KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 11

MATHEMATICS

COMMON TEST

MARCH 2023

MARKS: 75

TIME: 1½ hours

This question paper consists of 6 pages.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 4 questions.
2. Answer ALL the questions.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Clearly show ALL calculations, diagrams, graphs, etc. which you have used in determining your answers.
5. Answers only will NOT necessarily be awarded full marks.
6. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.
7. If necessary, round off answers correct to TWO decimal places, unless stated otherwise.
8. Write neatly and legibly.

QUESTION 1

1.1 Solve for x:

1.1.1 $x^2-2x=8$ (3)

1.1.2 $4x^2-x-2=0$ (answer correct to TWO decimal places) (3)

1.1.3 $x(x-1)\geq 6$ (4)

1.1.4 $2x+\sqrt{x+1}=1$ (5)

1.2 Solve simultaneously for x and y:

$x-y-3=0$ and $x^2-3y^2=13$ (6)

1.3 Given a quadratic equation $3x^2+7x+\frac{11h}{12}=0$.

1.3.1 For which value(s) of h will the roots be real? (3)

1.3.2 Determine the largest integral value of h for which the roots will be rational. (2)

[26]

QUESTION 2

2.1 **Simplify without using a calculator:**

2.1.1 $\left(\frac{1}{16}\right)^{-\frac{3}{4}}$ (3)

2.1.2 $\frac{54^n.6^{-2n+1}}{12^{n-1}.8^{-n}}$ (5)

2.1.3 $\sqrt{b\sqrt{a}-b}.\sqrt{b\sqrt{a}+b}$ (4)

2.2 Solve for x:

2.2.1 $7^x = \frac{1}{343}$ (2)

2.2.2 $3^{2x+1} + 26.3^x - 9 = 0$ (4)

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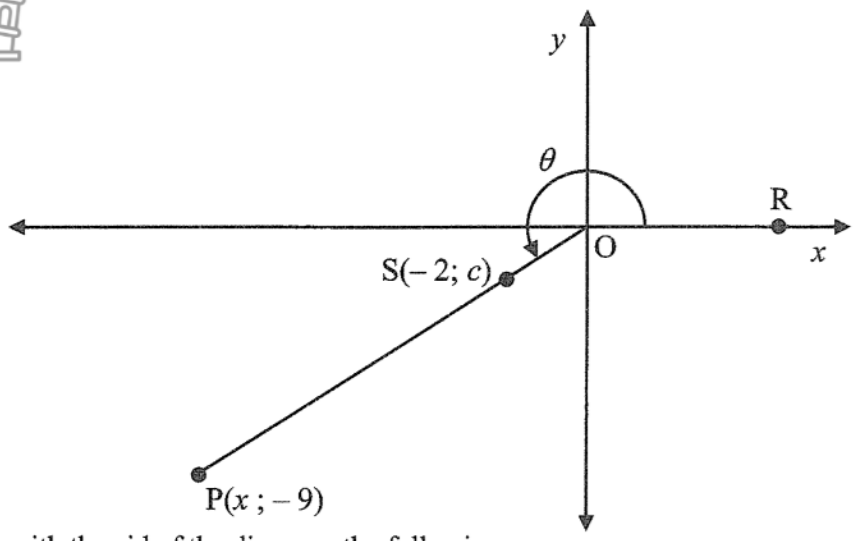
QUESTION 3

DO NOT USE A CALCULATOR WHEN ANSWERING QUESTION 3.

3.1 In the diagram below, $P(x;-9)$ is a point in the Cartesian plane such that OP = 15 units. $S(-2\ ;\ c)$ lies on OP. R is a point on the positive x-axis and $R\hat{O}P = \theta$.



