higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MATHEMATICS

(First paper)

NQF LEVEL 3

(10501053)

14 February 2025 (X-paper)
09:00–12:00

Non-programmable scientific calculators may be used

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

015Q1S2514

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
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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. Clearly show all calculations, diagrams, graphs, et cetera which you have used in determining the answers.
5. If required, answers should be rounded off to THREE decimal places, unless stated otherwise.
6. Diagrams are NOT drawn to scale.
7. Answers only will NOT necessarily be awarded full marks.
8. Complete the CENTRE NUMBER and EXAMINATION NUMBER on ADDENDUM A and B (attached). DETACH them from the question paper and submit with your ANSWER BOOK.
9. Use only a black or blue pen. Answers given in PENCIL will NOT be marked.
10. Write neatly and legibly.

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QUESTION 1

1.1 Given: The complex number $z_1 = (2 - 3i)^2$

1.1.1 Simplify z_1 (2)

1.1.2 Hence, rewrite z_1 in polar form. (4)

1.2 Simplify: $3i^5 - (i)(2i)^3 + \sqrt{-9}$ (4)

[10]

QUESTION 2

2.1 Given: $z = \frac{1}{5}(5 - 10i) - \frac{1-3i}{i-2}$

2.1.1 Simplify. (Give your answer in the standard form $z = a + bi$) (4)

2.1.2 Represent the complex number of QUESTION 2.1.1 in an Argand Diagram. (1)

2.2 $z_1 = 3cis25°$ and $z_2 = 2{,}9cis65°$ are two complex numbers.

2.2.1 Calculate $(z_1)(z_2)$. Leave your answer in polar form. (3)

2.2.2 Calculate $z_1 + z_2$ (4)

2.3 Given: $z = -4{,}5 - 2i$

2.3.1 Give the conjugate of z (1)

2.3.2 Calculate: $(z)(\bar{z})$ (4)

[17]

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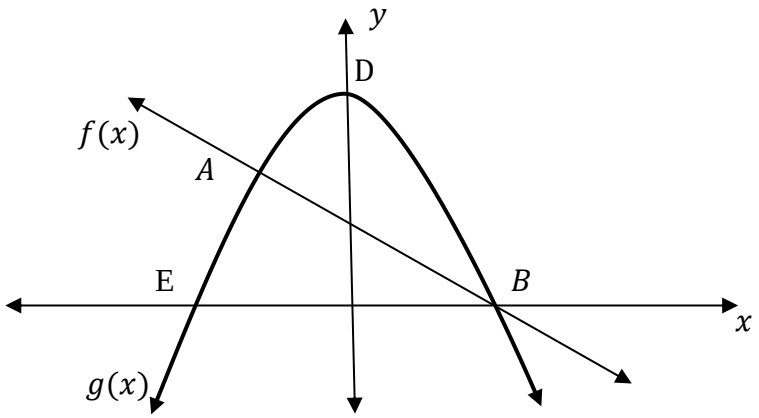
QUESTION 3

3.1 Given: $f(x) = mx + 6$ and $g(x) = -2x^2 + 8$

A and B are the points of intersection of the graphs of $f(x)$ and $g(x)$.
D is the turning point of $g(x)$.
E and B are the x–intercepts of $g(x)$.



3.1.1 Calculate the coordinates of B and E, the x-intercepts of $g(x)$. (3)

3.1.2 If $A(-0{,}5; 7{,}5)$ and $B(2; 0)$ are the coordinates where $f(x) = g(x)$; give the values of x for which $g(x) \geq f(x)$. (2)

3.1.3 For which value(s) of x is $g(x)$ decreasing? (1)

3.1.4 Calculate m, the gradient of $f(x)$. (2)

3.1.5 Give the domain of $f(x)$. (1)

3.2 Sketch the graph of $f(x) = \frac{-1}{x+2} - 3$ on ADDENDUM A.

Clearly show the asymptotes and the x- and y-*intercepts.* (4)

