



higher education  
& training

Department:  
Higher Education and Training  
**REPUBLIC OF SOUTH AFRICA**

**NATIONAL CERTIFICATE (VOCATIONAL)**

**MATHEMATICS**

(First Paper)

**NQF LEVEL 3**

(10501053)

**4 November 2019 (X-Paper)**

**09:00–12:00**

**This question paper consists of 6 pages, 3 diagram sheets and 1 formula sheet.**

**TIME: 3 HOURS**  
**MARKS: 100**

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**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. Write neatly and legibly.
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**QUESTION 1**

1.1 Write each of the following imaginary numbers in their simplest form:

1.1.1  $i^{\sqrt{64}}$  

1.1.2  $(2i)^5 \times i^9$  (2 × 2) (4)

1.2 Simplify each of the following without using a calculator:

1.2.1  $(12,6 + j4,9) + (-1,3 - j9,6)$  (2)

1.2.2  $(6 - i7)(6 + i7)$  (2)

1.2.3  $\frac{-7 - i2}{-4 + i}$  (3) 

1.2.4  $3(\cos 25^\circ + i \sin 25^\circ) \cdot 8(\cos 200^\circ + i \sin 200^\circ)$  (2)

1.2.5  $\frac{4(\cos 190^\circ + i \sin 190^\circ)}{2(\cos 70^\circ + i \sin 70^\circ)}$  (2)

1.3 Convert each of the following complex numbers into polar form and express the argument  $\theta$  as a positive angle:

1.3.1  $z = -6 + i9$  (3)

1.3.2  $z = \frac{-7 - i8}{2 - 3i}$  (5)

1.4 Simplify each of the following and express the answer in the form  $a + ib$ . Show ALL calculations.

1.4.1  $\frac{12|_{45^\circ} \cdot 6|_{180^\circ}}{8|_{20^\circ}}$   (4)

1.4.2  $\frac{3,8(\cos 120^\circ + i \sin 120^\circ)}{2,5 \cos 45^\circ}$  (3)

**[30]**

**QUESTION 2**

2.1 Solve for  $x$  in the following inequality:

$$\text{✿} \quad x^2 - 8x + 23 \leq 8 \quad (5)$$

2.2 Solve for  $x$  by completing the square:

$$5x^2 - 3 = 2x \quad (4)$$

2.3 Solve for  $x$  and  $y$  in:

$$\begin{aligned} y + 2x &= 2 \\ y^2 + 2x^2 &= 3xy \end{aligned} \quad \text{✿} \quad (4)$$

2.4 Simplify each of the following:

$$2.4.1 \quad \frac{a^2 - a}{a - 2} \cdot \frac{a + 1}{a^2 + 4a} \div \frac{a^2 - 3a - 4}{a^2 - 16}$$

$$2.4.2 \quad \frac{y}{y^2 - 16} - \frac{y + 1}{y^2 - 5y + 4}$$

(2 × 4) (8)

2.5 The following constraints are given for a linear programming problem:

$$\begin{aligned} x &\leq 6 \\ y &\leq 7 \\ 5x + 3y &\leq 36 \\ x - 6y + 6 &\leq 0 \end{aligned}$$

2.5.1 Use DIAGRAM SHEET 1 (attached) and sketch the graph with the given constraints. ✿ (4)

2.5.2 Determine the feasible region by shading. (1)

2.5.3 Find the values of  $x$  and  $y$  that will maximize the profit if the objective function is  $P = 100x + 200y$  by means of a boundary search. (4)

