



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

**NATIONAL CERTIFICATE
NOVEMBER EXAMINATION
MATHEMATICS N3
21 NOVEMBER 2016**

This marking guideline consists of 10 pages.

✓ = 1 Mark

QUESTION 1

$$\begin{aligned}
 1.1 \quad 1.1.1 \quad & \sqrt{49x^2 + 56x + 16} \\
 & = \sqrt{(7x+4)^2} \quad \checkmark \\
 & = 7x+4 \quad \checkmark
 \end{aligned} \tag{2}$$

$$\begin{aligned}
 1.1.2 \quad & \left(a^{\frac{1}{3}} - a^{-\frac{2}{3}}\right)(a + a^{-1} - 2)^{-1} && \left(a^{\frac{1}{3}} - a^{-\frac{2}{3}}\right)(a + a^{-1} - 2)^{-1} \\
 & = \left(\sqrt[3]{a} - \frac{1}{\sqrt[3]{a^2}}\right)(a + \frac{1}{a} - 2)^{-1} \quad \checkmark \quad \checkmark && = \left(a^{\frac{1}{3}} - \frac{1}{a^{\frac{2}{3}}}\right)(a + \frac{1}{a} - 2)^{-1} \quad \checkmark \quad \checkmark \\
 & = \left(\frac{\sqrt[3]{a} \cdot \sqrt[3]{a^2} - 1}{\sqrt[3]{a^2}}\right)\left(\frac{a^2 - 2a + 1}{a}\right)^{-1} \quad \checkmark && = \left(\frac{a-1}{a^{\frac{2}{3}}}\right)\left(\frac{a^2 - 2a + 1}{a}\right)^{-1} \quad \checkmark \quad \checkmark \\
 & = \left(\frac{a-1}{\sqrt[3]{a^2}}\right)\left(\frac{(a-1)^2}{a}\right)^{-1} \quad \checkmark \quad \checkmark && = \left(\frac{a-1}{a^{\frac{2}{3}}}\right)\frac{a}{(a-1)^2} \quad \checkmark \quad \checkmark \\
 & = \left(\frac{a-1}{a^{\frac{2}{3}}}\right)\frac{a}{(a-1)^2} \quad \checkmark && = \frac{a^{\frac{1}{3}}}{(a-1)} \quad \checkmark \\
 & = \frac{a^{\frac{1}{3}}}{(a-1)} \text{ or } \frac{\sqrt[3]{a}}{a-1} \quad \checkmark &&
 \end{aligned} \tag{7}$$

$$\begin{aligned}
 1.1.3 \quad & \frac{3x^2 - 7x + 2}{2x^2 - 5x - 3} \div \frac{x^2 + x - 6}{x^2 - 9} \\
 & \frac{(3x-1)(x-2)}{(2x+1)(x-3)} \times \frac{(x-3)(x+3)}{(x-2)(x+3)} \quad \checkmark \quad \checkmark \\
 & = \frac{3x-1}{2x+1} \quad \checkmark
 \end{aligned} \tag{6}$$

1.2

If $f(x)$ is divided by $2x+1$, then the remainder is $f\left(-\frac{1}{2}\right)$

$$\checkmark \text{ Hence } f\left(-\frac{1}{2}\right) = 16\left(\frac{-1}{2}\right)^3 - p\left(-\frac{1}{2}\right)^2 + 12\left(-\frac{1}{2}\right) + 3 = -7 \quad \checkmark$$

$$16\left(-\frac{1}{8}\right) - \frac{1}{4}p - 6 + 3 = -7$$

$$-2 - \frac{1}{4}p - 6 + 3 = -7$$

$$-\frac{1}{4}p = -7 + 5 \quad \checkmark$$

$$p = -2 \times -\frac{4}{1}$$

$$p = 8 \quad \checkmark$$

(4)
[19]**QUESTION 2**

2.1

$$\sqrt{0,125}$$

$$= \left(\frac{1}{8}\right)^{\frac{1}{2}} \quad \checkmark$$

$$= \left(\frac{1}{2^3}\right)^{\frac{1}{2}} \quad \checkmark$$

$$= 2^{-\frac{3}{2}} = 4^{-\frac{3}{4}} \quad \checkmark$$

$$\sqrt{0,125} = 4^x$$

$$\therefore \sqrt{\frac{1}{8}} = 4^x \quad \checkmark$$

$$\therefore \sqrt{2^{-3}} = 2^{2x} \quad \checkmark$$

$$\therefore -\frac{3}{2} = 2x$$

$$\therefore x = -\frac{3}{4} \quad \checkmark$$

$$\therefore \sqrt{0,125} = 4^{-\frac{3}{4}}$$

(3)

