## OCR 06 Algebra (Higher)

1. Simplify $5 x^{2} \times 4 x^{-5}$.
2. Simplify $8 y^{\frac{1}{2}} \div 2 y^{\frac{3}{2}}$.
3. A function is given by $y=5 x-3$. Write an expression for the inverse of this function.
4. A value, $x$, is input into this function.

$$
x \rightarrow-\times 2>-1 \gg y
$$

The output, $y$, is then input into this function.

$$
y \rightarrow+4>+\times 3>z
$$

Complete the function below.

$$
x \rightarrow \ldots \ldots .\rangle \rightarrow z
$$

5. Find the value of $x$ in the following.

$$
3(x-4)=2(8-2 x)
$$

6. Write $x^{2}+8 x+5$ in the form $(x+a)^{2}+b$.
7. Simplify $\frac{x^{2}-3 x-18}{x^{2}+4 x+3}$.
8. Rearrange the formula $y=\frac{x+3}{x-2}$ to make $x$ the subject.
9. Factorise $3 x^{2}+7 x-20$.
10. Find the formula for the $n$th term of the quadratic sequence $5,12,25,44,69, \ldots$.
11. Kasim adds together two fractions. His working is shown below.

$$
\frac{2}{x+1}+\frac{1}{x-2}=\frac{2+1}{x+1+x-2}=\frac{3}{2 x-1}
$$

Identify Kasim's error and calculate the correct answer.
12. By completing the square, show that the solutions to the equation $x^{2}-4 x-7=0$ are $x=2-\sqrt{11}$ and $x=2+\sqrt{11}$.
13. Prove algebraically that the difference between the squares of two consecutive odd integers is even.
14. A formula for the $n$th term of the sequence $6,11,20,33, \ldots$ is $2 n^{2}-n+5$. Write down a formula for the $n$th term of the sequence $10,15,24,37, \ldots$ and use it to show that 240 is a term of this sequence.
15. The equation $x^{3}+x-85=0$ has a solution between 4 and 5 .

Show that this solution is 4.3 to one decimal place.
16. List the integer values that satisfy both of the inequalities $2 y-3>-5$ and $3 y+1<13$.
17. A Fibonacci type sequence is given by $x_{n+2}=x_{n}+x_{n+1}$.
$x_{1}=a$ and $x_{2}=b$. Write expressions for the third and fifth terms. If the third term is 11 and the fifth term is 39 , find the values of $a$ and $b$.
18. The area of the triangle below is $14.28 \mathrm{~cm}^{2}$. Find the value of $x$.


## Not to scale

19. A straight line has equation $y=2 x-1$. A circle has equation $x^{2}+y^{2}=9$. Find the coordinates of the points of intersection of the circle and the straight line. Give your answers correct to 3 significant figures.
20. Sarah wants to make a rectangular pen for her rabbits. One side of the pen will be a brick wall and she has 16 m of wire fencing for the other three sides. Find possible values for $x$ if the area of the pen is at least $24 \mathrm{~m}^{2}$.

Brick wall


## GCSE (9-1)

## MATHEMATICS

## Section Check In

## Answers

1. $20 x^{-3}$
2. $4 y^{-1}$
3. $y=\frac{x+3}{5}$
4. 

$$
x \rightarrow \times 6>++9>z
$$

5. $3(x-4)=2(8-2 x)$

$$
3 x-12=16-4 x
$$

$$
7 x-12=16
$$

$$
7 x=28
$$

$$
x=4
$$

6. Complete the square:

$$
x^{2}+8 x+5=(x+4)^{2}-16+5=(x+4)^{2}-11
$$

7. $\frac{x^{2}-3 x-18}{x^{2}+4 x+3}=\frac{(x-6)(x+3)}{(x+1)(x+3)}=\frac{x-6}{x+1}$
8. $y=\frac{x+3}{x-2}$

$$
\begin{aligned}
y(x-2) & =x+3 \\
x y-2 y & =x+3 \\
x y-x & =2 y+3 \\
x(y-1) & =2 y+3 \\
x & =\frac{2 y+3}{y-1}
\end{aligned}
$$

9. $(3 x-5)(x+4)$
10. $u_{n}=3 n^{2}-2 n+4$
11. Kasim has just added the numerators and added the denominators of the fractions. He should have written each fraction over a common denominator and then just added the numerators.

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

## MATHEMATICS

## Section Check In

12. $x^{2}-4 x-7=0$

$$
\begin{aligned}
(x-2)^{2}-4-7 & =0 \\
(x-2)^{2}-11 & =0 \\
(x-2)^{2} & =11 \\
x-2 & = \pm \sqrt{11} \\
x=2+\sqrt{11} \text { or } x & =2-\sqrt{11}
\end{aligned}
$$

13. Let the two odd numbers be $(2 x+1)$ and $(2 x+3)$

$$
\begin{aligned}
& (2 x+1)^{2}=4 x^{2}+4 x+1 \\
& (2 x+3)^{2}=4 x^{2}+12 x+9
\end{aligned}
$$

