higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MATHEMATICS

NQF LEVEL 3

(First paper)

(10501053)

4 November 2024 (X-paper)
09:00–12:00

Calculators may be used.

This question paper consists of 7 pages, 2 answer sheets and 1 formula sheet.

009Q1N2404

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)
MATHEMATICS
NQF LEVEL 3
(First paper)
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer all the questions.
2. Read all the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Answers should be rounded off to THREE decimal places, unless stated otherwise.
5. Diagrams are NOT drawn to scale.
6. Clearly show ALL the calculations, diagrams, graphs, et cetera which you have used in determining the answers.
7. Answer QUESTION 3.3.2 and QUESTIONS 7.1 and 7.2 on the ANSWER SHEETS (attached). Write your EXAMINATION NUMBER and CENTRE NUMBER on them, DETACH them from the question paper and SUBMIT with the ANSWER BOOK.
8. Use only a black or blue pen.
9. A pencil may be used to draw the diagrams, graphs and sketches.
10. Write neatly and legibly.

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QUESTION 1

1.1 Simplify the following complex numbers and give the answer in standard form:

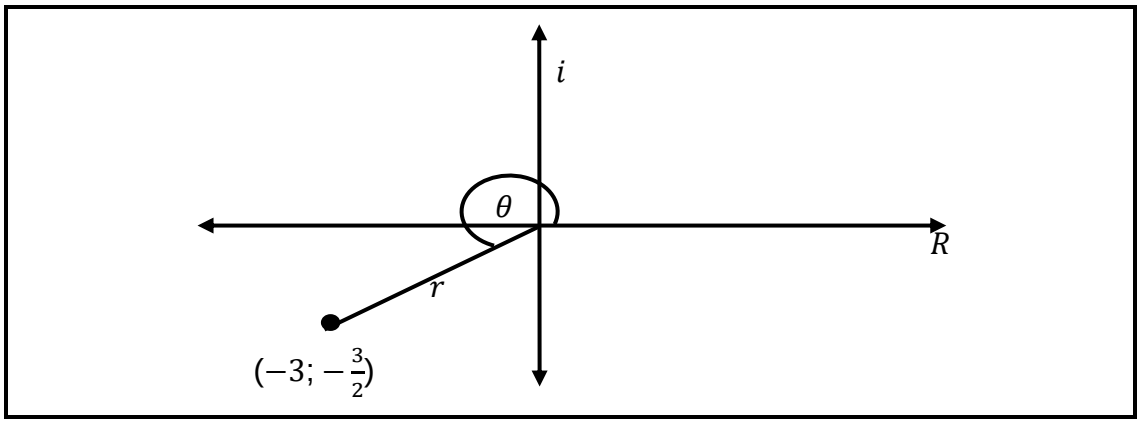
1.1.1 $2(3-4j)^2$ (4)

1.1.2 $\frac{-3+j}{5+3j}$ Give the answer in the simplest fraction form. (4)

1.2 Given: $z_1 = 12{,}4cis\ 45°;\ z_2 = cos75° + jsin75°\ and\ z_3 = -2cis(30°)$.

1.2.1 Calculate $z_4\ if\ z_4 = \frac{(z_1)(z_2)}{z_3}$. Leave the answer in rectangular form. (4)

1.3 Given: $z = bi + a$



1.3.1 Calculate the values of r and θ. (3)

[15]

QUESTION 2

2.1 Given: The complex number $z_1 = -4(3-j)$

2.1.1 Change z_1 to polar form, with a modulus in simplest surd form and a positive argument.

Show all the calculations. (4)

2.1.2 Show both the rectangular and polar form of z_1 on an Argand diagram with all the calculated values. (3)

2.2 Prove that $\frac{\sqrt{9}}{\sqrt{-8}} = \frac{-3\sqrt{2}i}{4}$ Show all calculations. (3)

2.3 Simplify: $3 - 6j^5 + 4j^{10}$ (5)

[15]