2.2 2.2.1

$$2 \log x + \log \frac{3}{4} - \log \left(2x + \frac{3}{4} \right) = 0 \quad 2 \log x + \log \frac{3}{4} - \log \left(2x + \frac{3}{4} \right) = 0$$

$$\log_{10} \frac{\frac{3}{4} x^2}{2x + \frac{3}{4}} = 0 \quad \checkmark \quad \therefore \log x^2 + \log \frac{3}{4} = \log \left(2x + \frac{3}{4} \right) \quad \checkmark$$

$$10^0 = \frac{\frac{3}{4} x^2}{2x + \frac{3}{4}} \quad \checkmark \quad \therefore \log \left(\frac{3x^2}{4} \right) = \log \left(2x + \frac{3}{4} \right) \quad \checkmark$$

$$\frac{3x^2}{8x+3} = 1 \quad \checkmark \quad \therefore \frac{3x^2}{4} = 2x + \frac{3}{4} \quad \checkmark$$

$$3x^2 = 8x + 3 \quad \checkmark \quad \therefore 3x^2 = 8x + 3 \quad \checkmark$$

$$3x^2 - 8x - 3 = 0 \quad \checkmark \quad \therefore 3x^2 - 8x - 3 = 0 \quad \checkmark$$

$$(3x+1)(x-3) = 0 \quad \therefore (3x+1)(x-3) = 0$$

$$3x+1=0 \quad x-3=0 \quad \therefore 3x+1=0 \quad x-3=0$$

$$x = \frac{-1}{3} \text{ (n/a)} \quad x = 3 \quad \checkmark \quad \therefore x = \frac{-1}{3} \text{ (n/a)} \quad x = 3 \quad \checkmark$$

(6)

2.2.2

$$\frac{4}{x-2} + \frac{2x-3}{4-x^2} = \frac{5}{x+2}$$

$$\frac{4}{x-2} - \frac{2x-3}{(x-2)(x+2)} = \frac{5}{x+2} \quad \checkmark \quad \checkmark$$

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

$$4x + 8 - 2x + 3 = 5x - 10$$

$$-3x = -21 \quad \checkmark$$

$$x = 7 \quad \checkmark$$

(5)
[14]

QUESTION 3

$$\begin{aligned}
 3.1 \quad & -18 - x^2 = 9x \\
 & x^2 + 9x + 18 = 0 \quad \checkmark \\
 & x^2 + 9x + \frac{81}{4} = -18 + \frac{81}{4} \quad \checkmark \\
 & \therefore \left(x + \frac{9}{2}\right)^2 = 2,25 \quad \checkmark \\
 & x = -\frac{9}{2} \pm \sqrt{2,25} \\
 & x = -3 \quad \text{or} \quad x = -6 \quad \checkmark \quad \checkmark
 \end{aligned}
 \tag{5}$$

$$\begin{aligned}
 3.2 \quad & \text{Let the number of women} = x \\
 & \therefore \text{the number of men} = x - 34 \\
 & \text{and the number of children} = x + 60 \\
 & \therefore x + x - 34 + x + 60 = 302 \quad \checkmark \\
 & \therefore 3x = 276 \\
 & \therefore x = 92
 \end{aligned}$$

There are 92 women \checkmark

$$\begin{aligned}
 & \text{Let the number of men} = x \\
 & \text{let the number of women} = x + 34 \quad \checkmark \\
 & \text{let the number of children} = \\
 & x + 34 + 60
 \end{aligned}$$

$$\begin{aligned}
 & \therefore x + x + 34 + x + 94 = 302 \quad \checkmark \\
 & 3x + 128 = 302 \\
 & 3x = 174 \\
 & x = 58
 \end{aligned}$$

There are 92 women \checkmark (3)

$$\begin{aligned}
 3.3 \quad & PV^n = C \\
 & V^n = \frac{C}{P} \quad \checkmark \\
 & \log V^n = \log \frac{C}{P} \quad \checkmark \\
 & n \log V = \log C - \log P \quad \checkmark \\
 & n = \frac{\log C - \log P}{\log V} \\
 & n = \frac{\log 18,3 - \log 2000}{\log 0,48} \quad \checkmark \\
 & n = \frac{1,262 - 3,301}{-0,319} \\
 & n = 6,395 \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 & PV^n = C \\
 & \therefore 2000 \times (0,48)^n = 18,3 \quad \checkmark \\
 & \therefore (0,48)^n = \frac{18,3}{2000} \quad \checkmark \\
 & \therefore \log(0,48)^n = \log\left(\frac{18,3}{2000}\right) \quad \checkmark \\
 & \therefore n \log(0,48) = \log\left(\frac{18,3}{2000}\right) \\
 & \therefore n = \frac{\log 18,3 - \log 2000}{\log 0,48} \quad \checkmark \\
 & \therefore n = \frac{1,262 - 3,301}{-0,319} \\
 & n = 6,395 \quad \checkmark
 \end{aligned}$$

(5)
[13]

