ACCOUNTING TECHNICIANS SCHEME, WEST AFRICA

QUANTITATIVE ANALYSIS PAPER FOR MARCH 2021 DIET

QUESTIONS AND MARKING SCHEME
Time Allowed: 3 hours

SECTION A: PART I MULTIPLE-CHOICE QUESTIONS (30 Marks)

ATTEMPT ALL QUESTIONS

Write ONLY the alphabet (A, B, C, D or E) that corresponds to the correct option in each of the following questions/statements

1. Mr. Banke got his data from books, newspapers, magazines, journals, online portals e.t.c. for a research. He collected..... data.

   A. Simple
   B. Primary
   C. Secondary
   D. Qualitative
   E. Quantitative

2. A sampling method based on a chance mechanism with unknown choice of selection is called ..... sampling.

   A. Stratified random
   B. Cluster
   C. Random
   D. Two-Stage
   E. Multi-Stage

3. The table below shows the personnel in each department of an Accounting firm

Department	**Number of Personnel**	**Pie Chart sectoral angles**
Audit	36	108^{o}
Taxation	X	Y
Public sector	25	75^{o}
Human resources	29	87^{o}

Find the values of X and Y

A. $90^{o}$and 30
B. 32^{o} and 90
C. 32 and 90^{o}
D. 30^{o} and 90
E. 30 and 90^{o}

4. The following are the data generated from the income of three casual workers (in ₦'000): 5, 25 and 125. Compute the geometric mean

A. ₦ 5,000
B. ₦ 25,000
C. ₦ 125,000
D. ₦ 625,000
E. ₦ 650,000

5. A population consists of five observations: 1,3,5,7 and 9. Compute its Coefficient of Variation.

A. 0.556
B. 0.566
C. 55.6%
D. 56.6%
E. 57.6%

6. The following data consists of the percentage scores obtained by eight candidates in a job interview: 70, 60, 50, 55, 48, 80, 65 and 40. What is the quartile range of the score?

A. 12
B. 17
C. 20
D. 22
E. 40

7. The table below shows the income and expenditure (in ₦'000) of an Auditor for five months. Find the regression coefficient of x on y given that the regression model of y on x is $y = a + bx$,
$\sum xy = 336, \quad \sum x^2 = 264, \quad \sum y^2 = 445, \quad \sum x = 32 \; and \; \sum y = 45$

Income x	2	4	6	8	12
Expenditure y	5	7	9	11	13

A. 1200.0
B. 810.8
C. 1.2000
D. 0.8108
E. 0.1200

8. A cab operator works on Friday, Saturday and Sunday of every week. His net returns for two consecutive weeks are tabulated below

Week	Net Returns (₦'000)		
	Friday	**Saturday**	**Sunday**
1	12	14	16
2	15	20	13

The moving average for Saturday of week 2 is

A. 13
B. 14
C. 15
D. 16
E 17

9. The unit prices of 4 household items A, B, C and D from a retail store for two consecutive years are given in the table below

Year	Prices of commodities per unit(₦)			
	A	**B**	**C**	**D**
2018	40	30	35	45
2019	30	25	30	35

The simple aggregate price index, using year 2018 as base year, is

A. 80%
B. 100%
C. 120%
D. 125%
E 150%

10. The probability rule of multiplication can best be represented by which of the following?

A $P(A \text{ and } B) = P(A) \times P\left(B/A\right)$

B $P(A \text{ and } B) = P(A) \times P(B)$

C $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

D $P(A \text{ or } B) = P(A) + P(B)$

E $P(A \text{ and } B) = P(A) + P(B) - P\left(B/A\right)$

11. Tickets numbered 1 to 20 are mixed and then a ticket is drawn at random. What is the probability that the ticket drawn has a number which is a multiple of 3 or 5.

A. $\frac{3}{12}$
B. $\frac{9}{20}$
C. $\frac{1}{2}$
D. $\frac{8}{15}$
E. $\frac{3}{5}$

12. The classification table below, which is extracted from the records of Centre for Disease Control, shows the statuses of those that contracted a deadly virus infection and their age categories for a particular area.

Status	Age category		
	Young	**Adult**	**Aged**
Those that survive	14	16	4
Those that died	2	4	10

What is the probability that an individual selected from this area will survive the infection given that he/she is an adult?

A. 0.32
B. 0.40
C. 0.50
D. 0.68
E 0.80

13. The value of x in this inequality $4x - 3 \geq 2x + 3$ is

A. $x \leq 3$
B. $x < 3$
C. $x > 3$
D. $x \geq 3$
E. $x = 3$

14. The point at which total revenue equals total cost is known as

A Total loss
B Break-even point
C Marginal volume
D Marginal cost
E Total profit

15. The supply function of a given commodity is defined by $y = x^2$. The producers' surplus when $y_0 = 36,$ is

A 144
B 162
C 180
D 216
E 432

16. The sum of GH₵300,000 is invested in a business for $2\frac{1}{2}$ years at the rate of 20% compounded semi-annually. What is the accrued amount of the investment?

A. GH₵150,000
B. GH₵450,000
C. GH₵473,232
D. GH₵483,153
E. GH₵500,000

17. An advertisement for the post of Secretary in YATCO plc., states that the post attracts an initial salary of ₦600,000 per annum with an annual increment of ₦2,000. In what year will he earn ₦614,000?

A. 12th year
B. 10th year
C. 8th year
D. 6th year
E. 5th year

18. The Average Cost function of a commodity is given by $AC = 2Q + 5$. The Marginal Cost (MC) when $Q = 10$ is

A. 250
B. 205
C. 55
D. 45
E. 25

19. ..... resources is needed for competitive activities (in an optimum way) in scientific Operation Research.

A. Manpower
B. Physical
C. Raw material
D. Scarce
E. Unlimited

20. In degenerate solution, the value of objective function

A increases infinitely
B is usually minimised
C decreases infinitely
D decreases exponentially
E is usually maximised

21. The objective function of a linear programming problem is given as Max: $Z = 3x + 4y$, where Z is contribution in GH$\not{c}$, x and y are units of raw materials in hundreds. If the corner point solutions are X(8, 0), Y(0, 12), and Z (6, 8), find maximum contribution

A. GH$\not{c}$2400
B. GH$\not{c}$3200
C. GH$\not{c}$4800
D. GH$\not{c}$5000
E. GH$\not{c}$5800

22. The demand for an item is 60,000 units per annum. The cost of an order is ₦25 and holding cost per unit of an item is ₦2.00 per annum. The number of orders per year is

A. 1225
B. 1200
C. 102.5
D. 49
E. 46

23. The time period between placing an order and its receipt in stock is known as ..... time.

A. Lead
B. Carrying
C. Shortage
D. Over
E. Holding

24. The following are the rules for drawing network diagram, **EXCEPT** that

A. Dummy can be used for correct dangling
B. Events or nodes must be progressively numbered
C. Network proceeds from left to right
D. Occasionally, avoid arrow that crosses another activity
E. Activities that start from the same source and end at the same destination should be avoided

25. In a network diagram, the critical activities have

A. Free float
B. Dependent float and free float
C. Independent float
D. Total float
E. No float

26. Which of the following is a policy in the sudden failure category?

A. The group and individual replacements policy
B. Gradual replacement policy
C. Immediate replacement policy
D. B and C
E. A and C

27. Which of the following must be achieved in the optimal solution of an assignment problem in the total opportunity cost table?

