



**THE CHARTERED INSTITUTE OF TAXATION OF  
NIGERIA (Chartered Institute by Act No. 76 of 1992)**

**STUDENTS' COMPANION APRIL 2013  
PROFESSIONAL EXAMINATION PT 1  
NEW SYLLABUS**

**QUESTION AND SUGGESTED SOLUTIONS**

**THE CHARTERED INSTITUTE OF TAXATION OF  
NIGERIA APRIL 2013: PROFESSIONAL EXAMINATION  
PT 1 : INCOME TAX SOLUTION  
ATTEMPT ALL QUESTIONS. SHOW ALL WORKINGS. TIME: 3 HOURS**

**PT 1 – NEW SYLLABUS**

**PT 1 INCOME TAX SOLUTION**

- 1 In the context of the Nigeria Tax Administration, various administrative set-ups were established.  
You are therefore required:
- a to enumerate the tax administrative machinery currently in existence in Nigeria. (5 marks)
- b Mention any ten (10) functions and Powers of the Federal Inland Revenue Service? (15 marks)
- (Total: 20 marks)

**SOLUTION**

- 1 a Tax administrative machinery currently existing in Nigeria includes:
- i. The Joint Tax board
  - ii. The Federal Board of Inland Revenue
  - iii. The State Board of Internal Revenue
  - iv. Local Government Revenue Committee
  - v. Joint State Revenue Committee
- b. Functions of the service
1. The service shall –
- Assess persons including companies, enterprises chargeable with tax;
  - Assess, collect, account and enforce payment of taxes as may be due to the government or any of its agencies;
  - Collect, recover and pay to the designated account, any tax under any provision of this Act or any other enactment or law;

- In collaboration with the relevant ministries and agencies, review the tax regimes and promote the application of tax revenues to stimulate economic activities and development;
- In collaboration with the relevant law enforcement agencies, carry out the examination and investigation with a view to enforcing compliance with the provisions of this Act;
- Make, from time to time, a determination of the extent of financial loss and such other losses by Government arising from tax fraud or evasion and such other losses (or revenue foregone) arising from tax waivers and other related matters;
- Adopt measures to identify, trace, freeze, confiscate or seize proceeds derived from tax fraud or evasion;
- Adopt measures which include compliance and regulatory actions, introduction and maintenance of investigative and control techniques on the detection and prevention of non-compliance;
- Collaborate and facilitate rapid exchange of information with relevant national or international agencies or bodies on tax matters;
- Undertake exchange of personnel or other experts with complimentary agencies for purpose of comparative experience and capacity building ;
- Establish and maintain a system for monitoring international dynamics of taxation in order to identify suspicious transactions and perpetrators and other persons involved
- Provide and maintain access to up to date and adequate data and information on all taxable persons, individuals, corporate bodies or all agencies of Government involved in the collection of revenue for the purpose of efficient, effective and correct tax administration and to prevent tax evasion or fraud.
- Maintain database, statistics, records and report on persons, organisations, proceeds, properties, document or other items or assets relating to tax administration including matters relating to waivers, fraud or evasion;
- Undertake and support research on similar measures with a view to stimulating economic development and determine the

manifestation, extent, magnitude and effects of tax fraud, evasion and other matters that affect effective tax administration and make recommendations to the government on appropriate intervention and preventive measures;

- Collate and continually review all policies of the Federal Government relating to taxation and revenue generation and undertake a systematic and progressive implementation of such policies;
- Liaise with the office of the Attorney-General of the Federation, all Government security and law enforcement agencies and such other financial supervisory institutions in the enforcement and eradication of tax related offences;
- Issue taxpayer identification number to every taxable person in Nigeria in collaboration with State Board of Internal Revenue and local Government Councils;
- Carry out and sustain rigorous public awareness and enlightenment campaign on the benefits of tax compliance within and outside Nigeria;
- Carry out oversight function over all taxes and levies accruable to the Government of the Federation and as it may be required, query, subpoena, sanction and reward any activities pertaining to the assessment, collection of and accounting for revenues accruable to the federation; and
- Carry out such other activities as are necessary or expedient for the full discharge of all or any of the functions under this Act.

2. The service may, from time to time, specify the form of returns, claims, statements and notices necessary for the due administration of the powers conferred on it by the Act.

2 Alhaji Mai Chidodo has been in the business of Sole proprietorship for several years. His Profit and Loss Account for the year ended 31<sup>st</sup> December, 2010 revealed the following:

Income:	₦	₦
Gross Trading Profit	500,000	
Profit on sales of fixed Assets	20,000	
Dividend (Gross)	40,000	
Rent from Bala (Nig.) Ltd. (Gross)	<u>80,000</u>	640,000

Expenditure:		
General Expenses	30,000	
Expansion Store	20,000	
Bank Charges	15,000	
Legal Expenses	18,000	
Bad Debts	50,000	
Depreciation	40,000	
Repairs to Premises	10,000	
Income Tax Provision	15,000	
Rates and Electricity	30,000	
Rent	80,000	
Salaries	<u>300,000</u>	<u>(608,000)</u>
Net Profit		<u><u>32,000</u></u>

The following additional information is available:

- i. Legal expenses include ~~₦~~10,000 for the acquisition of a new lease and ~~₦~~6,000 for renewal of an old lease.
- ii. Bad debts include ~~₦~~8,000 written off in respect of trading stock. 10% provision was made for trade debtors of ~~₦~~360,000.
- iii. Alhaji Mai Chindodo resides in the premises and one third ( $\frac{1}{3}$ ) of the rent, rates and repairs is for the portion occupied by him.
- iv Capital allowances for the year amounted to ~~₦~~30,000
- v General expenses include:

