



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE/**

GRADE 11

TECHNICAL MATHEMATICS P1

EXEMPLAR 2017

MEMORANDUM

MARKS: 150

This memorandum consists of 12 pages.

NOTE:

- If a candidate answered a question TWICE, mark only the FIRST attempt.
- If a candidate crossed out an answer and did not redo it, mark the crossed-out answer.
- Consistent accuracy applies to ALL aspects of the marking memorandum.
- Assuming values/answers in order to solve a problem is unacceptable.

QUESTION 1

<p>1.1.1</p>	$\left(\frac{1}{27}\right)^{\frac{1}{3}}$ $= (3^{-3})^{\frac{1}{3}} \text{ or } \left(\frac{1}{3}\right)^{3\left(\frac{1}{3}\right)}$ $= 3^{-1}$ $= \frac{1}{3}$	<p>✓ $(3^{-3})^{\frac{1}{3}}$ or $\left(\frac{1}{3}\right)^{3\left(\frac{1}{3}\right)}$</p> <p>✓ answer</p> <p style="text-align: right;">(2)</p>
<p>1.1.2</p>	$\frac{\sqrt{20} - \sqrt[3]{8}}{\sqrt{5} - 1}$ $= \frac{\sqrt{5 \times 4} - (2^3)^{\frac{1}{3}}}{\sqrt{5} - 1}$ $= \frac{2\sqrt{5} - 2}{\sqrt{5} - 1}$ $= \frac{2(\sqrt{5} - 1)}{\sqrt{5} - 1}$ $= 2 \checkmark$	<p>✓ $\sqrt{5 \times 4}$</p> <p>✓ $(2^3)^{\frac{1}{3}}$</p> <p>✓ common factor</p> <p>✓ answer</p> <p style="text-align: right;">(4)</p>
<p>1.1.3</p>	$\frac{\sqrt[4]{16x^8}}{\sqrt{81x^2} - \sqrt[3]{64x^3}}$ $= \frac{(2^4)^{\frac{1}{4}} \cdot (x^8)^{\frac{1}{4}}}{(9^2)^{\frac{1}{2}} \cdot (x^2)^{\frac{1}{2}} - (4^3)^{\frac{1}{3}} \cdot (x^3)^{\frac{1}{3}}}$ $= \frac{2x^2}{9x - 4x}$ $= \frac{2x^2}{5x}$ $= \frac{2x}{5}$	<p>✓ $(2^4)^{\frac{1}{4}} \cdot (x^8)^{\frac{1}{4}}$</p> <p>✓ $(9^2)^{\frac{1}{2}} \cdot (x^2)^{\frac{1}{2}}$</p> <p>✓ $(4^3)^{\frac{1}{3}} \cdot (x^3)^{\frac{1}{3}}$</p> <p>✓ simplification</p> <p>✓ answer</p> <p style="text-align: right;">(5)</p>

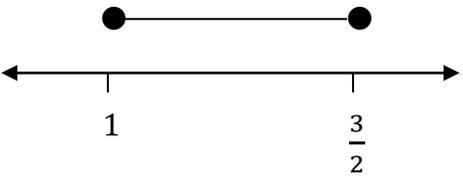
<p>1.1.4</p>	$\frac{6^{x+1} \cdot 9^{x-1}}{2^{x+1} \cdot 27^x}$ $= \frac{(3 \cdot 2)^{x+1} \cdot (3^2)^{x-1}}{2^{x+1} \cdot (3^3)^x}$ $= \frac{3^{x+1} \cdot 2^{x+1} \cdot 3^{2x-2}}{2^{x+1} \cdot 3^{3x}}$ $= 3^{x+1+2x-2-3x} \cdot 2^{x+1-x-1}$ $= 3^{-1} \cdot 2^0$ $= \frac{1}{3}$	<p>✓ prime numbers</p> <p>✓ simplification</p> <p>✓ laws</p> <p>✓ answer</p> <p>(4)</p>
<p>1.1.5</p>	$\frac{3^{2x} - 7 \cdot 3^x + 12}{2 \cdot 3^x - 8}$ $= \frac{(3^x - 4)(3^x - 3)}{2(3^x - 4)}$ $= \frac{3^x - 3}{2}$	<p>✓ Factorisation</p> <p>✓ common factor</p> <p>✓ answer</p> <p>(3)</p>
<p>1.1.6</p>	$\log_{\frac{1}{2}} 4 + \log_p p - \log_{10} 100$ $= \frac{\log 2^2}{\log 2^{-1}} + \frac{\log p}{\log p} - \frac{\log 10^2}{\log 10}$ $= \frac{2 \log 2}{-\log 2} + 1 - \frac{2 \log 10}{\log 10}$ $= -2 + 1 - 2$ $= -3$	<p>✓ $\frac{2 \log 2}{-\log 2}$</p> <p>✓ 1</p> <p>✓ $\frac{2 \log 10}{\log 10}$</p> <p>✓ answer</p> <p>(4)</p>