A. Draw lines horizontally or vertically through the total opportunity cost in such a manner as to minimise the number of lines necessary to cover all zero cells
B. Draw lines minimally to cover all zero cells in the total opportunity cost table in such a manner that number of lines drawn is equal to the number of rows or columns
C. Draw lines horizontally or vertically through the total opportunity cost in such a manner as to minimise the number of lines necessary to cover all non-zero cells
D. Draw lines horizontally or vertically through the total opportunity cost in such a manner as to maximise the number of lines necessary to cover all zero cells
E. Draw lines horizontally or vertically through the total opportunity cost in such a manner as to maximise the number of lines necessary to cover all non-zero cells

28. All the following are true about Simulation, **EXCEPT** that

A. Simulation is not a trial and error approach
B Simulation is an act of designing a model
C. Simulation experiments make use of model not the system itself
D. The result from simulation is an approximate solution
E. Simulation is an imitation of the reality

29. Consider the problem with two factories in the table below:

	Warehouse(W_1)	**Warehouse(W_2)**	**Warehouse(W_3)**	**Supply**
Factory A	C_{11}	C_{12}	C_{13}	10
Factory B	C_{21}	C_{22}	C_{23}	20
Demand	13	7	10	

Use the North-West Corner Method to find the sum of the allocations AW_2 and BW_3.

A. 14 units
B. 10 units
C. 8 units
D. 7 units
E. 5 units

30. The unit transportation cost (₦'00), the quantities demanded and quantities supplied of an item from the 3 different sources to 3 different destinations are given in the table below

Source	Destination			Supply
	P	**Q**	**R**	
A	9	8	7	1500
B	7	6	5	x
C	8	4	3	950
Demand	y	1100	800	3250

What is the value of $x + y$?

A. 800
B. 950
C. 1,350
D. 2,150
E 3,250

SECTION A: PART II SHORT -ANSWER QUESTIONS (20 MARKS)

ATTEMPT ALL QUESTIONS

Write the correct answer that best completes each of the following questions/statements

1. A number is chosen at random from the first twenty-five natural numbers. What is the probability that such number is a multiple of 5?

2. Use the table below to determine the second value of moving average of order 4

Month (x)	1	2	3	4	5	6	7	8	9	10	11	12
Sales (y)	14	24	42	19	29	38	43	58	48	43	64	78

3. How long will it take a sum of money to double itself at an interest rate of 19% compounded quarterly?

4. The earliest event time and the latest event time are found from the ..... of activities.

5. One of the reasons for the study of Replacement Analysis is to know when and how best an equipment can be replaced in order to ..... the total costs of ..... them.

6. The marks obtained by the students in an Accounting examination are 12, 11, 10, 7, 8, and 16. If the mean is estimated to be 10, then the coefficient of variation is .....

7. The following data: $\sum xy = 14560,\ \sum x^2 = 13160,\ \sum y^2 = 16418,\ \sum x = 350,\ \sum y = 316$ are obtained from the production costs (x) and returns (y) of a manufacturing company for the period 2004 to 2011. Compute the coefficient of determination, leaving your answer in 3 places of decimal.

8. A man's salary in 1960 was ₦500 per annum and it increased by 20% each year. Find how much he earned in the years 1960 to 1964 inclusive.

9. The total monthly revenue of Layink enterprise (in Naira) is given by the equation, $R = 300{,}000(0.5)^{0.7x}$ where $x(₦'000)$ is the amount spent on overheads. What is the total revenue, if ₦7,000 is spent on overheads?

10. The amount by which the objective function decreases (or increases) as a result of the availability of one unit less or more of the scarce resource is known as.....

11. Given that the annual demand is 70,000 units, the re-order quantity is 3,000 units, ordering cost is L$30 per order and holding cost per item is L$3 per annum, then total cost per annum is .....

12. The aggregate index number of a group of commodities can either be ..... or .....

13. If the following demands: 100, 150, 200, 250, 300, 350 have the corresponding probabilities: 0.05, 0.15, 0.20, 0.10, 0.20, 0.3, use the following random numbers: 43, 76, 23, 63,08 to find the demand forecast for random number 63 using Monte Carlo's simulation method.

14. In the use of Hungarian method, an optimal assignment is reached when the number of ..... is equal to number of .....

15. The solution to a transportation problem with **m** rows (supplies) and **n** columns (destination) is feasible if the number of positive allocations is ....

16. The probability of rejecting the null hypothesis when it is true is known as .....

17. The sampling technique which involves dividing the population into two or more stages in which some groups are randomly selected is called ..... sampling.

18. Linear programming, transportation and assignment problems are some examples of.....models.

19. The three types of MEAN are Arithmetic mean, ...and ..... mean.

20. The absolute measure of the return on a project is known as ..... while the relative measure relating to the size and timing of the cash flows to the initial investment is known as .....

SECTION B: ATTEMPT ANY FOUR QUESTIONS (50 MARKS)

QUESTION 1

a. The daily withdrawals (₦'000) from the Automated Teller Machine (ATM) of a small community microfinance bank by 5 customers are given as follows: 12, 7, 9, 7, and 10. By using the data given, calculate the

i. Arithmetic mean of the daily withdrawals ($1^1/_2$ Marks)

ii. Geometric mean of the daily withdrawals (2 Marks)

iii. Harmonic mean of the daily withdrawals (2 Marks)

b. The volume of petrol (in ten thousands of litres) sold by 50 selected filling stations during a fuel scarcity, in a particular local government area, is tabulated as follows

Volume	**Number of filling stations**
0.6 – 1.5	10
1.6 – 2.5	8
2.6 – 3.5	12
3.6 – 4.5	7
4.6 – 5.5	6
5.6 – 6.5	4
6.6 – 7.5	3

Calculate the

i. Modal quantity of fuel ($2^1/_2$ Marks)

ii. Median quantity of fuel ($2^1/_2$ Marks)

iii. 7^{th} decile quantity of fuel (2 Marks)

(Total $12^1/_2$ Marks)

QUESTION 2

The following table shows the book value (Y) and the age (X) of equipment

Age (in years)	**Book Value (₦'000)**
1	40
2	38
3	25
4	20
5	12
6	5

a. Derive a regression equation to explain the relationship between the age of the equipment and the book value. (8 Marks)

b. Compute the Pearson's correlation coefficient between X and Y.

