UNIVERSITY EXAMINATIONS

UNIVERSITEITSEKSAMENS

UNISA university of south africa

DSC1520 (475250) May/June 2017

QUANTITATIVE MODELLING I

Duration 2 Hours 100 Marks

EXAMINERS :
FIRST DR M FICK
SECOND MS CH PAPENFUS

Programmable pocket calculator is permissible

Closed book examination.

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This paper consists of 21 pages including paper for rough work plus instructions for completing a mark-reading sheet The paper comprises 30 questions that count a total of 100 marks

Please complete the attendance register on the back page, tear it off and hand it to the invigilator.

Answer ALL questions on the mark-reading sheet supplied Carefully follow the instructions for completing the mark-reading sheet Also pay attention to the following

- Only one option (indicated as [1] [2] [3] [4] [5]) per question is correct Do not mark more than one option per question on the mark-reading sheet
- Marks will not be deducted for incorrect answers

You are strongly advised to write your name on the mark-reading sheet. Then, if you have entered your student number incorrectly, we will still be able to link you to the mark-reading sheet.

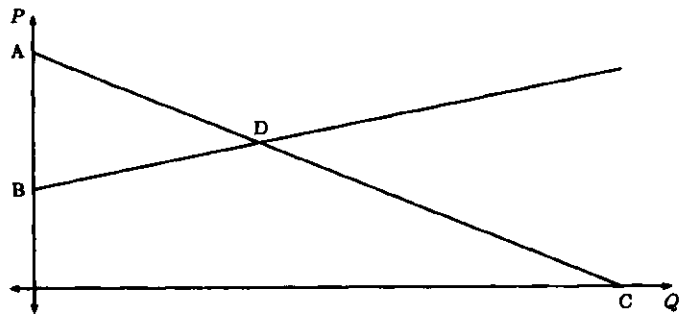
Questions 1 and 2 are based on the following information:

The demand and supply functions for accommodation at a B&B are given by

$$P_d = 952 - 8Q \quad \text{and} \quad P_s = 400 + 4Q,$$

where P is the price per room and Q is the number of rooms occupied

The following graph represents these functions



Question 1

The coordinates of the intercepts at A, B and C are

[1] A = (0, 95,2), B = (0, 40), C = (11,9; 0).

[2] A = (0, 100), B = (0; 119), C = (952, 0).

[3] A = (0, 119), B = (0, 100), C = (400; 0)

[4] A = (0, 952), B = (0, 400), C = (119; 0)

[5] none of the above

Question 2

What does point D represent? Provide the coordinates at point D

[1] Break-even, D = (46,67; 586,68)

[2] Equilibrium, D = (46, 584)

[3] Equilibrium, D = (587; 47)

[4] Break-even, D = (47, 587)

[5] None of the above

Question 3

Consider the demand function

$$P = 100 - 5Q,$$

with P being price and Q quantity Find the price elasticity of demand when $Q = 8$ Is demand elastic or inelastic? Justify your answer.

[1] $\varepsilon_d = -1{,}5$, demand is elastic, $\varepsilon_d < -1$.

[2] $\varepsilon_d = -0{,}03$; demand is inelastic; $|\varepsilon_d| < 0$

[3] $\varepsilon_d = 0{,}5$, demand is elastic, $|\varepsilon_d| > 0$.

[4] $\varepsilon_d = 1{,}5$, demand is inelastic; $\varepsilon_d > 1$

[5] None of the above

Rough work

Question 4

The demand function of a certain product is given by

$$P = 100 - 20Q,$$

where P is price per item and Q is the number of units produced (in thousands) The daily fixed costs amount to R40 and the production cost per unit is R10 How many units should be produced per day to break even?

