | 6 | 9 | 12 | 15 | 17 | 20 | 23 | 26 |
| 3 | .0523 | .0552 | .0581 | .0610 | .0640 | .0669 | .0698 | 86 | 3 | 6 | 9 | 12 | 15 | 17 | 20 | 23 | 26 |
| 4 | .0698 | .0727 | .0756 | .0785 | .0814 | .0843 | .0872 | 85 | 3 | 6 | 9 | 12 | 15 | 17 | 20 | 23 | 26 |
| 5 | 0.0872 | 0.0901 | 0.0929 | 0.0958 | 0.0987 | 0.1016 | 0.1045 | 84 | 3 | 6 | 9 | 12 | 14 | 17 | 20 | 23 | 26 |
| 6 | .1045 | .1074 | .1103 | .1132 | .1161 | .1190 | .1219 | 83 | 3 | 6 | 9 | 12 | 14 | 17 | 20 | 23 | 26 |
| 7 | .1219 | .1248 | .1276 | .1305 | .334 | .1363 | .1392 | 82 | 3 | 6 | 9 | 12 | 14 | 17 | 20 | 23 | 26 |
| 8 | .1392 | .1421 | .1449 | .1478 | .1507 | .1536 | .1564 | 81 | 3 | 6 | 9 | 11 | 14 | 17 | 20 | 23 | 26 |
| 9 | .1564 | .1593 | .1622 | .1650 | .1679 | .1708 | .1736 | 80° | 3 | 6 | 9 | 11 | 14 | 17 | 20 | 23 | 26 |
| 10° | 0.1736 | 0.1765 | 0.1794 | 0.1822 | 0.1851 | 0.1880 | 0.1908 | 79 | 3 | 6 | 9 | 11 | 14 | 17 | 20 | 23 | 26 |
| 11 | .1908 | .1937 | .1965 | .1994 | .2022 | .2051 | .2079 | 78 | 3 | 6 | 9 | 11 | 14 | 17 | 20 | 23 | 26 |
| 12 | .2079 | .2108 | .2136 | .2164 | .2193 | .2221 | .2250 | 77 | 3 | 6 | 9 | 11 | 14 | 17 | 20 | 23 | 26 |
| 13 | .2250 | .2278 | .2306 | .2334 | .2363 | .2391 | .2419 | 76 | 3 | 6 | 8 | 11 | 14 | 17 | 20 | 23 | 25 |
| 14 | .2419 | .2447 | .2476 | .2504 | .2532 | .2560 | .2588 | 75 | 3 | 6 | 8 | 11 | 14 | 17 | 20 | 23 | 25 |
| 15 | 0.2588 | 0.2616 | 0.2644 | 0.2672 | 0.2700 | 0.2728 | 0.2756 | 74 | 3 | 6 | 8 | 11 | 14 | 17 | 20 | 22 | 25 |
| 16 | .2756 | .2784 | .2812 | .2840 | .2868 | .2896 | .2924 | 73 | 3 | 6 | 8 | 11 | 14 | 17 | 20 | 22 | 25 |
| 17 | .2924 | .2952 | .2979 | .3007 | .3035 | .3062 | .3090 | 72 | 3 | 6 | 8 | 11 | 14 | 17 | 19 | 22 | 25 |
| 18 | .3090 | .3118 | .3145 | .3173 | .3201 | .3228 | .3256 | 71 | 3 | 6 | 8 | 11 | 14 | 17 | 19 | 22 | 25 |
| 19 | .3256 | .3283 | .3311 | .3338 | .3365 | .3393 | .3420 | 70 | 3 | 5 | 8 | 11 | 14 | 16 | 19 | 22 | 25 |
| 20° | 0.3420 | 0.3448 | 0.3475 | 0.3502 | 0.3529 | 0.3557 | 0.3584 | 69 | 3 | 5 | 8 | 11 | 14 | 16 | 19 | 22 | 25 |
| 21 | .3584 | .3611 | .3638 | .3665 | .3692 | .3719 | .3746 | 68 | 3 | 5 | 8 | 11 | 14 | 16 | 19 | 22 | 24 |
| 22 | .3746 | .3773 | .3800 | .3827 | .3854 | .3881 | .3907 | 67 | 3 | 5 | 8 | 11 | 13 | 16 | 19 | 21 | 24 |
| 23 | .3907 | .3934 | .3961 | .3987 | .4014 | .4041 | .4067 | 66 | 3 | 5 | 8 | 11 | 13 | 16 | 19 | 21 | 24 |
| 24 | .4067 | .4094 | .4120 | .4147 | .4173 | .4200 | .4226 | 65 | 3 | 5 | 8 | 11 | 13 | 16 | 19 | 21 | 24 |