(2 Marks)

c. Compute the standard error of the estimate. ($2^1/_2$ Marks)

(Total $12^1/_2$ Marks)

QUESTION 3

a. An amount of GMD35,000 is invested at 14% for 17 years.

i. Calculate the Simple and Compound Interests. (5 Marks)

ii. How much will it amount to at the end of 17 years based on the simple interest calculated in a(i) above? (2 Marks)

b. For an essay writing competition, a total of four students that competed reeceived
a cash prize. The first prize was GMD2,000. Each prize is GMD500 less than the first prize.

i. What was the total sum of cash given out to students for the essay writing competition? ($2^1/_2$ Marks)

ii. Find the number of terms in the geometric progression 6, 12, 24, ..., 1536 (3 Marks)

(Total $12^1/_2$ Marks)

QUESTION 4

A company runs a production line that contains 250 identical components. They fail on a regular basis according to the following table

Life span (months)	**Observed frequency**
1	6
2	14
3	20
4	30
5	15
6	10
7	5

a. Determine the probabilities distribution of the life span ($3^1/_2$ Marks)

b. Determine the expected life span ($5^1/_2$ Marks)

c. Calculate the average number of components replaced in the period? ($3^1/_2$ Marks)

Total $12^1/_2$ Marks)

QUESTION 5

A local contractor has been awarded to construct a state-of-the-art bus terminal in the state's secretariat. The contractor divided the stages of the project into 12 activities. The table below gives the activity, preceding activity and estimated activity duration

Activity	**Preceding Activity**	**Activity duration (weeks)**
K	-	4
L	-	8
M	K	5
N	K	9
O	K	3
P	M	7
Q	M	5
R	M	3
S	L,N	5
T	P,S	3
U	Q,T	5
V	O,R	4

a. Construct the Activity – On – Arrow network diagram for the project (6 Marks)

b. Determine all possible paths and their durations ($3^1/_2$ Marks)

c. Identify the critical path and its duration (2 Marks)

d. State the shortest completion time for the project (1 Mark)

(Total $12^1/_2$ Marks)

QUESTION 6

a. The AJAX production company produces four varieties of chocolate: C_1, C_2, C_3 and C_4. For quality assurance purposes, the customers were asked, through copies of questionnaire, to indicate their choices. The pieces of information about daily consumptions of the chocolate based on the customers' responses are given as follows

Chocolate	C_1	C_2	C_3	C_4
Number of customers' response	14	9	15	12

You are required to

i. Use the above information to simulate the next 10 results using the following random numbers: 15, 20, 87, 09, 34, 56, 60, 07, 75 and 40. ($4^1/_2$ Marks)

ii. Based on your answer in (i) above, advise the producer on how the variety of chocolate that has the least consumption can be improved upon. (2 Marks)

b. The information about the number of cars arriving for parking (per hour) and their associated probabilities, in a particular garage, is given as follows

Arriving time (hour)	4	5	6	7	8
Probability	0.1	0.15	0.25	0.30	0.20

You are required to

i. Simulate the next 10 results using the following random numbers: 52, 37, 82, 69, 98, 96, 33, 50, 27 and 50. (5 Marks)

ii. Estimate the average number of cars arriving at the park per hour on the basis of the simulated frequency. (1 Mark)

(Total $12^1/_2$ Marks)

FORMULAE

Sample variance, s^2 = $\dfrac{\sum(x-\bar{x})^2}{n-1}$

Economic Order Quantity

Q = $\sqrt{\dfrac{2cd}{n}}$

Z_{cal} = $\dfrac{\bar{x}-\mu}{\dfrac{\sigma}{\sqrt{n}}}$

Slope of a regression equation

b = $\dfrac{n\sum xy-\sum x\sum y}{n\sum x^2-\left(\sum x\right)^2}$

Elasticity of demand, $e=\left(-\dfrac{p}{q}\right)\left(\dfrac{dq}{dp}\right)$

The 95% confidence interval for μ

$=\bar{x}\pm t_{\frac{\alpha}{2},n-1}\dfrac{s}{\sqrt{n}}$

The trend equation, y = a + bt, where t = x_i - x_m

b = $\dfrac{\sum ty}{\sum t^2}$. **a =** $\bar{y}-bx_m$, **x_m = median of x values**

SARPI = $\dfrac{\sum\left(\dfrac{P_n}{P_o}\times 100\right)}{N}$

SAPI = $\dfrac{\sum P_{ni}}{\sum P_{oi}}\times 100$

$t = \dfrac{p}{\sqrt{\dfrac{pq}{n}}}$

EOQ with stock-out

$$Q = \sqrt{\frac{2cd}{h}} \times \sqrt{\frac{h + c_s}{c_s}}$$

$$LPI = \frac{\sum p_1 q_o}{\sum p_o q_o} \times 100$$

$$Z = \frac{p - \hat{p}}{\sqrt{\frac{\hat{p}(1 - \hat{p})}{n}}}$$

$$Q_i = L_{Q_i} + \left(\frac{\frac{iN}{4} - \sum f_{Q_i}}{f_{Q_i}} \right) c$$

$$D_i = L_{D_i} + \left(\frac{\frac{iN}{10} - \sum f_{D_i}}{f_{D_i}} \right) c$$

$$P_i = L_{P_i} + \left(\frac{\frac{iN}{100} - \sum f_{P_i}}{f_{P_i}} \right) c$$

Spearman's rank correlation coefficient

$$r = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$$

EOQ with gradual replenishment

$$Q = \sqrt{\frac{2cd}{h\left(1 - \frac{d}{r}\right)}}$$

$$\text{Length of Inventory cycle} = \frac{Q}{d}$$

$$\text{Number of } production runs = \frac{d}{Q}$$

$$\text{Production cost} = Ordering\,\text{cost} + Holdering\,\text{cost}$$

$$Mode = L_{mo} + \left(\frac{\Delta_1}{\Delta_1 + \Delta_2} \right) c$$

SOLUTION TO QUESTIONS

SECTION A: PART 1 MULTIPLE-CHOICE

1. C
2. C
3. E
4. B
5. D
6. B
7. C
8. D
9. A
10. A
11. B
12. E
13. D
14. B
15. A
16. D
17. C
18. D
19. D
20. D
21. D
22. D
23. A
24. D
25. E
26. A
27. B
28. A
29. B
30. D

WORKINGS (MCQ)

3. Sum of angles for the sector is 360°

108°+Y+ 75°+87°=360°

Y= 360°- 270°

Y= 90°.

Let Z represent total personnel of the firm

Angle of sector for Auditor department $= \frac{36}{Z} \times 360^\circ = 108^\circ$

$$Z = \frac{36 \times 360^\circ}{180^\circ} = 120$$

Angle of sector for Taxation department $= \frac{x}{120} \times 360^\circ = 90^\circ$

$$x = \frac{120 \times 90^\circ}{360^\circ} = 30$$

30 and 90° (E)

4. $GM = \sqrt[3]{5 \times 25 \times 125} = 5^{(1+2+3)\times 1/3} = 5^2 \times 1000$ = ₦25,000 (B)

5. x = 1,3,5,7,9

$$\bar{x} = \frac{\sum x}{n} = \frac{25}{5} = 5$$

$$s^2 = \frac{\sum (x - \bar{x})^2}{n} = \frac{16+4+0+4+16}{5} = 8$$

$$s^2 = \sqrt{8} = 2.83$$

$$CV = \frac{s}{\bar{x}} \times 100 = \frac{2.83}{5} \times 100 = 56.6\%$$ (D)

6. Arranging the data in an ascending order of magnitude

40, 48, 50, 55, $\Downarrow$ 60, 65, 70, 80

Since n = 8, Q_1 is the median of 40, 48, 50, 55

i.e $Q_1 = \frac{48+50}{2} = \frac{98}{2}$

$Q_1 = 49$

Q_3 is the median of 60, 65, 70, 80

i.e $Q_3 = \frac{65+70}{2} = \frac{135}{2}$

$Q_3 = 67.5$

$Quartile range = Q_3 - Q_1 = 67.5 - 49 = 18.5$ (B)

7. For regression of y on x : $y = a + bx$ where b is given as

b = $\frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}$ and a = $\frac{\sum y}{n} - b\frac{\sum x}{n}$

for regression of x on y : $x = a^1 + b^1 y$ where b is given as

b^1 = $\frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum y^2) - (\sum y)^2}$ and a^1 = $\frac{\sum x}{n} - b^1\frac{\sum y}{n}$

Regression coefficient of x on y is b^1 = $\frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum y^2) - (\sum y)^2}$ = $\frac{5(335) - (32)(45)}{5(445) - 45^2}$

$= \frac{1680 - 1440}{2225 - 2045} = \frac{240}{200} = 1.2$ (C)

8.

