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**MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA**

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

MATHEMATICS TEST

TERM 1

MARKING GUIDELINE

2021

Time: 1,5 hours

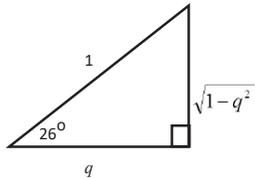
Marks: 73 Section A

Time: 2 hours

Marks: 100 Section A and B

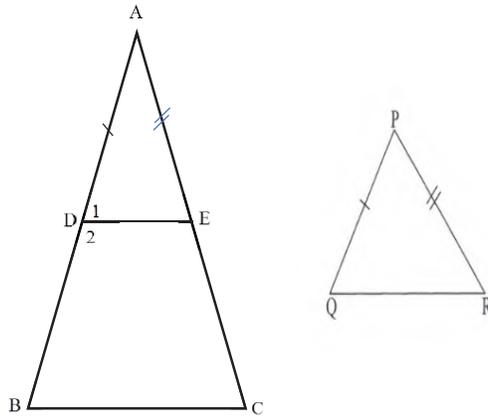
QUESTION 1		
1.1	$-5; \quad 4; \quad 21; \quad 46; \dots$ $\quad \quad 9 \quad 17 \quad 25$ $\quad \quad \quad 8 \quad 8$ $2a=8$ $\therefore a=4$ $3a+b=9$ $3(4)+b=9$ $\therefore b=-3$ $a+b+c=-5$ $4-3+c=-5$ $\therefore c=-6$ $T_n = 4n^2 - 3n - 6$	$\checkmark a=4$ $\checkmark b=-3$ $\checkmark c=-6$ $\checkmark T_n$ (4)
1.2	$T_{(15)} = 4(15)^2 - 3(15) - 6$ $= 849$	$\checkmark \text{answer} \quad (1)$
1.3	$364 = 4n^2 - 3n - 6$ $4n^2 - 3n - 370 = 0$ $(4n+37)(n-10) = 0$ $n = \frac{-37}{4} \text{ or } n = 10$ $\therefore n = 10$	$\checkmark 360 = 4n^2 - 3n - 6$ $\checkmark n = \frac{-37}{4}, \text{NA}$ $\checkmark \therefore n = 10$ (3)
		[8]
QUESTION 2		
2.1.1	$\sum_{i=2}^m 32(2)^{5-i} < 500$ $256+128+64+\dots < 500$ $S_n = \frac{a(1-r^m)}{1-r}$ $\frac{256\left(1-\frac{1}{2}^m\right)}{1-\frac{1}{2}} < 500$ $\frac{512\left(1-\frac{1}{2}^m\right)}{1} < 500$	$\frac{256\left(1-\frac{1}{2}^m\right)}{1-\frac{1}{2}} < 500$ \checkmark $\checkmark \text{correct use of logs}$ $\checkmark \therefore m > 5.4$ $\checkmark m = 6$ (4)

	$1 - \frac{1^m}{2} < \frac{125}{128}$ $\frac{1^m}{2} > \frac{3}{128}$ $m > \log_{\frac{1}{2}} \frac{3}{128}$ $m > 5.4$ $\therefore m = 6$	
2.1.2	$S_{\infty} - S_4 = \frac{a}{1-r} - \frac{a(1-r^n)}{1-r}$ $= \frac{256}{1-\frac{1}{2}} - \frac{256\left(1-\frac{1}{2}^4\right)}{1-\frac{1}{2}}$ $= 512 - 480$ $= 32$	$\checkmark S_{\infty} - S_4$ \checkmark substitution \checkmark answer (3)
[7]		
QUESTION 3		
3.1	$2x; x+1; 6-x; \dots$ $x+1-2x = 6-x-(x+1)$ $-+1 = -2x+5$ $x = 4$	$\checkmark T_2 - T_1 = T_3 - T_2$ \checkmark answer (2)
3.2	$8; 5; 2; \dots$ $-575 = \frac{n}{2}[2(8) + (n-1)(-3)]$ $-1150 = n(19-3n)$ $3n^2 - 19n - 1150 = 0$ $(3n+50)(-23) = 0$ $n = 23 \text{ or } n \neq -\frac{50}{3}$	\checkmark substitution of S_n \checkmark substitution of a and d \checkmark standard form $\checkmark n = 23$ only (4)
[6]		

