higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MATHEMATICS

(First paper)

NQF LEVEL 4

(10501064)

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

Nonprogrammable scientific calculators may be used.

This question paper consists of 10 pages, 2 answer sheets and a formula sheet of 2 pages.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)
MATHEMATICS
(First paper)
NQF LEVEL 4
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. Leave at least THREE lines after each question.
5. Answer QUESTION 2.4.7 on ANSWER SHEET A and QUESTION 6.2.3 on ANSWER SHEET B. Detach the ANSWER SHEETS and submit with your ANSWER BOOK.
6. Start each section on a new page.
7. Diagrams are NOT drawn to scale.
8. Where necessary, final answers should be rounded off to TWO decimal places, unless stated otherwise.
9. Use only a black or blue pen.
10. Write neatly and legibly.

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QUESTION 1

1.1 Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1.1–1.1.5) in the ANSWER BOOK.

1.1.1 Given $z_1 = 5 + 2i$ and $z_2 = 3 - 2i$ .Then $z_1 \times z_2$ in standard form is …

A $19 - 4i$.
B $11 - 4i$.
C $8 + 2i - 2i$.
D $5 + 8i$.

1.1.2 $5i^3 - i^{12}$ simplified is equal to …

A $15i^2 - 12i^{11}$.
B $-1 - 5i$.
C $-5i + 1^6$.
D $4i^{-9}$.

1.1.3 The factors for $x^2 + 64$ are …

A $x(x + 64)$.
B $(x - 8)(x + 8)$.
C $(x + 64)(x + 1)$.
D $(x - 8i)(x + 8i)$.

1.1.4 Given $z = 2 \text{ cis } (12°)$, then $z^3 = \ldots$

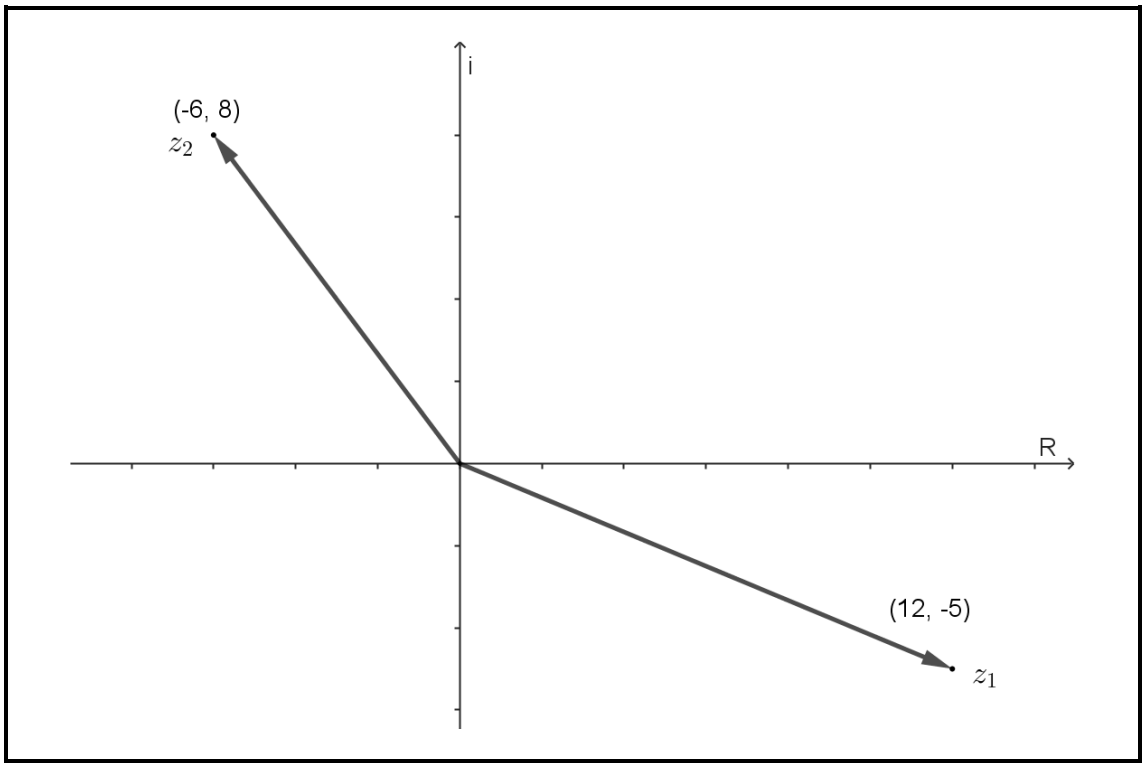
A $6 \text{ cis } (12°)^3$.
B $8 \text{ cis}(36°)$.
C $6 \text{ cis}(36°)$
D $2^3\text{cis}(12^{3}°)$