Week	Day	Returns	3-day Moving total	3-day Moving average
1	Fri	12		
1	Sat	14	42	14
1	Sun	16	45	15
2	Fri	15	51	17
2	Sat	20	48	16
2	Sun	13		

The moving average for Saturday week 2 is 16
(D)

9. $Simple\ Aggregate\ \text{Price Index}, SAPI = \dfrac{\sum P_{2019}}{\sum P_{2018}} \times 100$

$$SAPI = \frac{30+25+30+35}{40+30+35+45} \times 100$$

$$SAPI = \frac{120}{150} \times 100 = 80\% \qquad \text{(A)}$$

11. $S = \{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20\}$
Let $E = event\ of\ getting\ multiple\ of\ 3\ or\ 5$

$$E = \{3,6,9,12,15,18,5,10,20\}$$

$$P(E) = \frac{n(E)}{n(S)} = \frac{9}{20} \qquad (B)$$

12. Let S represent Surviving
Let A represent Adult

$$P(S/A) = \frac{P(S \cap A)}{P(A)} = \frac{\frac{16}{50}}{\frac{20}{50}} = \frac{16}{20} = 0.8 \qquad \text{(E)}$$

13. $4x - 3 \geq 2x + 3$
$4x - 3 + 3 \geq 2x + 3 + 3$
$4x \geq 2x + 6$
$4x - 2x \geq 6$
$2x \geq 6$
$x \geq \frac{6}{2} => x \geq 3 \qquad (D)$

15. $y = x^2$
$x = y^{\frac{1}{2}}$
$x_0 = (y_0)^{\frac{1}{2}}$
When $y_0 = 36, \quad x_0 = (36)^{\frac{1}{2}}, \quad x_0 = 6$
Producers' surplus $= (x_0 y_0) - \int_0^{x_0} f(x)dx$

$= (x_0 y_0) - \int_0^{x_0} f(x)dx$

$= (6) \times (36) - \int_0^6 x^2 dx$

$= 216 - \left| \frac{x^3}{3} \right|_0^6$ (A)

$= 216 - \left(\frac{6^3}{3} \right)$

$= 216 - 72$

$= 144$

Alternatively,

$y = x^2$

$x = y^{\frac{1}{2}}$

When $x_0 = 0, \quad y_1 = 0$

Producers' surplus $= \int_{y_1}^{y_0} g(y)dy$

$= \int_0^{36} (y)^{\frac{1}{2}} dy$

$= \left| \frac{2 \times y^{\frac{3}{2}}}{3} \right|_0^{36}$

$= \frac{2}{3} \times (36)^{\frac{3}{2}} - 0$

$= 144$ (A)

16. $A = P(1+r)^n$,

where $n = 2 \times 2\frac{1}{2} = 5$

$r = \frac{20\%}{2} = 10\% = 0.1$

$P =$ ₦ 300,000

$A = 300{,}000(1+0.1)^5$

$A = 300{,}000(1+0.1)^5$

$A =$ ₦ 483,153

(D)

17. The salary is an AP with $a = 600,000,\ d = 2000\ \ L = 614,000$

Since the last term of AP is $L = a + (n-1)d$

$614,000 = 600,000 + (n-1) \times 2000$

$614,000 = 600,000 + 2000n - 2000$

$614,000 = 598,000 + 2000n$

$16,000 = 2000n$

$n = 8 years$ (C)

18. $AC = 2Q + 5$

$TC = Q \times (AC)$

$TC = Q \times (2Q + 5)$

$= 2Q^2 + 5Q$

$MC = \frac{d(TC)}{dQ}$

$= 4Q + 5$

For $Q = 10,$

$MC = 4 \times 10 + 5$

$MC = 45$ (D)

21. X(8, 0): Z= 3(8) + 0= 24

Y(0, 12): Z = 0 + 4(12) = 48

Z (6, 8): Z= 3(6) + 4(8) = 50

Therefore, maximum contribution = 50 x 100

= GH⊄5000

(D)

22.

$c = 25, d = 60{,}000, h = 2$

$Q = \sqrt{\frac{2cd}{h}} = \sqrt{\frac{2 \times 25 \times 60{,}000}{2}} = 1225$

$\therefore Number of orders per year is$

$\frac{Demand}{Q} = \frac{60{,}000}{1225} = 48.97 \approx 49$ (D)

29.

	W_1	W_2	W_3	Supply
A	10	-	-	10

	B	3	7	10	20
AW2 +	Demand	13	7	10	30

Sum of the allocation BW3 = 0 + 10 = 10

(B)

30. For Supply column:

$$1{,}500 + x + 950 = 3{,}250$$
$$2{,}450 + x = 3{,}250$$
$$x = 3{,}250 - 2{,}450$$
$$x = 800$$

For Demand column:

$$y + 1{,}100 + 800 = 3{,}250$$
$$y + 1{,}900 = 3{,}250$$
$$y = 3{,}250 - 1{,}900$$
$$y = 1{,}350$$
$$\Rightarrow x + y = 800 + 1{,}350 = 2{,}150$$

(D)

SECTION A: PART II SHORT-ANSWER QUESTIONS (SAQ)

1. $\frac{1}{5}$ or 0.2
2. 30.25
3. 3.7 years/3.73 years/ 3.734 years/3.7337 years/ 4 years
4. Duration
5. Minimize, maintaining (in that order)
6. 30%
7. 0.721
8. ₦3,720.80
9. ₦10,047.88
10. Shadow cost/shadow price/dual price
11. L$5,200
12. Weighted, unweighted
13. 300 units/300
14. Covered lines, rows / columns
15. $m + n - 1$
16. Significance level
17. Multi–Stage
18. Allocation
19. Harmonic mean/ Geometric mean, Geometric/Harmonic
20. NPV/Net present value, IRR/Internal Rate of Return (in that order)

WORKINGS (SAQ)

1. Let A=Event of multiples of 5

$n(A) = 5,\ i.e\ 5,10,15,20,25$

$$p(A) = \frac{n(A)}{n(S)} = \frac{5}{25}$$

2.

