higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MATHEMATICS
(First Paper)
NQF LEVEL 3

SUPPLEMENTARY EXAMINATION

(10501053)

5 March 2014 (X-Paper)
09:00–12:00

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

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.

QUESTION 1

1.1 Without the use of a calculator and without conversion to polar form, simplify the given complex numbers to standard form of $a+bi$:

1.1.1 $\left(12\sqrt{-2}\right)\left(-4\sqrt{-4}+1\right)$ (3)

1.1.2 $\dfrac{24j^{8}-36j^{16}+48j^{25}}{12j^{8}}$ (4)

1.1.3 $-(10+4i)-(6+4i)$ (2)

1.1.4 $\dfrac{(2i)^{5}}{4i}$ (2)

1.2 Given: $z=1+\sqrt{3}i$

1.2.1 Calculate the modulus (r) and the argument (θ) of z. (4)

1.2.2 Express z in polar form. (1)

1.2.3 Represent z graphically in an Argand diagram. (2)

1.3 Simplify the following complex numbers to standard form:

1.3.1 $\dfrac{5-2i}{(3+4i)(2-i)}$ (5)

1.3.2 $(1-2j)(2+j)-2j(3-2j)$ (4)

1.4 Simplify the following complex number and leave the answer in polar form:

$$(4cis60)(6cis40)\left(\frac{1}{2}cis(-20)\right)$$ (3)

[30]

QUESTION 2

2.1 Given: $f(x) = -x^2 - 2x + 3$ and
$g(x) = -2.2^{x-1} + 1$

2.1.1 Use ADDENDUM A (attached) and draw neat graphs of the above functions on the same set of axis. Clearly indicate intercepts with the axes. (8)

2.1.2 Write down the axis of symmetry of $f(x)$. (1)

2.1.3 What is the range of $f(x)$? (1)

2.1.4 What is the range of $g(x)$? (1)

2.2 Determine the domain and range of *h(x)* and *d(x)* in the following functions:

2.2.1 $h(x) = \frac{x+4}{3}$ (2)

2.2.2 $d(x) = 2x^2 - 2$ (2)

2.3 A clothing company manufactures yellow T-shirts and black trousers for a daycare school.

The following system of inequalities are obtained:

$x \geq 200$

$x + y \leq 600$

$x + 2y \leq 900$

$50x + 100y \leq 45000$

2.3.1 Sketch the graphs with the given constraints. (Use ADDENDUM B to answer QUESTION 2.3.1.) (4)

2.3.2 Indicate the feasible region of the graphs in QUESTION 2.3.1. (1)

2.3.3 Determine the numbers of T-shirts and pairs of trousers that will yield a maximum and minimum daily profit if $P = 30x + 40y$. (4)

2.4 Solve for x:
$-10x < -x^2$ (2)

2.5 Prove that $x=-4$ is a solution of the equation:

$$\frac{2x+3}{5}-\frac{4-x}{4}=\frac{2x-1}{6}-\frac{3}{2}$$ (5)

2.6 Solve for x by using a quadratic formula:

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

2.7 Solve for x and y:

$$y=(x-2)^2+9$$
$$y=2x+4$$ (5)

2.8 Simplify the following:

$$\frac{2x^2+x}{2x-1}\times\frac{4x^2-1}{x^2}\div\frac{2x+1}{x}$$ (5)

2.9 Simplify the following:

$$\frac{a}{ab+b^2}-\frac{2b}{a^2-b^2}+\frac{b}{a^2-ab}$$ (5)

[50]

QUESTION 3

3.1 Determine:

$f'(x)$ from the first principles if $f(x)=3x^2-1$ (4)

3.2 Calculate the following:

$$\lim_{h\to 0}\frac{(4+h)^2-16}{h}$$ (3)

3.3 Use differentiation rules to determine $\frac{dy}{dx}$ of the following. (Leave your answer with POSITIVE exponent and in SURD form where applicable.)

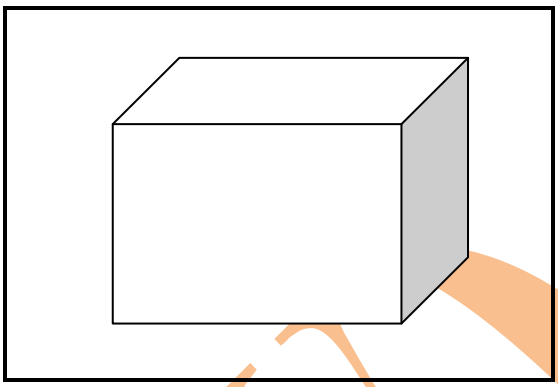
3.3.1 $y=4\sqrt{x}-2\sqrt[3]{x}+3$ (3)