	<del>₦</del>
Christmas gifts to customer	8,000
Alhaji Mai Chindodo's fine for traffic offence	10,000
Trade Magazines	2,000
Other Magazines	5,000
- vi. Alhaji Mai Chindodo is married with six children under 14 years of age and has a dependant relative
- vii Alhaji Mai Chindodo's Private use of business vehicle ~~₦~~10,000
- viii Alhaji Mai Chindodo has a life assurance policy on which he pays a premium of ~~₦~~20,000 annually.
- ix The loses brought forward from 2010 year of assessment is ~~₦~~10,000

You are required to compute Alhaji Mai Chindodo's Personal Income Tax Liability for 2011 year of assessment. (20 marks)

## SOLUTION

2 ALHAJI MAI CHIDODO

COMPUTATION OF INCOME TAX LIABILITY FOR 2011

	#	#
Net profit reported		
32,000		
Add: Expansion of store	20,000	
Depreciation	40,000	
Income Tax Provision	15,000	
Legal cost of Acquiring lease	10,000	
General Provision for Bad debts	36,000	
Rates & Electricity (1/3*30,000)	10,000	
Repairs (1/3*10,000)	3,334	
Rent (1/3*80,000)	26,667	
Fine for Traffic offence	10,000	
Other magazines	5,000	
Private use of Vehicle	<u>10,000</u>	
<u>186,001</u>		
218,001		
Deduct:		
Profit on sale of Fixed Assets	20,000	
Dividend	40,000	
Rent	<u>80,000</u>	
<u>(140,000)</u>		
Adjusted Profit		
78,001		
Loss b/f	10,000	
Relieved	<u>(10,000)</u>	
<u>(10,000)</u>		
		Nil
68,001		
Capital Allowance	30,000	
Relieved	<u>30,000</u>	
<u>(30,000)</u>		
		Nil
Adjusted Profit		
38,001		
Add: Unearned Income		
Dividend	40,000	

Rent	<u>80,000</u>
<u>120,000</u>	
Statutory Income	
158,001	
Less: Relief	
Personal Allowance (20% of 38,001) +5,000	12,600
Children Allowance	10,000
Insurance Premium	20,000
dependant Relative	<u>4,000</u>
<u>46,600</u>	
Chargeable Income	
<u>111,401</u>	
Tax Borne	
1 <sup>st</sup> 30,000 @ 5%	
1,500	
Next 30,000 @ 10%	
3,000	
Next 50,000 @ 15%	
7,500	
Next 1,401 @ 20%	
<u>280.2</u>	
12,280.20	
Less: Withholding Tax	
Dividend	
(4,000)	
Rent	
<u>(8,000)</u>	
Net Tax Due	
<u>280.2</u>	

- 3 The enactment of Industrial Development (Income Tax Relief) Act 1990 was one of the steps taken by the Federal Government of Nigeria to accelerate the industrial development of the country.

In relation to this law, you are required to:

- a State the conditions required for a company to qualify for a pioneer certificate

- (6 marks)
- b List five (5) important matters to be stated in the application for pioneer certificate (5 marks)
- c State the relief available under the Act. (2 marks)
- d State the reason why Production day is important to a pioneer company. (3 marks)
- e State two major tax advantages which the company enjoys after the expiration of the pioneer period. (4 marks)
- (Total: 20 marks)

### SOLUTION

- 3 a. The industrial Development (Income Tax Relief) Act 1990 as amended stipulate that
- for a company to qualify for a pioneer certificate, the Federal Executive Council must
- be satisfied that:
- An industry is not being carried on in the country on a scale suitable to the economic requirement of Nigeria, and there is need for development in that industry.
  - It is expedient in the public interest to encourage such industry
  - Minimum Capital Expenditure required is N50,000 and N150, 000 for indigenous controlled company and for any other company respectively.
- b. Five important matters to be stated in the application includes
- Whether the company will be indigenously controlled or otherwise
  - Particulars of Assets
  - Estimate of the probable date of production day
  - Particulars of loan and or share capital
  - Product and by-product to be manufactured.
- c. The relief stated in the law is that a pioneer company shall enjoy a tax free period of
- 3years which can be extended for a maximum of another period of 2years.
- d) Production day is important because the enactment of Industrial Development (Income Tax Relief) Act 1990 was one of the steps taken by the Federal Government of Nigeria to accelerate the industrial development of the country.



In relation to this law, you are required to:

- State the conditions required for a company to qualify for pioneer certificate
  - List (5) important matters to be stated in the application for pioneer certificate
  - State the Relief available under the Act
  - State the reason why Production day are important to a pioneer company
  - State two major tax advantages which the company enjoys after the expiration of the pioneer period:
    - Qualifying capital expenditure of the company must not fall below the statutory minimum as on that day.
    - That is the day when the tax free period starts to run
    - It must be certified by the Federal Inland Revenue Service as the date when the company starts production in commercial quantity.
- e) The two major tax advantages of a pioneer company after the expiration of the pioneer period are:
- The net qualifying expenditure for capital items during the pioneer period are accumulated and are qualified for both initial and annual allowances in the new business
  - The loss made in the pioneer period and certified as such by the FIRS (Board) is available for relief after the pioneer period.

- 4 a The enabling law on withholding tax requires that each withholding tax cheque paid to the relevant tax authority must be accompanied with a payment schedule, which is a list of those who suffer the deduction that makes up the amount on the cheque.