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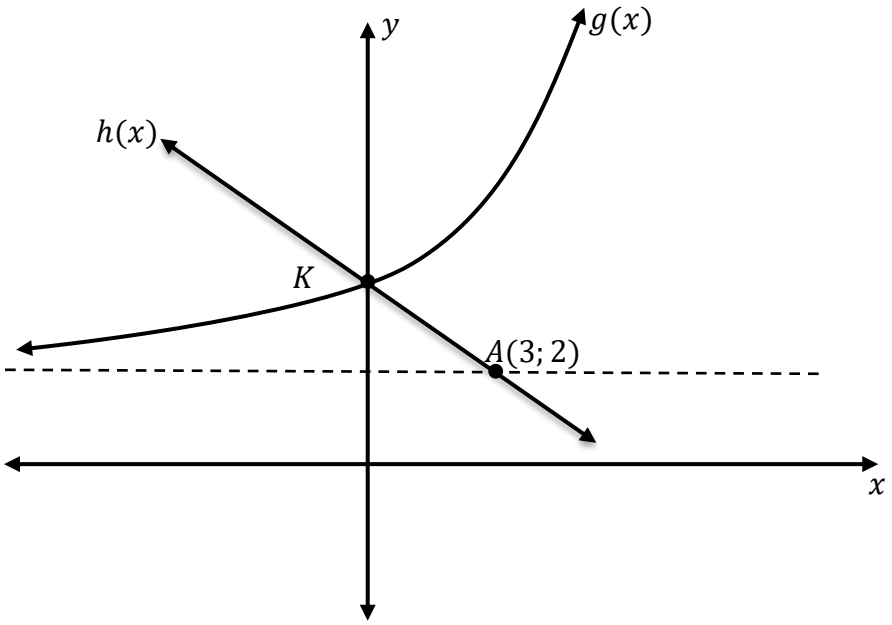
3.3 Below are the graphs of $h(x) = -\frac{1}{3}x + 3$; $g(x) = 3^x + p$.

Point $K(x; y)$ is the $y\text{-}intercept$ of $g(x)$ and $h(x)$
$A(3; 2)$ is a point on the line $h(x)$



3.3.1 Give the value of p, the asymptote of $g(x)$. (2)

3.3.2 Is the function $g(x)$ ccontinuous or discontinuous? (1)

3.3.3 Give the coordinate of K, the $y\text{-}intercept$ of $g(x)$ and $h(x)$. (1)

3.3.4 For which value(s) of x is $h(x) < g(x)$? (2)

3.3.5 Give the range of the straight line $h(x)$. (1)
[20]

QUESTION 4

4.1 Simplify: $\frac{x^2-y^2}{5x-5y}$ (3)

4.2 Solve for x if:

4.2.1 $x^2 - 3x - 4 = 0$ (3)

4.2.2 $2x^3 - 3x^2 = 5x$ (4)

4.2.3 $3(x + 11) = -5 + 2(x + 3)^2$ (Use the quadratic formula.) (5)

4.2.4 $x(x - 7) \geq 18$ (4)

4.3 Solve for x and y if: $y = x - 1$ and $y^2 = 2(x - 1)$ (4)

[23]

QUESTION 5

5.1 Given: The equation $h(x) = -\frac{1}{2} - 5x^2$

Calculate the derivative $h'(x)$ making use of first principles. (4)

5.2 Calculate:

$$\lim_{x \to -4} \frac{x^2 - 16}{x^3 + 16x}$$ (2)

5.3 Differentiate using differentiation rules. Give answers with positive exponents and surd form where applicable.

5.3.1 $y = \frac{4}{3x} - 4\sqrt{x} + \frac{x}{4} - 4\pi$ (4)

5.3.2 If $y = (x^6 - 1)^2$ show that $\frac{dy}{dx} = 12x^5\sqrt{y}$ (5)

[15]

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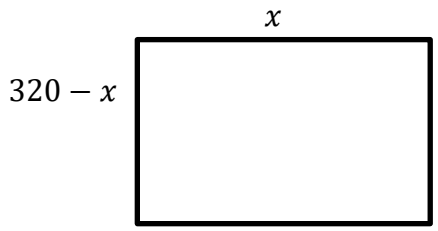
QUESTION 6

The area of the rectangle below is given by the equation $A = 320x - x^2$.
The length of the rectangle is x cm and the width is $(320 - x)$ cm.



6.1 Calculate the value of x which will maximize the area. (3)

6.2 Calculate the distance of the width of the rectangle. (2)
[5]

QUESTION 7

A retailer wants to buy a maximum of 20 cartridges for two different kinds of printers – type A and type B. His budget allows him to spend R45 000 on the cartridges. Type A cartridges cost R1 800 each and type B cartridges R3 000 each. He needs to buy at least 6 of each type.

Let the amount of type A cartridges be x and Type B cartridges be y.