Determine, with the aid of the diagram, the following:

3.1.1 The value of x. (2)

3.1.2 $\tan\theta$ (1)

3.1.3 The value of c. (3)

3.2 **Without using a calculator,** determine the value of each of the following expressions:

3.2.1 $$\frac{\sin(180^\circ - x)}{\cos(90^\circ + x) + \sin(360^\circ - x)}$$ (4)

3.2.2 $$\frac{\cos 295^\circ . \cos 752^\circ}{\sin 238^\circ . \cos 65^\circ}$$ (5)

[15]

QUESTION 4

4.1 Prove the following identity:

$$\frac{\sin^2(180^\circ+\theta)+\cos(-\theta).\sin(90^\circ-\theta)}{\sin\theta}+\frac{1}{\tan\theta}=\frac{1+\cos\theta}{\sin\theta} \quad (5)$$

4.2 Solve for x, where $x\in[0^\circ;360^\circ]$:

$\sin x=-0,4$. (3)

4.3 Consider the equation: $\sqrt{3}\cos^2\alpha-\sin\alpha\cos\alpha=0$.

4.3.1 **Without using a calculator**, determine the general solution of this equation. (6)

4.3.2 Hence, determine the values of α for which $\sqrt{3}\cos^2\alpha-\sin\alpha\cos\alpha=0$ in the interval $\alpha\in[-270^\circ;90^\circ]$. (2)

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TOTAL: 75

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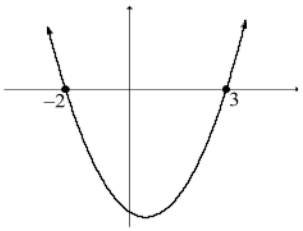
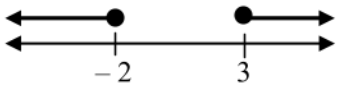
MARKING GUIDELINE

MARKS: 75

This marking guideline consists of 7 pages.

GRADE 11
Marking Guideline

QUESTION 1

1.1.1	$x^2-2x=8$ $x^2-2x-8=0$ $(x+2)(x-4)=0$ $x=-2$ or $x=4$	✓ standard form ✓ factors ✓ both answers (3)
1.1.2	$4x^2-x-2=0$ $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ $=\frac{-(-1)\pm\sqrt{(-1)^2-4(4)(-2)}}{2(4)}$ $=0,84$ or $x=-0,59$	✓ substitution ✓ answer; ✓ answer (3)
1.1.3	$x(x-1)\geq 6$ $x^2-x-6\geq 0$ $(x-3)(x+2)\geq 0$  OR  $x\leq -2$ or $x\geq 3$	✓ standard form ✓ critical values ✓ ✓ answer (4)
1.1.4	$2x+\sqrt{x+1}=1$ $\sqrt{x+1}=1-2x$ $\left(\sqrt{x+1}\right)^2=(1-2x)^2$ $x+1=1-4x+4x^2$ $4x^2-5x=0$ $x(4x-5)=0$ $x=0$ or $x\neq\frac{5}{4}$	✓ isolating surd ✓ squaring both sides ✓ standard form ✓ both answers ✓ rejecting $x=\frac{5}{4}$ (5)

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1.2	$x-y-3=0$ $x=y+3$ ..... line 1 $x^2-3y^2=13$ ..... line 2 Substitute line 1 into line 2: $(y+3)^2-3y^2=13$ $y^2+6y+9-3y^2=13$ $-2y^2+6y-4=0$ $y^2-3y+2=0$ $(y-2)(y-1)=0$ $y=1$ or $y=2$ $x=4$ or $x=5$	✓ making x the subject of the formula ✓ substitution ✓ standard form ✓ factors ✓ y-values ✓ x-values (6)
1.3.1	$\Delta=b^2-4ac$ $=7^2-4(3)\left(\frac{11h}{12}\right)$ $=49-11h$ For real roots: $49-11h\geq 0$ $-11h\geq -49$ $h\leq\frac{49}{11}$ OR $h\leq 4,45$	✓ $\Delta=49-11h$ ✓ $49-11h\geq 0$ ✓ answer (3)
1.3.2	Consider $49-11h$: If $h=4$, $49-11(4)=5$. Roots are irrational. If $h=3$, $49-11(3)=16$. Roots are rational. Largest integral value of h for rational roots = 3. Answer only: full marks	✓ $49-11h=49-11(3)=16$ ✓ answer (2)
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Marking Guideline