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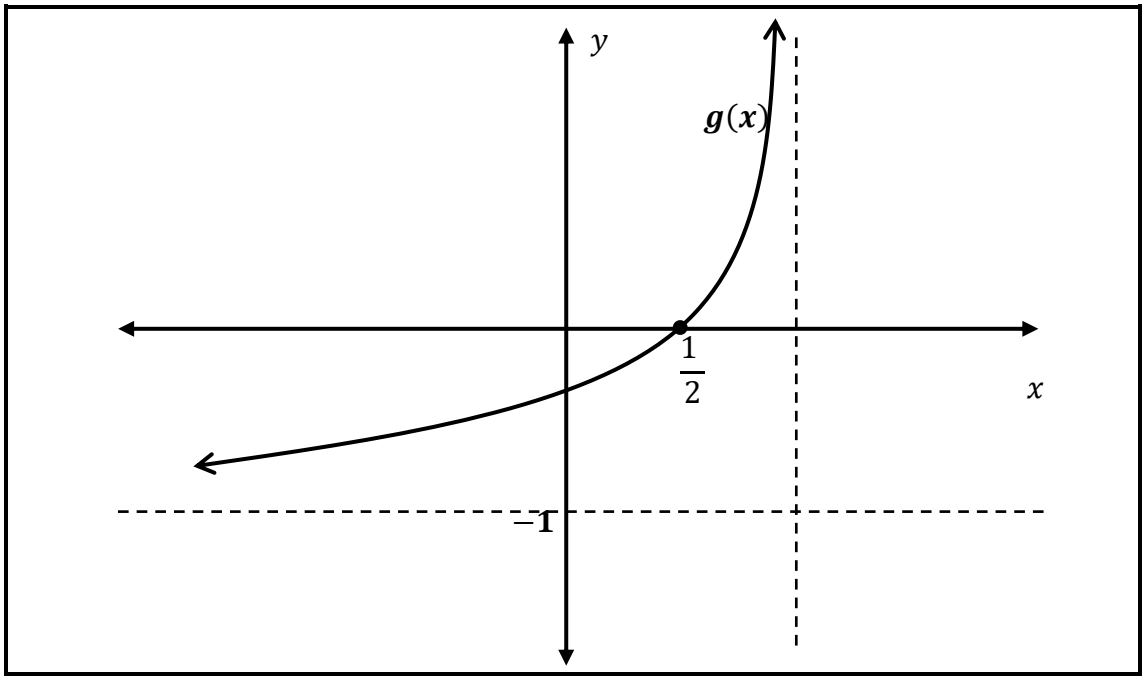
QUESTION 3

3.1 Given below is the graph of $g(x) = \frac{a}{x-p} + q \; ; for \; x < 2$



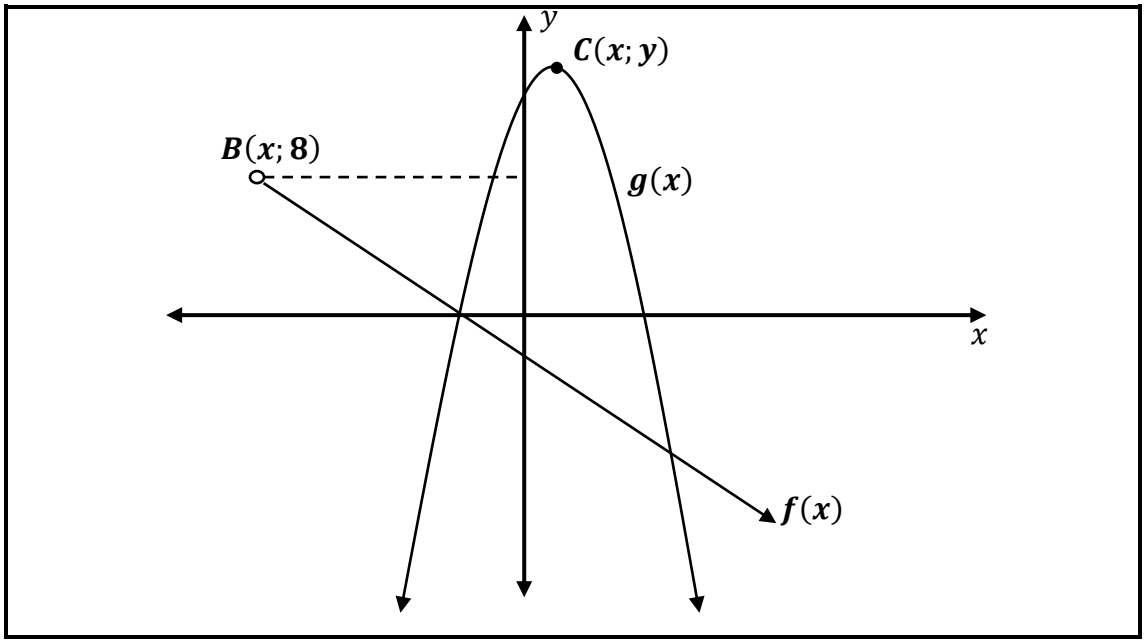
3.1.1 Complete: $p = \ldots$ and $q = \ldots$ (2)