[1] 0,5 or 4

[2] 200

[3] 4 000

[4] 500 or 4 000

[5] None of the above

Question 5

Workers at a building site have the option to eat lunch provided by an outside company When the price per lunch is R40, there is a demand for 80 lunches It is known that for each R5 increase in price, demand decreases by three lunches Determine the demand function for lunches with quantity demanded (Q) as a function of price (P)

[1] $Q = 104 - 0{,}6P$

[2] $Q = 136{,}67 - 1{,}67P$

[3] $Q = 56 + 0{,}6P$

[4] $Q = 40 - \frac{3}{5}P$

[5] None of the above

Question 6

John manufactures wooden toys for a flee market His marginal cost function is given by

$$MC = 2Q^2 - 8Q + 10,$$

where Q is the number of units manufactured It is known that his fixed costs amount to R100 John's total cost function is

[1] $TC = 4Q + 92$

[2] $TC = \frac{2}{3}Q^3 - 4Q^2 + 100.$

[3] $TC = \frac{2}{3}Q^3 - 4Q^2 + 10Q + 100.$

[4] $TC = 2Q^2 - 8Q + 110$

[5] none of the above

Rough work

Question 7

Find the derivative of the function

$$f(x) = \frac{x^2+6}{2x+5}.$$

Simplify your answer

[1] $-\frac{2(x+6)(x-1)}{(2x+5)^2}$

[2] $\frac{2(x+6)(x-1)}{(2x+5)^2}$

[3] $\frac{2x-12}{(2x+5)^2}$

[4] $-\frac{2(x^2+6)}{(2x+5)^2}$

[5] None of the above

Question 8

A firm has the following total revenue and cost functions:

$$TR = 40Q - 8Q^2 \quad \text{and} \quad TC = 8 + 16Q - Q^2,$$

where Q is the number of units produced and sold (in thousands).

How many units should be produced to maximise profit?

[1] 1,714

[2] 3,111

[3] 1 714

[4] 3 111

[5] None of the above.

Question 9

Demand for a certain type of bicycle is modelled by the function

$$P = 850 - 8Q^2,$$

where P is the price per bicycle and Q the number of bicycles demanded

Find the consumer surplus when six bicycles are demanded. What does this value mean?

[1] $CS = 562$; consumers are willing to pay R562 more per bicycle than they actually pay

[2] $CS = -4\,250$, consumers pay R4 250 more for six bicycles than they should

[3] $CS = -1\,152$, consumers are willing to pay R1 152 less than they actually pay

[4] $CS = 1\,152$; consumers are willing to pay R1 152 more for 6 bicycles than they actually pay.

[5] None of the above.

Rough work

Question 10

Bongi supplies trays of fresh sandwiches to offices daily Her daily fixed costs amount to R744, while her variable cost is R17 per tray Bongi's total cost and marginal cost functions (in terms of the number of trays supplied, Q) are given by

[1] $TC = 17 + 744Q, \ MC = 744$

[2] $TC = 744 + 17Q, \ MC = 17$

[3] $TC = 761Q, \ MC = 761Q$

[4] $TC = 744Q - 17 \ \ MC = -17$

[5] none of the above

Question 11

The demand and supply functions for a product are given by

$$P_d = 136 - 4Q \quad \text{and} \quad P_s = 14 + 5Q,$$

where P is price and Q is quantity By working throughout with values rounded to two decimals, the producer surplus at equilibrium is

[1] 459,41

[2] 461,09

[3] 474,46

[4] 649,25

[5] none of the above

Question 12

Integrate the function

$$f(t) = \frac{t^{10} - \sqrt{t}}{t^3}$$

[1] $0{,}125t^8 - 0{,}67t^{-1{,}5} + c$

[2] $7t^6 + 2{,}5t^{-3{,}5}$

[3] $\frac{t^8}{8} + \frac{2}{3\sqrt{t^3}} + C$

[4] $\frac{10t^9 - 0{,}5t^{-0{,}5}}{3t^2}$

[5] None of the above

Question 13

Use the rules of logarithms to solve the equation

$$\ln(3x + 1) - \ln(5 + x) = \ln(2)$$

[1] $x = 1{,}5$

[2] $x = 1{,}8$

[3] $x = 9$

[4] $x = 11$

[5] None of the above

Rough work

Question 14

The consumer price index (CPI) of a country is approximated by the function

$$C(t) = 170{,}63e^{0{,}03t},$$

where t is the number of years from now ($t = 0$). Approximately how long will it take for the CPI to reach 220?

[1] 4,5 years

[2] 8,5 years

[3] 130 years

[4] 351 years

[5] None of the above

Question 15

Solve the following system of simultaneous equations

$$\begin{aligned} x + y + z &= 5 && (1) \\ 2x + y - z &= 2 && (2) \\ x - y + z &= -2 && (3) \end{aligned}$$

[1] $x = 0;\ y = 7;\ z = -3{,}5$

[2] $x = 0,\ y = 3{,}5,\ z = 1{,}5$

[3] $x = 1{,}33,\ y = 1{,}5,\ z = 2{,}17$

[4] $x = 21;\ y = 16;\ z = -7$

[5] No solution exists.