You are required to list out the particulars which must be stated in the payment schedule. (8

marks)

- b Jones (Nig.) Limited has been trading for many years and makes up its financial statements to 31<sup>st</sup> December annually.

The financial result for the years ended December 31<sup>st</sup> 2009 and 2010 (as adjusted for tax purposes were as follows:

	Year ended 31 <sup>st</sup> December	
	2009	2010
	₦	₦
Trading Profit	5,000,000	7,000,000
Gross Bank Interest Received	800,000	1,200,000

Gross Debenture Interest received	400,000	400,000
Dividend received from:		
Haris Ltd (Net)	360,000	360,000
Dividend paid to shareholders (Gross)	2,000,000	3,000,000

You are required to:

- i Compute the company's Income Tax Liabilities for the relevant years of assessment. Ignore capital Allowances. (4 marks)
  - ii Determine the net withholding tax payable or receivable by Jones (Nig.) Ltd, arising from dividends paid and received by it. (8 marks)
- (Total: 20 marks)

### SOLUTION

- 4 a. The particular which must be stated in the payment schedule forwarded to the relevant

tax authorities are:

- Name of the tax payers who suffered the deductions
- The addresses of the tax payers
- The nature of their activities/ services
- Their tax file number
- The total amount payable
- The rate of tax applied
- The amount of tax withheld
- The balance paid to the taxpayer
- The date of payment
- The tax period of the contract for which returns were being made
- The cheque numbers and dates.

- b) i JONES (NIGERIA) LIMITED

#### COMPUTTATION OF INCOME TAX LIABILITY

YEAR OF ASSESSMENT	2009	2010
	₦	₦
Trading Profit (adjusted)	5,000,000	7,000,000
Bank interest received	800,000	1,200,000
Debenture interest received	<u>400,000</u>	<u>400,000</u>
Total Profits	<u>6,200,000</u>	<u>8,600,000</u>
Tax Rate	30%	30%

	Tax Payable	1,860,000	2,580,000
	Education Tax (2% of Total Profit)	124,000	172,000
b.	ii.	<b>JONES (NIGERIA) LIMITED</b>	
		<b>Net Amount of Withholding Tax for 2009</b>	
		With Tax on Dividend received (Gross dividend	<del>₦</del>
		<del>₦</del> 360,000 * 10/9= N400,000 *10% Tax thereon)	(40,000)
		Withholding Tax on dividend paid (10% of N2,000,000)	<u>200,000</u>
		The Net Withholding Tax payable by the company	<u>160,000</u>
		<b>Net Amount of Withholding Tax for 2010</b>	
		With Tax on Dividend received (Gross dividend	<del>₦</del>
		<del>₦</del> 360,000 * 10/9= N400,000 *10% Tax thereon)	(40,000)
		Withholding Tax on dividend paid (10% of N3,000,000)	<u>300,000</u>
		The Net Withholding Tax payable by the company	<u>260,000</u>

5. Supersonic Limited is a foreign company operating a cable service in Nigeria, UK and other parts of the world. The following information is provided by the accountant as the company's operating results for the year ended 31<sup>st</sup> December 2007.

Income from cable services:	₦	₦
From Nigeria to UK		1,009,280
From US to Nigeria		1,360,000
From Nigeria to Italy		1,781,120
Other income from other areas		<u>1,120,000</u>
		5,270,400
Less; Administrative overheads:		
Salaries and perquisites	1,752,000	
Other expenses	1,128,000	
Depreciation	<u>512,000</u>	
		<u>3,392,000</u>
Net profit		<u>1,878,400</u>

The following additional information is provided:

i	Other expenses include:	
	Donation to Ikeja bomb blast victims through Nigeria Red Cross Society	250,000
	License fees paid to NCC	150,000
	Donations to Palace Democratic Party	350,000
ii	Capital Allowances as agreed with FIRS	768,000

You are required to compute:

- a. Total profit of Supersonic Limited that will be subjected to Nigeria tax for the 2008 year of assessment. (16 marks)



**SOLUTION**

- 1 a. Customs help in revenue collection by collecting taxes e.g VAT on goods and services
- Protects the community by debarring prohibited goods from being imported into the country.
  - Aids trade facilitation between countries and
  - Protection of national security
- b
- Reduction in foreign investment
  - Revenue leakage and fraud
  - Reduction in national security and community protection.
  - Increased costs which are ultimately borne by the community
  - Maintenance of barriers to international trade and economic growth.
  - Reduction in public trust and confidence in Government institutions.
  - Reduction in the level of trust and co-operation between customs administrations and other Government agencies
  - Reduction in the level of voluntary compliance with customs laws and regulation
  - Low staff morale and “esprit de corps”.
  - Promote bad governance
  - Aids capital flight
2. a. In accordance with the Standards for provision of Taxation Services 3, “who is a taxpayer”? (5 marks)
- b. Give four (4) examples of situation where information may be known to a CITN member from the returns of another taxpayer. (4 marks)
- c. For the purposes of the Customs valuation agreement, list out four (4) conditions in which persons shall be considered related. (8 marks)
- d. What do you understand by the term “general expenses” as contained in Article 5 of the Customs valuation agreement? (3 marks)
- (Total: 20 marks)

**SOLUTION**

- 2 a A taxpayer is a client, a member’s employer or any other third party recipient of tax services.