**[30]**

**QUESTION 3**

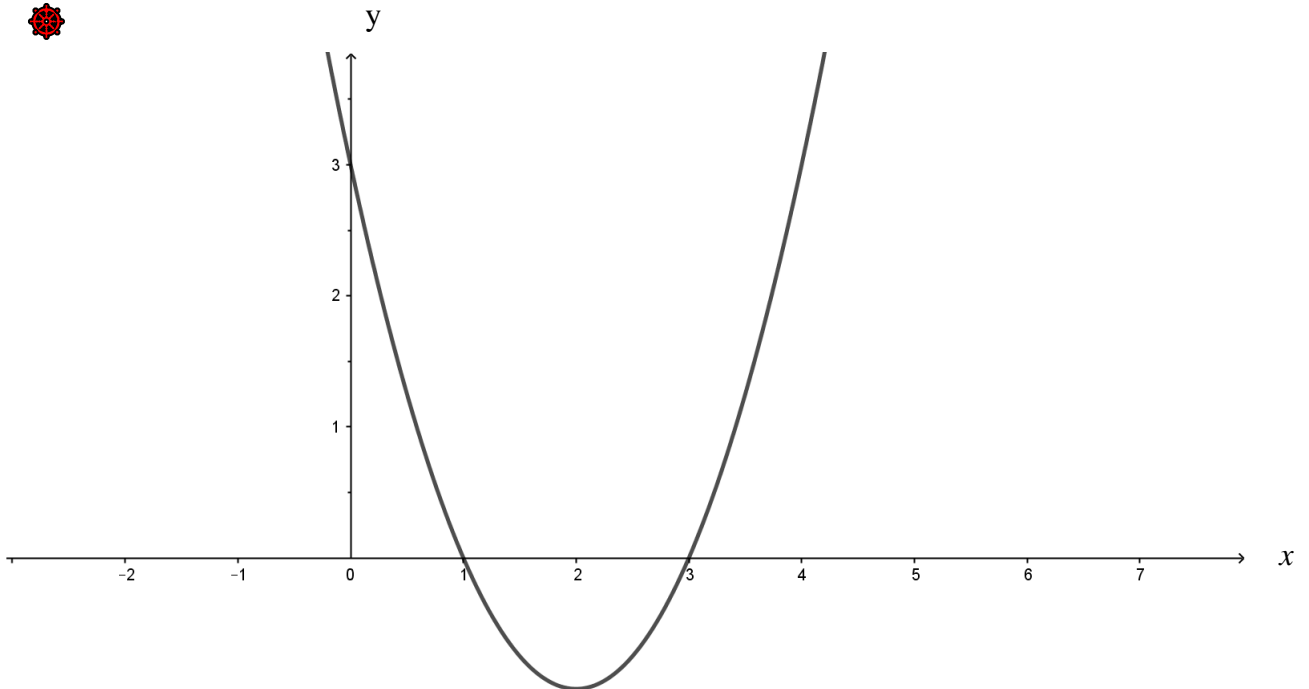
3.1 Given  $f(x): 2y - x = -1$  and  $g(x) = \frac{4}{x-4} + 2$



Use DIAGRAM SHEET 2 and sketch the graphs of  $f(x)$  and  $g(x)$  on the same system of axes. Indicate the asymptotes of  $g(x)$  (8)

3.2 In the figure below the graph of  $y = ax^2 + bx + q$  is shown.

Study the graph and answer the questions.



3.2.1 Find the equation for the graph  $y = ax^2 + bx + q$ . (4)

3.2.2 Calculate the turning point of the graph  $y = ax^2 + bx + q$ . (4)


3.3 Use DIAGRAM SHEET 3 (attached) and sketch the graph of  $y = \left(\frac{1}{2}\right)^x$  where  $-3 \leq x \leq 3$  (4)



**[20]**

**QUESTION 4**


4.1 If  $s(t) = t^2 + 3t$ , find the derivative  $\frac{ds}{dt}$  from first principles. (4)

4.2  Determine the following limit:


$$\lim_{x \rightarrow \infty} \frac{4 - x^2}{x^3 - 2} \quad (3)$$

4.3 Use differentiation rules to determine  $\frac{dy}{dx}$  of each of the following. Leave the answer with a positive exponent and in surd form where applicable.