Question 16

An animal feed is to be made from corn, soybean and cottonseed. The feed should supply 1 800 units of fiber, 2 800 units of fat and 2 200 units of protein. The number of units of fiber, fat and protein that one unit of each ingredient provides, is shown in the following table.

Units of	Corn	Soy-bean	Cotton-seed	Required
Fiber	10	20	30	1 800
Fat	30	20	40	2 800
Protein	20	40	25	2 200

If X, Y and Z are the number of units of corn, soybean and cottonseed required, respectively, then the system of equations representing the constraints on making the feed with these requirements is

[1] $X + 2Y + 3Z = 18,\ 3X + 4Y + 2{,}5Z = 28;\ 2X + 4Y + 2{,}5Z = 22$

[2] $X + 3Y + 2Z = 180,\ 2X + 2Y + 4Z = 280;\ 3X + 4Y + 2{,}5Z = 220$

[3] $10X + 20Y + 30Z = 1\,800;\ 30X + 20Y + 40Z = 2\,800,\ 20X + 40Y + 25Z = 2\,200$

[4] $10X + 30Y + 20Z = 1\,800;\ 20X + 20Y + 40Z = 2\,800;\ 30X + 40Y + 25Z = 2\,200$

[5] none of the above.

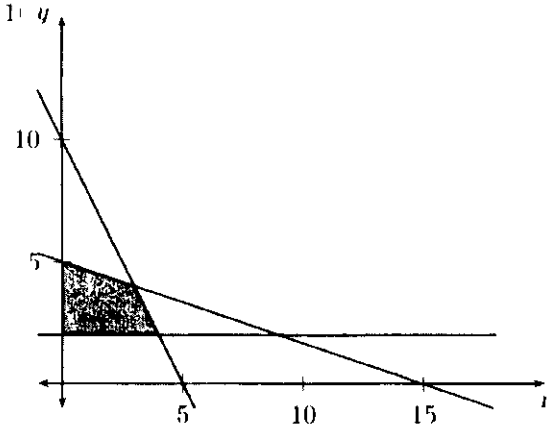
Rough work

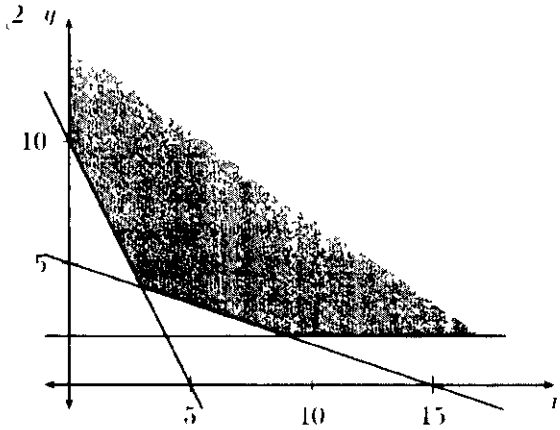
Questions 17 and 18 are based on the following LP model:

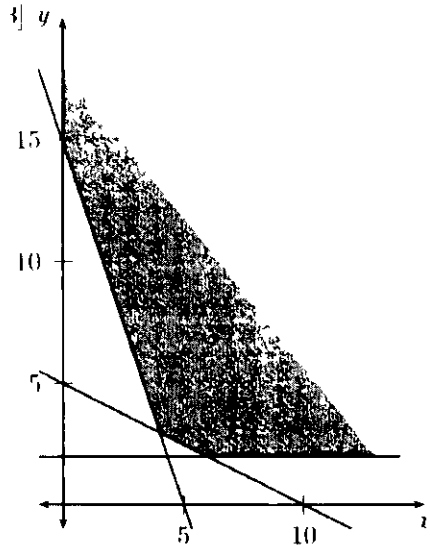
$$\begin{aligned} \text{Minimise} \quad & Z = 1{,}8x + 1{,}2y \\ \text{subject to} \quad & 2x + 6y \geq 30 \\ & 4x + 2y \geq 20 \\ & y \geq 2 \\ & x \geq 0 \end{aligned}$$