QUESTION 2

2.1.1	$\left(\frac{1}{16}\right)^{-\frac{3}{4}} = 16^{\frac{3}{4}}$ $= (2^4)^{\frac{3}{4}}$ $= 2^3$ $= 8$ **OR** $\left(\frac{1}{16}\right)^{-\frac{3}{4}} = \left[\left(\frac{1}{2}\right)^4\right]^{-\frac{3}{4}}$ $= \left(\frac{1}{2}\right)^{-3}$ $= 2^3$ $= 8$	✓ $16^{\frac{3}{4}}$ ✓ $(2^4)^{\frac{3}{4}}$ ✓ answer (3) **OR** ✓ $\left[\left(\frac{1}{2}\right)^4\right]^{-\frac{3}{4}}$ ✓ $\left(\frac{1}{2}\right)^{-3}$ ✓ answer (3)
2.1.2	$\frac{54^n.6^{-2n+1}}{12^{n-1}.8^{-n}}$ $= \frac{\left(2.3^3\right)^n.(2.3)^{-2n+1}}{\left(3.2^2\right)^{n-1}.\left(2^3\right)^{-n}}$ $= \frac{2^n.3^{3n}.2^{-2n+1}.3^{-2n+1}}{3^{n-1}.2^{2n-2}.2^{-3n}}$ $= 2^{n-2n+1-2n+2+3n}.3^{3n-2n+1-n+1}$ $= 2^3.3^2$ $= 72$	✓ writing bases i.t.o. prime factors ✓ law: raising a power to a power ✓ adding and subtracting indices ✓ $2^3.3^2$ ✓ answer (5)
2.1.3	$\sqrt{b\sqrt{a}-b}.\sqrt{b\sqrt{a}+b}$ $= \sqrt{\left(b\sqrt{a}-b\right).\left(b\sqrt{a}+b\right)}$ $= \sqrt{b^2a-b^2}$ $= \sqrt{b^2(a-1)}$ $= b\sqrt{(a-1)}$	✓ writing as a single surd ✓ difference of two squares ✓ take out common factor ✓ answer (4)
2.2.1	$7^x = \frac{1}{343}$ $7^x = \frac{1}{7^3}$ $7^x = 7^{-3}$ $x = -3$	✓ $343 = 7^3$ ✓ answer (2)

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Marking Guideline

2.2.2	$3^{2x+1}+26.3^{x}-9=0$ $3.3^{2x}+26.3^{x}-9=0$ $(3.3^{x}-1)(3^{x}+9)=0$ $3^{x}=\frac{1}{3}$ or $3^{x}\neq -9$ $x=-1$ **OR** $3^{2x+1}+26.3^{x}-9=0$ Let $k=3^{x}$: $3k^{2}+26k-9=0$ $(3k-1)(k+9)=0$ $k=\frac{1}{3}$ or $k\neq -9$ $3^{x}=\frac{1}{3}$ or $3^{x}\neq -9$ $x=-1$	✓✓ one mark for each correct factor ✓ $3^{x}\neq -9$ ✓ $x=-1$ (4) **OR** ✓✓ one mark for each correct factor ✓ $3^{x}\neq -9$ ✓ $x=-1$ (4)
		[18]

