

**DSC1520**

( 472077)

October/November 2012

**DEPARTMENT OF DECISION SCIENCES  
 QUANTITATIVE MODELLING I**

Duration 2 Hours

100 Marks

**EXAMINERS**

FIRST

SECOND

MS GV MABE-MADISA

MRS MF IMMELMAN

**Programmable pocket calculator is permissible****Closed book examination**

**This examination question paper remains the property of the University of South Africa and may not be removed from the examination venue**

This paper consists of 24 pages and 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.
- There are 30 questions for a total of 100 marks.

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.

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### Question 1

Simplify

$$\frac{1}{6} - \frac{5}{6} - \frac{2}{3} + \frac{1}{3} \times \frac{3}{4}$$

- [1]  $\frac{-5}{6}$
- [2]  $\frac{11}{36}$
- [3]  $\frac{5}{3}$
- [4]  $\frac{5}{6}$
- [5] None of the above

### Question 2

The selling price of a new washing machine is R485. The price includes a value added tax (VAT) of 21% of the original price without VAT. Calculate the price without VAT.

- [1] R300,00
- [2] R101,85
- [3] R242,39
- [4] R400,83
- [5] None of the above

### Question 3

Determine the value of  $x$

$$5^{3x+8} = 5^5$$

- [1] 1
- [2] -1
- [3] Impossible to calculate
- [4] 2
- [5] None of the above

### Question 4

The roots of the quadratic equation  $0 = x^2 + x - 6$  are

- [1]  $x = 2$  and  $x = -3$
- [2]  $r = 3$  and  $y = 2,5$
- [3]  $x = -0,5$  and  $x = -6,25$
- [4]  $x = -2$  and  $x = 3$
- [5] none of the above

**ROUGH WORK**

### Question 5

$\log_5 \left( \frac{15}{0,45} \right)$  to three decimal places is equal to

- [1] -2,107
- [2] 2,179
- [3] 3.739
- [4] 0,701
- [5] none of the above

### Question 6

A house was valued at R366 000 in 2003 and R480 000 in 2007. Calculate the percentage increase in the value of the house between 2003 and 2007.

- [1] 30%
- [2] 31%
- [3] 31,15%
- [4] 30,15%
- [5] None of the above

### Question 7

Find the derivative of the function

$$G(Q) = \frac{4\sqrt{Q}}{Q^2}$$

- [1]  $G'(Q) = -6Q^{-\frac{5}{2}}$
- [2]  $G'(Q) = \frac{4}{Q}$
- [3]  $G'(Q) = 6\sqrt{Q}$
- [4]  $G'(Q) = \sqrt{Q}$
- [5] None of the above

### Question 8

The lines  $3y - 6x + 8 = -1$  and  $y = tx - 4$  are parallel. What is the value of  $t$ ?

- [1] 2
- [2] -3,5
- [3] -4
- [4] 8
- [5] None of the above

**ROUGH WORK**

**Question 9**

Calculate

$$\int_{x=1}^{x=5} (2x + x^3) dx$$

- [1] 180
- [2] 69,25
- [3] 180,50
- [4] 132
- [5] None of the above

**Question 10**

Differentiate the following function

$$f(x) = -2x^2 + 10x - 8$$

- [1]  $4x^2 + 10x$
- [2]  $-4x + 10$
- [3]  $4x + 10$
- [4]  $2x + 10$
- [5] None of the above

**Question 11**

Evaluate

$$\int (3x^2 - 2x) dx$$

- [1]  $3x^2 - 2x + c$
- [2]  $3x^3 - 2x^2 + c$
- [3]  $x^6 - x^2 + c$
- [4]  $x^3 - x^2 + c$
- [5] None of the above

**Question 12**

If the demand function is  $P = 80 - 2Q$ , where  $P$  and  $Q$  are the price and quantity respectively, determine the expression for the price elasticity of demand in terms of  $P$  only

- [1]  $\frac{P-80}{4P}$
- [2]  $\frac{P}{40-\frac{1}{2}P}$
- [3]  $\frac{P}{P-80}$
- [4]  $\frac{4P}{P-80}$
- [5] None of the above