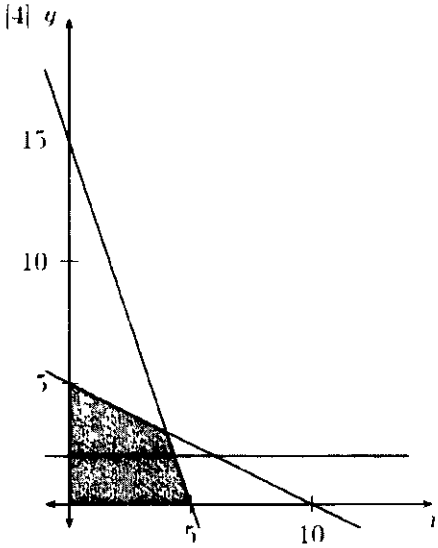
Question 17

The feasible region for this model is given by









[5] none of the above

Rough work

Question 18

The optimal solution is

[1] $x = 5,\ y = 0;\ Z = 9{,}00$

[2] $x = 3,\ y = 4,\ Z = 10{,}20$

[3] $x = 0,\ y = 10,\ Z = 12{,}00$

[4] $x = 9;\ y = 2;\ Z = 18{,}60.$

[5] none of the above

Question 19

The demand and supply functions for a certain commodity are

$$P_d = 150 - 6Q^2 \quad \text{and} \quad P_s = 10Q^2 + 2Q,$$

where P is price and Q is quantity The equilibrium quantity and price are

[1] $Q_e = 3{,}125,\ P_e = \text{R}91{,}41$

[2] $Q_e = 3;\ P_e = \text{R}96{,}00$

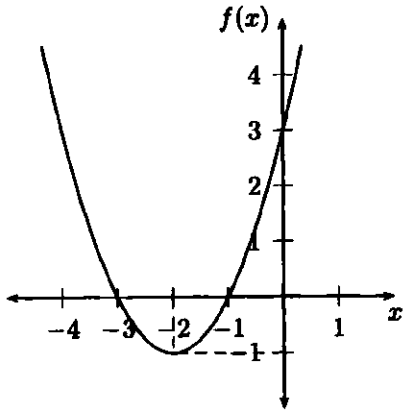
[3] $Q_e = 6;\ P_e = \text{R}66{,}00$

[4] $Q_e = 13,\ P_e = \text{R}864.$

[5] none of the above.

Question 20

Consider the following graph·



The quadratic function graphed here, is

[1] $f(x) = -x^2 + 4x + 3$

[2] $f(x) = -2x^2 + 2x - 3$

[3] $f(x) = x^2 - 4x + 3.$

[4] $f(x) = x^2 + 4x + 3$

[5] none of the above

Rough work

Question 21

The annual revenue (in millions of rand) generated by a television company can be approximated by the function

$$f(t) = 5{,}78 + 8{,}59 \ln t,$$

where t is the number of years since the company started The rate of change in revenue 15 years after the company started, is

[1] R0,57 per annum

[2] R6,35 per annum

[3] R572 667 per year

[4] R87 272 667 per year.

[5] none of the above.

Question 22

Find the derivative of the function

$$f(x) = e^{x^2-3x}.$$

[1] $(2x-3)e^{x^2-3x}$

[2] e^{x^2-3x}

[3] $\frac{e^{x^2-3x}}{2x-3}$

[4] $2xe^{x^2-3x} + 3e^{x^2-3x}$

[5] None of the above

Question 23

The demand for seats at a mini soccer match is given by

$$Q = 192 - P^2,$$

where Q is the number of seats and P is the price per seat Find the price elasticity of demand if seats cost R6 each What does this value mean?