| 25 | 0.4226 | 0.4253 | 0.4279 | 0.4305 | 0.4331 | 0.4358 | 0.4384 | 64 | 3 | 5 | 8 | 10 | 13 | 16 | 18 | 21 | 24 |
| 26 | .4348 | .4410 | .4436 | .4462 | .4488 | .4514 | .4540 | 63 | 3 | 5 | 8 | 10 | 13 | 16 | 18 | 21 | 23 |
| 27 | .4540 | .4566 | .4592 | .4617 | .4643 | .4669 | .4695 | 62 | 3 | 5 | 8 | 10 | 13 | 15 | 18 | 21 | 23 |
| 28 | .4695 | .4720 | .4746 | .4772 | .4797 | .4823 | .4848 | 61 | 3 | 5 | 8 | 10 | 13 | 15 | 18 | 20 | 23 |
| 29 | .4848 | .4874 | .4899 | .4924 | .4950 | .4975 | .5000 | 60° | 3 | 5 | 8 | 10 | 13 | 15 | 18 | 20 | 23 |
| 30° | 0.5000 | 0.5025 | 0.5050 | 0.5075 | 0.5100 | 0.5125 | 0.5150 | 59 | 3 | 5 | 8 | 10 | 13 | 15 | 18 | 20 | 23 |
| 31 | .5150 | .5175 | .5200 | .5225 | .5250 | .5275 | .5299 | 58 | 2 | 5 | 7 | 10 | 12 | 15 | 17 | 20 | 22 |
| 32 | .5299 | .5324 | .5348 | .5373 | .5398 | .5422 | .5446 | 57 | 2 | 5 | 7 | 10 | 12 | 15 | 17 | 20 | 22 |
| 33 | .5446 | .5471 | .5495 | .5519 | .5544 | .5568 | .5592 | 56 | 2 | 5 | 7 | 10 | 12 | 15 | 17 | 19 | 22 |
| 34 | .5592 | .5616 | .5640 | .5664 | .5688 | .5712 | .5736 | 55 | 2 | 5 | 7 | 10 | 12 | 14 | 17 | 19 | 22 |
| 35 | 0.5736 | 0.5760 | 0.5783 | 0.5807 | 0.5831 | 0.5854 | 0.5878 | 54 | 2 | 5 | 7 | 9 | 12 | 14 | 17 | 19 | 21 |
| 36 | .5878 | .5901 | .5925 | .5948 | .5972 | .5995 | .6018 | 53 | 2 | 5 | 7 | 9 | 12 | 14 | 16 | 19 | 21 |
| 37 | .6018 | .6041 | .6065 | .6088 | .6111 | .6134 | .6157 | 52 | 2 | 5 | 7 | 9 | 12 | 14 | 16 | 18 | 21 |
| 38 | .6157 | .6180 | .6202 | .6225 | .6248 | .6271 | .6293 | 51 | 2 | 5 | 7 | 9 | 11 | 14 | 16 | 18 | 20 |
| 39 | .6293 | .6316 | .6338 | .6361 | .6383 | .6406 | .6428 | 50° | 2 | 4 | 7 | 9 | 11 | 13 | 16 | 18 | 20 |
| 40° | 0.6428 | 0.6450 | 0.6472 | 0.6494 | 0.6517 | 0.6539 | 0.6561 | 49 | 2 | 4 | 7 | 9 | 11 | 13 | 15 | 18 | 20 |
| 41 | .6561 | .6583 | .6604 | .6626 | .6648 | .6670 | .6691 | 48 | 2 | 4 | 7 | 9 | 11 | 13 | 15 | 17 | 20 |
| 42 | .6691 | .6713 | .6734 | .6756 | .6777 | .6799 | .6820 | 47 | 2 | 4 | 6 | 9 | 11 | 13 | 15 | 17 | 19 |
| 43 | .6820 | .6841 | .6862 | .6848 | .6905 | .6926 | .6947 | 46 | 2 | 4 | 6 | 8 | 11 | 13 | 15 | 17 | 19 |
| 44 | .6947 | .6967 | .6988 | .7009 | .7030 | .7050 | .7071 | 45 | 2 | 4 | 6 | 8 | 10 | 12 | 15 | 17 | 19 |
| | 60′ | 50′ | 40′ | 30′ | 20′ | 10′ | 0′ | | 1′ | 2′ | 3′ | 4′ | 5′ | 6′ | 7′ | 8′ | 9′ |

## ස්වභාවික කෝසයින

## இயற்கைக் கோசைன்கள்

## NATURAL COSINES

*End*

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