**ROUGH WORK**

### Question 13

Solve for  $Q$  if  $\log Q - \log\left(\frac{Q}{Q+1}\right) = 0,8$

- [1] 5,31
- [2] 7,13
- [3] 6,00
- [4] Impossible to calculate
- [5] None of the above

### Question 14

Solve the inequality

$$-x - 3 \geq 6 - 2x$$

- [1]  $x \leq -3$
- [2]  $x \geq 3$
- [3]  $x \geq 9$
- [4]  $x \geq -9$
- [5] None of the above

### Question 15

What is the value of maximum revenue if total revenue is given by

$$R(x) = -\frac{1}{5}x^2 + 30x + 81$$

where  $x$  is the quantity sold?

- [1] 75
- [2] 1 206
- [3] 152,65
- [4] 81
- [5] None of the above

### Question 16

The  $y$ -intercept of the line  $5y - 10x + 5 = -2x + 3y$  equals

- [1]  $\frac{1}{2}$
- [2]  $-2\frac{1}{2}$
- [3] 5
- [4] -10
- [5] none of the above



**ROUGH WORK**

**Question 17**

Find the values of  $x$  for which the function

$$f(x) = x^3 + 5x^2$$

has a minimum or maximum value

- [1]  $x = 0, x = \frac{-10}{3}$
- [2]  $x = 3,33, x = 0$
- [3]  $x = 0,33, x = 0$
- [4]  $x = 0, x = \frac{-3}{10}$
- [5] None of the above

**Question 18**

Find the equation of the straight line passing through point (2, 1) and (1, 2)

- [1]  $y = -x + 3$
- [2]  $y = -x$
- [3]  $y = x - 1$
- [4]  $y = x + 3$
- [5] None of the above

**Question 19**

The number of people who contracted a contagious disease  $t$ -days after an epidemic started is approximated by the exponential equation

$$Q(t) = \frac{5000}{1 + 1249e^{-0,33t}}$$

Approximately how many people had contracted the disease after 15 days?

- [1] 200
- [2] 408
- [3] 600
- [4] 508
- [5] None of the above

**ROUGH WORK**

**Question 20**

Calculate the consumer surplus for the demand function  $P = 50 - 4Q$  when the market price is  $P = 10$

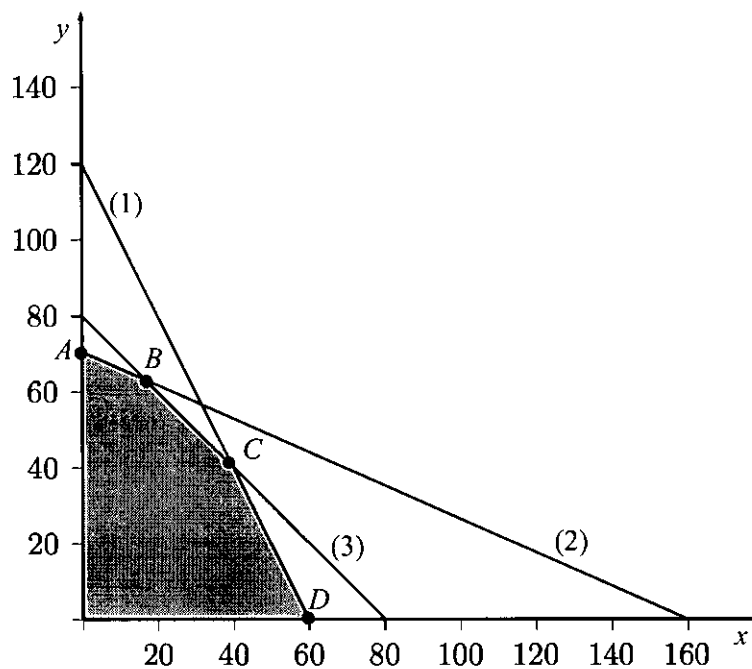
- [1] 312,50
- [2] 112 50
- [3] 200,00
- [4] 12 50
- [5] None of the above

**Question 21**

In the graph below, the set of inequalities

- (1)  $2x + y \leq 120$
- (2)  $x + 2y \leq 140$
- (3)  $x + y \leq 80$
- $x, y \geq 0$

has been drawn and the feasible region is shaded in grey. Determine the maximum value of the function  $P = 2x + 30y$  subject to the set of inequalities above.