[1] $\varepsilon_d = -0{,}46$; inelastic since $|\varepsilon| < 1$, a 1% price increase will result in 0,46% less seats to be sold

[2] $\varepsilon_d = 0{,}46$; elastic since $|\varepsilon| > 0$, a 1% price increase will result in 0,46% more seats to be sold

[3] $|\varepsilon_d| = -0{,}5 < 0$, demand is inelastic

[4] $\varepsilon_d = -\frac{P^2}{Q}$ which is always < 0, demand is always elastic

[5] None of the above

Question 24

Find the derivative of the function

$$f(x) = 3x^3 - \frac{1}{x} + e^{2x}$$

[1] $9x^2 - \frac{1}{x^2} + 2e^{2x}$

[2] $9x^2 + \frac{1}{x^2} + e^{2x}$

[3] $9x^2 + \frac{1}{x^2} + 2e^{2x}$

[4] $\frac{3x^2}{4} - \ln x + \frac{e^{2x}}{2}$

[5] None of the above

Rough work

Question 25

Customers of a hardware store are willing to buy

$$Q = 80 - P^2$$

boxes of nails at P rand per box Find the marginal revenue if the price per box is R3

[1] -6

[2] 53

[3] 71

[4] 213

[5] None of the above

Question 26

Evaluate the definite integral

$$\int_{-1}^{2} (9x^2 - 4x + 1)\,\mathrm{d}x$$

[1] 11

[2] 17

[3] 24

[4] 51

[5] None of the above

Questions 27 and 28 are based on the following function:

$$f(x) = x^3 - 6x^2 + 1$$

Question 27

The second derivative of f is

[1] $\frac{\mathrm{d}^2y}{\mathrm{d}x^2} = -24$

[2] $f''(x) = 3x(x-4)$

[3] $f'(2) = -24.$

[4] $f''(x) = 6x - 12$

[5] none of the above

Question 28

The turning points of f and the nature of each are

[1] $x = 0$ (maximum) and $x = 4$ (minimum)

[2] $x = 0$ (maximum) and $x = 1{,}33$ (minimum).

[3] $x = 0$ (minimum) and $x = 4$ (maximum)

[4] $x = 2$ (minimum)

[5] none of the above

Rough work

Question 29

If the slope of the function f is given by

$$6x^2 - 4x - 3,$$

and it is known that f goes through the point $(0, 1)$, then

[1] $f(x) = 12x - 4$

[2] $f(x) = 6x^3 - 4x^2 - 3x - 1$

[3] $f(x) = 3x^3 - 2x^2 - 3x + 1$

[4] $f(x) = 2x^3 - 2x^2 - 3x + 1$

[5] none of the above

Question 30

Find the integral

$$\int x^2\sqrt{x^3+5}\,\mathrm{d}x$$

[1] $\frac{1}{9}\sqrt{(x^3+5)^3} + C$

[2] $\frac{2}{9}\sqrt{(x^3+5)^3} + C$

[3] $\frac{1}{2}(x^3+5)^{\frac{3}{2}} + C$

[4] $\frac{2}{3\sqrt{x^3+5}} + C$

[5] None of the above

TOTAL: [100]

Rough work

UNIVERSITY OF SOUTH AFRICA UNISA university of south africa UNIVERSITEIT VAN SUID-AFRIKA

EXAMINATION MARK READING SHEET EKSAMEN-MERKLEESBLAD

PART 1 (GENERAL/ALGEMEEN) DEEL 1

*STUDY UNIT e g PSY100 X
STUDIE EENHEID bv PSY100-X

1

PAPER NUMBER
VRAESTELNOMMER 2

INITIALS AND SURNAME
VOORLETTERS EN VAN 3

DATE OF EXAMINATION
DATUM VAN EKSAMEN 4

EXAMINATION CENTRE (E G PRETORIA)
EKSAMENSENTRUM (BV PRETORIA) 5

STUDENT NUMBER
STUDENTENOMMER 6 7

UNIQUE PAPER NO
UNIEKE VRAESTEL NR 8 9

For use by examination invigilator

Vir gebruik deur eksamenopsiener

IMPORTANT

1 USE ONLY AN HB PENCIL TO COMPLETE THIS SHEET
2 MARK LIKE THIS
3 CHECK THAT YOUR INITIALS AND SURNAME HAS BEEN FILLED IN CORRECTLY
4 ENTER YOUR STUDENT NUMBER FROM LEFT TO RIGHT
5 CHECK THAT YOUR STUDENT NUMBER HAS BEEN FILLED IN CORRECTLY
6 CHECK THAT THE UNIQUE NUMBER HAS BEEN FILLED IN CORRECTLY
7 CHECK THAT ONLY ONE ANSWER PER QUESTION HAS BEEN MARKED
8 DO NOT FOLD