QUESTION 4		
4.1	$S_{25} = \frac{25}{8}[14 - 4(25)]$ $= -268\frac{3}{4}$	✓answer (1)
4.2	$T_{25} = S_{25} - S_{24}$ $T_{25} = -268\frac{3}{4} - \left(\frac{24}{8}[14 - 4(24)] = 22\frac{3}{4}\right)$	✓method ✓substitution ✓answer (3)
4.3	$S_1 = T_1 = \frac{1}{8}[14 - 4(1)] = \frac{5}{4}$ $T_2 = \frac{2}{8}[14 - 4(2)] - \frac{5}{4} = \frac{1}{4}$ $T_3 = \frac{3}{8}[14 - 4(3)] - \frac{3}{2} = -\frac{3}{4}$ <p>5; 1; -3; $\rightarrow T_n = 9 - 4n$</p> $\frac{5}{4}; \frac{1}{4}; -\frac{3}{4}; \rightarrow T_n = \frac{9 - 4n}{4}$	$\checkmark S_1 = T_1 = \frac{5}{4}$ $\checkmark T_2 = \frac{1}{4}$ $\checkmark T_3 = -\frac{3}{4}$ $\checkmark T_n = 9 - 4n$ $\checkmark T_n = \frac{9 - 4n}{4}$ (5)
[9]		
QUESTION 5		
5.1.1	$\cos 334^\circ = \cos(360^\circ - 26^\circ)$ $= \cos 26^\circ$ $= q$	✓answer (1)
5.1.2	 <p> $\sin 52^\circ = \sin 2(26^\circ)$ $= 2 \sin 26^\circ \cos 26^\circ$ $= 2 \cdot \sqrt{1 - q^2} (q)$ $= 2q \sqrt{1 - q^2}$ </p>	✓diagram ✓identity ✓answer (3)
5.1.3	$\sin 86^\circ = \sin(60^\circ + 26^\circ)$ $= \sin 60^\circ \cos 26^\circ + \cos 60^\circ \sin 26^\circ$ $= \frac{\sqrt{3}}{2} \cdot q + \frac{1}{2} \sqrt{1 - q^2}$	✓identity ✓answer (2)

QUESTION 6

6.1



Constructions:

Draw PQ on AB such that PQ = AD

Draw PR on AE such that PR = AE

In $\triangle ADE$ and $\triangle PQR$

1. $AD = PQ$ [construction]

2. $AE = PR$ [construction]

3. $\hat{A} = \hat{P}$ [given]

$\triangle ADE \equiv \triangle PQR$ [SAS]

$\hat{D}_1 = \hat{Q}$ [from congruency]

But $\hat{D}_1 = \hat{B}$

$\therefore \hat{D}_1 = \hat{B}$

$\therefore DE \parallel BC$ [corresponding \angle s equal]

$\frac{AB}{AD} = \frac{AC}{AE}$ [line \parallel side of \triangle]

But $AD = PQ$ and $AE = PR$ [construction]

$\frac{AB}{PQ} = \frac{AC}{PR}$

✓Construction

✓S/R

✓S/R

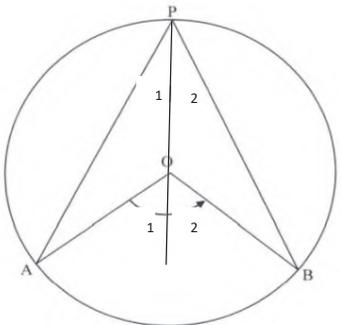
✓ $\therefore \hat{D}_1 = \hat{B}$
✓S/R

✓S/R

(6)

6.2.1	Line from centre to midpoint of chord	√Reason (1)
6.2.2	<p>In $\triangle ROP$ and $\triangle RVS$</p> <ol style="list-style-type: none"> $\hat{R} = \hat{R}$ [common] $\hat{S}_1 = 90^\circ$ [angle in semi-circle] $\hat{P}_2 = 90^\circ$ (proven) $\hat{S}_1 = \hat{P}_2$ $\hat{V} = \hat{O}_2$ (angles in Δ) <p>$\triangle ROP \parallel \triangle RVS$ [\angle; \angle; \angle]</p>	<p>√S/R</p> <p>√R</p> <p>√S</p> <p>√R (4)</p>
6.2.3	<p>In $\triangle RVS$ and $\triangle RST$</p> <ol style="list-style-type: none"> $\hat{R} = \hat{R}$ (common) $\hat{T}_1 = \hat{S}_1 = 90^\circ$ (angle in semi circle) $\hat{T}\hat{S}\hat{R} = \hat{V}$ (\angles in Δ) <p>$\triangle RVS \parallel \triangle RST$ (\angle; \angle; \angle)</p>	<p>√S √R</p> <p>√R (3)</p>
6.2.4	<p>In $\triangle STV$ and $\triangle RST$</p> <p>$\hat{R}\hat{T}\hat{S} = \hat{V}\hat{T}\hat{S} = 90^\circ$ (Angles on straight line)</p> <p>$\hat{R} = 90^\circ - \hat{T}\hat{S}\hat{R}$ $= \hat{T}\hat{S}\hat{V}$</p> <p>$\hat{T}\hat{S}\hat{R} = \hat{V}$ (angles in Δ)</p> <p>$\triangle RST \parallel \triangle STV$ ([A,A,A])</p> <p>$\frac{RT}{ST} = \frac{TS}{VT}$ (from similarity)</p> <p>$ST^2 = VT \cdot TR$</p>	<p>√S √R</p> <p>√S</p> <p>√R</p> <p>√S (5)</p>
		[19]