3.3.2 $y=\frac{x^2-2x}{3}$ (2)

3.3.3 $y=12x^{10}-\sqrt{6x}+tx$ where t is a constant number (3)

3.4 The volume of a certain rectangular box is given by the equation below:

$$f(x) = x^3 - 8x^2 + 5x + 50$$



Calculate the value of x for which the volume is a maximum. (5)
[20]

TOTAL: 100

ADDENDUM A

2.1.1 Detach ADDENDUM A and hand it in with your ANSWER BOOK when completed.

EXAMINATION NUMBER:

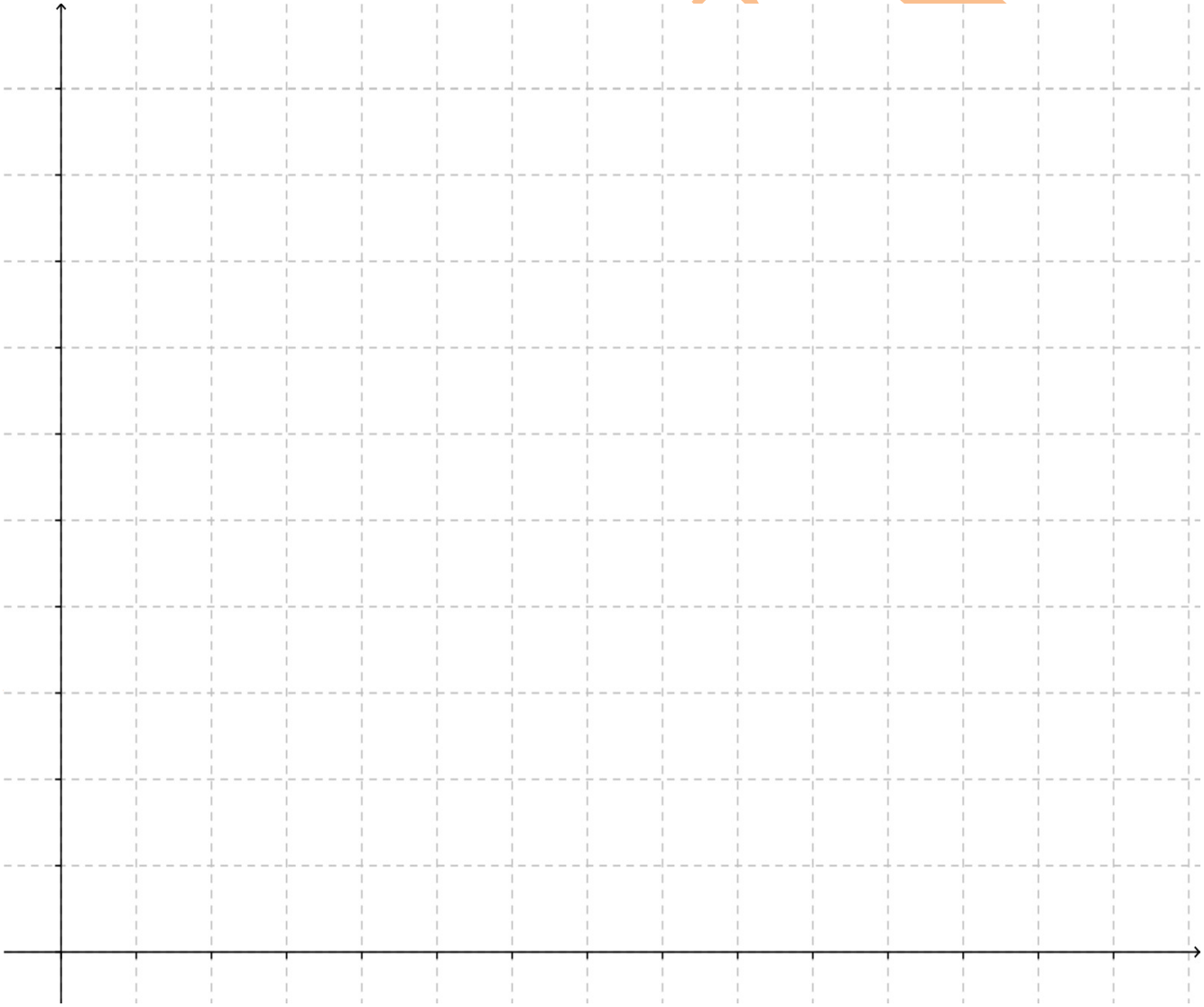
CENTRE NUMBER:

ADDENDUM B

2.3.1 Detach ADDENDUM B and hand it in with your ANSWER BOOK when completed.

EXAMINATION NUMBER:

CENTRE NUMBER:



FORMULA SHEET

MATHEMATICS L3

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

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

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

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

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

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