The above constraints are given by the following equations:

$x \geq 6$
$y \geq 6$
$x + y \leq 20$
$1\,800x + 3\,000y \leq 45\,000$
$x; y \geq 0$

7.1 Sketch these inequalities on ADDENDUM B (attached). (4)

7.2 Shade and indicate the feasible region. (2)

7.3 The profit made on Type A cartridge is R400 and the profit on Type B cartridge R1000. The profit equation is given as:

$P = 400\,x + 1000\,y$

Calculate the maximum profit and indicate how many of each type of cartridges the retailer needs to sell to maximise his profit. (4)
[10]

TOTAL 100

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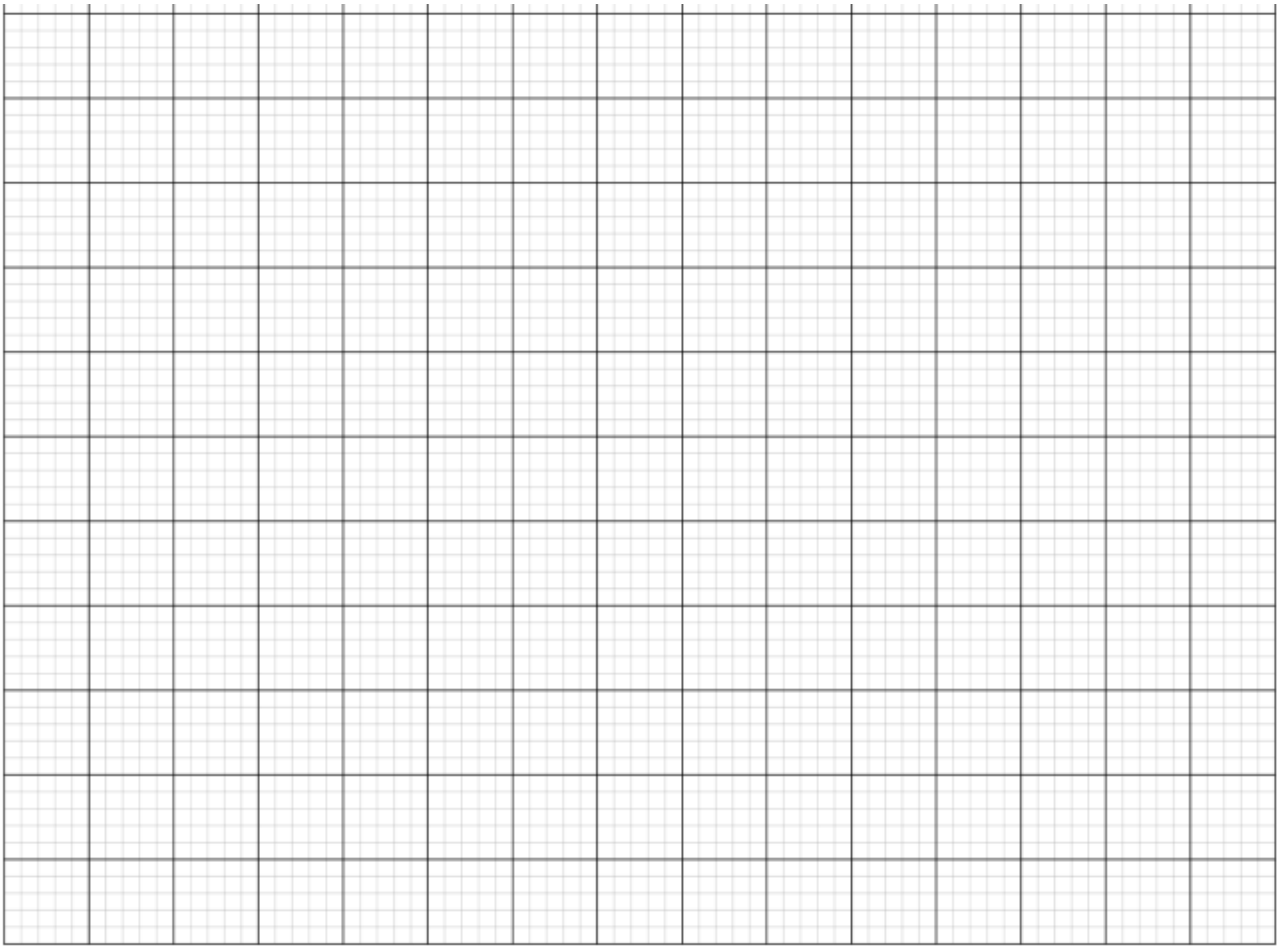
CENTRE NUMBER: | | | | | | | | | | |