- [1] 2 100
- [2] 1 840
- [3] 1 280
- [4] 2 300
- [5] None of the above

**ROUGH WORK**

### Question 22

The cost to produce and sell a number  $x$  of a toy is  $C = 2\,700 + 25x$ . The selling price of a toy is R45. How many toys should be produced to break even?

- [1] 1 350
- [2] 600
- [3] 135
- [4] 540
- [5] None of the above

### Question 23

What is the marginal cost when  $Q = 8$ , if the total cost function is given by

$$TC = \frac{1}{3}Q^3 - 30Q^2 + 2\,800Q + 900$$

- [1] 2 384
- [2] 2 444
- [3] 3 084
- [4] 21 461
- [5] None of the above

### Question 24

Solve the following system of simultaneously linear equations

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

The sum of the values of  $x, y$  and  $z$  of the solution is

- [1] 10,5
- [2] 6
- [3] 3,75
- [4] impossible to calculate
- [5] none of the above

### Question 25

Simplify the following expression

$$\left(\frac{4L^2}{L^{-2}}\right)^2$$

- [1]  $16L^8$
- [2]  $8L^8$
- [3]  $16L^4$
- [4]  $16L^{-8}$
- [5] None of the above

**ROUGH WORK**

**Question 26**

Choose the correct graphical representation of the following set of inequalities