4.3.1  $y = \frac{1}{4}x^8 - \frac{1}{2}x^4 + 2$

4.3.2  $y = \frac{2}{x} - \sqrt{x}$  

4.3.3  $y = (x + 2)(3x - 5)$  (3 × 3) (9)

4.4 Find the greatest product that can be obtained by multiplying two numbers of which the sum is 32. 

**HINT:** Make the one number ( $x$ ) and the other number ( $32 - x$ ). (4)  
[20]

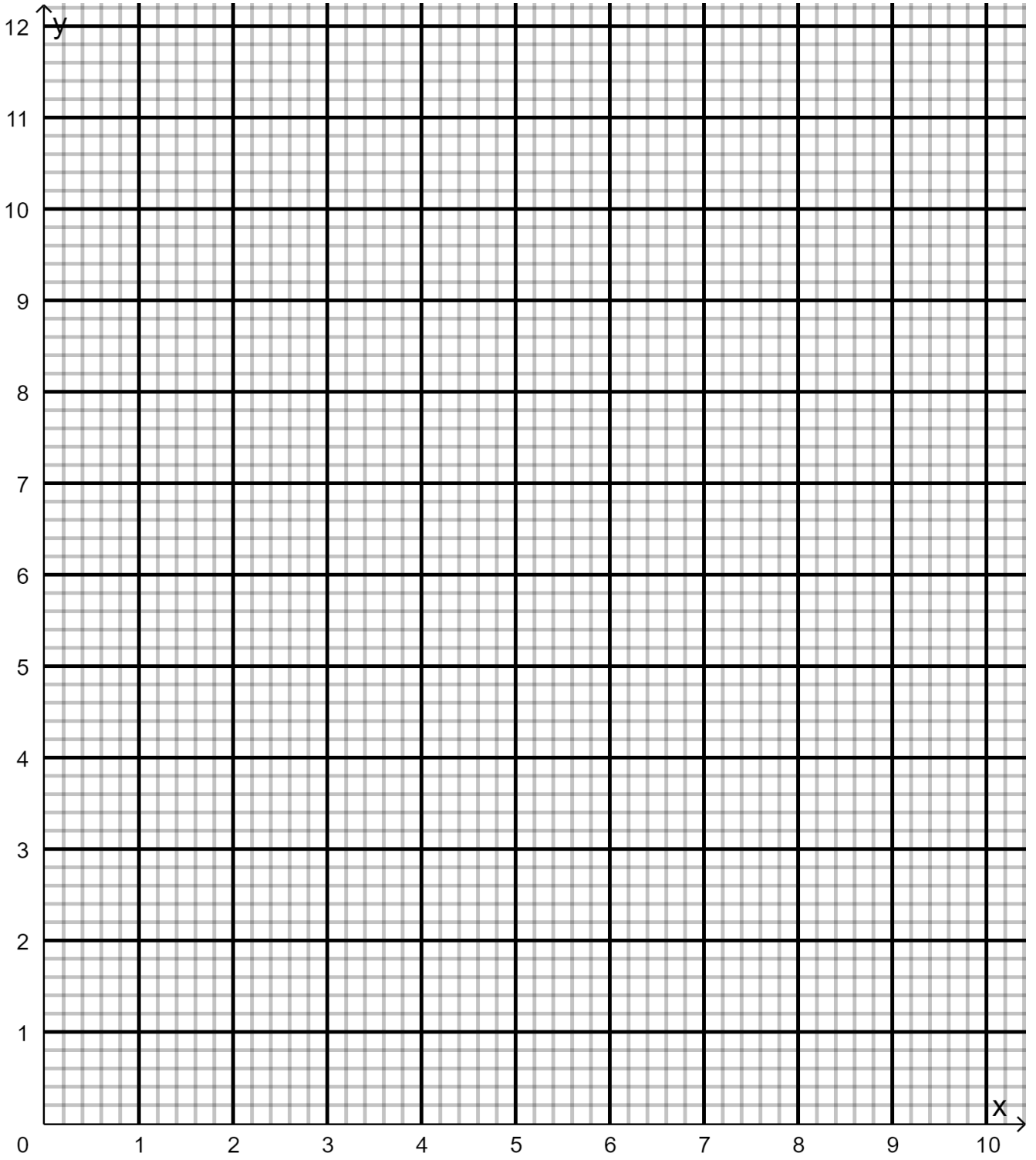
**TOTAL: 100**

**DIAGRAM SHEET 1**

**EXAMINATION NUMBER:**

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**QUESTION 2.5.1**

