DSC1520
QUANTITATIVE MODELLING I

Duration : 2 Hours
100 Marks

EXAMINERS :
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Programmable pocket calculator is permissible.
Closed book examination.

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removed from the examination venue.

This paper consists of 27 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.

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.
Question 1

A department store has advertised a discount of 35% on all items in the store. The price of a lady’s blouse including the discount is R60,00. What was the original price of the blouse?

[1] R81,00
[2] R92,31
[3] R99,00
[4] R104,00
[5] None of the above

Question 2

Solve the following equation for \( x \):

\[ 2^{5x+3} = 16. \]

[1] 1
[2] 5
[3] \( -\frac{1}{5} \)
[4] 0,2
[5] None of the above

Question 3

Simplify the following expression

\[ \frac{2}{3} + \frac{1}{2} - 2 + \frac{1}{2} \left( -\frac{1}{2} + 2 \frac{1}{6} \right). \]

[1] \( \frac{1}{5} \)
[2] \( \frac{11}{12} \)
[3] \( \frac{17}{24} \)
[4] \( \frac{5}{7} \)
[5] None of the above
ROUGH WORK
Question 4

Simplify the following expression:

\[ 4\sqrt{x^{-4}y^{3}} \left( \frac{4x^{2}}{y^{-4}} \right). \]

[1] \(2xy^{4}\)
[2] \(\frac{2y^{3}}{x^{3}}\)
[3] \(2xy^{2}\)
[4] \(2y^{\frac{11}{4}}\)
[5] None of the above

Question 5

Evaluate

\[ \log_{3}\left( \frac{1073}{7} \right) \]

and give your answer correct to three decimal places.

[1] \(3,022\)
[2] \(4,581\)
[3] \(7,516\)
[4] \(8,123\)
[5] None of the above
ROUGH WORK
Question 6

The graphs 1, 2, 3 and 4 below, represent the graphs of

[1] \( y - \frac{1}{2}x = 0; \ y - 4x + 2 = 0; \ y - 3x - 6 = 0; \ y - 5 = 0 \), respectively.

[2] \( y - \frac{1}{2}x = 0; \ y + 3x + 6 = 0; \ y + 4x - 2 = 0; \ y - 5 = 0 \), respectively.

[3] \( y + \frac{1}{2}x = 0; \ y + 3x + 6 = 0; \ y + 4x - 2 = 0; \ y + 5 = 0 \), respectively.

[4] \( y + \frac{1}{2}x = 0; \ y + 4x - 2 = 0; \ y + 3x + 6 = 0; \ y + 5 = 0 \), respectively.

ROUGH WORK
Question 7

Find the slope of the straight line passing through the points (5 ; 10) and (6 ; 8).

[1]  \(-2\)
[2]  \(-0.2\)
[3]  \(0.2\)
[4]  \(2\)
[5]  None of the above

Question 8

The values of \(p\) and \(q\) that satisfy the set of equations

\[
\begin{align*}
3p + 2q - 9 &= 0 \\
4p - 6q - 25 &= 0,
\end{align*}
\]

are:

[1]  \(p = \frac{1}{2}; q = 4\).
[2]  \(p = 4; q = -1\frac{1}{2}\).
[3]  \(p = -\frac{3}{2}; q = \frac{27}{4}\).
[4]  \(p = -\frac{3}{2}; q = 4\).

Question 9

A linear line cuts the y-axis at 10 and passes through the point (2 ; 4). The equation of the line is.

[1]  \(y = -\frac{1}{2}x + 10\).
[2]  \(y = \frac{1}{2}x + 10\).
[3]  \(y = 3x + 10\).
[4]  \(y = -3x + 10\).
ROUGH WORK
Question 10

The regular price of a bicycle is R1 300,40 and the current sale price is R980,20. By what percentage was the price reduced? Choose the option closest to the correct answer.

[1] 24.62%
[2] 30.38%
[3] 69.62%
[4] 75.38%
[5] None of the above

Question 11

If the demand function is \( P = 90 - 2Q \), where \( P \) and \( Q \) are the price and quantity respectively, give an expression for the price elasticity of demand in terms of \( P \) only.

[1] \( \frac{P - 90}{2P} \)
[2] \( \frac{P}{90 - \frac{1}{2}P} \)
[3] \( \frac{P}{90 - P} \)
[4] \( \frac{P}{P - 90} \)
[5] None of the above

Question 12

If the demand function is

\[ P = 215 - 5Q \]

where \( P \) and \( Q \) are the price and quantity respectively, determine the point price elasticity of demand if the price \( P \) equals 15.

[1] \( \frac{5}{15} \)
[2] \( -\frac{40}{5} \)
[3] \( \frac{20}{15} \)
[4] \( -\frac{40}{15} \)
[5] None of the above
ROUGH WORK
Question 13

Solve the following system of linear equations:

\[-p + q + 2r = 8 \quad (1)\]
\[p + q + 2r = 0 \quad (2)\]
\[2q - 2r = 2 \quad (3)\]

The sum of the values of $p$, $q$ and $r$ of the solution is


Question 14

The information in the following market is:

Demand function : $Q = 35 - 0,1P$
Supply function : $Q = -10 + 0,2P$

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

[1] $P = 20; \quad Q = 150$
[2] $P = 200; \quad Q = 15$
[3] $P = 150; \quad Q = 20$
[4] $P = 66,66; \quad Q = 28$
[5] None of the above
ROUGH WORK
Question 15

The cost $y$ (in rands) of manufacturing $x$ bicycles is

$$y = 240x + 720.$$ 

How many bicycles have been manufactured if the cost is R30 000?

