higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MATHEMATICS
(First Paper)
NQF LEVEL 3

(10501053)

20 February 2020 (X-Paper)
09:00–12:00

This question paper consists of 6 pages, 2 diagram sheets and 1 formula sheet.

009Q1S2020

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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. Write neatly and legibly.

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QUESTION 1

1.1 Simplify the following complex numbers without using a calculator.

1.1.1 $(-1+2i)\{(1-5i)+(3+4i)\}$ (3)

1.1.2 $\dfrac{1}{(2+3i)} \times \dfrac{1}{(1-2i)}$ (leave your answer in the form $a+ib$) (4)

1.1.3 $12(cos45° + isin45°) \times 20(cos120° + isin120°)$
{leave your answer in the form $r(\cos\theta + i\sin\theta)$ } (2)

1.1.4 $(2+5i)2 + 5(7+2i) - i(4-6i)$ (2)

1.2 Consider the following complex number $\dfrac{5+5i}{3-4i}$

1.2.1 Simplify the complex number in the form $a+bi$. (4)

1.2.2 Determine the *modulus(r)* and *argument*(θ) of the complex number showing all the steps. (4)

1.2.3 Show the complex number on an *Argand* diagram. (3)

1.3 Simplify to the standard form $a+bi$.

$$\frac{(3\underline{|150°})}{(2\underline{|30°})(0{,}5\underline{|10°})}$$ (3)

1.4 Solve for x by making use of the quadratic formula and leave your answer in the form $a+bi$.

$$5x^2 + 2x + 10 = 0$$ (5)

[30]

QUESTION 2

2.1 Solve for x in $4x^2 - 3 = 2x$ by completing the square. (4)

2.2 Solve for z in $2z^2 = 7z - 6$ using the quadratic formula. (4)

2.3 Solve the quadratic inequality $3x^2 - 8x - 4 > 8$. (4)

2.4 Simplify the following expressions:

2.4.1 $\dfrac{28x-14}{45x-30} \div \dfrac{14x+7}{30x-20}$ (4)

2.4.2 $\dfrac{x-2}{x}-\dfrac{x}{x-4}$ (4)

[20]

QUESTION 3

3.1 Differentiate the following with respect to x. (Leave answers with POSITIVE exponents and in SURD form where applicable.)

3.1.1 $r(x)=x^2\sqrt[3]{x^2}$ (3)

3.1.2 $y=\dfrac{-x^3}{3}+\dfrac{x^2}{2}+x-6$ (4)

3.1.3 $f(x)=(3x)^{-4}$ (2)