1.1.5 Solve x if $12i - 8i^2 = xi + 8$ where $i = \sqrt{-1}$

A $x = 12i$
B $x = -16 - 12i$
C $x = 4i - 8$
D $x = 12$

(5 × 1) (5)

1.2 The Argand diagram below represent two complex numbers z_1 and z_2:



1.2.1 Write z_1 in polar form. Leave the answer with $0 \leq \theta \leq 360$. (1)

1.2.2 Apply de Moivre's Theorem and determine $(z_1 + z_2)^4$. Use THREE decimals during calculations. Round the final answer to TWO decimals.

Leave the answer in polar form with $0 \leq \theta \leq 360$. (3)

1.3 Calculate $a + bi$ if given $(a + bi)(-5 + 3i) = -27 + 21i$ (3)

1.4 Solve for x and y in the following identity and express any non-real solutions in the form $a \pm bi$ for all values where $y \in N$.

$ix^2 + y^2i^2 + 12 = 2xi^3 - yi + yi^2$ (4)

[16]

QUESTION 2

2.1 Given $f(x) = 5x^3 + 7x^2 - 2x - 4$ and $g(x) = x$

Determine the remainder if $f(x)$ is divided by $g(x)$. (Long division is excluded). (1)

2.2 The expression $x^4 - 15x^2 + px + 24$, is divisible by $(x + 1)$.

Determine the value of p. (2)

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2.3 The equation of the tangent to $g(x) = 2x^3 - mx^2 + nx$ at $(-1; -25)$ is $y = 40x + 15$. Calculate the values of m and n. (4)

2.4 Given the following function:

$f(x) = \frac{x+8}{3}$ with domain $\{x: -2 \leq x < 7; x \in R\}$ and $g^{-1}(x) = \sqrt{x}$ with range $\{: -3 \leq y \leq 0; y \in R\}$

2.4.1 Determine the equation of g(x) in the form $y = \ldots$. (1)

2.4.2 Give the relevant domain of $g(x)$. (1)

2.4.3 Determine the equation of $f^{-1}(x)$ in the form $y = \ldots$. (1)

2.4.4 Prove that $f\left(f^{-1}(x)\right) = x$ (2)

2.4.5 Determine the exact value for which $f(a+2) + g(a) = 8$.

Determine which answer is within the given intervals of $g(x)$ *and* $f(x)$. (3)

2.4.6 Determine the range for $f(x)$ (2)

2.4.7 Draw a neat graph of $g(x)$ *and* $g^{-1}(x)$ on the same system of axes on ANSWER SHEET A, clearly showing the nature of start and endpoints that corresponds with given data.

Show the line about which $g(x)$ will reflect $g^{-1}(x)$. (3)

[20]

QUESTION 3

3.1 Given the following equation $f(x) = -x^3$ Determine the derivative of $f(x)$ making use of first principles. Show all the steps. (2)

3.2 Use differentiation rules to determine the derivatives of the following, leaving your answer with POSITIVE EXPONENTS and in SURD form where applicable:

3.2.1 $y = 2\sin 3x + 2x^5 + 6\,ln\,x + 12^{\frac{1}{2}}$ (2)

3.2.2 $y = -2e^{5x} + 3\sqrt{x} + \frac{2}{\sqrt[2]{4x^3}} - \frac{2}{x}$ (4)

3.2.3 $y = \sqrt[3]{9x^2 + 6}$ (4)

3.2.4 $f(x) = 4e^{3x} \times \tan 3x$ (2)

[14]

QUESTION 4

4.1 Determine the following integrals and simplify the answers. Leave the answer with POSITIVE EXPONENTS and in SURD form where applicable:

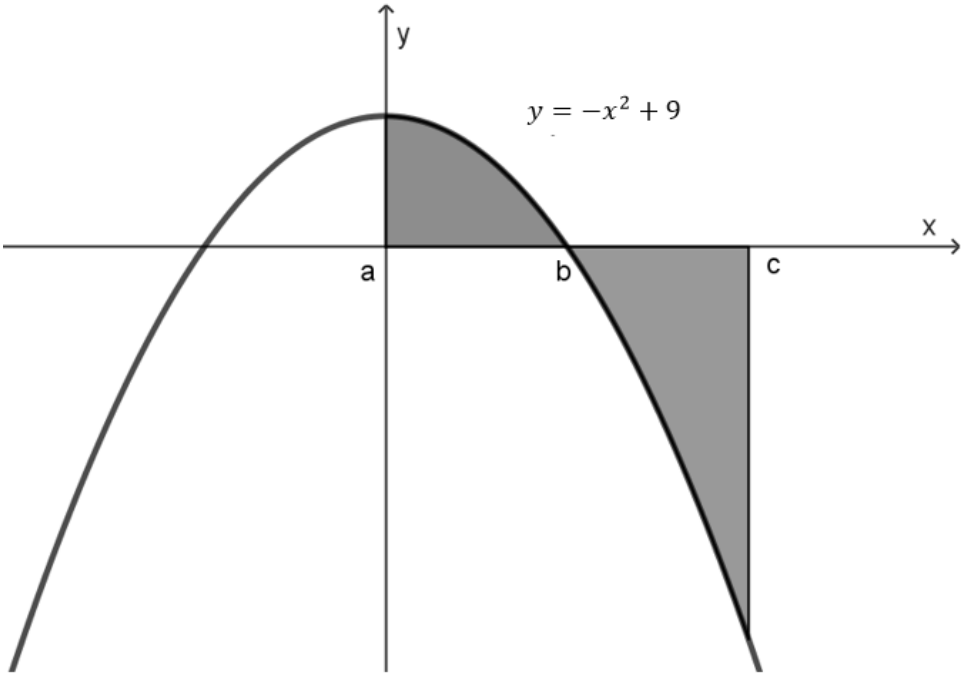
4.1.1 $\int(-15sin5x + 8e^{4x} + 36x^2 + 5)\,dx$ (3)

4.1.2 $\int\left(\frac{2}{x} + \frac{2}{\sqrt[3]{x}} + \frac{10}{x^6} - \frac{5}{3x^2} + 23\right)dx$ (4)

4.1.3 $\int\left(\frac{x^3 - 8}{x - 2}\right)dx$ (3)

4.2 The diagram below represents the graph of $y = -x^2 + 9$. The area is bounded by the graph and the x −axis, the lines $x = 0$ and $x = 6$.

Calculate the magnitude of the shaded area by making use of integration.