<p>1.2</p>	$LHS = \frac{\log 3^{\frac{3}{2}} + \log 2^{\frac{3}{2}} - \log 5^{\frac{3}{2}}}{\log \frac{6}{5}}$ $= \frac{\frac{3}{2} \log 3 + \frac{3}{2} \log 2 - \frac{3}{2} \log 5}{\log \frac{6}{5}}$ $= \frac{\frac{3}{2} (\log 3 + \log 2 - \log 5)}{\log \frac{6}{5}}$ $= \frac{\frac{3}{2} \log \left(\frac{3 \times 2}{5} \right)}{\log \frac{6}{5}}$ $= \frac{\frac{3}{2} \log \frac{6}{5}}{\log \frac{6}{5}}$ $= \frac{3}{2}$	<p>✓ surds to exponents</p> <p>✓ power rule ✓ division rule</p> <p>✓ common factor ✓ multiplication law and division law</p> <p>✓ Simplification</p> <p>(6)</p> <p>[28]</p>
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QUESTION 2

<p>2.1.1</p>	$3^x + 3^{x-1} = \frac{4}{9}$ $3^x \left(1 + \frac{1}{3}\right) = \frac{4}{9}$ $3^x \left(\frac{4}{3}\right) = \frac{4}{9}$ $3^x = \frac{1}{3}$ $3^x = 3^{-1}$ $\therefore x = -1$	<p>✓ Common factor ✓ $\left(\frac{4}{3}\right)$ ✓ $\frac{1}{3}$ ✓ 3^{-1} ✓ answer</p> <p>(5)</p>
<p>2.1.2</p>	$2^x = 5$ $\log 2^x = \log 5$ $x \log 2 = \log 5$ $x = \frac{\log 5}{\log 2}$ $x = 2.32$	<p>✓ $\log 2^x = \log 5$ ✓ $x = \frac{\log 5}{\log 2}$ ✓ answer</p> <p>(3)</p>
<p>2.1.3</p>	$\log_4(x-6) + \log_4 x = 2$ $\log_4 x(x-6) = 2$ $x^2 - 6x = 4^2$ $x^2 - 6x - 16 = 0$ $(x-8)(x+2) = 0$ $x = 8 \text{ or } x = 2$ $\therefore x = 8 \text{ or } x \neq -2$	<p>✓ $x(x-6)$ ✓ $x^2 - 6x = 4^2$ ✓ standard form ✓ factorisation ✓ values ✓ Restriction</p> <p>(6)</p>
<p>2.2.1</p>	$i\left(R + \frac{nr}{m}\right) = nE$ $R + \frac{nr}{m} = \frac{nE}{i}$ $R = \frac{nE}{i} - \frac{nr}{m}$	<p>✓ Cross-multiplication ✓ Division by i ✓ answer</p> <p>(3)</p>
<p>2.2.2</p>	$R = \frac{nE}{i} - \frac{nr}{m}$ $R = \frac{5.6 \times 2.4}{2.3} - \frac{5.6 \times 0.4}{2}$ $= 4.72$	<p>✓ Substitution ✓ Answer</p> <p>(2)</p>
<p>2.3</p>	$\log 15 = \log(5 \times 3)$ $= \log\left(\frac{10}{2} \times 3\right)$ $= \log 10 - \log 2 + \log 3 = 1 - a + b$	<p>✓ $\log\left(\frac{10}{2} \times 3\right)$ ✓ rules ✓ answer</p> <p>(3)</p>

QUESTION 3

<p>3.1.1</p>	$g(x) = 0$ $x^2 - 3x = 0$ $x(x - 3) = 0$ $x = 0 \text{ or } x = 3$	<ul style="list-style-type: none"> ✓ standard form ✓ common factor ✓ both values <p style="text-align: right;">(3)</p>
<p>3.1.2</p>	$g(x) = 5$ $x^2 - 3x = 5$ $x^2 - 3x - 5 = 0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4(1)(-5)}}{2(1)}$ $x = \frac{3 \pm \sqrt{29}}{2}$ $\therefore x = 4.19 \text{ or } x = -1.19$	<ul style="list-style-type: none"> ✓ standard form ✓ formula ✓ substitution ✓ simplification ✓ both values <p style="text-align: right;">(5)</p>
<p>3.2</p>	$\frac{2x - 3}{x - 1} = \frac{x + 1}{3}$ $(x - 1)(x + 1) = 3(2x - 3)$ $x^2 - 1 = 6x - 9$ $x^2 - 6x + 8 = 0$ $(x - 4)(x - 2) = 0$ $x = 4 \text{ or } x = 2$	<ul style="list-style-type: none"> ✓ $(x - 1)(x + 1) = 3(2x - 3)$ ✓ standard form ✓ factorisation ✓ both values <p style="text-align: right;">(4)</p>
<p>3.3</p>	$(2x - 3)(x - 1) \leq 0$ <p>Critical values: $\frac{3}{2}$ and 1</p>  $1 \leq x \leq \frac{3}{2}$	<ul style="list-style-type: none"> ✓ critical values ✓ representation ✓ endpoints ✓ notation <p style="text-align: right;">(5)</p>