3.1.2 Calculate the value of a and give the equation of $g(x)$. (3)

3.1.3 Calculate the $y - intercept$ of $g(x)$. (1)

3.2 Shown below are the graphs of $f(x) = -x - 3$ and $g(x) = -x^2 + 2x + 15$.

$B\ (x; 8)$ is a point on $f(x)$. $C(x; y)$ is the turning point of $g(x)$



3.2.1 Give the domain of $f(x)$ (3)

3.2.2 Calculate the coordinates of point C, the turning point of $g(x)$ (4)

3.2.3 For which value(s) of x is $f(x) \leq g(x)$ (1)

3.3 Given: The equation of $f(x) = 3.3^x - 1$

3.3.1 Calculate the $x - and\ y - intercepts\ of\ f(x)$ and give the intercepts in coordinate form. (2)

3.3.2 Sketch the graph of $f(x)$ on the applicable ANSWER SHEET A. Show the asymptote and intercepts. (3)

3.3.3 Determine the equation of the asymptote of $f(x)$. (1)

[20]

QUESTION 4

4.1 Simplify the expression: (3)

$$\frac{x^3 - x^2}{x} \div x^2$$

4.2 Solve for x. Show all the calculations and methods used.

4.2.1 $2(x-4) = 5 - \frac{3}{x-2}$ (4)

4.2.2 $x^2 - 15x - 16 < 0$ (Give the answer in interval notation.) (4)

4.2.3 $5x^2 - 8x - 1 = 0$ (Use the quadratic formula.) (4)

4.3 Solve for x *and* y if: $x = 3 - 2y$ *and* $2x^2 - 16x = 16y - 4xy$. (5)

[20]

QUESTION 5

5.1 Determine $\frac{dy}{dx}$ Give your answer in surd form and positive exponent(s) where applicable.

5.1.1 $y = -5x(2x - \frac{3}{x^2})$ (3)

5.1.2 $y = \frac{4x^2 - 4}{(2x-2)}$ (3)

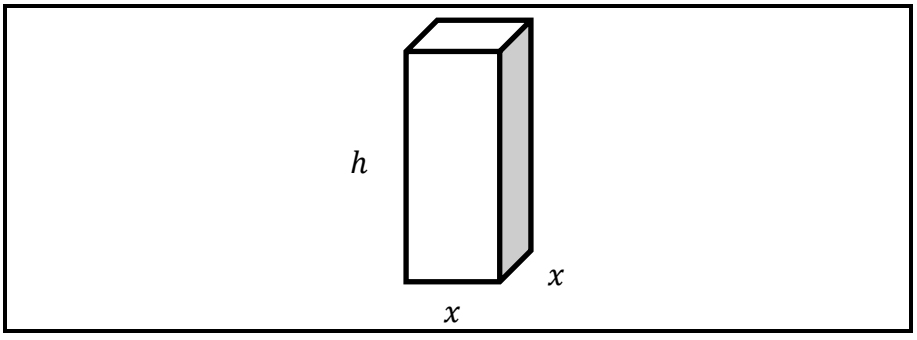
5.2 Given: $h(x) = 1 - 3x^2$.

Calculate the derivative $h'(x)$ using the First Principle. (4)

[10]

QUESTION 6

The rectangular prism with a square base has a length and width of $x\ centimetres$ and height h as shown in the sketch below. The height $h = 60 - x$



6.1 If the volume of the rectangular prism is given by $V = 60x^2 - x^3$.

Calculate the value of x for which the volume will be a maximum. (6)

6.2 Hence, calculate the height of the rectangular prism. (2)

6.3 Calculate the maximum volume of the rectangular prism. (2)

[10]

QUESTION 7

The owner of a fashionable clothing factory plans to manufacture shorts and trousers. A maximum of 60 pairs of shorts and 40 pairs of trousers can be manufactured daily, while a total of not more than 70 pieces of clothing can be manufactured daily.

It takes 5 hours to manufacture a pair of shorts and 10 hours for a pair of trousers, while there are at most 500 working hours available per day.

Let x represent the number of pairs of shorts and y the number of pairs of trousers manufactured daily.