[1] 120  
[2] 122  
[3] 123  
[4] 125  
[5] None of the above

Question 16

The consumer surplus for the demand function $P = 50 - 4Q$ when the market price in equilibrium is $P = 10$, is


Question 17

The weekly growth of a mouse in a research laboratory takes place according to the formula:

$$y = \frac{46,04}{1 + 13,720(0,596)^x}$$

where $y$ is the average mass (in grams) and $x$ the number of weeks since birth. What is the average mass of a mouse after 10 weeks?

[1] 42,72g  
[2] 46,04g  
[3] 46,12g  
[4] 50,17g  
[5] None of the above
ROUGH WORK
Question 18

A company makes two products, A and B. Product A requires 12.5 hours of machining time and 30 minutes of finishing time per unit. Product B requires 10 hours of machining time and one hour of finishing time per unit. There are 10 000 hours and 600 hours available for machining and finishing respectively. Severe material shortages for the two products will limit their production to a maximum of 700 units for product A and 400 units for product B per day. If x and y are the number of units of product A and B produced per day respectively, choose the system of inequalities that describes the process.

[1] 12.5x + 10y ≤ 10 000; 0.5x + y ≤ 600; x ≤ 700; y ≤ 400; x, y ≥ 0
[2] 12.5x + 10y ≥ 10 000; 0.5x + y ≤ 600; x ≤ 700; y ≤ 400; x, y ≥ 0
[3] 12.5x + 10y ≤ 10 000; 0.5x + y ≤ 600; x ≥ 700; y ≥ 400; x, y ≥ 0
[4] 12.5x + 10y ≤ 10 000; 0.5x + y ≥ 600; x ≥ 700; y ≤ 400; x, y ≥ 0
[5] None of the above

Question 19

The roots of a quadratic function are 2 and –3. The coordinates of the turning point are

[1] (0.5; 6.25).
[2] (−0.5; −6.25).
[3] (0.5; 5.25).
[4] (−0.5; −5.25).

Question 20

The demand function of a firm is \( Q = 150 − 0.5P \), where P and Q represent the price and quantity respectively. At what value of P is marginal revenue equal to zero?

[1] 0
[2] 75
[3] 113
[4] 150
[5] None of the above
ROUGH WORK
Question 21

Questions 21, 22 and 23 are based on the following: *Lighting Warehouse produces q solar lamps at a fixed cost of R10 000 per week. Each lamp costs R150 to produce and is sold for R350.*

What are the equations for total revenue, total cost and profit function?

[1] \[350q; 150q + 10 000; 200q - 10 000\]
[2] \[150q + 10 000; 200q - 10 000; 350q\]
[3] \[350q; 200q - 10 000; 150q + 10 000\]
[4] \[200q - 10 000; 350q; 150q + 10 000\]
[5] None of the above

Question 22

Calculate the break-even quantity per week.

[1] 20
[2] 50
[3] 100
[4] 200
[5] None of the above

Question 23

How many lamps were produced and sold if they made a loss of R2 000?

[1] 10
[2] 40
[3] 50
[4] 60
[5] None of the above
ROUGH WORK
**Question 24**

Find the values of $x$ for which the function $f(x) = -2x^3 + 9x^2 - 12x + 36$ has a maximum or a minimum value.

1. $x = 1; x = 2$
2. $x = -1; x = 2$
3. $x = 1; x = -6$
4. $x = -3; x = -6$
5. None of the above

**Question 25**

If the total revenue is given by

$$TR = 2x^5 - x^2 + 10x + 15,$$

what is the marginal revenue when $x = 5$?

1. 150
2. 6250
3. 6350
4. 6450
5. None of the above

**Question 26**

Find the derivative of the function:

$$\frac{d}{dx} \left[ \frac{x^2 + x}{\sqrt{x}} \right].$$

1. $\frac{3}{2}x^{\frac{1}{2}} - \frac{1}{2}x^{\frac{3}{2}}$
2. $\frac{3}{2}x^{\frac{1}{2}} + \frac{1}{2}x^{\frac{1}{2}}$
3. $\frac{2}{5}x^\frac{5}{2} + 2x^{\frac{1}{2}}$
4. $\frac{2}{5}x^{\frac{5}{2}} + \frac{2}{3}x^{\frac{2}{3}}$
5. None of the above
ROUGH WORK
Question 27

Evaluate the following integral:

\[ \int_{}^1 x^2 (\sqrt{x} + \sqrt[3]{x^3}) \, dx. \]

[1] \( x + \frac{2}{3} x^2 + c \)
[2] \( \frac{x^2}{2} + \frac{2}{5} x^\frac{5}{2} + c \)
[3] \( \frac{x^2}{2} + \frac{5}{2} x^\frac{5}{2} + c \)
[4] \( x + x^\frac{3}{2} + c \)
[5] None of the above

Question 28

Evaluate the following definite integral:

\[ \int_{-1}^2 (-2x + 3) \, dx. \]

[1] \(-5\)
[2] \(-3\)
[3] \(3\)
[4] \(6\)
[5] None of the above
ROUGH WORK
Question 29

In the graph below the following set of inequalities

\[ \begin{align*}
  x + y & \leq 10 \\
  5x + 4y & \leq 40 \\
  x & \leq 4 \\
  x, y & \geq 0
\end{align*} \]

was drawn and the feasible region of the set of inequalities shaded in grey.

Determine the maximum value of the profit function

\[ Z = 18x + 12y, \]

subject to the set of inequalities above. The maximum profit is equal to

[1] 120
ROUGH WORK
Question 30

Which set of graphs represents the functions

A: $y - x^2 - 2 = 0$;  B: $y - x^2 = 0$;  C: $y - x^2 + 3 = 0$;  D: $y + x^2 = 0$?

[1] None of the above

TOTAL: [100]
ROUGH WORK