Month(x)	Sales (y)	4 – Month moving total	2 of 4 – Month moving total	4 – Month average
1	14			
2	24			
		99		
3	42		213	26.63
		114		
4	19		242	30.25
		128		
5	29		257	32.13
		129		
6	38		297	37.13
		168		
7	43		355	44.38
		187		
8	58		379	47.38
		192		
9	48		405	50.63
		213		
10	43		446	55.75
		233		
11	64			
12	78			

The second value of moving average of order 4 is 30.25

3. Compound interest formula

$A = P(1 + r)^n$,

Since interest is compounded quarterly, then

$A = P\left(1+\frac{r}{4}\right)^{4n}$

Since A= 2P given,

Therefore, $2P = P\left(1+\frac{0.19}{4}\right)^{4n}$

$2 = (1 + 0.0475)^{4n}$

$$n = \frac{0.3010}{4 \times 0.02015}$$

$$n = 3.7337 = 4$$

Answer is: 4 years or 3.7337 years

6. $$Mean = \frac{\sum X}{n} = 10$$

where $n = 7$

$$\sum X = 12 + 11 + 10 + 7 + 8 + U + 16$$

$$\sum X = 64 + U$$

$$\therefore 10 = \frac{64 + U}{7}$$

$$70 = 64 + U$$

$$U = 70 - 64$$

$$U = 6$$

Coefficient of variation $= \frac{SD}{Mean} \times \frac{100}{1}$

Coefficient of variation $= \frac{\sqrt{Variance}}{\bar{x}} \times \frac{100}{1}$

Coefficient of variation $= \frac{\sqrt{10}}{10} \times \frac{100}{1}$

Coefficient of variation $= \frac{3.162}{10} \times \frac{100}{1}$

Coefficient of variation $= 0.3162 \times 100 = 31.62\%$

7. Coefficient of determination = r^2 where r is the correlation coefficient given as follows

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{[n(\sum x^2 - (\sum x)^2][n(\sum y^2 - (\sum y)^2]}}$$

$$r = \sum xy = 14560,\ \sum x^2 = 13160,\ \sum y^2 = 16418,\ \sum x = 350,\ \sum y = 316$$

$$r = \frac{8(14560) - (350)(316)}{\sqrt{[8(13160) - (350)^2][8(16418) - (316)^2]}} = \frac{5880}{6926} = 0.84897$$

Coefficient of determination = $r^2 = (0.84897)^2 = 0.7207 \approx 0.721$ (3 d.p)

8. Salary in 1960 =N500, increament is r = 20% + 100% =120% = 1.2
n=5

This salary follows GP

$$S_n = \frac{a(r^n - 1)}{r - 1}$$

$$S_5 = \frac{500(1.2^5 - 1)}{1.2 - 1}$$

$$S_5 = ₦3{,}720.80$$

9. $x = \frac{7000}{1000} = 7$, since x is in thousands of naira

$$R = 300{,}000(0.5)^{0.7(7)}$$

$$R = 300{,}000(0.5)^{4.9}$$

R = 300,000 ×0.03349292

R = ₦10,047.88

11. $.Total cost per annum = ordering cost per annum + holding cost per annum$

$$= \frac{cd}{Q} + \frac{Qh}{2}$$

$$= \frac{(30)(70000)}{3000} + \frac{(3000)(3)}{2} = \frac{2100000}{3000} + \frac{9000}{2} = 700 + 4500$$

$$= ₦5{,}200$$

13.

Demand	100	150	200	250	300	350
Probability	0.05	0.15	0.20	0.10	0.20	0.30
Cum.prob.	0.05	0.20	0.40	0.50	0.70	1.00
Random number range	0 - 4	5 - 19	20-39	40-49	50-69	70 - 99

The demand for Random Number 63 = 300 units

SECTION B
QUESTION 1

a. i. Arithmetic Mean, AM = $\frac{\sum_{i=1}^{n} x_i}{n}$

$$AM = \frac{12+7+9+7+10}{5} \quad (\tfrac{1}{2}\,mark)$$

$$AM = \frac{45}{5}$$

$$AM = 9 \quad (\tfrac{1}{2}\,mark)$$

Therefore, the Arithmetic Mean daily withdrawal is ₦9,000 ($\frac{1}{2}\,mark$)

ii. Geometric Mean, GM = $\sqrt[n]{x_1 \cdot x_2 \cdots x_n}$ ($\frac{1}{2}\,mark$)

$$GM = \sqrt[5]{12\times 7\times 9\times 7\times 10} \quad (\tfrac{1}{2}\,mark)$$

$$GM = \sqrt[5]{52{,}920}$$

$$GM = 8.804890658$$

($\frac{1}{2}\,mark$)

Also accept:

8.8, 8.80, 8.805, 8.8049, 8.80489

Therefore, the Geometric Mean daily withdrawal is ₦8,804,89

($\frac{1}{2}\,mark$)

iii. Harmonic Mean, HM = $\frac{n}{\sum_{i=1}^{n} \frac{1}{x_i}}$ ($\frac{1}{2}\,mark$)

$$HM = \frac{5}{\frac{1}{12}+\frac{1}{7}+\frac{1}{9}+\frac{1}{7}+\frac{1}{10}} \quad (\tfrac{1}{2}\,mark)$$

for 1dp,

$$HM = \frac{5}{0.1+0.1+0.1+0.1+0.1}$$

$$HM = \frac{5}{0.5} = 10 \quad (½ \text{ mark})$$

Therefore, the Geometric Mean daily withdrawal is ₦10,000.00

($\frac{1}{2}\,mark$)

OR For 2dp,

$$HM = \frac{5}{0.08+0.14+0.11+0.14+0.10}$$

$$HM = \frac{5}{0.083+0.143+0.111+0.143+0.1}$$

$$HM = \frac{5}{0.57}$$

HM = 8.771929825

$(\frac{1}{2}\,mark)$

Also accept:

8.7, 8.77, 8.7719 and 8.77193

Therefore, the Harmonic Mean daily withdrawal is

₦8,771.93

$(\frac{1}{2}\,mark)$

OR For 3dp,

$$HM = \frac{5}{0.083+0.143+0.111+0.143+0.100}$$

$$HM = \frac{5}{0.58}$$

HM = 8.620689655

$(\frac{1}{2}\,mark)$

Also accept:

8.6, 8.62, 8.621, 8.6207 and 8.62069

Therefore, the Harmonic Mean daily withdrawal is

₦8,620.69

$(\frac{1}{2}\,mark)$

OR For 4dp,

$$HM = \frac{5}{0.0833+0.1429+0.1111+0.1429+0.1}$$

$$HM = \frac{5}{0.5802}$$

HM = 8.617718028

$(\frac{1}{2}\,mark)$

Also accept:

8.6, 8.62, 8.618, 8.6177 and 8.61772

Therefore, the Harmonic Mean daily withdrawal is

₦8,617.72
$(\frac{1}{2}\,mark)$

b.