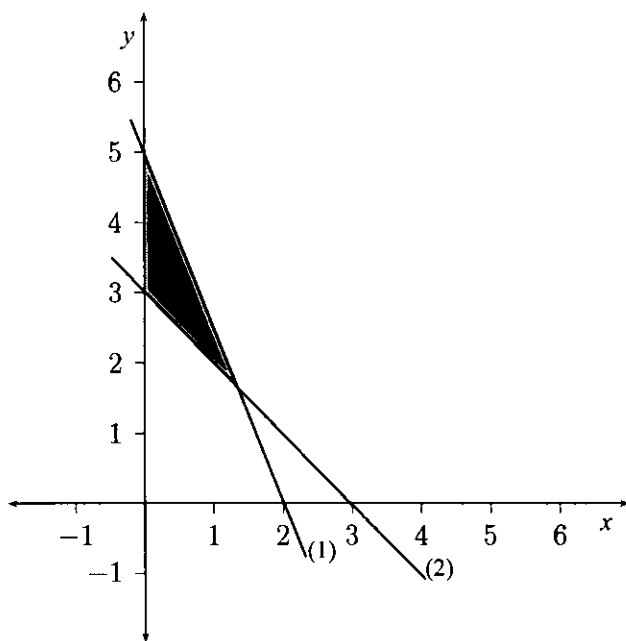
$$y \geq 5 - 2,5x \quad (1)$$

$$y \leq 3 - x \quad (2)$$

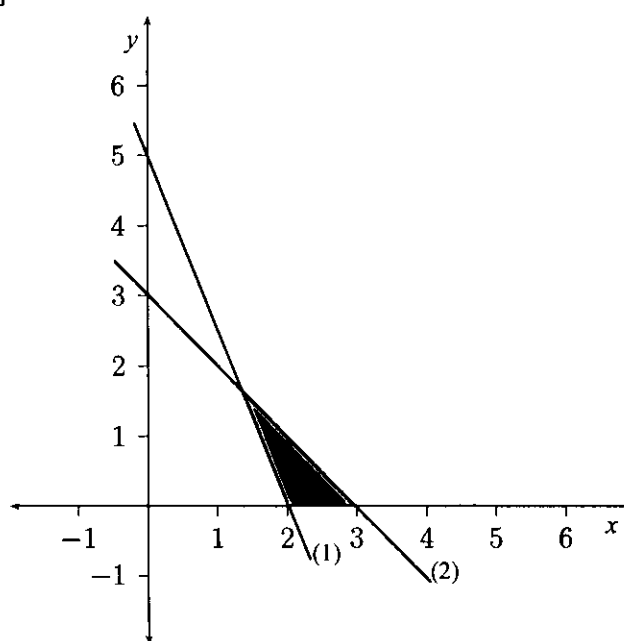
$$x \geq 0$$

$$y \geq 0$$

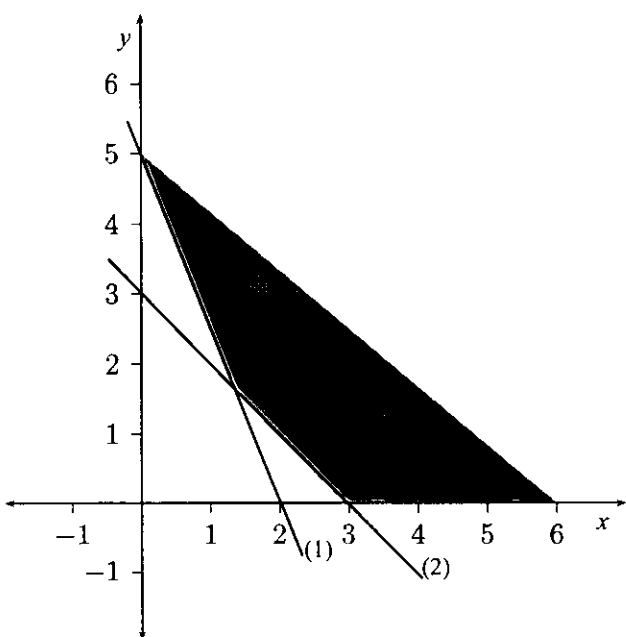
[1]



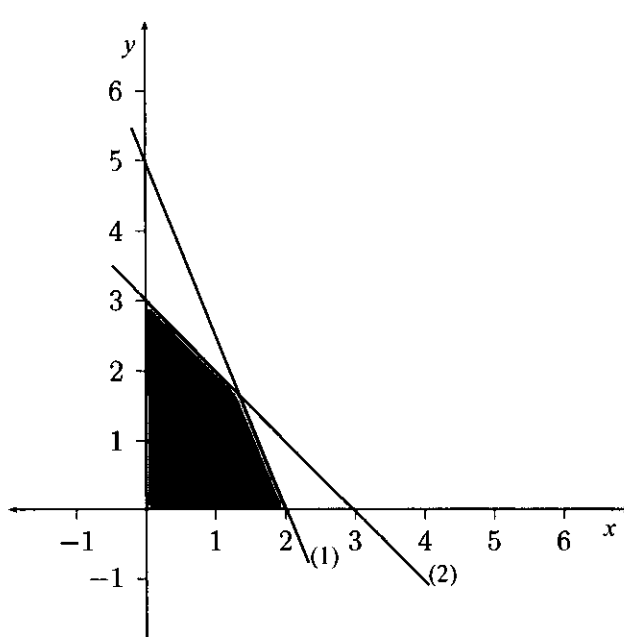
[2]



[3]



[4]



[5] None of the above

[TURN OVER]



**ROUGH WORK**

**Questions 27 and 28 are based on the following story:**

A manufacturing plant makes two types of inflatable boat a two-person boat and a four-person boat. Each two-person boat requires 0,9 labour hours from the cutting department and 0,8 labour hours from the assembly department. Each four-person boat requires 1,8 labour hours from the cutting department and 1,2 labour hours from the assembly department. The maximum hours available for the cutting and assembly departments are 864 and 672 respectively. The company makes a profit of R2 500 on a two-person boat and R4 000 on a four-person boat. Let  $x$  and  $y$  be the number of two-person boats and four-person boats made respectively.