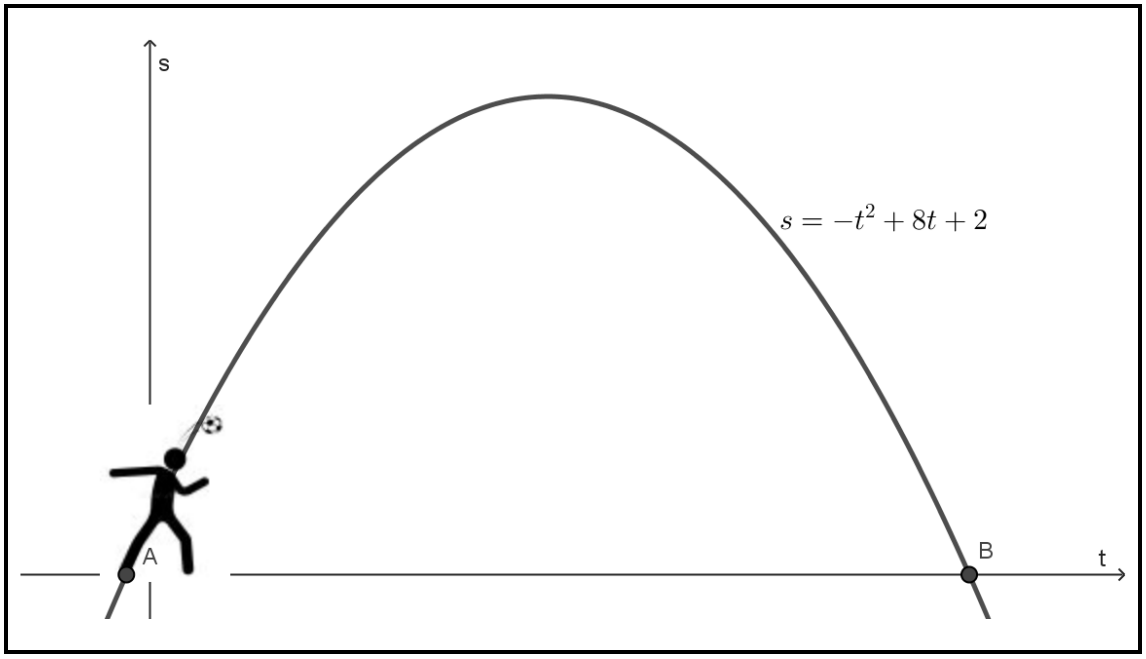


(5)
[15]

QUESTION 5

5.1 A soccer player passes the ball with her head. The motion of the ball is expressed in terms of distance (s) in meters and time(t) in seconds.

The equation of motion is $(t) = -t^2 + 8t + 2$.



5.1.1 Determine the height the ball at $t = 3$. (1)

5.1.2 Calculate the velocity of the ball at $t = 3$. (2)

5.1.3 What is the acceleration of the ball? (1)

5.2 Consider the following third-degree polynomial:

$f(x) = x^3 - qx^2 + x + 26$

5.2.1 Given that $f'(x) = 3x^2 - 8x + 1$. Determine the value of q in $f(x)$. (2)

5.2.2 If $x = -2$ is a root of $f(x)$, determine the other roots of $f(x)$. Write the non-real roots in the form $a \pm bi$. (5)

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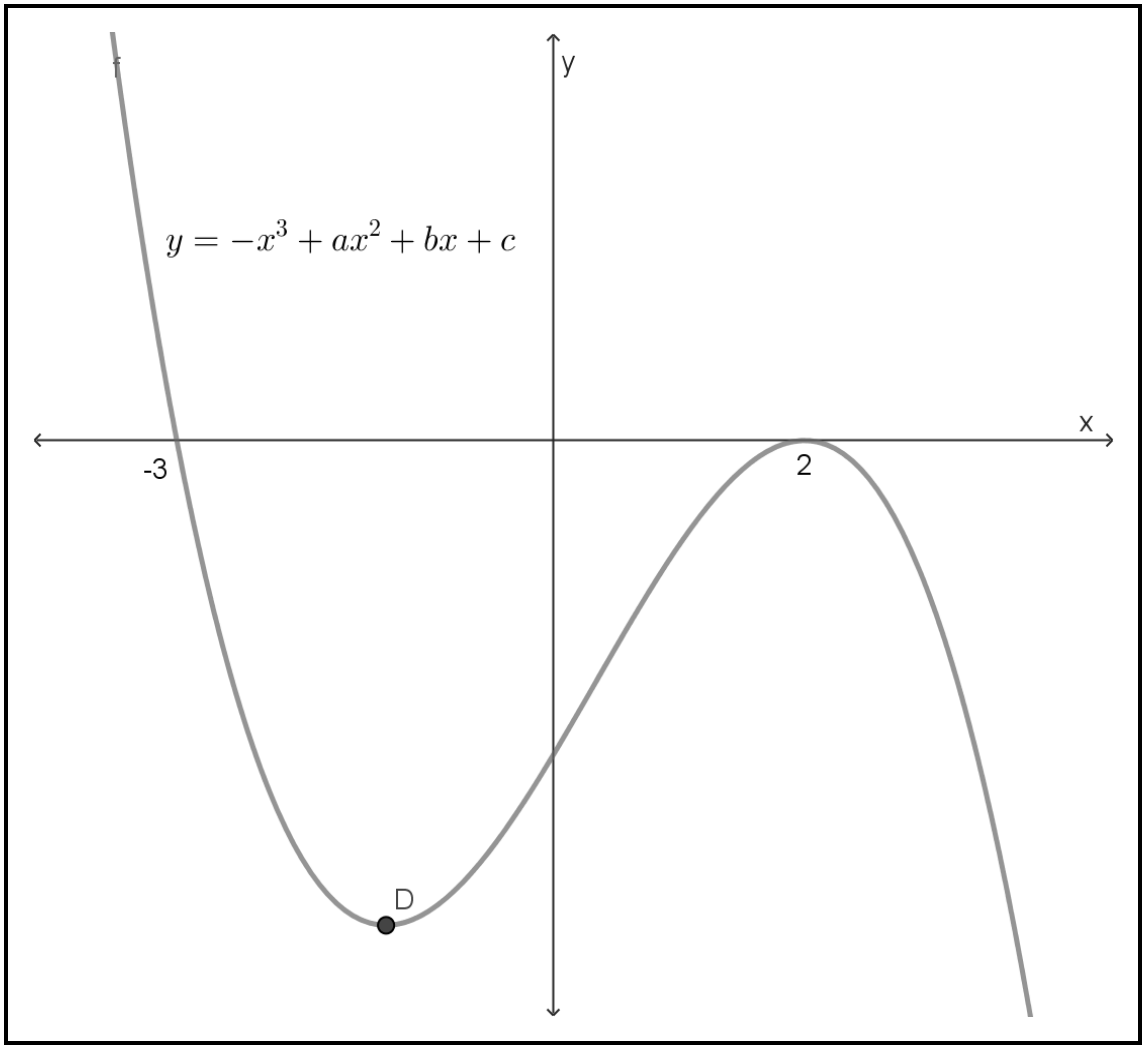
5.3 The equation defining the graph below is $y = -x^3 + ax^2 + bx + c$