Class interval	f	cf
0.6 – 1.5	10	10
1.6 – 2.5	8	18
2.6 – 3.5	12	30
3.6 – 4.5	7	37
4.6 – 5.5	6	43
5.6 – 6.5	4	47
6.6 – 7.5	3	50

(½ Mark for CF column with at least one correct value)

i. Mode = $L_{mo} + \left(\frac{\Delta_1}{\Delta_1 + \Delta_2}\right)c$

Modal class = 2.6 – 3.5 (i.e class with the highest frequency of 12)

$L_{mo} = 2.55 \quad \Delta_1 = 12 - 8 = 4$

$\Delta_2 = 12 - 7 = 5 \quad and\ c = 1.0$ $(\frac{1}{2}\,mark)$

Mode = $2.55 + \left(\frac{4}{4+5}\right)1.0$ $(\frac{1}{2}\,mark)$

Mode = $2.55 + 0.444444$

Mode = 2.994444 $(\frac{1}{2}\,mark)$

Modal quantity of fuel = $2.994444 \times 10{,}000 = 29{,}944.44\,litres$ $(\frac{1}{2}\,mark)$

Also accept – Mode =2.95

Modal quantity = 29,500 litres

Mode = 2.99

Modal quantity = 29,900 litres

Mode = 2.994
Modal quantity = 29,940 litres
Mode = 2.9944
Modal quantity = 29,944 litres
Mode = 2.994444
Modal quantity = 29,944.4 litres

ii. Median = $L_{me} + \left(\frac{\frac{N}{2} - \sum f_{me}}{f_{me}} \right) c$

Median position = $\frac{N}{2} th = \frac{50}{2} th = 25th$

Median class = 2.6 – 3.5

$L_{me} = 2.55 \quad \sum f_{me} = 18$ ($\frac{1}{2} mark$)

$F_{me} = 12 \quad and \quad c = 1.0$

Median = $2.55 + \left(\frac{25-18}{12} \right) 1.0$ ($\frac{1}{2} mark$)

Median = $2.55 + 0.583333$

Median = 3.133333 ($\frac{1}{2} mark$)

Median quantity of fuel
= 3.133333 x 10,000
= 31,333.33 litres

iii. $7th\ decile = D_7$

$D_7 = L_{D_7} + \left(\frac{\frac{7}{10} N - \sum f_{D_7}}{f_{D_7}} \right) c$

$= \frac{7 \times 50}{10} th = 35th$

D_7 *class* $= 3.6 - 4.5$

$L_{D_7} = 3.55, \quad \sum f_{D_7} = 30$

$F_{D_7} = 7 \quad and \quad c = 1.0$

$D_7 = 3.55 + \left(\frac{35-30}{7}\right)1.0$ ($\frac{1}{2}$ *mark*)

$D_7 = 3.55 + 0.714285$

$D_7 = 4.264285$ ($\frac{1}{2}$ *mark*)

Therefore, 7th decile quantity of fuel
= 4.264285 x 10,000
= 42,642.85 litres

Also, accept
- D_7 = 4.3 = 43,000 litres
- D_7 = 4.26 = 42,000 litres
- D_7 = 4.264 = 42,640 litres
- D_7 = 4.2643 = 42,643 litres
- D_7 = 4.26428 = 42,642.8 litres ($7\frac{1}{2}$ *marks*)

(Total 12 $\frac{1}{2}$ Marks)

QUESTION 2

(a)

Age (X)	Book Value (Y) ('000)	XY ('000)	X^2	Y^2 ('000)
1	40	40	1	1,600
2	38	76	4	1,444
3	25	75 (½) for at least one comment	9 (½) for at least one comment	625 (½) for at least one comment
4	20	80	16	400
5	12	60	25	144
6	5	30	36	25
$\sum X$ = 21 (½)	$\sum Y$ = 140 (½)	$\sum XY$ = 361 (½)	$\sum Y$ = 91 (½)	$\sum Y_2$ = 4238 (½)

The regression equation explaining the relationship between the age of the equipment (X) and the book value (Y) is given as:

$\hat{y} = \hat{a} + \hat{b}x$ (½)

Where

$$\hat{b} = \frac{\sum XY - \frac{\sum X \sum Y}{n}}{\sum X^2 - \frac{\left(\sum X\right)^2}{n}}$$

$= \frac{361 - \frac{(21)(140)}{6}}{91 - \frac{(21)^2}{6}}$ (½)

$= \frac{-129}{17.5}$ (½) = -7.371 (½)

= -7.371428571

(for b, accept: -7.3, -7.37, -7.371, -7.3714, -7.37143 or -7371.43)

-

$$\hat{a} = \frac{\sum Y}{n} - \hat{b}\frac{\sum X}{n}$$

$$= \frac{140}{6} - (-7.371)\left(\frac{21}{6}\right) \quad (½)$$

= 23.333 + 25.799 (½)

= 49.132 (½)

(for a, accept: 49.1, 49.13, 49.133, 49.1333, 49.13334 or 49133.34)

The regression equation is

$\hat{y} = 4913334 - 7371.43X$ (½)

(Total 8 Marks)

b.

$$= \frac{361 - \frac{(21)(140)}{6}}{\sqrt{\left[91 - \frac{(21)^2}{6}\right]\left[4328 - \frac{(140)^2}{6}\right]}} \quad (½)$$

$$= \frac{-129}{\sqrt{(17.5)(1061.33)}} \ (½)$$

$$= \frac{-129}{136.284}$$

= - 0.9465527868 (½)

(for r, also accept: -0.9, -0.95, -0.947 or -0.9466)

c. Standard Error = $Se = \sqrt{\frac{\sum Y^2 - a\sum Y - b\sum XY}{n-2}}$

$$= \sqrt{\frac{(4238) - (49.132)(140) - (-7.371)(361)}{6-2}} \quad (½)$$

$$= \sqrt{\frac{4238-6878.48+2+660.931}{4}}(½) = \sqrt{\frac{6898.931-6878.48}{4}}$$

$$Se = \sqrt{\frac{20.451}{4}} = \sqrt{5.11275} \quad (½)$$

$$Se = 2.261139093$$

For Se, also accept 2.3, 2.26, 2.261, 2.2611 or 2.26114

The standard error of the estimate is 2,261.14 (½)

(Total 12 $\frac{1}{2}$ Marks)

QUESTION 3

a. i. $P = GMD35000, r = \frac{14}{100} = 0.14,$ (1)

$$t = 17$$

$$Simple\ interest = P \times R \times T = 35{,}000 \times 0.14 \times 17 \ (½)$$

$$Simple\ interest = GMD83{,}300 \ (½)$$

$$Compound\ interest = Amount - Principal$$

i.e C.I = A – P (½)

where A = P(i+r) (1)

A = 35,000 (1 + 0.14) 17 (½)

A = 35,000 (9.276464197) (½)

A = 324,676.25 (½)

(For A, also accept any value within the range of 324,676.25 to 325,500)

Therefore, C.I = 324, 676.25 – 35,000 (½)

C.I = GMD 289, 676.25 (½)

For C.I, also accept any value within the range of 289,676.25 to 290,500

ii. Amount = $A_{17} = P + I$ (½)

Amount = 35,000 + 83,300 (½)

Amount = GMD 118,300 (1)

A LITER for a(ii)

$A_{17} = P(1 + rn)$ (1)

A_{17} = 35,000 [1 + (0.14) (17)] (½)

A_{17} = GMD 118,300 (½)

b.i. $n = 4, a = 2000 \; and d = -500$

$$Sn = \frac{n}{2}[(2a + (n-1)d] \; (1)$$

$$S4 = \frac{4}{2} \times (2(2000) + (4-1)(-500)(½)$$

$$= 2 \times (4000 + (3)(-500)$$

$$= 2(4000 - 1500)(½)$$

$$= 2(2500) \; (½)$$

$$= GMD \; 5{,}000 \; (½)$$

ii. $a_1 = 6, a_2 = 12, a_3 = 24, \ldots . a_n = 1536$

$$r = \frac{a_2}{a_1} = \frac{12}{6} = 2 \quad (½)$$

$$1539 = (6)(2)^{n-1}(½)$$
$$256 = (2)^{n-1}$$
$$2^8 = 2^{n-1}(½)$$
$$8 = n - 1(½)$$
$$n = 8 + 1$$
$$n = 9 \; (½)$$

Hence, there are 9 terms (½)

(Total 12 $\frac{1}{2}$ Marks)

QUESTION 4

a.