The following inequalities are obtained from the above description:

$x \leq 60$
$y \leq 40$
$x + y \leq 70$
$5x + 10y \leq 500$
$x; y \geq 0$
$x; y \epsilon N_0$

7.1	Draw the constraints on the applicable ANSWER SHEET B.	(4)
7.2	Shade the feasible region.	(2)
7.3	The profit is R15 on a pair of shorts and R25 on a pair of trousers. Give the equation indicating the profit P in terms of $x \; and \; y$.	(1)
7.4	Use the coordinates of the vertices of the feasible region to calculate the number of pairs of shorts and pairs of trousers which should be manufactured, to maximise the profit.	(3)
		[10]

TOTAL: 100

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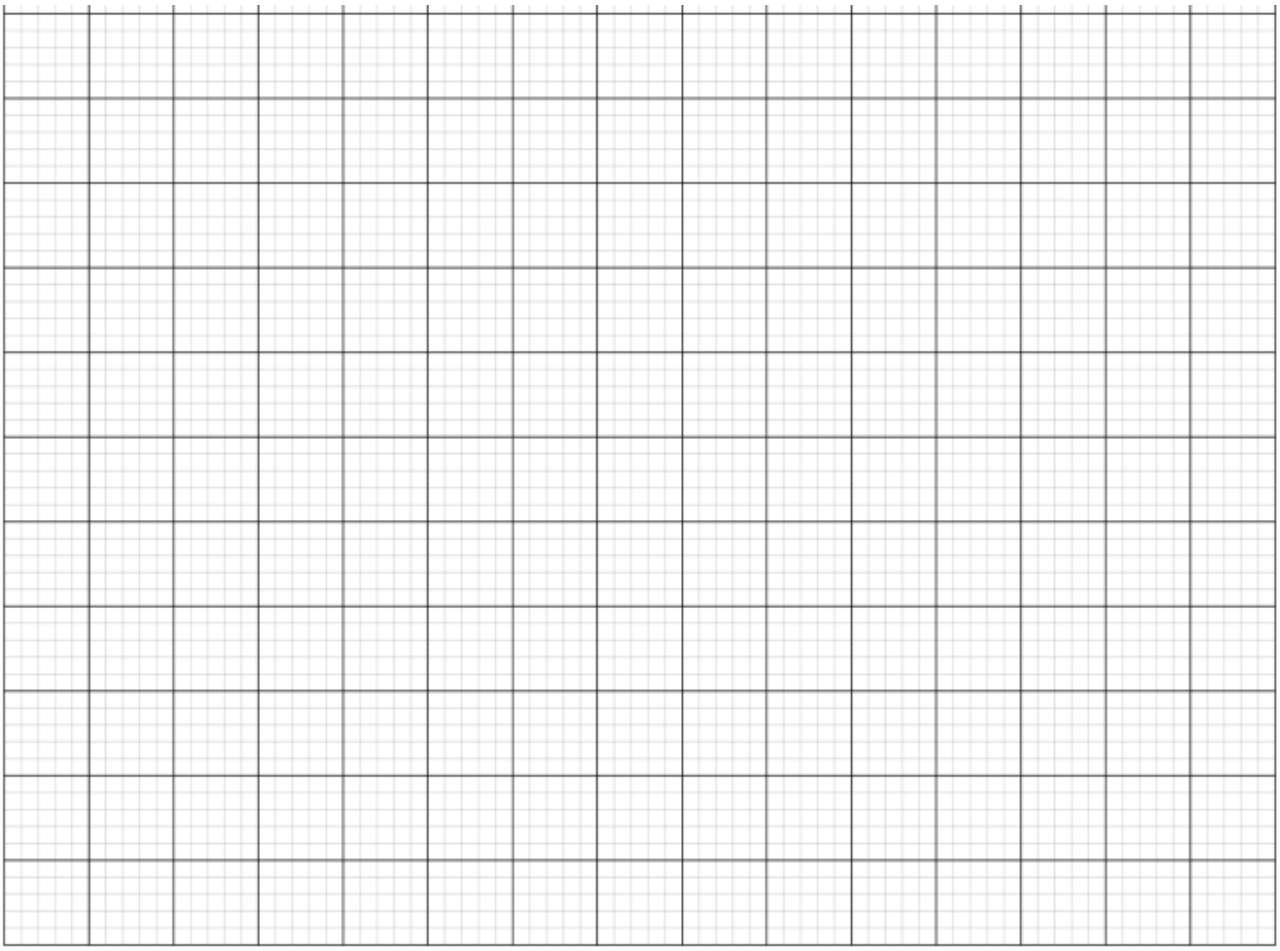
CENTRE NUMBER: | | | | | | | | | | |

