

QUESTION 1

- (a) Differentiate the function $f(x) = 2x^2 + 3x$ (3 marks)
- (b) Solve the equation $2(5^{2x}) - 5^x = 6$ (5 marks)
- (c) Given that the probability density function (pdf) of a normal distribution is given by the formula $f(x) = \frac{1}{\delta\sqrt{2\pi}} e^{-\frac{1}{2}(\frac{x-\mu}{\delta})^2}$ take the standard deviation ($\delta = 4$), the population mean ($\mu=2$) and $\pi=3.124$
- (i) Find $f(4)$ (8 marks)
- (ii) State the Central Limit Theorem under normal distribution (4 marks)
- (Total: 20 Marks)**

QUESTION 2

- (a) A company manufactures two types of phones Android brand (X) and Apple brand (Y), on which its aim is to maximise profit. The company wish to know the idea combination of X and Y. All the electronic components are produced in three stages: Assembly, Inspection & Testing, and Packing. Basic requirements are as shown in the table below;

Product	Assembly	Inspection & testing	Packaging
X	1	1	3
Y	2	4	20
Maximum available. (hours)	600	60	3600

The profit per product X is k10 and Y is k15.

- (i) State the objective function. $10x + 15y$ (5 marks)
- (ii) State the constraints as functions. $x + 2y \leq 600$ $3x + 20y \leq 3600$ $x + 4y \leq 60$ (5 marks)
- (b) A concrete mixture includes: 65kgs stones, 115kg sand and 55kg quarry dust. Calculate the percentage composition of the quarry dust. (6 marks)
- (C) Simplify $\log_a 4 + \log_a 3^2 + \log_a 9 \div \log_a 6$ $\frac{55}{235} \times 100$ (4 marks)

(Total: 20 Marks)

QUESTION 3

(a) Births at the hospital occur randomly at an average rate of 1.8 births per hour. Calculate:

- (i) the probability of observing 4 births in a given hour at the hospital. (6 marks)
- (ii) the mean value of observing a birth at the hospital. (2 marks)
- (iii) the variation(variance) of observing a birth at the hospital. (4 marks)

(b) Solve the following system of equation elimination method.

$$2x + y - z = 1$$

$$x + 3z = 2$$

$$-3x - y + z = -1$$

(8 marks)

(Total: 20 Marks)

QUESTION 4

(a) To find the derivatives of a function of functions, we need to apply the chain rule:

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$

Find $\frac{dy}{dx}$

(i) $y = (x^2 + 3)^5$ (5 marks)

(ii) $y = \sqrt{4x^2 - x}$ (5 marks)

(b) The accrued amount formula (simple interest) is given by:

$$A_n = P(1 + i)^n$$

(i) Make P the subject of the formula (5 marks)

(ii) If some principal amount is invested at 12% and amounts to K4917.25 after 3 years. Calculate the principal amount. (5 marks)

(Total: 20 Marks)

$$P(x=4) = \frac{e^{-m} m^x}{x!}$$

$$= \frac{e^{-1.8} 1.8^4}{4!}$$

$$= \frac{6.04964 + 4.14 \times 10.4976}{0.12, 3}$$

$$A_n = \frac{P(1+i)^n}{(1+i)^n}$$

$$P = \frac{A_n}{(1+i)^n}$$

$$P = \frac{4917.25}{(1+0.12)^3}$$

$$P = \frac{4917.25}{1.404928}$$

$$P = 3500.001624$$

$$= K3500$$

QUESTION 5

(a) Consider the variables in the table below

X	6	8	9	12	10
Y	3.5	4.3	5.2	5.8	6.4

- (i) Fit a regression line $y = a + bx$
Where $a = \bar{y} - b\bar{x}$ and $b = \frac{1}{n} \frac{\sum x_i y_i - \bar{x}\bar{y}}{\sum x_i^2 - (\bar{x})^2}$
- (ii) Find the value of y if x increased by 0.75

(b) Simplify the following expressions

- (i) $(\alpha - \beta)(\alpha^2 + \alpha\beta + \beta^2)$
(ii) $(\alpha - \beta)(\alpha + \beta)$

Handwritten calculations for Question 5(a)(i):

x	y	xy	x ²	y ²
6	3.5	21	36	12.25
8	4.3	34.4	64	
9	5.2	46.8	81	
12	5.8	69.6	144	
10	6.4	64	100	
Σ	45	225.2	425	215.8

$b = \frac{1(45)(225.2) - 215.8}{5(425) - (45)^2} = \frac{1134 - 215.8}{2125 - 2025} = \frac{918.2}{100} = 9.182$

$a = \bar{y} - b\bar{x} = 5.04 - 9.182$

(Total: 20 Marks)

QUESTION 6

(a) Compute the mean, variance and the standard deviation for the earnings for share data using the grouping shown in the frequency table below:

Class	Mid-value	Frequency	$f(x)$	f_x^2
0-10		3		
10-20		4		
20-30		6		
30-40		10		
40-50		7		
		$n = \sum f_i = 30$		

From the table above, compute

- (i) the mid-values, $f(x)$ and f_x^2 for each class (4 marks)
(ii) The mean of the earnings (2 marks)
(iii) The standard deviation for the earnings (4 marks)

(b) Ten competitors in a beauty contest were ranked by two judges as shown in the table below

First judge	1	6	5	10	3	2	4	9	7	8
Second judge	3	5	8	4	7	10	2	1	6	8

Find the correlation coefficient between the rankings using Spearman's rank correlation (10 marks)

(Total: 20 Marks)

QUESTION 7

(a) Mr. Wiseman had some money which he wanted to convert in different currency thus, he entered the exchange rate shop and found the following rates:

1 Rand = K6 1 Dollar = K8 1 Pound = K9.5

Convert:

- (i) \$6,200 USD to Pound (4 Marks)
- (ii) \$1,400 Pound to Rand (3 Marks)
- (iii) 8,000 Rand to Dollar (3 Marks)

(b) The following data relate to a set of commodities used in a particular process

commodity	2005		2006	
	Price (K)	Quantity (Units)	Price (K)	Quantity (Units)
A	36	100	40	95
B	80	12	90	10
C	45	16	41	18
D	5	1100	6	1200

Calculate Laspeyres and Paasche price indices for 2006 taking 2005 as base year. (10 marks)

$$L = \frac{\sum P_1 q_0}{\sum P_0 q_0}$$

$$P (P) = \frac{\sum P_1 q_1}{\sum P_0 q_1}$$

(Total: 20 Marks)