Life span x	Obsev. Frequency	Prob. Distributions
1	6	0.06 (½)
2	14	0.14 (½)
3	20	0.20 (½)
4	30	0.30 (½)
5	15	0.15 (½)
6	10	0.10 (½)
7	5	0.05 (½)

(3½ee)

b.

x	P(x)	xP(x)
1	0.06	0.06
2	0.14	0.28
3	0.20	0.60
4	0.30	1.20
5	0.15	0.75
6	0.10	0.60
7	0.05	0.35

(4)
(-½ee)

Expected life span in months = $\sum$ X P (X)

= 3.84 (1½) (-½ with no unit "month")

C. Average number replaced in the period

$$= \frac{total\ no.of\ items\ used\ per\ period}{Average\ life\ span}$$ (1)

$$= \frac{250}{3.84}$$ (1)

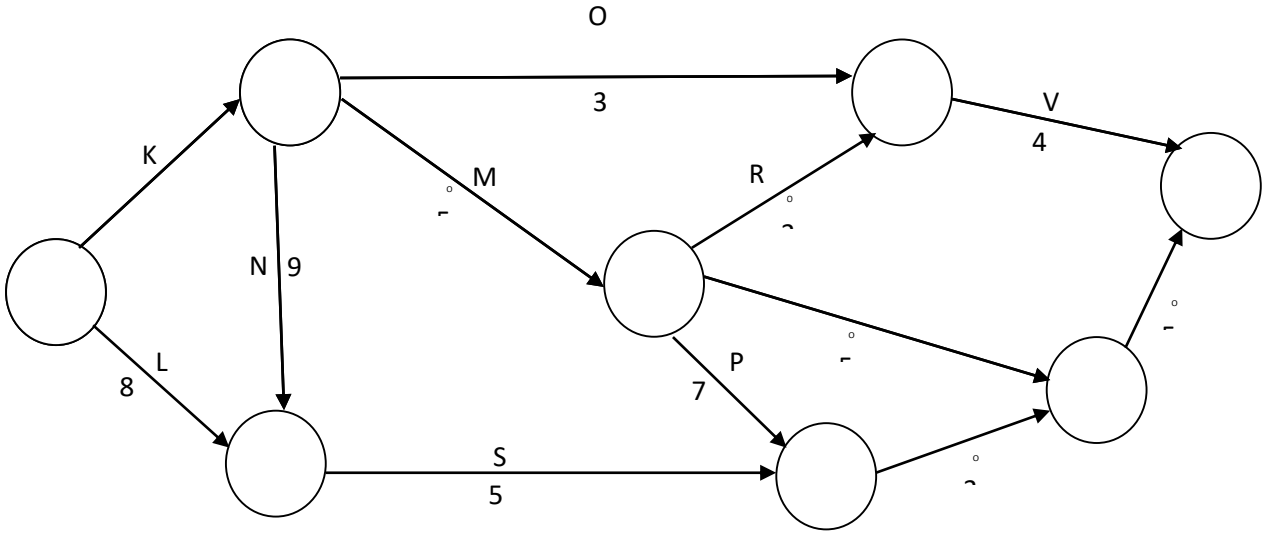
= 65.10 (½)

= 66 (1)

(Total 12½ Marks)

QUESTION 5

a. The network diagram



(6 *mark*)

(½ for each wrong or unwanted path)

* Without arrows, score is zero

b.

Paths	Durations
K → O → V	4+3+4 = 11 weeks
K → N → S → T → U	4+9+5+3+5 = 26 weeks
L → S → T → U	8+5+3+5 = 21 weeks
K → M → P → T → U	4+5+7+5+5 = 24 weeks
K → M → Q → U	4+5+5+5 = 19 weeks
K → M → R → V	4+5+3+4 = 16 weeks

($3\frac{1}{2}$ *marks*)

(-½ each error)

c. The critical path is ~~K~~ → N → S → ~~T~~ → U (*1 mark*)
and its duration is 26 weeks (*1 mark*)

d. The shortest completion time for the project is 26 weeks (*1 mark*)

(Total 12½ Marks)

QUESTION 6

ai.

Chocolate	Frequency	Probability	Cumulative Probability	Range interval
C_1	14	0.28	0.28	00 – 27
C_2	9	0.18	0.46	28 – 45
C_3	15	0.30	0.76	46 – 75
C_4	12	0.24	1.00	76 – 99

(1)-½ee (½) for at least (1) one correct answer

The simulation of the next 10 results is therefore carried out as tabulated in the table below.

Random number	Corresponding chocolate
15	C_1
20	C_1
87	C_4
09	C_1
34	C_2
56	C_3
60	C_3
07	C_1
75	C_3
40	C_2

(*2 marks*)
(-½ ee)

ii. The simulation results are summarized in the table below

Chocolate	Simulated Frequency
C_1	4
C_2	2
C_3	3
C_4	1

(*2 marks*)

Also, accept

C_4 has the least consumption

b.

Time	Probability	Cumulative Probability	Random number interval
4	0.10	0.10	00 – 09
5	0.15	0.25	10 – 24
6	0.25	0.50	25 – 49
7	0.30	0.80	50 – 79
8	0.20	1.00	80 – 99
		(½ mark) for at least getting One correct	(1 mark) (-½ ee)

The simulation of the next 10 results is therefore carried out and the results are tabulated below:

Car arriving time (hr)	Random number	Simulated arriving time
1	52	7
2	37	6
3	82	8
4	69	7
5	98	8
6	96	8
7	33	6
8	50	7
9	27	6
10	50	7
		∑m = 70 (½)

(3 marks)
-½ ee

ii. The average number of cars arriving per hour $= \frac{70}{10}$ (½)

$= 7 \text{ cars}$ (½ Mark)

(Total 12½ Marks)