ANSWER SHEET A

QUESTION 3.3.2



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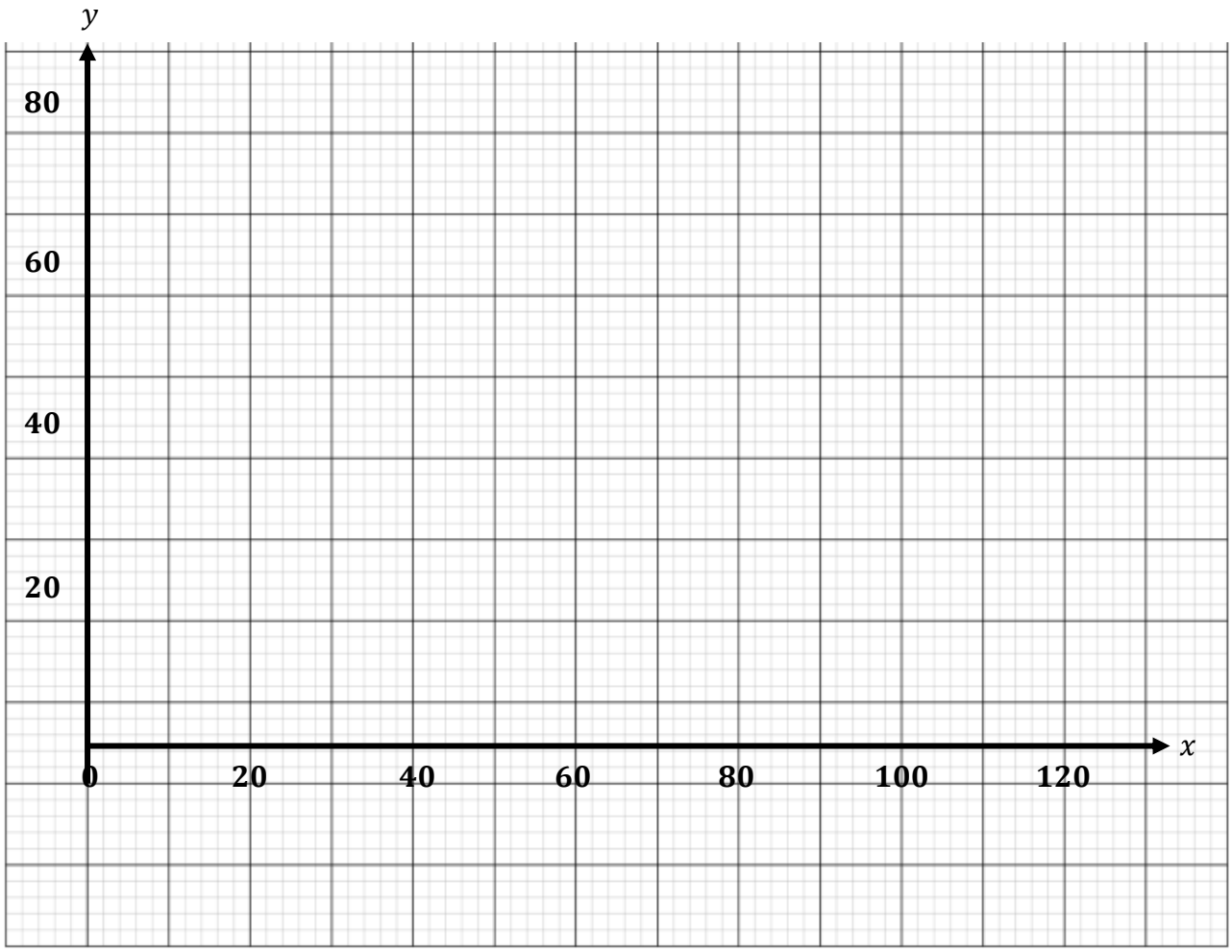
ANSWER SHEET B

QUESTIONS 7.1 and 7.2



(4 + 2 = 6)

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(10501053)

MATHEMATICS L3 (First Paper)

FORMULA SHEET

1. $z = r.\cos\theta + r.j\sin\theta$

2. $z = a \pm bj \;\; or \;\; z = a \pm bi \qquad where \;\; i = j = \sqrt{-1}$

3. $r = \sqrt{a^2 + b^2} \quad OR \quad r = \sqrt{z\,.\,\bar{z}}$

4. $\theta = \; tan^{-1}\left(\frac{b}{a}\right)$

5. $r\,cis\,\theta$

6. $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

7. $y = ax^2 + bx + c \quad OR \quad y = a\,(x - p)^2 + q$

8. $x = \; -\frac{b}{2a}\,; \;\; y = \frac{4ac - b^2}{4a}$

9. $y = a(x - x_1)(x - x_2)$

10. $y = \frac{a}{x - p} + q$

11. $f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$

12. $\frac{d}{dx} \;\; ax^n = n.a\,x^{n-1}$

13. $\frac{d}{dx} \;\; k \;=\; 0$

14. $D_x[k.f(x)] = k.D_x\,[f(x)]$

16. $D_x[f(x) + g(x)] = \;\; D_x[f(x)] + \;\; D_x[g(x)]$

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