3.2 Find the derivative of $y=\dfrac{1}{x}$ from first principles. (4)

3.3 Determine $\lim_{x\to\infty}\dfrac{-4x}{7x-3}$ (3)

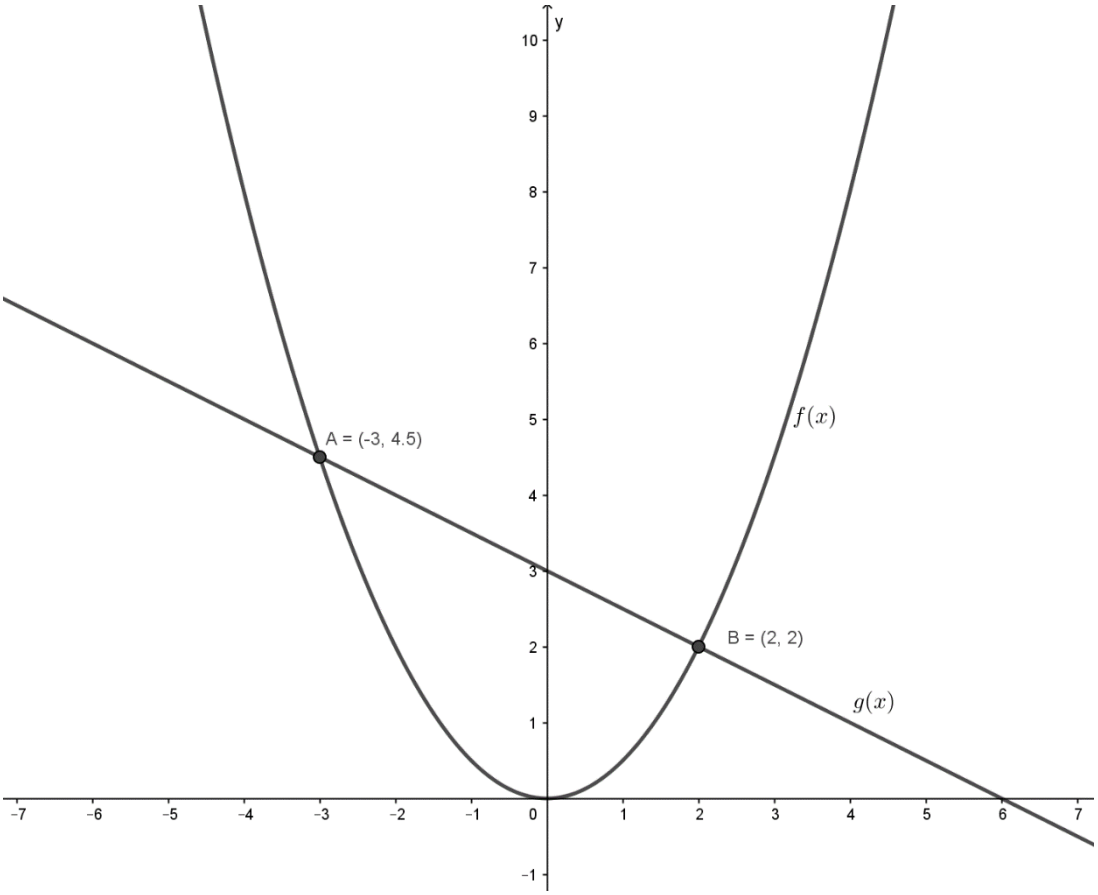
3.4 Find TWO numbers whose difference is 4 and whose product is a minimum. (4)

[20]

QUESTION 4

4.1 Use DIAGRAM SHEET 1 to draw the graphs of $\boldsymbol{y = 3^x}$ and $y = \dfrac{1}{x-2} + 1$ on the same system of axes. (6)

4.2 The following graphs represent $f(x) \cap g(x)$. Study the drawings and answer the questions.



4.2.1 Determine the equation for $f(x)$. (4)

4.2.2 Determine the equation for $g(x)$. (4)

4.2.3 Is $f(x)$ continuous or discontinuous? (1)

4.2.4 Is $g(x)$ a function or a relation? (1)

4.2.5 Write down the domain of $g(x)$. (2)

4.2.6 Write down the range of $f(x)$. (2)

4.3 The following constraints represent the production of two types of juices per day.

$x \geq 50$

$y \geq 60$

$x + y \leq 200$

$4x + 5y \leq 900$

4.3.1 Use DIAGRAM SHEET 2 and sketch the graph with the given constraints. (4)

4.3.2 Determine the feasible region. (1)

4.3.3 Find the values of x and y that will minimise the profit if the objective function is $P = 0{,}3x + 0{,}5y$. (5)

[30]