QA - MARKING GUIDE

QUESTION 1		MARKS	TOTAL MARKS
a(i)	For correct substitution into arithmetic mean formular	½	
	For getting AM = 9	½	
	For correct arithmetic mean daily withdrawal i.e ₦9,000	½	1½
(ii)	For correct Geometric mean formular	½	
	For correct substitution into Geometric mean formular	½	
	For getting GM = 8.804890658 or 8.8 or 8.80 or 8.805 or 8.8049 or 8.80489	½	2
(iii)	For correct Geometric mean daily withdrawal i.e ₦8,804.89	½	
	For correct Harmonic mean formular	½	
	For correct substitution into Harmonic mean formular	½	2
	For getting HM of 10 or 8.7719 or 8.6207 or 8.6177		
	For correct HM mean daily with withdrawal of ₦10,000 or ₦8,771.90 or ₦8,620.70 or ₦8,617.70		

b(i)	For correct modal class i.e 2.6 – 3.5	½	
	For correct values of L_{mo} = 2.55, Ai = 4, A2 = 5 and c = 10 (All must be correct)	½	
	For correct substitution into mode formular (His own values)	½	
	For correct mode i.e 2.994444 or 2.95 or 2.99 or 2.994 or 2.9944 or 2.99444	½	
	For correct modal quantity of fuel i.e 29,944.44 litres or 29,500 litres or 29,900 litres or 29,940 litres or 29,944 litres or 29,944.4 litres.	½	2½
(ii)	For correct cf column (at least one correct value)	½	
	For correct values of L_{me} = 2.55, $\sum f_{me}$ = 18, f_{me} = 12 and c = 10 (All must be correct)	½	
	For correct substitution into median formular (His own values)	½	
	For correct median i.e 3.133333 or 3.15 or 3.13 or 3.133 or 3.1333 or 3.13333	½	
	For correct median quantity of fuel i.e 31,500 litres or 31,300 litres or 31,330 litres or 31,333 litres or 31,333.3 litres or 31,333.33 litres	½	
	For correct values of L_{D7} =3.55, $\sum f_{D7}$ = 30, f_{D7} =7 and c = 1.0 (All must be correct)	½	2½

(iii)	For correct substitution into D_7 formular (His own values) For correct D_7 i.e 4.264285 or 4.25 or 4.26 or 4.264 or 4.2643 or 4.26428 For 7^{th} decile quantity of fuel i.e 42,500 litres or 42,600 litres or 42, 640 litres or 42,643 litres or 42,642.81 litres or 42,642.85 litres **Total:**	½ ½ ½	2 **12**½
QUESTION 2			
a.	For correct XY column (at least one correct value) For correct X^2 column (at least one correct value) For correct Y^2 column (at least one correct value) For correct ∑ X = 21 For correct ∑ Y = 140 For correct ∑ XY = 361 For correct $\sum X^2 = 91$ For correct $\sum Y^2 = 4238$	½ ½ ½ ½ ½ ½ ½ ½ ½	

	For correct regression equation formular i.e $\hat{Y} = \hat{a} + \hat{b}X$ For correct substitution into $\hat{b}$ formular (His own values) For correct simplification to get $\hat{b} = \frac{-129}{17.5}$ For correct $\hat{b}$ = -7.371428571 or -7.3 or -7.37 or -7.371 or -7.3714 or -7.37143 or -7371.43 For correct $\hat{a}$ formular i.e $\frac{\sum Y}{n} - \frac{\hat{b}\sum X}{n}$ For correct substitution into a formular (His own values) For correct $\hat{a}$ = 49.132 or 49.1 or 49.13 or 49.133 or 49.1333 or 49.13334 or 49133.34 For correct regression equation i.e $\hat{Y}$ = 49133.34 – 7371.43X	½ ½ ½ ½ ½ ½ ½	8
(b)	For correct r formular For correct substitution into r formular (His own values) For correct simplification to get $r = \frac{-129}{\sqrt{(17.5)(1061.33)}}$ For correct r = -0.9465527868 or -0.9 or -0.95 or -0.947 or -0.9466	½ ½ ½ ½	2

(c)	For correct standard error, S_e formular For correct substitution into S_e formular (His own values) For correct simplication to get $S_e = \sqrt{5.11275}$ For correct $S_e = 2.261139093$ or 2.3 or 2.26 or 2.261 or 2.2611 or 2.26114 For correct standard error of the estimate i.e 2,261.14 **Total**:	½ ½ ½ ½ ½	2½ 12½
QUESTION 3			
a(i)	For correct substitution into simple interest formular For correct simple interest i.e SI =GMD 83,300 For correct amount to formular i.e $A = P(1+r)^t$ For correct substitution into A formular For correct simplication of A i.e A = 35,000 (9.276464197) For correct A within the range of 324,676.25 to 325,500 For correct CI formular: CI = A – P For correct substitution into C.I formular i.e C.I = 324,676.25 – 35,000	½ ½ 1 ½ ½ ½ ½ ½	5

(ii)	For correct C.I within the range of GMD 289,676.25 to GMD 290,500 For correct amount formular i.e $A_{17} = P + SI$ or $A = P + SI$ For correct substitution into amount, A formular i.e $A = 35{,}000 + 83{,}300$ For correct amount GMD 118,300 A LITER FOR a(ii) For correct amount formular i.e $A_n = P(1 + rn)$ or $A = P(1 + rn)$ For correct substitution into amount formular For correct amount = GMD 118,300	½ ½ 1 1 ½ ½	2 2
b(i)	For correct sum or nth term formular i.e $S_n = \frac{n}{2}[2a + (n-1)d]$ For correct substitution into S_n formular For correct simplication of S_4 to get $S_4 = 2(4000 - 1500)$ For correct $S_4 = GMD\,5{,}000$	1 ½ ½ ½	2½
(ii)	For correct common ratio, r = 2 For correct nth term of G.P formular i.e $a_n = ar^{n-1}$	½ ½	

	For correct substitution into a_n formular For correct simplification to get $2^8 = 2^{n-1}$ For correct further simplification to get $8 = n-1$ For correct n = 9 **Total**:	½ ½ ½ ½	 3 12½
QUESTION 4			
(a)	For correct probability distribution column (-½ for each error)	3½	3½
(b)	For correct xP(x) column (-½ for each error) For correct expected life span in months i.e 3.84 (-½ for no unit: "month")	4 1½	 5½
(c)	For correct average number replaced in the period formular For correct substitution into the formula i.e average number replaced (His own value) For getting average number replaced as 65.10 For collect average number replaced in the period i.e 66 **Total:**	1 1 ½ 1	 3½ 12½

QUESTION 5			
(a)	For correct network diagram with correct paths and arrows (-½ for each wrong or unwanted path) (without arrows, score the candidate zero) **NOTE**: ½ mark for each of the 12 correct paths	6	6
(b)	For all the 6 correct paths with the corresponding durations (-½ for each error)	3½	3½
(c)	For correct critical path i.e ~~K~~ ⟶ ~~N~~ ⟶ ~~S~~ ⟶ ~~T~~ U For correct critical path duration i.e 26 weeks	1 1	 2
(d)	For correct shortest completion time i.e 26 weeks **Total**:	1	1 12½

QUESTION 6			
a(i)	For correct probability column (-½ for each error)	1	
	For correct cumulative probability column (at least one correct)	½	
	For correct range interval column (-½ for each error)	1	
	For correct simulated type of chocolate consumed column i.e corresponding chocolate column (-½ for each error)	2	4½
(ii)	For either displaying the simulated frequency indicating C_4 as least consumed chocolate or for stating C_4 to be the least consumed chocolate	2	2
b(i)	For correct cumulative probability column (at least one correct)	½	
	For correct random number interval column (-½ for each error)	1	
	For correct simulated number of cars arriving per hour column (-½ for each error)	3½	5
(ii)	For correct expression for the average number of cars per hour i.e $\frac{70}{10}$ (His own total)	½	

	For correct average number of cars per hour i.e 7 cars **Total:**	½	1 **12½**