<p>3.4</p>	<p> $y - x - 3 = 0 \dots\dots\dots(1)$ $x^2 + 4x + y = -1 \dots\dots\dots(2)$ From (1) $y = x + 3$ Subst. y in (2) $x^2 + 4x + x + 3 = -1$ $x^2 + 5x + 4 = 0$ $(x + 4)(x + 1) = 0$ $\therefore x = -4$ or $x = -1$ Subst. x in (1) $y = -4 + 3$ or $y = -1 + 3$ $\therefore y = -1$ or $y = 2$ <p style="text-align: center;">OR</p> From (1) $x = y - 3$ Subst. x in (2) $(y - 3)^2 + 4(y - 3) + y + 3 = -1$ $y^2 - y - 2 = 0$ $(y - 2)(y + 1) = 0$ $\therefore y = 2$ or $y = -1$ Subst. y in (1) $x = 2 - 3$ or $x = -1 - 3$ $\therefore x = -1$ or $x = -4$ </p>	<p> $\checkmark y = x + 3$ \checkmark substitution \checkmark standard form \checkmark factors \checkmark both values of x $\checkmark\checkmark$ each value of y (7) </p> <p style="text-align: center;">OR</p> <p> $\checkmark x = y - 3$ \checkmark substitution \checkmark standard form \checkmark factors \checkmark both values of y $\checkmark\checkmark$ each value of x (7) </p>
<p>3.5</p>	<p> Let the number of hours used by the heater be x and number used by the electric motor be y. Then $3x + 4y = 44 \dots\dots\dots(1)$ and $2x + y = 21 \dots\dots\dots(2)$ $4(2x + y) = 4(21)$ $8x + 4y = 84$ $\underline{3x + 4y = 44}$ $5x = 40$ $\therefore x = 8$ $y = 21 - 2(8)$ $\therefore y = 5$ \therefore energy consumption of the heater is 8 kJ/h and electric motor 5 kJ/h. <p style="text-align: center;">OR</p> </p>	<p> \checkmark equate the y values \checkmark method $\checkmark 5x = 40$ \checkmark value of x \checkmark substitution \checkmark value of y (6) </p> <p style="text-align: center;">OR</p>

	$3x + 4y = 44 \dots\dots\dots(1)$ and $2x + y = 21 \dots\dots\dots(2)$ from (2) $y = 21 - 2x$ substitute y in (1) $3x + 4(21 - 2x) = 44$ $3x + 84 - 8x = 44$ $5x = 40$ $\therefore x = 8$ Subst. x in (2) $2(8) + y = 21$ $\therefore y = 5$	✓ $y = 21 - 2x$ ✓ substitution ✓ $5x = 40$ ✓ value of x ✓ substitution ✓ value of y (6) [30]
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QUESTION 4

4.1	$\Delta = 16$ The roots are real, rational and unequal	✓ real ✓ rational ✓ unequal (3)
4.2	$\Delta = b^2 - 4ac$ $\Delta = (-2)^2 - 4(-4)(1)$ $\therefore \Delta = 20$ The roots are real, irrational and unequal	✓ delta ✓ substitution ✓ value ✓ real, irrational ✓ unequal (5) [8]

QUESTIONS

5.1	$x = 0$ and $y = 2$	✓ $x = 0$ ✓ $y = 2$ (2)
5.2	y -intercept is not defined, $x \neq 0$ x -intercept, $f(x) = 0$ $0 = -\frac{2}{x} + 2$ $2x = 2$ $x = 1$	✓ not defined ✓ $f(x) = 0$ ✓ $2x = 2$ ✓ value of x (4)
5.3	$r^2 = 9$ $r = 3$	✓ $r^2 = 9$ ✓ value of r (2)

<p>5.4</p>		<ul style="list-style-type: none"> ✓ asymptote ✓ intercepts of f ✓ shape of f ✓ intercepts of the circle ✓ shape of g <p style="text-align: right;">(5)</p>
<p>5.5</p>	$y = -x + c$ $2 = -(0) + c$ $\therefore c = 2$ $\therefore y = -x + 2$	<ul style="list-style-type: none"> ✓ -1 ✓ substitution ✓ equation <p style="text-align: right;">(3)</p>
<p>5.6</p>	$y \in R, y \neq 2$	<ul style="list-style-type: none"> ✓ $y \in R$ ✓ restriction <p style="text-align: right;">(2)</p>
<p>5.7</p>	$-3 \leq x \leq 3 \text{ or } x \in [-3,3]$	<ul style="list-style-type: none"> ✓ domain <p style="text-align: right;">(1)</p>