QUESTION 7

7.1		
	<p>Construction: Draw PO extended</p> <p>$OP = OA$ (radii)</p> <p>$\hat{P}_1 = \hat{A}$ (angles opp. equal sides)</p> <p>But $\hat{O}_1 = \hat{P}_1 + \hat{A}$ (ext. angle of triangle)</p> <p>$\hat{O}_1 = 2\hat{P}_1$</p> <p>Similarly</p> <p>$\hat{O}_2 = 2\hat{P}_2$</p> <p>$A\hat{O}B = 2A\hat{P}B$</p>	<p>✓Construction</p> <p>✓S/R</p> <p>✓S/R</p> <p>✓S</p> <p>✓S (5)</p>
7.2.1	Angles in the same segment	<p>✓answer (1)</p>
7.2.2	<p>$\hat{P}_2 = \hat{S}_1 = y$ (angles opp equal sides)</p> <p>$\hat{S}_1 = \hat{P}_3 = y$ (tan cord theorem)</p> <p>$\hat{P}_2 = \hat{P}_3$</p> <p>PQ bisects $T\hat{P}S$</p>	<p>✓S ✓R</p> <p>✓S ✓R (4)</p>
7.2.3	$\hat{P}\hat{O}Q = 2\hat{S}_1 = 2y$ (\angle at centre = 2 \angle at circumference)	<p>✓S ✓R (2)</p>
7.2.4	<p>$T\hat{P}A = \hat{P}_2 + \hat{P}_3$ (proven)</p> <p>$T\hat{P}A = \hat{P}\hat{Q}O$ (proven)</p> <p>PT is a tangent (converse theorem tan cord)</p>	<p>✓S</p> <p>✓R (2)</p>
7.2.5	<p>$\hat{O}\hat{P}Q + \hat{O}\hat{Q}P = 180^\circ - 2y$ (angles of triangle)</p> <p>$\hat{O}\hat{Q}P = 90^\circ - y$ (angles opp equal sides)</p> <p>$90^\circ - y + y + \hat{Q}\hat{A}P = 180^\circ$</p> <p>$\hat{Q}\hat{A}P = 90^\circ$</p>	<p>✓S ✓R</p> <p>✓S/R</p> <p>✓S (4)</p>
		[18]

OPTIONAL:

QUESTION 8

8.1.1	$\begin{aligned} & \sin 236^\circ \cdot \cos 169^\circ + \sin 371^\circ \cdot \cos(-124^\circ) \\ &= -\sin 56^\circ(-\cos 11^\circ) + \sin 11^\circ \cdot (-\cos 56^\circ) \\ &= \sin(56^\circ - 11^\circ) \\ &= \sin 45^\circ \\ &= \frac{1}{\sqrt{2}} \end{aligned}$	$\begin{aligned} & \sqrt{-\sin 56^\circ(-\cos 11^\circ)} \\ & \sqrt{\sin 11^\circ \cdot (-\cos 56^\circ)} \\ & \sqrt{\sin 45^\circ} \\ & \frac{1}{\sqrt{2}} \end{aligned} \quad (4)$
8.1.2	$\begin{aligned} & \frac{-\cos^2 10^\circ + \sin^2 190^\circ}{\cos(-145^\circ) \cdot \cos 235^\circ} \\ &= \frac{-\cos^2 10^\circ + \sin^2(180^\circ + 10^\circ)}{\cos(180^\circ - 35^\circ) \cdot \cos(270^\circ - 35^\circ)} \\ &= \frac{-\cos^2 10^\circ + \sin^2 10^\circ}{-\cos 35^\circ \cdot (-\sin 35^\circ)} \\ &= \frac{-(\cos^2 10^\circ - \sin^2 10^\circ)}{\cos 35^\circ \sin 35^\circ} \\ &= \frac{-\cos 2 \times 10^\circ}{\cos 35^\circ \sin 35^\circ} \\ &= \frac{-\cos 20^\circ}{\cos 35^\circ \sin 35^\circ} \\ &= \frac{-2 \cos 20^\circ}{2 \cos 35^\circ \sin 35^\circ} \\ &= \frac{-2 \cos 20^\circ}{\sin 2 \times 35^\circ} \\ &= \frac{-2 \sin 70^\circ}{\sin 70^\circ} \\ &= -2 \end{aligned}$	$\begin{aligned} & \sqrt{+\sin^2 10^\circ} \\ & \sqrt{-\cos 35^\circ} \\ & \sqrt{-\sin 35^\circ} \\ & \sqrt{-\cos 20^\circ} \\ & \sqrt{-2 \sin 70^\circ} \\ & \sqrt{\sin 70^\circ} \end{aligned} \quad (6)$
8.2.1	$\frac{\cos 2A + \sin A}{\cos^2 A} = \frac{2 \sin A + 1}{1 + \sin A}$ <p>LHS:</p> $\begin{aligned} \frac{\cos 2A + \sin A}{\cos^2 A} &= \frac{1 - 2 \sin^2 A + \sin A}{1 - \sin^2 A} \\ &= \frac{1 + \sin A - 2 \sin^2 A}{1 - \sin^2 A} \end{aligned}$	$\begin{aligned} & \sqrt{1 - 2 \sin^2 A} \\ & \sqrt{1 - \sin^2 A} \end{aligned}$