**Question 27**

The profit  $P$  is given by

- [1]  $P = 2\,500x + 4\,000y$
- [2]  $P = 0,9x + 0,8y$
- [3]  $P = 864x + 672y$
- [4]  $P = 1,8x + 1,2y$
- [5] none of the above

**Question 28**

The constraints of the problem are

- [1]  $0,9x + 1,8y \leq 864, 0,8x + 1,2y \leq 672, x, y \geq 0$
- [2]  $0,9x + 0,8y \leq 864, 1,8x + 1,2y \leq 672, x, y \geq 0$
- [3]  $2,7x \leq 864, 2y \leq 672, x, y \geq 0$
- [4]  $1,7x + 3y \leq 1\,536, x, y \geq 0$
- [5] none of the above

**Question 29**

A company manufactures radios. If  $x$  is the number of radios that retailers are likely to purchase at a price  $p(x) = 10 - \frac{x}{1\,000}$  rand per unit and the cost function is given by  $C(x) = 5\,000 + 2x$ , what is the revenue function of the manufacturing company?

- [1]  $R(x) = 10 - \frac{x}{1\,000}$
- [2]  $R(x) = 10 - \frac{x}{1\,000} - 5\,000 + 2x$
- [3]  $R(x) = 10x - 0,001x^2$
- [4]  $R(x) = 1\,000 - x$
- [5] None of the above

**ROUGH WORK**

**Question 30**

The demand and supply functions for tent hire are given by the following equations

$$\text{Demand function } P = 60 - 0,6Q$$

$$\text{Supply function } P = 20 + 0,2Q$$

where  $P$  and  $Q$  are the price and quantity respectively. The equilibrium price and quantity are

- [1]  $P = 300, Q = 20$
- [2]  $P = 50, Q = 30$
- [3]  $P = 20, Q = 300$
- [4]  $P = 30, Q = 50$
- [5] none of the above

**TOTAL****[100]**

**ROUGH WORK**

**ROUGH WORK**

**ROUGH WORK**

## ROUGH WORK



**PART 1 (GENERAL/ALGEMEEN) DEEL 1**

STUDY UNIT e.g. PSY100-X  
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VRAESTELNOMMER

STUDENT NUMBER  
STUDENTENOMMER

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9	9	9	9	9	9	9	9	9	9

INITIALS AND SURNAME  
VOORLETTERS EN VAN

DATE OF EXAMINATION  
DATUM VAN EKSAMEN

EXAMINATION CENTRE (E.G. PRETORIA)  
EKSAMENSENTRUM (BY PRETORIA)

UNIQUE PAPER NO.  
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For use by examination invigilator  
Vir gebruik deur eksamenopsiener

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| <p><b>IMPORTANT</b></p> <ol style="list-style-type: none"> <li>USE ONLY AN HB PENCIL TO COMPLETE THIS SHEET</li> <li>MARK LIKE THIS </li> <li>CHECK THAT YOUR INITIALS AND SURNAME HAS BEEN FILLED IN CORRECTLY</li> <li>ENTER YOUR STUDENT NUMBER FROM LEFT TO RIGHT</li> <li>CHECK THAT YOUR STUDENT NUMBER HAS BEEN FILLED IN CORRECTLY</li> <li>CHECK THAT THE UNIQUE NUMBER HAS BEEN FILLED IN CORRECTLY</li> <li>CHECK THAT ONLY ONE ANSWER PER QUESTION HAS BEEN MARKED</li> <li>DO NOT FOLD</li> </ol> | <p><b>BELANGRIK</b></p> <ol style="list-style-type: none"> <li>GEBRUIK SLEGS N HB POTLOOD OM HIERDIE BLAD TE VOLTOOI</li> <li>MERK AS VOLG </li> <li>KONTROLEER DAT U VOORLETTERS EN VAN REG INGEVUL IS</li> <li>VUL U STUDENTENOMMER VAN LINKS NA REGS IN</li> <li>KONTROLEER DAT U DIE KORREKTE STUDENTENOMMER VERSTREK HET</li> <li>KONTROLEER DAT DIE UNIEKE NOMMER REG INGEVUL IS</li> <li>MAAK SEKER DAT NET EEN ALTERNATIEF PER VRAAG GEMERK IS</li> <li>MOENIE VOU NIE</li> </ol> |
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**PART 2 (ANSWERS/ANTWOORDE) DEEL 2**

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Specimen only