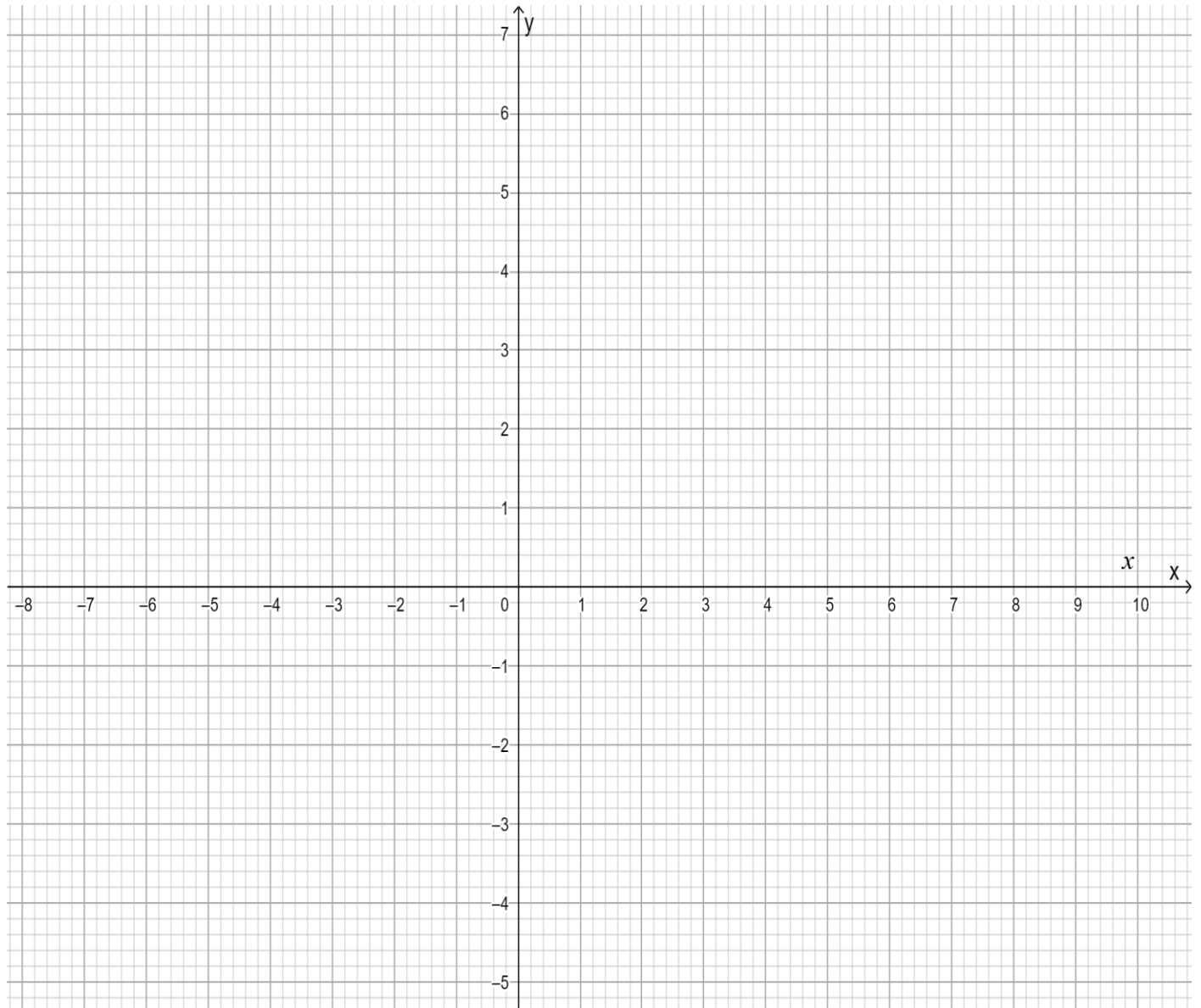


**DIAGRAM SHEET 2**

**EXAMINATION NUMBER:**

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**QUESTION 3.1**



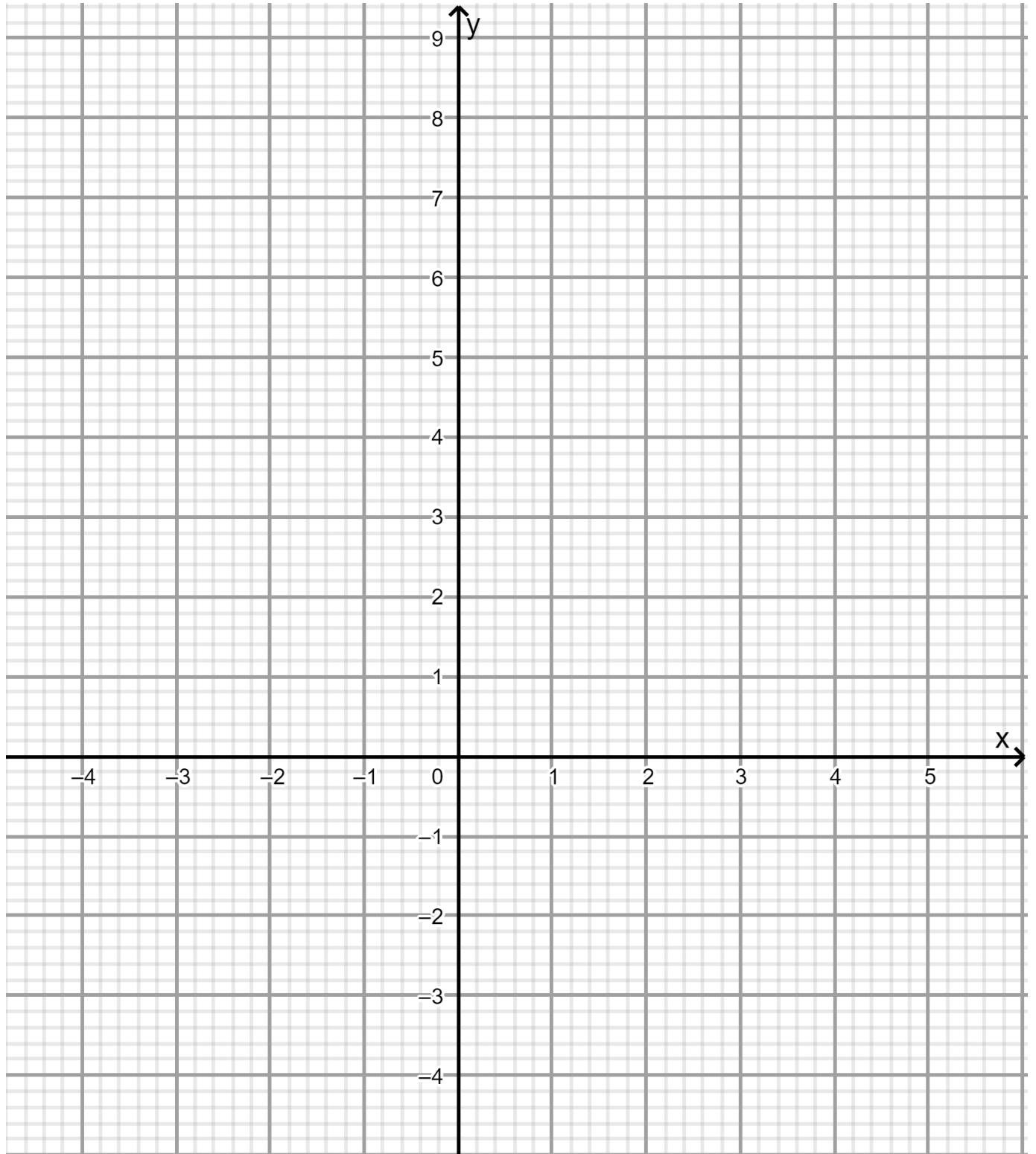


**DIAGRAM SHEET 3**

**EXAMINATION NUMBER:**

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**QUESTION 3.3**



**FORMULA SHEET**

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

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

3.  $r = \sqrt{a^2 + b^2}$  or  $r = \sqrt{z \times \bar{z}}$

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

5.  $r \cos \theta = r \cos \theta$

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

7.  $y = ax^2 + bx + c$

8.  $y = a(x - p)^2 + q$

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

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

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

12.  $\frac{d}{dx} x^n = nx^{n-1}$

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

14.  $Dx[kf(x)] = kDx[f(x)]$

15.  $Dx[f(x) \pm g(x)] = Dx[f(x)] \pm Dx[g(x)]$