	$= \frac{(1 + 2 \sin A)(1 - \sin A)}{(1 - \sin A)(1 + \sin A)}$ $= \frac{1 + 2 \sin A}{(1 + \sin A)}$ <p>$\therefore LHS = RHS$</p>	<p>✓ factorise numerator ✓ factorise denominator (4)</p>
8.2.2	$\frac{\sin(x + 45^\circ)}{\cos(x - 45^\circ)} = \frac{\sin 2x + 1}{(\sin x + \cos x)^2}$ <p>LHS:</p> $\frac{\sin(x + 45^\circ)}{\cos(x - 45^\circ)} = \frac{\sin x \cos 45^\circ + \cos x \sin 45^\circ}{\cos x \cos 45^\circ + \sin x \sin 45^\circ}$ $= \frac{\sin x \cdot \frac{\sqrt{2}}{2} + \cos x \cdot \frac{\sqrt{2}}{2}}{\cos x \cdot \frac{\sqrt{2}}{2} + \sin x \cdot \frac{\sqrt{2}}{2}}$ $= 1$ <p>RHS:</p> $\frac{\sin 2x + 1}{(\sin x + \cos x)^2} = \frac{\sin 2x + 1}{\sin^2 x + \sin x \cos x + \cos^2 x}$ $= \frac{\sin 2x + 1}{1 + 2 \sin x \cos x}$ $= \frac{\sin 2x + 1}{1 + \sin 2x}$ $= 1$ <p>$\therefore LHS = RHS$</p>	<p>✓ $\sin x \cos 45^\circ + \cos x \sin 45^\circ$ ✓ $\cos x \cos 45^\circ + \sin x \sin 45^\circ$ $\frac{\sqrt{2}}{2}$ ✓ Substituting $\frac{\sqrt{2}}{2}$ $\sqrt{1}$</p> <p>✓ simplifying denominator ✓ square identity $\sqrt{1}$ (7)</p>
8.3.1	$2 \sin(3x - 15^\circ) + 1 = 0$ $\sin(3x - 15^\circ) = -\frac{1}{2}$ <p>Ref angle: $x = 30^\circ$</p> <p>3rd</p> $3x - 15^\circ = 180^\circ + 30^\circ + k.360^\circ; \quad k \in \mathbb{Z}$ $3x = 225^\circ + k.360^\circ; \quad k \in \mathbb{Z}$ $x = 75^\circ + k.120^\circ; \quad k \in \mathbb{Z}$ <p>4th</p> $3x - 15^\circ = 360^\circ - 30^\circ + k.360^\circ; \quad k \in \mathbb{Z}$ $3x = 345^\circ + k.360^\circ; \quad k \in \mathbb{Z}$	<p>✓ $\sin(3x - 15^\circ) = -\frac{1}{2}$</p> <p>✓ $x = 75^\circ + k.120^\circ$ ✓ $k \in \mathbb{Z}$</p> <p>✓ $x = 115^\circ + k.120^\circ$ (4)</p>

	$x = 115^\circ + k \cdot 120^\circ; \quad k \in \mathbb{Z}$	
8.3.2	$x \in \{-245^\circ; -165^\circ; -125^\circ; -45^\circ; -5^\circ, 75^\circ\}$	✓ three correct ✓ six correct (2)