- b
- Husband and wife
  - Trustees and beneficiaries
  - Group of companies
  - Employers and employees
- c
- They are officers or directors of one another's business
  - They are legally recognized partners in business
  - They are employers and employees
  - Any person directly or indirectly owns, controls or holds 5% or more of the outstanding voting stock or shares or both of them.
  - One of them directly or indirectly controls the other.
  - Both of them are directly or indirectly are controlled by a third person
  - Together they directly or indirectly control a third person or
  - They are members of the same family. (8 marks)
- d
- General expenses include the direct and indirect costs of marketing the goods in question. (3 marks)
3. a. According to Value Added Tax Act, describe zero rated items. (4 marks)
- b. Enumerate the purposes and usefulness of the following major FORMS used in Value Added Tax operation in Nigeria:
- i. VAT Form 006 (1 mark)
  - ii. VAT Form 004 (1 mark)
  - iii. VAT Form 001 (1 mark)
  - iv. VAT Form 003 (1 mark)
  - v. VAT Form 002 (1 mark)
  - vi. VAT Form 005 (1 mark)
- c. A VATable product was sold by a wholesaler to a retailer at a price of ₦620,000. The manufacturer purchased its major inputs for ₦450,000. The product eventually got to the final consumer at a price of ₦820,000.
- You are required to compute the total VAT payable for the period. (10 marks)  
(Total: 20 marks)

## SOLUTION

3. a Zero – Rated items are Vatable goods whose applicable rate is zero percent (0%).

The Implication is that a refund of the VAT input is due.

b VAT FORM 001 – VAT Registration Form

Is a VAT registration form. In 2 parts A + B. The form is to be completed by all VATable persons for VAT. The explanatory Notes at the back of the form are also part of the form.

Part A is in 3 sections. Section 1(a) – (d) has the following items.

Name of VATable person, Place of business and not a P. O. Box, telephone and

E-mail address, TIN and date of incorporation or registration of business.

Section 2 is about the nature of business and type of goods and services.

Section 3 required the person to provide the date of commencement of business.

Part B is merely on certification. The signature of the principal officer of the VATable person is to be affixed. Other items on part B are the full names of the VATable person, Official Stamp, designation and date.

The Explanatory Notes at the back of the form interpretes the following terms VATable Person, Place of Business, Incorporation, Registration Number, Goods and Services. Date of Commencement of Business and Principal Officer.

VAT FORM 002

- Is a VAT Return form in duplicate, white and pink copies.
- The form is to be completed by a VATable person to show the transactions involving VAT for every month and remittance statement.
- The white copies are to be sent to the relevant tax office together with the payment due. While the duplicate copy (the pink) is retained by the VATable person for record purpose. There is an illustration to the VAT return form in 15 boxes. The boxes show details on supplies, purchases VAT deduction, VAT on imports, total VAT payable, total deductions etc. Two signatures will appear on the declaration part of the form to the effect that the particulars in this returns are true and correct. The VATable persons sign as well as the Tax Controller. Details on the e-ticket which has been checked by the controller will also appear on the form.

- The form must be completed and sent to the tax office even if no VATable supplies have occurred.

#### VAT FORM 003

This is the VAT return form completed by the tax office and sent to the regional office in a month.

#### VAT FORM 004

This is the VAT return form sent by a regional office for VAT collection to the Head office in Abuja

#### VAT FORM 005

Used to render returns and VAT collections made to the Federation Account in a given period.

#### VAT FORM 006

Used by Nigerian Custom Service to show VAT collected by the Service on a monthly basis

### 3c Computation of Total VAT Payable.

Computation of Total Output VAT	₦
Sales Value	820,000
VAT Output @ 5%	41,000
Computation of Total Input VAT	
Cost of Input	450,000
VAT Input @ 5%	22,500
Computation of Total VAT Payable	
VAT Output	41,000
Less:	
VAT Input	<u>22,500</u>
VAT Payable	<u>18,500</u>

#### Workings

$$1) \quad \frac{5}{100} \times 820,000 = 41,000$$

$$2) \quad \frac{5}{100} \times 450,000 = 22,500$$



4. a. How can damaged and neglected goods be disposed of? (8 marks)  
 b. What is End-use duty relief? (4 marks)  
 c. List out End-use goods that are qualified for end-use duty relief. (5 marks)  
 d. What are the conditions to be met before claiming End-use relief? (3 marks)  
 (Total: 20 marks)

### SOLUTION

- 4 a Goods can be disposed either by:
- Destroying the goods
  - Returning the goods to the supplier
  - Placing them under customs warehousing or free zone procedures
  - Delivering them free of charge to a charity
- b End use goods that are quality for end use duty relief.
- Ship work goods
  - Aircraft and parts
  - Hydrocarbon oil
  - Marine propulsion engine
  - Military equipment
  - Fish
  - Cheese
  - Casein (used in the cheese industry)
- c End – use duty relief means you pay either a reduced rate of import duty or none at all. (10 marks)
- d To be able to enjoy end user relief, the following conditions must be met.
- Authority must be given by the customs
  - The goods must be eligible for end user
  - The goods should be put to prescribed use within certain time
5. a. What are the tax incentives applicable to Free Trade Zone operations in Nigeria? (10 marks)  
 b. List the benefits of tax incentives offered by the relevant tax laws in Nigeria. (10 marks)  
 (Total: 20 marks)