ADDENDUM A

QUESTION 3.2



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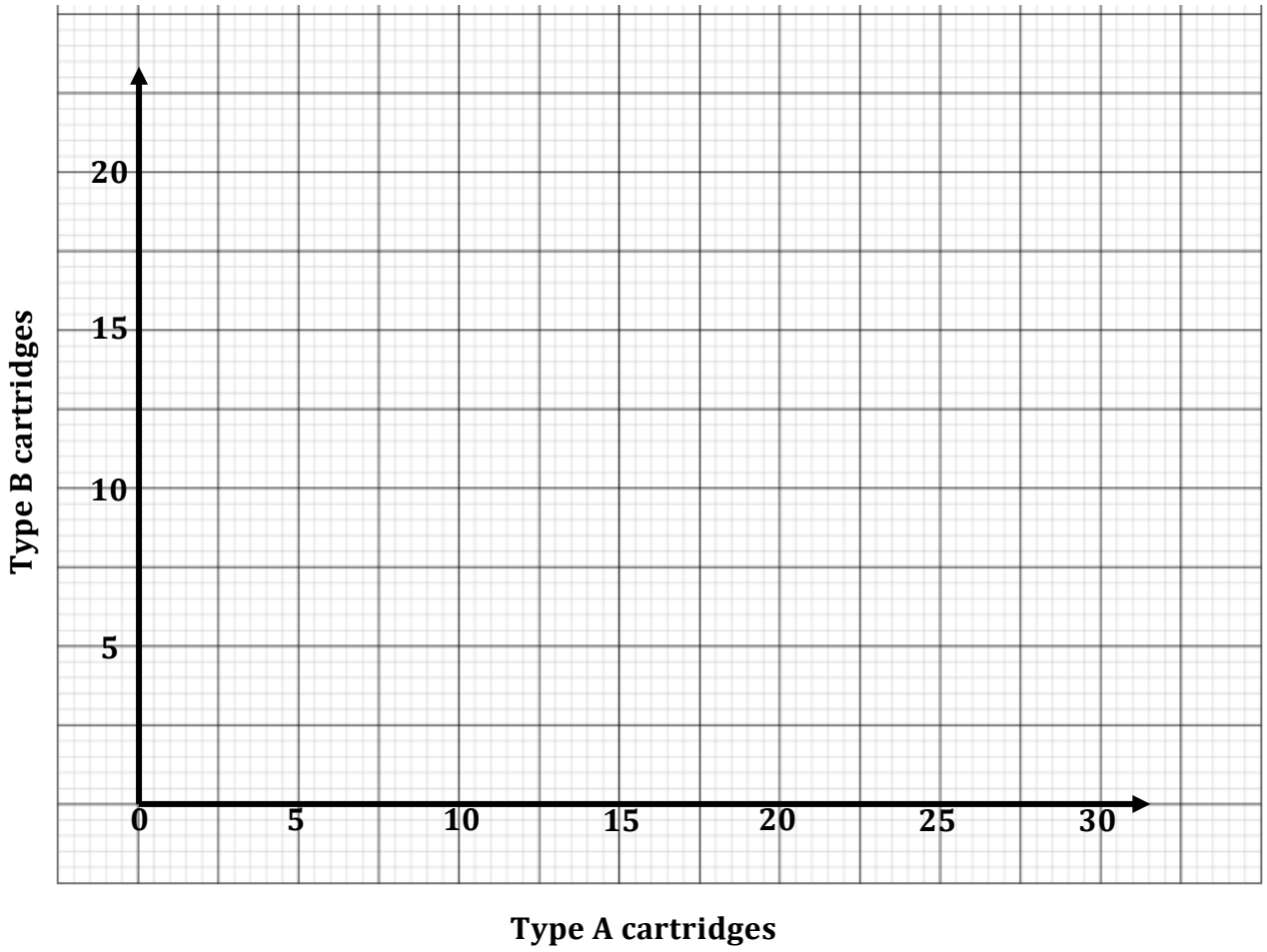
ADDENDUM B

QUESTION 7.1 and 7.2



(10501053)

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. $r = \sqrt{a^2 + b^2} \quad or \quad r = \sqrt{z \;\; x \;\; \bar{z}}$

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

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

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

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

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

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

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

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