QUESTION 4

$$\begin{aligned}
 4.1 \quad M(x_M; y_M) &= \left(\frac{-2+1}{2}; \frac{1-2}{2} \right) \checkmark \\
 &= \left(\frac{-1}{2}; \frac{-1}{2} \right) \checkmark
 \end{aligned} \tag{2}$$

$$\begin{aligned}
 4.2 \quad DM = MB \quad \dots \quad \text{diagonals of parm} \\
 \text{Midpoint of } DB = M(x_M; y_M) &= \left(\frac{-1}{2}; \frac{-1}{2} \right) \\
 \therefore M(x_M; y_M) &= \left(\frac{x+2}{2}; \frac{y+2}{2} \right) = \left(\frac{-1}{2}; \frac{-1}{2} \right) \checkmark \\
 \therefore \frac{x+2}{2} &= \frac{-1}{2} \quad \text{and} \quad \frac{y+2}{2} = \frac{-1}{2} \checkmark \\
 \therefore x &= -3 \quad \quad \quad y = -3 \\
 \text{Coordinates of } D &= (-3; -3) \checkmark
 \end{aligned} \tag{3}$$

$$\begin{aligned}
 4.3 \quad BC &= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \\
 &= \sqrt{[1-2]^2 + [-2-2]^2} \\
 &= \sqrt{1+16} \checkmark \\
 &= \sqrt{17} \text{ units } \checkmark
 \end{aligned} \tag{2}$$

$$\begin{aligned}
 4.4 \quad m_{BC} &= \frac{2-(-2)}{2-1} = 4 \checkmark \\
 \alpha &= \tan^{-1} m = \tan^{-1}(4) = 75,964^\circ \checkmark
 \end{aligned} \tag{2}$$

$$\begin{aligned}
 4.5 \quad \text{The gradient of a line perpendicular to } BC &= -\frac{1}{4} \\
 \text{The equation of the line is} \\
 y - y_A &= -\frac{1}{4}(x - x_A) \\
 y - 1 &= -\frac{1}{4}(x + 2) \checkmark \checkmark \\
 y - 1 &= -\frac{1}{4}x - \frac{1}{2} \\
 \therefore y &= -\frac{1}{4}x + \frac{1}{2} \checkmark
 \end{aligned} \tag{3}$$

4.6 The gradient is not defined when a line is parallel to the y-axis(that is, vertical). ALL x co-ordinates are equal

$\therefore x = -2$ is the equation of the lineequation 1 ✓

$2y - x = 5$ equation 2

Solve equation 1 and 2 simultaneously

Substitute 1 into 2

$\therefore 2y - (-2) = 5$

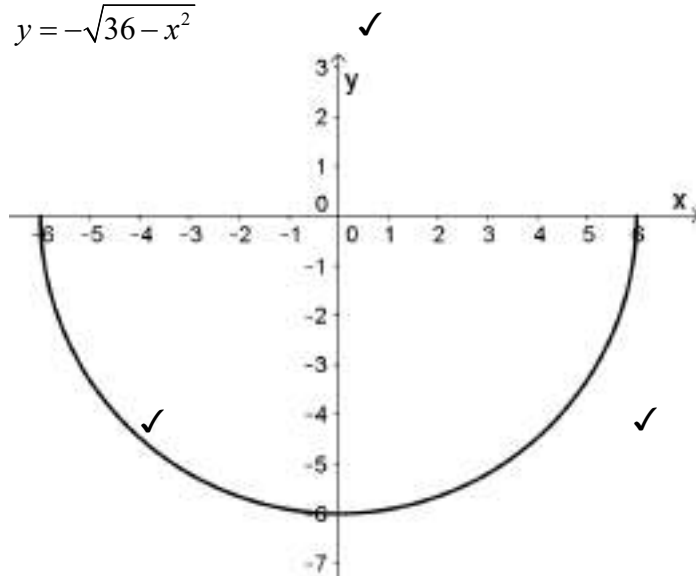
$y = \frac{3}{2}$ ✓

Point of intersection $(-2; \frac{3}{2})$ ✓

(3)
[15]

QUESTION 5

5.1 $y = -\sqrt{36 - x^2}$



1 mark for scale
2 marks for correct graph

(3)

5.2 5.2.1 Since the zeros of $f(x)$ are 0, 6 and 6 (the x-axis is tangent to the curve):

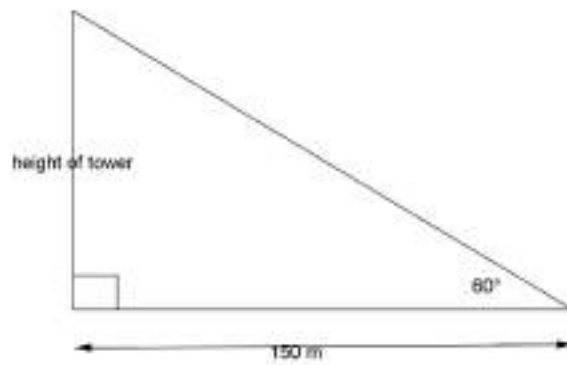
$f(x) = -x(x-6)(x-6)$ ✓ Coefficient of x^3 is -1 as given.