## SOLUTION

- 5 a - Profits arising from the operations in the free trade zone is exempted from tax
- Plants, machinery and other equipments imported into the country for the use of free Trade Zone is exempted from VAT
  - Dividends received from the profits of the operation carried out in the free trade zone is also exempted from tax
  - There is also exemption from paying state and local government levies and taxes
  - Fixed asset brought into the country operation in the free Trade zone enjoys accelerated capital allowance.
  - Profits or gains of 100% export oriented undertaking established within and outside an export free zone shall be exempted from tax for the first three (3) consecutive assessment years provided that:
    - 1 the undertaking is 100% export oriented;
    - 2 the undertaking is not formed by splitting or breaking up or reconstructing a business already in existence,
    - 3 It manufactures, produces and exports articles during the relevant year and the exports proceeds form 75% of its turnover;
    - 4 The undertaking is not formed by transfer of machinery or plant previously used for any purpose to the new undertaking or where machinery or plants previously used for any purpose is transferred does not exceed 25% of the total value of the machinery or the undertaking
    - 5 The undertaking repatriates at least 75% of the export earnings to Nigeria and replaces it in a domiciliary account in any registered and licensed bank in Nigeria
- b - Stimulation of production

- Acceleration of rate of economic development
- Improvement on the standard of living
- Diversification of revenue base
- Enhancement of income redistribution
- Encouragement of foreign investors
- Encouragement of tax compliance
- Increase in revenue base
- Serving as a tool for tax planning
- Aids tax management

### PT 1 QUANTITATIVE TECHNIQUE

- 1 a. Write short notes on the following sampling techniques:
- i. Simple random sampling. (3 marks)
  - ii. Stratified random sampling. (3 marks)
  - iii. Systematic random sampling. (3 marks)
  - iv. Cluster sampling. (3 marks)
- b. What do you understand by the term correlation? (2 marks)  
 Illustrate the following by means of scatter diagrams:
- i. Perfect negative correlation. (2 marks)
  - ii. Weak positive correlation. (2 marks)
  - iii. No correlation (2 marks)
- (8 marks)  
(Total: 20 marks)

### SOLUTION

- 1 a (i) **Simple Random Sampling**
- A process of selecting a sample from a population where every member of the population has an equal chance of being selected. |e.g in selecting the winning numbers in a lottery. (3 marks)
- (ii) **Stratified Random Sampling**
- A modification of simple random sampling whereby the population is divided into sub-populations called strata's and a simple random sample is carried out within each strata. The selected samples from each strata are then combined to represent a sample of the whole population. (3 marks)
- (iii) **Systematic Random Sampling**
- The items or individuals in a population are arranged in some logical way e.g serially. The array of data, etc is then divided into bands from which one or more items are selected in a systematic manner. For instance, in selecting

100 invoices for a vouching test in a population of 1000 invoices, every 10<sup>th</sup> invoice may be selected. The first invoice is randomly selected from the first band of 10 invoices. If for instance the 3<sup>rd</sup> invoice is selected, then other members of the sample will be the 13<sup>th</sup>, 23<sup>rd</sup>, 33<sup>rd</sup>, etc invoices.

(3 marks)

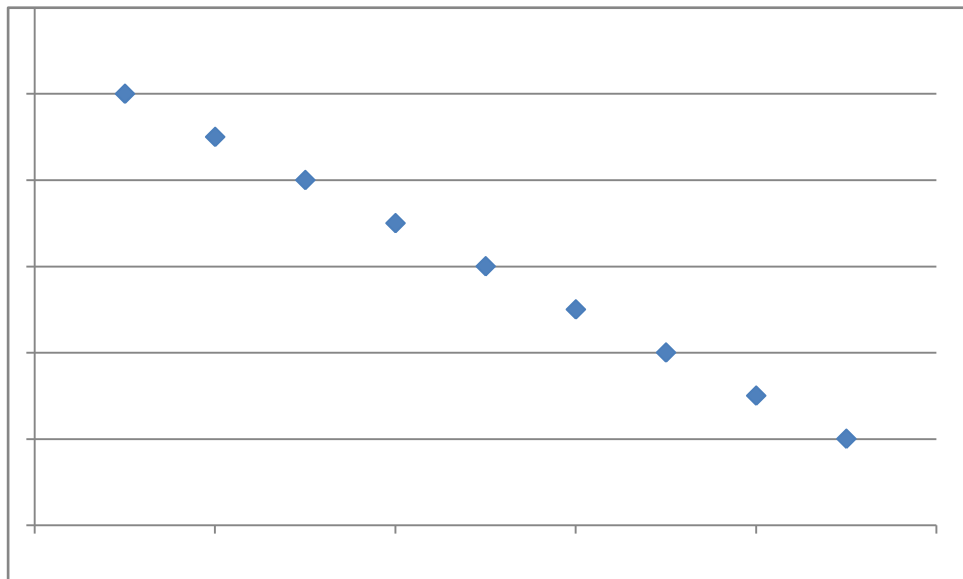
(iv) **Cluster Sampling**

This sampling technique is used when a population is dispersed over a wide geographical area and there are constraints in reaching all the members of the population. The population is divided into clusters. A particular cluster which is considered as having all or nearly all the characteristics of the population is then selected for study. All the items in the cluster, without exception, are included in the sample.