BELANGRIK

1 GEBRUIK SLEGS N HB POTLOOD OM HIERDIE BLAD TE VOLTOOI
2 MERK AS VOLG
3 KONTROLEER DAT U VOORLETTERS EN VAN REG INGEVUL IS
4 VUL U STUDENTENOMMER VAN LINKS NA REGS IN
5 KONTROLEER DAT U DIE KORREKTE STUDENTENOMMER VERSTREK HET
6 KONTROLEER DAT DIE UNIEKE NOMMER REG INGEVUL IS
7 MAAK SEKER DAT NET EEN ALTERNATIEF PER VRAAG GEMERK IS
8 MOENIE VOU NIE

PART 2 (ANSWERS/ANTWOORDE) DEEL 2

10

1	c1	c2	c3	c4	c5	36	c1	c2	c3	c4	c5	71	c1	c2	c3	c4	c5	106	c1	c2	c3	c4	c5
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30	c1	c2	c3	c4	c5	65	c1	c2	c3	c4	c5	100	c1	c2	c3	c4	c5	135	c1	c2	c3	c4	c5
31	c1	c2	c3	c4	c5	66	c1	c2	c3	c4	c5	101	c1	c2	c3	c4	c5	136	c1	c2	c3	c4	c5
32	c1	c2	c3	c4	c5	67	c1	c2	c3	c4	c5	102	c1	c2	c3	c4	c5	137	c1	c2	c3	c4	c5
33	c1	c2	c3	c4	c5	68	c1	c2	c3	c4	c5	103	c1	c2	c3	c4	c5	138	c1	c2	c3	c4	c5
34	c1	c2	c3	c4	c5	69	c1	c2	c3	c4	c5	104	c1	c2	c3	c4	c5	139	c1	c2	c3	c4	c5
35	c1	c2	c3	c4	c5	70	c1	c2	c3	c4	c5	105	c1	c2	c3	c4	c5	140	c1	c2	c3	c4	c5

MARK READING SHEET INSTRUCTIONS

Your mark reading sheet is marked by computer and should therefore be filled in thoroughly and correctly

USE ONLY AN HB PENCIL TO COMPLETE YOUR MARK READING SHEET

PLEASE DO NOT FOLD OR DAMAGE YOUR MARK READING SHEET

Consult the illustration of a mark reading sheet on the reverse of this page and follow the instructions step by step when working on your sheet

Instruction numbers ❶ to ❿ refer to spaces on your mark reading sheet which you should fill in as follows

❶ Write your paper code in these eight squares, for instance

P	S	Y	1	0	0	-	X

❷ The paper number pertains only to first-level courses consisting of two papers

WRITE | 0 | 1 | for the first paper and | 0 | 2 | for the second If only one paper, then leave blank

❸ Fill in your initials and surname

❹ Fill in the date of the examination

❺ Fill in the name of the examination centre

❻ WRITE the digits of your student number HORIZONTALLY (from left to right) Begin by filling in the first digit of your student number in the first square on the left, then fill in the other digits, each one in a separate square

❼ In each vertical column mark the digit that corresponds to the digit in your student number as follows [-]

❽ WRITE your unique paper number HORIZONTALLY
NB Your unique paper number appears at the top of your examination paper and consists only of digits (e g 403326)

❾ In each vertical column mark the digit that corresponds to the digit number in your unique paper number as follows [-]

❿ Question numbers 1 to 140 indicate corresponding question numbers in your examination paper The five spaces with digits 1 to 5 next to each question number indicate an alternative answer to each question The spaces of which the number correspond to the answer you have chosen for each question and should be marked as follows [-]

♦ For official use by the invigilator Do not fill in any information here

Tear

attendance register (university copy) UNISA

Fill-in/MCQ

Examination period

Student number

Surname

First Names

Subject

Code of paper

Number of paper

Centre

Date

This is to certify that I have read the rules governing the examinations as set out on the inside cover of this examination answer book and in the examination instructions

That the information supplied by me in this answer book is correct and valid

I undertake to adhere to the procedures, rules and regulations of the University of South Africa as published in the official brochures

Signature of candidate

ID Number

Batch No

28092015MCQ

Signature of invigilator

UNISA invigilator's personnel number

NOTE Not a valid document if not completed by the invigilator

Tear

attendance register (student copy) UNISA

Fill-in/MCQ

Examination period

Student number

Surname

First Names

Subject

Code of paper

Number of paper

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