TOTAL: 100

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DIAGRAM SHEET 1

EXAMINATION NUMBER: | | | | | | | | | | | | | |

QUESTION 4.1

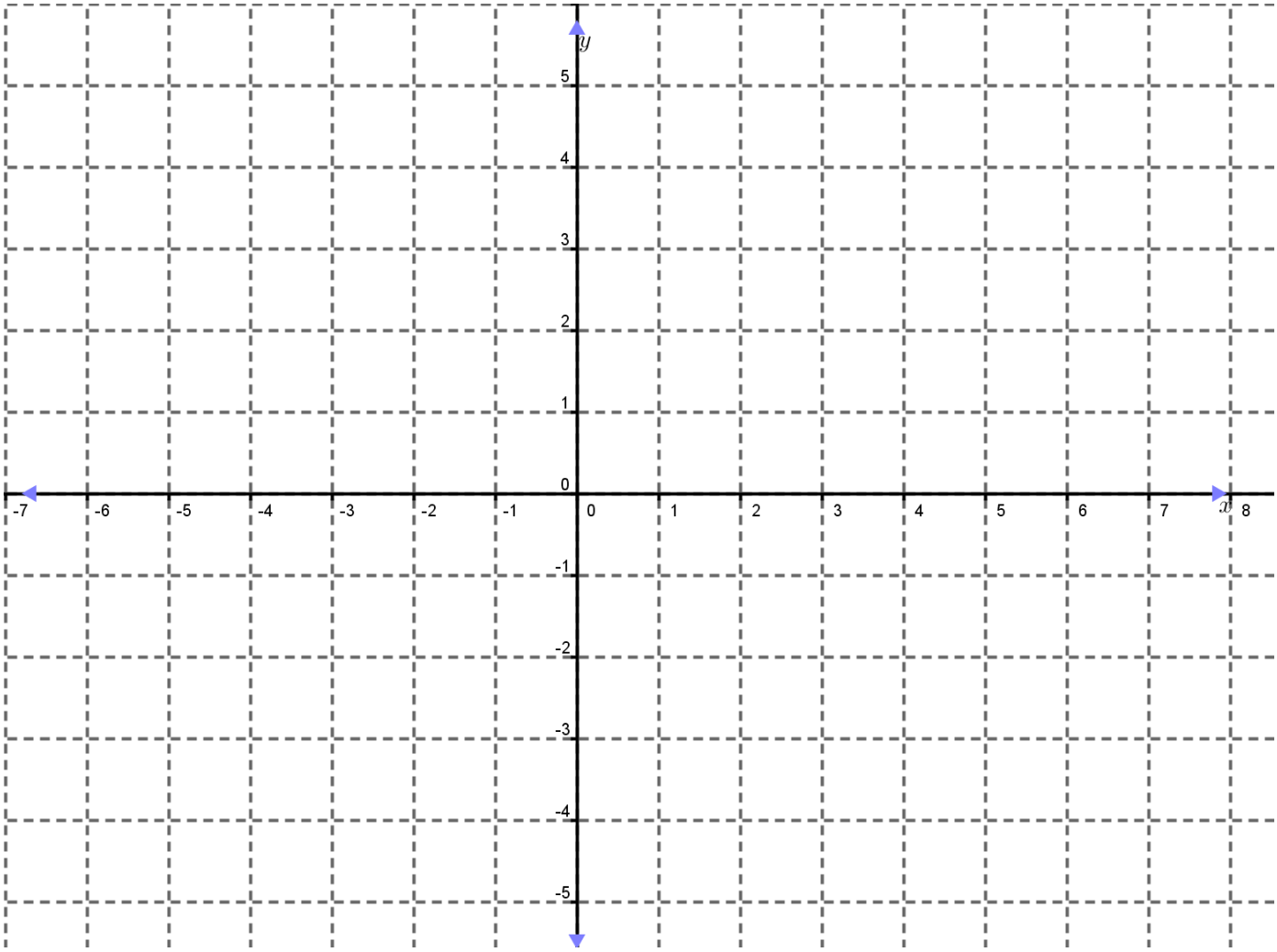
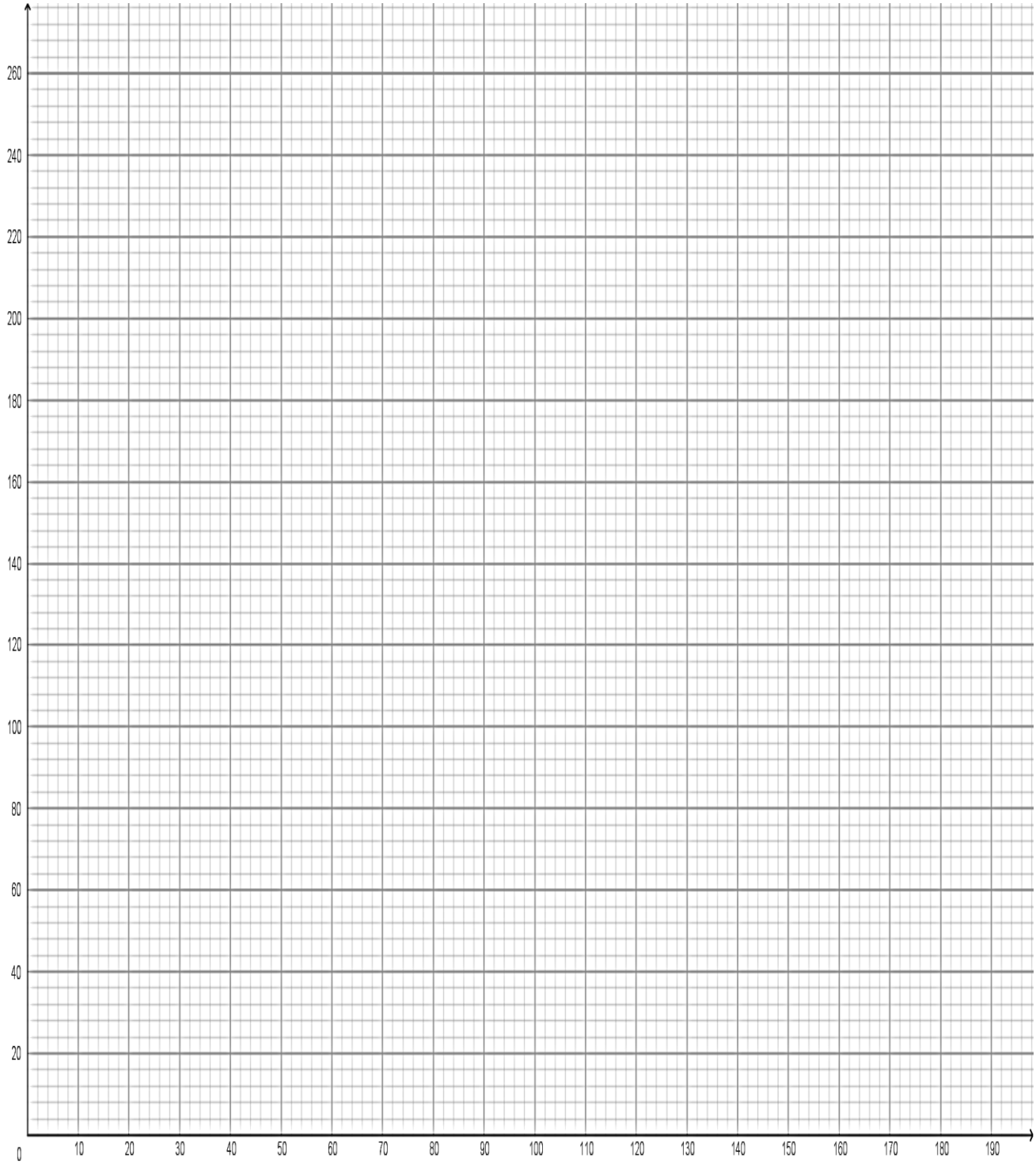


DIAGRAM SHEET 2

EXAMINATION NUMBER: | | | | | | | | | | | | | |

QUESTION 4.3.1



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

5. $r \angle\theta = r\ cis\ \theta$

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

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

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

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

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

11. $f'(x) = \lim\limits_{h \to 0} \dfrac{f(x+h) - f(x)}{h}$

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

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

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

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

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