(3 marks)

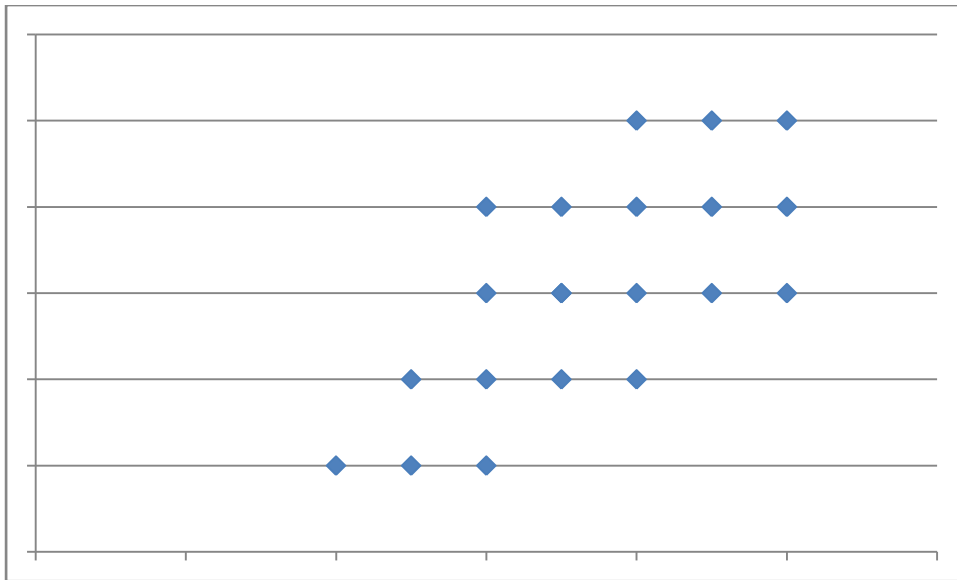
b). Correlation is the degree of linear association between two variables. An example is the price of a particular item and the quantity demanded.

(i)



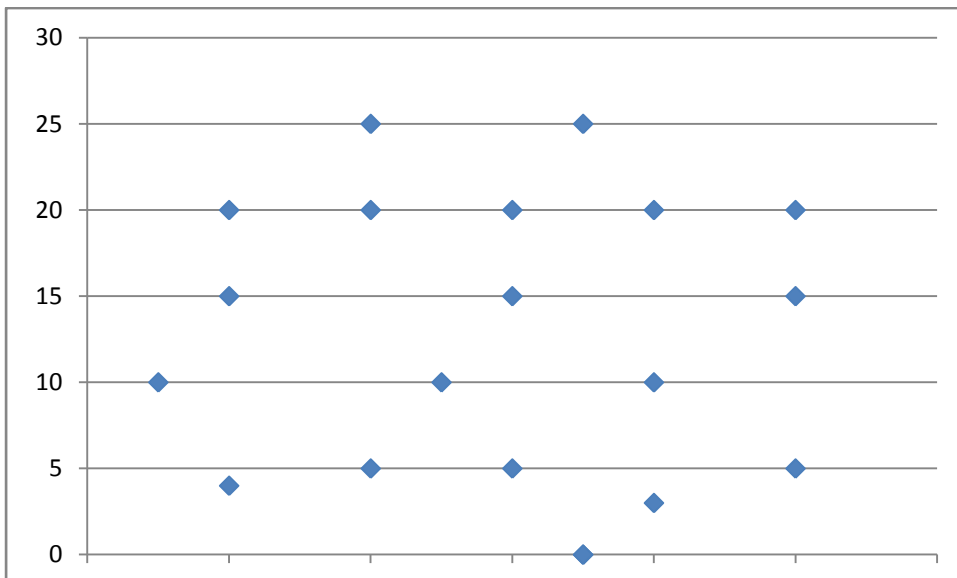
Perfect Negative Correlation

(2 marks)



Weak Positive Correlation

(2 marks)



No Correlation

(2 marks)

2. A survey of a small town of 20,000 households provided the following data:  
 60% of the households have a refrigerator,  
 35% of the households have a telephone,  
 15% of the households have a colour-television set,  
 18% of the households have both a refrigerator and a telephone,  
 12% of the households have both a telephone and a colour-television set,  
 10% of the households have both a refrigerator and a colour-television set,  
 8% of the households have a refrigerator, a telephone and a colour-television set.  
 Required:

a. Calculate:

- i. The number of households having both a refrigerator and a telephone but not a colour-television set. (2 marks)

- ii. The number of households having both a refrigerator and a colour-television set but not a telephone. (2 marks)
  - iii. The number of households having both a telephone and a colour-television set but not a refrigerator. (2 marks)
  - iv. The number of households having a refrigerator only. (2 marks)
  - v. The number of households having a telephone only. (2 marks)
  - vi. The number of households having a colour-television set only. (2 marks)
  - vii. The number of households having neither refrigerator nor telephone nor a colour-television set. (2 marks)
- b. Draw a venn diagram to show household possessions in the small town. (6 marks)
- (Total: 20 marks)

**SOLUTION**

- 2 a Let X represent the number of households having a refrigerator
- b Let Y represent the number of households having a telephone
- c Let Z represent the number of households having a colour TV set

Given:

60% of 20,000 households have a refrigerator (X) = 12,000 households

35% of 20,000 households have a telephone (Y) = 7,000 households

15% of 20,000 households have a colour TV set (Z) = 3,000 households

18% of 20,000 households have both a refrigerator and a telephone

$$(X \cap Y) = 3,600 \text{ households}$$

12% of 20,000 households have both a telephone and a colour TV set

$$(Y \cap Z) = 2,400 \text{ households}$$

10% of 20,000 households have both a refrigerator and a colour TV set

$$(X \cap Z) = 2,000 \text{ households}$$

8% of 20,000 households have a refrigerator, a telephone and a colour TV set

$$(X \cap Y \cap Z) = 1,600 \text{ households}$$

- (i) No of households having both a refrigerator and a telephone but not a colour TV set