[19]

QUESTION 6

<p>6.1</p>	$q = -2$ $g(x) = a \cdot 2^x - 2$ $0 = a \cdot 2^1 - 2$ $2a = 2$ $\therefore a = 1$	<ul style="list-style-type: none"> ✓ value of q ✓ $0 = a \cdot 2^1 - 2$ ✓ $2a = 2$ ✓ $\therefore a = 1$ <p style="text-align: right;">(4)</p>
<p>6.2</p>	$x > 1$	<ul style="list-style-type: none"> ✓ $x > 1$ <p style="text-align: right;">(1)</p>
<p>6.3</p>	$x > 1$	<ul style="list-style-type: none"> ✓ $x > 1$ <p style="text-align: right;">(1)</p>

[6]

QUESTION 7

7.1	$r = 3$ $p(x) = \sqrt{r^2 - x^2}$ $p(x) = \sqrt{9 - x^2}$	✓ r ✓ formula ✓ equation (3)
7.2	$x / -3 \leq x \leq 3$	✓ endpoints ✓ notation (2)
7.3	$0 = -2x + 3$ $x = \frac{3}{2}$	✓ $h = 0$ ✓ value of x (2)
7.4.1	$x = 0$	✓ $x = 0$ (1)
7.4.2	$\frac{3}{2} \leq x \leq 3$	✓ endpoints ✓ notation (2) [10]

QUESTION 8

8.1	x -intercept, $f(x) = 0$ $-2x^2 - 3x + 2 = 0$ $2x^2 + 3x - 2 = 0$ $(2x - 1)(x + 2) = 0$ $\therefore x = \frac{1}{2}$ or $x = -2$ $AB = 2\frac{1}{2}$ units	✓ $f(x) = 0$ ✓ standard form ✓ factors ✓ value of x ✓ length (5)
8.2	$C(0;2)$	✓ 0 ✓ 2 (2)

<p>8.3</p>	$x = \frac{-2 + \frac{1}{2}}{2}$ $x = \frac{-3}{4}$ $f\left(\frac{-3}{4}\right) = -2\left(\frac{-3}{4}\right)^2 - 3\left(\frac{-3}{4}\right) + 2$ $= \frac{25}{8}$ $D\left(\frac{-3}{4}; \frac{25}{8}\right)$ <p style="text-align: center;">OR</p> $x = \frac{-b}{2a}$ $x = \frac{-(-3)}{2(-2)}$ $x = -\frac{3}{4}$ $f\left(\frac{-3}{4}\right) = -2\left(\frac{-3}{4}\right)^2 - 3\left(\frac{-3}{4}\right) + 2$ $= \frac{25}{8}$ $D\left(\frac{-3}{4}; \frac{25}{8}\right)$	<p>✓ method</p> <p>✓ value of x</p> <p>✓ substitution</p> <p>✓ co-ordinates of D</p> <p style="text-align: right;">(4)</p> <p style="text-align: center;">OR</p> <p>✓ method</p> <p>✓ value of x</p> <p>✓ substitution</p> <p>✓ co-ordinates of D</p> <p style="text-align: right;">(4)</p>
<p>8.4</p>	<p>Max = $\frac{25}{8}$</p>	<p><input type="checkbox"/> $\frac{25}{8}$</p> <p style="text-align: right;">(1)</p> <p style="text-align: right;">[12]</p>

QUESTION 9

9.1	$i_{eff} = \left(1 + \frac{i_{nom}}{n}\right)^n - 1$ $i_{eff} = \left(1 + \frac{0.106}{4}\right)^4 - 1$ $\therefore i_{eff} = 0.1102884317$ $\therefore \text{interest rate is } 11.03\%$	✓ formula ✓ substitution ✓ simplification ✓ rate (4)
9.2.1	R 1000	✓ answer (1)
9.2.2	Depreciating. The graph is decreasing	✓ depreciating ✓ reason (2)
9.2.3	$A = P(1 - i)^n$ $i = 1 - \sqrt[n]{\frac{A}{P}}$ $i = 1 - \sqrt[10]{\frac{196.87}{1000}}$ $\therefore i = 0.1500019016$ $\therefore \text{interest rate is } 15\%$	✓ formula ✓ i , subject ✓ substitution ✓ rate (4)
9.3	$A = P(1 + i)^n \cdot (1 + i)^n$ $A = 5200(1 + 0.094)^4 \cdot (1 + 0.02)^8$ $\therefore A = R8727.18$	✓ formula ✓ substitution ✓ answer (4) [15]

		TOTAL: 150
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