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Marking Guideline

QUESTION 3

3.1.1	$x^2+y^2=r^2$ [Pythagoras] $x^2+(-9)^2=15^2$ $x^2=144$ $x=-12$	✓ substitution in Pythagoras ✓ answer (2)
3.1.2	$\tan\theta=\frac{-9}{-12}=\frac{9}{12}=\frac{3}{4}=0,75$	✓ answer $(\frac{9}{12}$ or $\frac{3}{4}$ or $0,75)$ (1)
3.1.3	Using point S: $\tan\theta=\frac{c}{-2}$ Therefore: $\frac{c}{-2}=\frac{3}{4}$ **OR** $\frac{c}{-2}=\frac{9}{12}$ $4c=-6$ **OR** $12c=-18$ $c=-\frac{3}{2}=-1,5$	✓ $\tan\theta=\frac{c}{-2}$ ✓ $\frac{c}{-2}=\frac{3}{4}$ **OR** $\frac{c}{-2}=\frac{9}{12}$ ✓ answer (3)
3.2.1	$\frac{\sin(180^\circ-x)}{\cos(90^\circ+x)+\sin(360^\circ-x)}$ $=\frac{\sin x}{-\sin x-\sin x}$ $=\frac{\sin x}{-2\sin x}$ $=-\frac{1}{2}$	✓ $\sin(180^\circ-x)=\sin x$ ✓ $\cos(90^\circ+x)=-\sin x$ ✓ $\sin(360^\circ-x)=-\sin x$ ✓ answer (4)
3.2.2	$\frac{\cos 295^\circ.\cos 752^\circ}{\sin 238^\circ.\cos 65^\circ}$ $=\frac{\cos 65^\circ.\cos 32^\circ}{-\sin 58^\circ.\cos 65^\circ}$ $=\frac{\cos 32^\circ}{\sin 238^\circ}$ $=\frac{\cos 32^\circ}{-\sin 58^\circ}$ $=\frac{\cos 32^\circ}{-\cos 32^\circ}$ **OR** $\frac{\sin 58^\circ}{-\sin 58^\circ}$ $=-1$	✓ $\cos 295^\circ=\cos 65^\circ$ ✓ $\cos 752^\circ=\cos 32^\circ$ ✓ $\sin 238^\circ=-\sin 58^\circ$ ✓ $-\sin 58^\circ=-\cos 32^\circ$ **OR** $\cos 32^\circ=\sin 58^\circ$ ✓ answer (5)
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Marking Guideline

QUESTION 4

4.1	$\frac{\sin^2(180^\circ+\theta)+\cos(-\theta).\sin(90^\circ-\theta)}{\sin\theta}+\frac{1}{\tan\theta}$ $=\frac{(-\sin\theta)^2+\cos\theta.\cos\theta}{\sin\theta}+\frac{1}{\tan\theta}$ $=\frac{(-\sin\theta)^2+\cos\theta.\cos\theta}{\sin\theta}+\left(1\div\frac{\sin\theta}{\cos\theta}\right)$ $=\frac{\sin^2\theta+\cos^2\theta}{\sin\theta}+\frac{\cos\theta}{\sin\theta}$ $=\frac{1}{\sin\theta}+\frac{\cos\theta}{\sin\theta}$ $=\frac{1+\cos\theta}{\sin\theta}$	✓ $\cos(-\theta)=\cos\theta$ ✓ $\sin(90^\circ-\theta)=\cos\theta$ ✓ $\sin^2(180^\circ+\theta)=(-\sin\theta)^2$ ✓ $\frac{\cos\theta}{\sin\theta}$ ✓ $\sin^2\theta+\cos^2\theta=1$ (5)
4.2	$\sin x=-0,4$ Ref $\angle$: $23,58^\circ$ $x=180^\circ+23,58^\circ$ or $x=360^\circ-23,58^\circ$ $x=203,58^\circ$ $x=336,42^\circ$	✓ Ref $\angle$: $23,58^\circ$ ✓ $x=203,58^\circ$ ✓ $x=336,42^\circ$ (3)
4.3.1	$\sqrt{3}\cos^2\alpha-\sin\alpha\cos\alpha=0$ $\cos\alpha(\sqrt{3}\cos\alpha-\sin\alpha)=0$ $\cos\alpha=0$ or $\sqrt{3}\cos\alpha-\sin\alpha=0$ $\alpha=90^\circ+k.180^\circ,\ k\in Z$ $\sin\alpha=\sqrt{3}\cos\alpha$ $\frac{\sin\alpha}{\cos\alpha}=\sqrt{3};\ \cos\alpha\neq 0$ $\tan\alpha=\sqrt{3}$ $\alpha=60^\circ+k.180^\circ, k\in Z$	✓ factorisation ✓ both equations ✓ $\alpha=90^\circ+k.180^\circ$ ✓ $\tan\alpha=\sqrt{3}$ ✓ $\alpha=60^\circ+k.180^\circ$ ✓ $k\in Z$ (6)
4.3.2	$\alpha=-90^\circ$ or 90° $\alpha=-120^\circ$ or 60°	✓ $\alpha=-90^\circ$ or 90° ✓ $\alpha=-120^\circ$ or 60° (2)
		[16]

TOTAL: 75