$$= X \cap Y - X \cap Y \cap Z = 3,600 - 1,600 = 2,000 \text{ households}$$

- (ii) No of households having both a refrigerator and a colour TV set but not a refrigerator

$$= X \cap Z - X \cap Y \cap Z = 2000 - 1600 = 400 \text{ households}$$

- (iii) No of households having both a telephone and a colour TV set but not a refrigerator

$$= Y \cap Z - X \cap Y \cap Z = 2400 - 1600 = 800 \text{ households}$$

(iv) No of households having a refrigerator only

$$= X - (2000 + 1600 + 400) = 12000 - 4000$$

$$= 8000 \text{ households}$$

(v) No of households having a telephone only

$$= Y - (2000 + 1600 + 800) = 7000 - 4400$$

$$= 2,600 \text{ households}$$

(vi) No of households having a colour TV set only

$$= Z - (1600 + 400 + 800) = 3000 - 2800$$

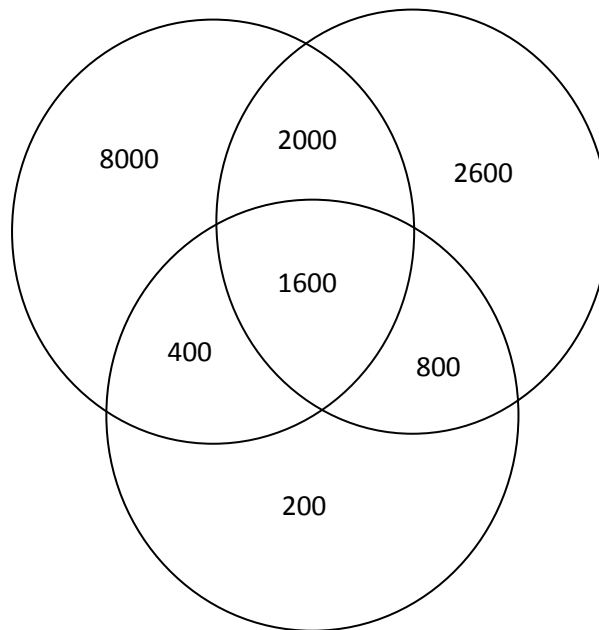
$$= 200 \text{ households}$$

(vii) No of households that have neither a refrigerator, nor a telephone, nor a colour TV set

$$= 20,000 - (1600 + 8000 + 2600 + 200 + 2000 + 400 + 800)$$

$$= 20,000 - (15,600) = 4,400 \text{ households}$$

X(Refrigerator)



Y(Telephone)

Z(Colour TV set)

Venn Diagram showing household possessions

- 3 a. Define the following in relation with probability:
- i. Mutually exclusive events. (2 marks)
  - ii. Independent events. (2 marks)
  - iii. Addition rule. (2 marks)
  - iv. Multiplication rule. (2 marks)
- b. In a factory, there is an 80% probability that a machine is set up correctly, and a 90% probability that a good part will be produced if the machine is correctly set up. On the other hand, a bad part will be produced 95% of the time if the machine is not correctly set up.
- On March 28, 2012, the machine was set up and a bad part was produced.
- What is the probability that the machine is incorrectly set up? (12 marks)

(Total: 20 marks)

**SOLUTION**

- 3 b (i) **Mutually Exclusive Events:** are events which cannot happen at the same time.

The occurrence of one of the events precludes the occurrence of the other.  
e.g A person cannot be classified as "Male" and "Female" at the same time.

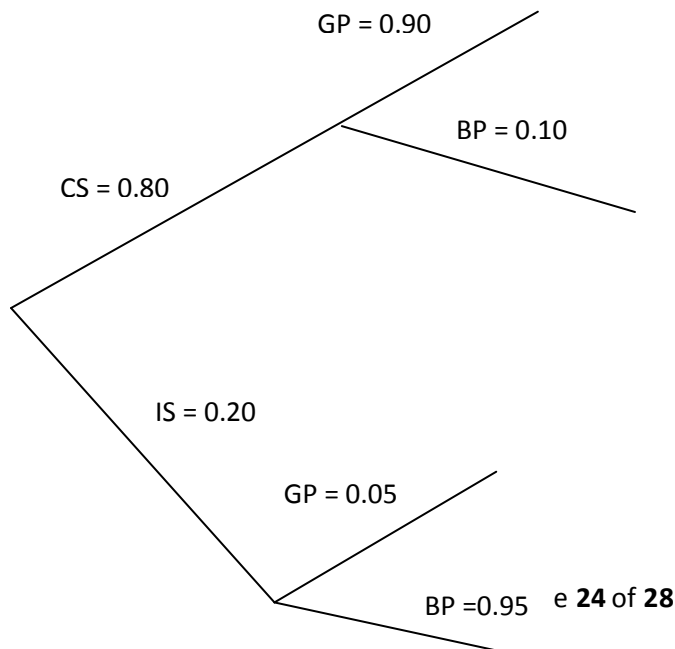
(2 marks)

- (iii) **Independent Events** – Two or more events are independent if the occurrence or non-occurrence of any of the events does not affect the occurrence or non-occurrence of the others. e.g the outcome of any toss of a coin is independent of the outcome of any preceding or succeeding tosses. (2 marks)

- (iv) **Multiplication Rule (AND):**  $P(X \text{ and } Y) = P(X) \times P(Y)$

This rule is used when there is a string of independent events for which each individual probability is known and it is required to know the overall probability.