5.3.1 Determine the value/s of a, b *and* c in $y = -x^3 + ax^2 + bx + c$. (4)

5.3.2 Apply differentiation to determine the coordinates of turning point D. (3)
[18]

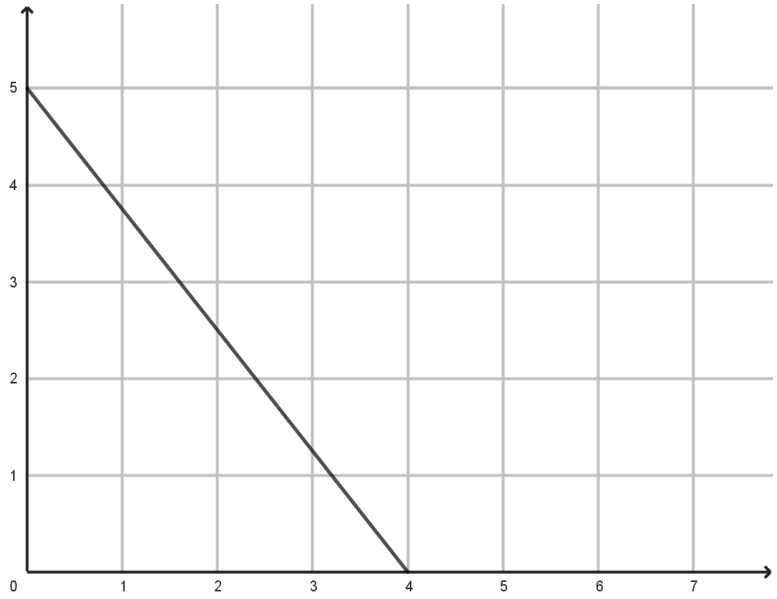
QUESTION 6

6.1 A farmer buys Jersey cows for milk production and Hereford cattle for its meat. The Jersey cows cost R 12500 per cow and Hereford cattle cost R10 000. The farmer can spend a maximum of R50 000.

Let Jersey cows be x and Hereford cattle be y.

6.1.1 Model the constraints by making use of the given data above and leave it in the simplified format $y \ldots \ldots \ldots$ (1)

6.1.2 The graph below represents the feasible region where the x-axis represents the Jersey cows and the y-axis represents the Hereford cattle.



Write down all the feasible solutions as ordered pairs.

(2)

6.2 The table below gives the minimum quantities of chemicals that will ensure proper growth in crops. There are two types of fertiliser, 'Zonk-bloom' and 'Rhizome-root' fertiliser.