$f(x) = -x^3 + 12x^2 - 36x$ ✓

$a = 12, b = -36$ and $c = 0$ ✓ ✓ ✓

(5)

6.2

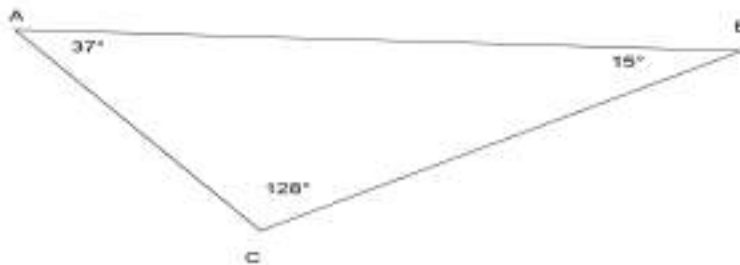


$$\tan 60^\circ = \frac{\text{height of tower}}{150}$$

$$\text{height of tower} = 150 \times \tan 60^\circ = 259,808 \text{ m} \quad \checkmark \quad \checkmark$$

(3)

6.3



6.3.1

$$\hat{A} = 127^\circ - 90^\circ = 37^\circ \quad \checkmark$$

$$\hat{B} = 270^\circ - 255^\circ = 15^\circ \quad \checkmark$$

$$\hat{C} = 180^\circ - 15^\circ - 37^\circ = 128^\circ \quad \checkmark$$

$$\frac{BC}{\sin A} = \frac{AB}{\sin C} \quad \checkmark$$

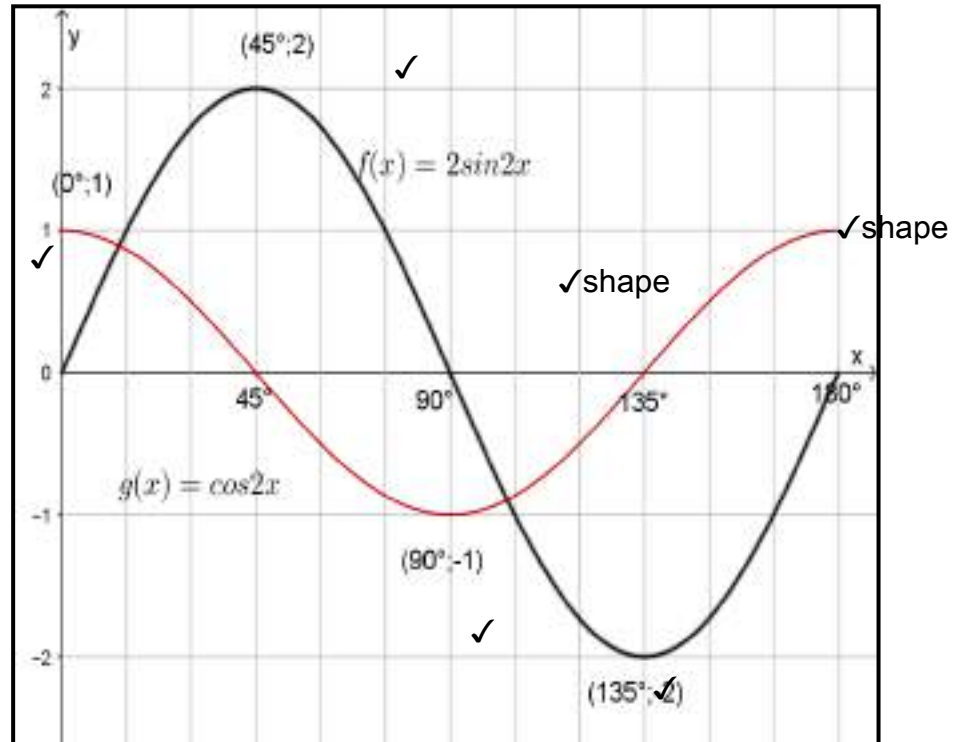
$$\frac{BC}{\sin 37^\circ} = \frac{0,67}{\sin 128^\circ} \quad \checkmark$$

$$BC = \frac{0,67 \times \sin 37^\circ}{\sin 128^\circ}$$

$$= 0,51 \text{ km} \quad \checkmark$$

(5)

6.4 6.4.1



Shape(1 each = 2) Min TP (1 each = 2) Max TP (1 each = 2) = 6 (6)

6.4.2 13° and 103° ✓ ✓ (2)
[23]

TOTAL: 100