(2 marks)



CS = Correct Set up
IS = Incorrect Set up
GP = Good Part
BP = Bad Part



$$CSGP = 0.80 \times 0.90 = 0.72$$

$$CSBP = 0.80 \times 0.10 = 0.08$$

$$ISGP = 0.20 \times 0.05 = 0.01$$

$$ISBP = 0.20 \times 0.95 = 0.19$$

- i. Probability of getting a Bad Part =  $0.08 + 0.19 = 0.272$
- ii. Probability that machine is incorrectly setup after getting a bad part

$$= \frac{ISBP}{CSBP+ISBP} = \frac{0.19}{0.08+0.19}$$

$$= \frac{0.19}{0.27} = 0.704$$

4. a. A new machine is expected to last for six (6) years and to produce yearly savings of ₦2,500,000.

What is the maximum sum worth paying for the machine, assuming compound interest rate at 10% per annum? (8, marks)

- b. A new machine costs ₦6,250,000 and will replace existing equipment whose scrap value is ₦1,250,000. The new machine will produce year end savings in running costs of ₦750,000 a year.

Assuming that the company's cost of capital is 8.5% per annum, analyse how long the machine must last in order for it to be worth buying. (The old machine could carry on working but would produce no savings in running costs).

Note that you are expected to clearly tabulate your workings. (12 marks)

(Total: 20 marks)

### SOLUTION

- 4 (a)

Yr	Cash Inflows	Discounting Factor	Present Value
	₦	(10.0%)	₦
1	2,500,000	0.9091	2,272,750
2	2,500,000	0.8264	2,066,000
3	2,500,000	0.7513	1,878,250
4	2,500,000	0.6830	1,707,500
5	2,500,000	0.6209	1,552,250
6	2,500,000	0.5645	1,411,250
Net Present Value			10,888,000

The maximum sum worth paying for the machine is equal to the net present value (NPV) of the future cash in flows = ₦10,888,000

- b.
- |                                  |           |
|----------------------------------|-----------|
|                                  | ₦         |
| Cost of new machine              | 6,250,000 |
| Less: Scrap value of old machine | 1,250,000 |

Net investment in new machine

5,000,000

Yr	Cash Inflows	Discounting Factor	Present Value	Cumulative Present Value
		(8.5%)	₦	₦
1	750,000	0.9217	691,275	691,275
2	750,000	0.8495	637,125	1,308,400
3	750,000	0.7829	587,175	1,895,575
4	750,000	0.7216	541,200	2,436,775
5	750,000	0.6650	498,750	2,935,525
6	750,000	0.6129	459,675	3,395,200
7	750,000	0.5649	423,675	3,818,875
8	750,000	0.5207	390,525	4,209,400
9	750,000	0.4799	359,925	4,569,325
10	750,000	0.4423	331,725	4,901,050
11	750,000	0.4076	305,700	5,206,750

Conclusion: The machine must last for at least eleven (11) years to be worth of buying

5. Simplex Limited manufactures two brands of bathing soap, Classic and Deluxe. The company has furnished you with the following data relating to the production and sales of the two products:

	Classic	Deluxe
Selling price per unit	₦85	₦120
Variable cost of production per unit	₦80	₦112
Material A required per unit	4 grams	5 grams
Material B required per unit	5 grams	3 grams
Material C required per unit	-	4 grams
Grade A Labour required per unit	2 ½ minutes	5 minutes
Grade B Labour required per unit	4 minutes	2 minutes

The maximum quantity of Deluxe that can be sold is 150,000 units per month. If only 900 kilograms of Material A and 10,000 hours of Grade B labour will be available in a particular month.

Required:

- Formulate a linear programming model clearly showing the objectives and constraints. (7 marks)
- Solve the problem using the graphical approach, highlighting the feasible region. (7 marks)
- Advise management based on an interpretation of your solution in (b) (3 marks)

- d. What are the basic assumptions made by you in using this method to arrive at your solution? (3 marks)  
(Total: 20 marks)

**SOLUTION**

- 5 (a) Let the quantities of Classic and Deluxe produced be X and Y respectively.

Objective: Maximise  $5x + 8y$

Subject to the following constraints:

$$4x + 5y \leq 900,000 \text{ (Material A)}$$

$$4x + 2y \leq 600,000 \text{ (Grade B Labour)}$$

$$Y \leq 150,000 \text{ (Demand for Deluxe)}$$

$$x, y \leq 0 \text{ (Non-negativity)}$$

(Note: the question had 9000 for Material A and 10,000 for Grade B Labour. This was an error in the question affecting non-negative constraints of the linear programming principle)

- b) i At point d:

$$4x + 5y = 900,000$$

$$Y = 150000$$

$$4x + 5(150,000) = 900,000$$

$$4x = 900,000 - 750,000 = 150,000$$

$$x = \frac{150000}{4} = 37,500$$

- ii. Total Contribution

$$= 5(37,500) + 8(150,000)$$

$$= 187,500 + 1,200,000 = \text{N}1,387,500$$

- c) Point d on the graph is the optimal solution to the linear programming problem. Therefore, the management of Simplex Limited is advised to produce 37,500 units of Classic and 150,000 units of Deluxe. This product mix would produce the highest contribution of ~~N~~1,387,500. (3 marks)

- d (i) Linearity – unit selling prices and variable costs of production are fixed per unit and vary directly with output.
- ii) Continuous variables are allowed e.g It is allowed to produce one-half of a car, even if this is not realistic in real life.

- iii) Certainty – No allowance is made for probabilistic elements in the allocation problem. All the objective and constraint coefficients are assumed to be fixed and known.
- iv) Non-negativity. Negative quantities cannot be produced.