CHEMICAL	MINIMUM UNITS	'ZONK-BLOOM'	'RHIZOME-ROOT'
K	16	8	2
P	5	1	1
N	20	2	7
Cost R/bag		R80/bag	R160/bag

6.2.1 Write the cost equation in terms of x and y. (1)

6.2.2 Two of the constraints are $x \geq 0$ and $y \geq 0$. Model the other constraints in respect of the above information in terms of x and y. (3)

6.2.3 Use ANSWER SHEET B and complete the following questions:

a) Represent the inequalities graphically. (3)

b) Indicate the feasible region on the graph. (1)

c) Draw the search line on the graph. (1)

d) Use the search line to determine the point that will inform you on how many bags of each type will ensure proper fertilisation, but at a minimum cost. Indicate the point on the graph. (1)

e) Determine analytically the coordinates of the point identified in QUESTION 6.2.3(d). Show the calculation. (2)

f) Hence, calculate the minimum costs. (1)

6.2.4 A farmer uses 2 bags of Zonk bloom and 5 bags of Rhizome root fertiliser. Calculate the potassium (K) content of this mix. (1)

[17]

TOTAL: 100

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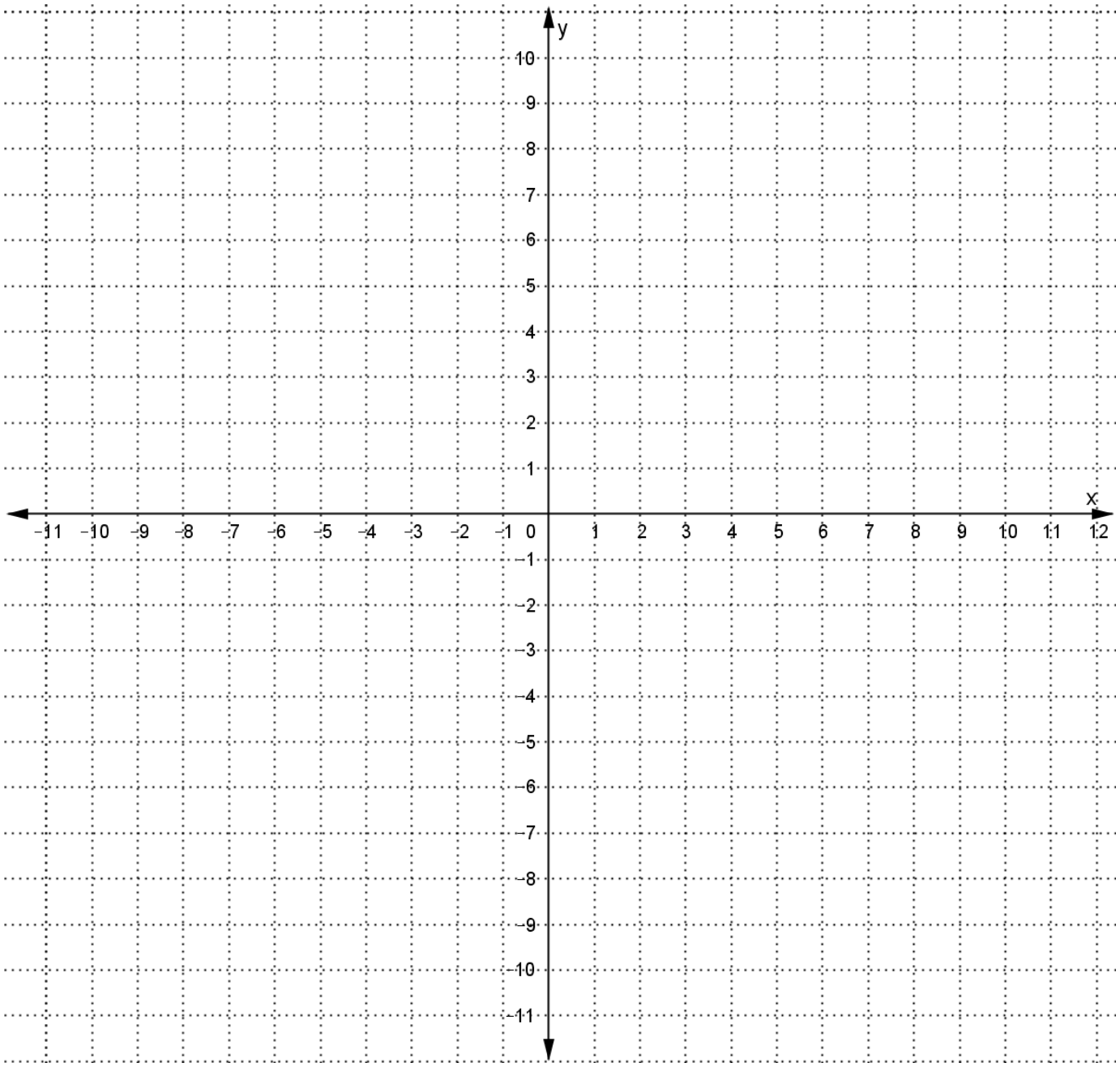
EXAMINATION NUMBER:

CENTRE NUMBER:

ANSWER SHEET A

2.4.7



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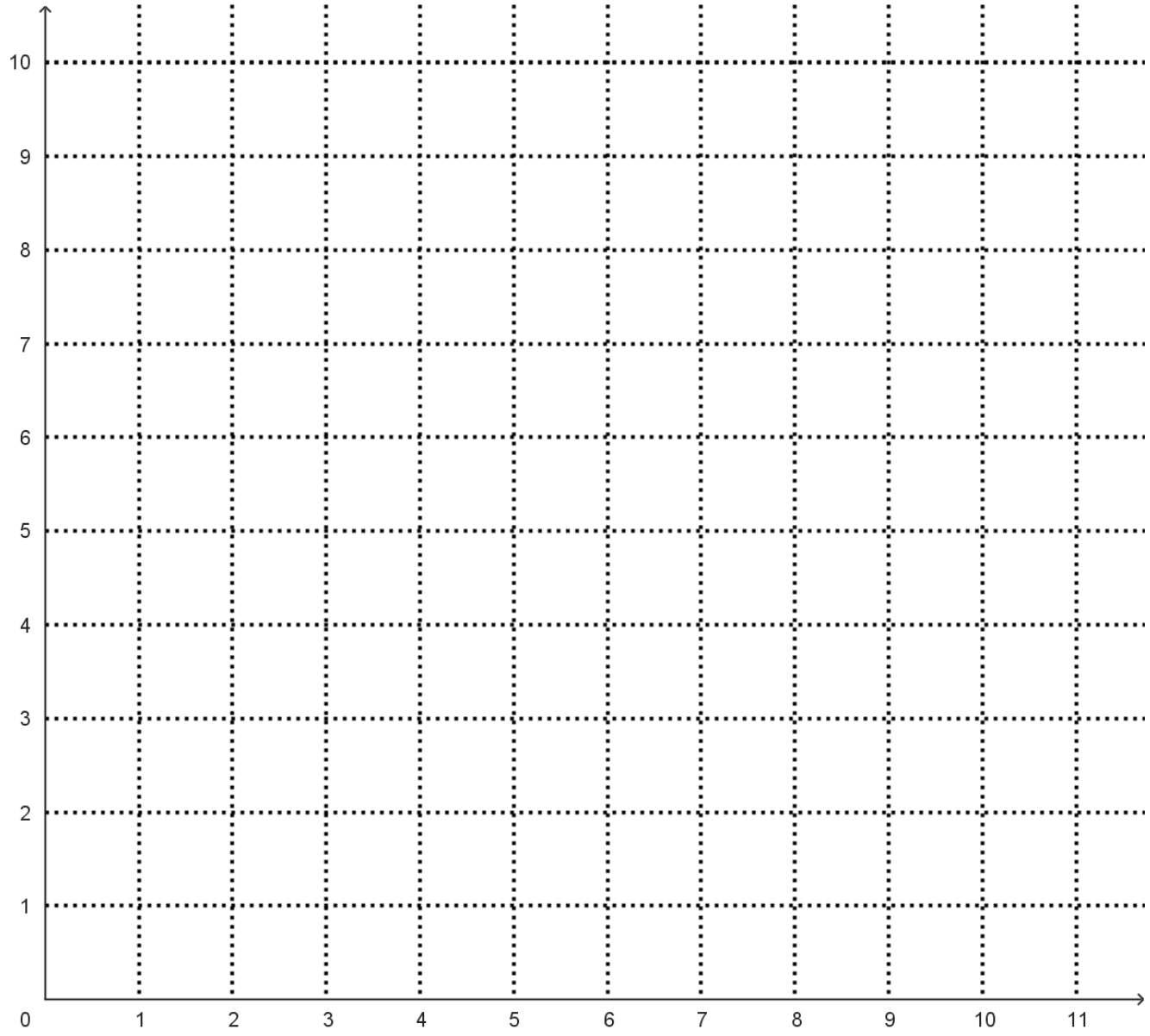
ANSWER SHEET B

6.2.3



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FORMULA SHEET

1. $z = r\cos\theta \pm rj\sin\theta$ or $z = r\cos\theta \pm ri\sin\theta$

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

3. $r\angle\theta = rcis\theta$ where 'r' represent modulus and 'θ' represent argument

4. $m = \lim_{h\to 0} \dfrac{f(x+h) - f(x)}{h}$

5. $\dfrac{d}{dx}\, x^n = nx^{n-1}$

6. $\dfrac{d}{dx}\, k = 0$

7. $\dfrac{dy}{dx} = u.\dfrac{dv}{dx} + v.\dfrac{du}{dx}$ or $\dfrac{d}{dx}[f(x).g(x)] = f(x)g'(x) + f'(x)g(x)$

8. $\dfrac{dy}{dx} = \dfrac{v.\dfrac{du}{dx} - u.\dfrac{dv}{dx}}{v^2}$ or $\dfrac{d}{dx}\left[\dfrac{f(x)}{g(x)}\right] = \dfrac{f'(x)g(x) - f(x)g'(x)}{[g(x)]^2}$

9. $\dfrac{dy}{dx} = \dfrac{dy}{du} \times \dfrac{du}{dx}$

10. If $y = \big(f(x)\big)^n$ then $\dfrac{dy}{dx} = n\big(f(x)\big)^{n-1} f'(x)$

11. If $y = ln\, kx$ then $\dfrac{dy}{dx} = \dfrac{k}{kx}$ or If $f(x) = \ln kx$ then $f'(x) = \dfrac{k}{kx}$

12. If $y = e^x$ then $\dfrac{dy}{dx} = e^x$ or If $f(x) = e^x$ then $f'(x) = e^x$

13. If $y = e^{kx}$ then $\dfrac{dy}{dx} = ke^{kx}$ or If $f(x) = e^{kx}$ then $f'(x) = ke^{kx}$

14. If $y = \sin x$ then $\dfrac{dy}{dx} = \cos x$ or If $f(x) = \sin x$ then $f'(x) = \cos x$

15. If $y = \cos x$ then $\dfrac{dy}{dx} = -\sin x$ or If $f(x) = \cos x$ then $f'(x) = -\sin x$

16 If $y = \tan x$ then $\dfrac{dy}{dx} = \sec^2 x$ or If $f(x) = \tan x$ then $f'(x) = \sec^2 x$

17. If $y = \cot x$ then $\dfrac{dy}{dx} = -cosec^2 x$ or If $f(x) = \cot x$ then $f'(x) = -cosec^2 x$

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18. If $y = \sec x$ then $\frac{dy}{dx} = \sec x \tan x$ or If $f(x) = sec\ x$ then $f'(x) = \sec x\ tanx$

19 If $y = cosec\ x \rightarrow \frac{dy}{dx} = -cosec\ xcot\ x$ or If $f(x) = cosec\ x \rightarrow f'(x) = -cosec\ x \cot x$

20. $\int x^n dx = \frac{x^{n+1}}{n+1} + c$

21. $\int kx^n dx = k \int x^n dx$ where k is a constant value

22. $\int [f(x) \pm g(x)]dx = \int f(x)dx \pm \int g(x)dx$

23. $\int \frac{k}{x} dx = k\ ln\ x + c$

24 $\int e^{kx} dx = \frac{e^{kx}}{k} + c$

25. $\int \sin kx\ dx = -\frac{\cos kx}{k} + c = -\frac{1}{k}\cos kx + c$

26. $\int \cos kx\ dx = \frac{\sin kx}{k} + c = \frac{1}{k}\sin kx + c$

27. $\int \sec^2 kx\ dx = \frac{\tan kx}{k} + c = \frac{1}{k}\tan kx + c$

28. $A = \int_a^b y\ dx$

29. $[f(x)]_a^b = f(b) - f(a)$

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