Subtracting gives

$$
\begin{aligned}
(2 x+3)^{2}-(2 x+1)^{2} & =4 x^{2}+12 x+9-\left(4 x^{2}+4 x+1\right) \\
& =4 x^{2}+12 x+9-4 x^{2}-4 x-1 \\
& =8 x+8 \\
& =8(x+1)
\end{aligned}
$$

If $x$ is an integer, $x+1$ is an integer so $8(x+1)$ is even.
14. Each term is 4 larger than the corresponding term in the first sequence so the formula for the $n$th term is $2 n^{2}-n+9$
$2 n^{2}-n+9=240$
$2 n^{2}-n-231=0$
$(2 n+21)(n-11)=0$
$n=-10.5$ or $n=11$
$n$ can only be a positive integer so $n=11$ and therefore 240 is a term in the sequence.
15. Try $x=4.25, x^{3}+x-85=-3.98 \ldots$

Try $x=4.35, x^{3}+x-85=1.66 \ldots$
As there is a sign change between $x=4.25$ and $x=4.35,4.3$ is a solution to one decimal place.
16. $2 y-3>-5$
$2 y>-2$
$y>-1$

$$
\begin{aligned}
3 y+1 & <13 \\
3 y & <12 \\
y & <4
\end{aligned}
$$

The integers which satisfy both inequalities are in the interval $-1<y<4$ so $0,1,2$ and 3 .

## Section Check In

17. The first term is $a$; the second term is $b$; the third term is $a+b$; (the fourth term is $a+2 b$ ); the fifth term is $2 a+3 b$.
Form two simultaneous equations:

$$
\begin{array}{r}
2 a+3 b=39 \quad \rightarrow 2 a+3 b=39 \\
a+b=11 \quad \times 3 \rightarrow 3 a+3 b=33
\end{array}
$$

Substituting gives $a=-6$
Substituting gives $b=17$
18. Area of triangle $=\frac{1}{2} a b \sin C$
$\frac{1}{2} \times x \times 6.8 \times \sin 30=14.28$
$x=\frac{14.28 \times 2}{6.8 \times \sin 30}=8.4 \mathrm{~cm}$
19. Substitute $y=2 x-1$ into $x^{2}+y^{2}=9$

$$
\begin{array}{r}
x^{2}+(2 x-1)^{2}=9 \\
x^{2}+4 x^{2}-4 x+1=9 \\
5 x^{2}-4 x-8=0
\end{array}
$$

Using the quadratic formula: $x=\frac{-b \pm \sqrt{b^{2}-4 a c}}{2 a}$
$x=\frac{4 \pm \sqrt{4^{2}-4 \times 5 \times-8}}{2 \times 5}=1.7266 \ldots$ or $-0.9266 \ldots$...e. 1.73 or -0.927 (to 3 significant figures)
Substitute into $y=2 x-1$
If $x=1.73, y=2.46$
If $x=-0.927, y=-2.85$
So the coordinates of the points of intersection are $(1.73,2.45)$ and $(-0.927,-2.85)$.
20. Let the width be $x$
$x(16-2 x) \geq 24$
$-2 x^{2}+16 x-24 \geq 0$
$(x-2)(6-x) \geq 0$
$2 \leq x \leq 6$ (in metres)

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## GCSE (9-1)

MATHEMATICS

## Section Check In

| Assessment Objective | Qu. | Topic | $\mathbf{R}$ | A | G |
| :---: | :---: | :---: | :---: | :---: | :---: |
| AO1 | 1 | Simplify an expression involving products of powers |  |  |  |
| AO1 | 2 | Simplify an expression involving quotients of powers |  |  |  |
| AO1 | 3 | Write an expression for an inverse function |  |  |  |
| AO1 | 4 | Complete a composite function |  |  |  |
| AO1 | 5 | Solve a linear equation involving brackets and unknowns on both sides of the equation |  |  |  |
| AO1 | 6 | Complete the square |  |  |  |
| AO1 | 7 | Factorise a quadratic expression to simplify an algebraic fraction |  |  |  |
| AO1 | 8 | Rearrange a formula where the subject appears twice |  |  |  |
| AO1 | 9 | Factorise a quadratic expression where $a \neq 0$ or 1 |  |  |  |
| AO1 | 10 | Find a formula for the $n$th term of a quadratic sequence |  |  |  |
| AO2 | 11 | Add two algebraic fractions |  |  |  |
| AO2 | 12 | Solve a quadratic equation by completing the square |  |  |  |
| AO2 | 13 | Use algebra to construct a proof |  |  |  |
| AO2 | 14 | Use a formula for the $n$th term of a quadratic sequence |  |  |  |
| AO2 | 15 | Find an approximate solution to a cubic equation |  |  |  |
| AO3 | 16 | Solve two linear inequalities |  |  |  |
| AO3 | 17 | Set up and solve two simultaneous equations to solve a problem involving sequences |  |  |  |
| AO3 | 18 | Substitute values into a formula and solve to find an unknown |  |  |  |
| AO3 | 19 | Solve linear and quadratic simultaneous equations and use the quadratic formula |  |  |  |
| AO3 | 20 | Set up and solve a quadratic inequality in one variable in context |  |  |  |


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| AO1 | 10 | Find a formula for the $n$th term of a quadratic sequence |  |  |  |
| AO2 | 11 | Add two algebraic fractions |  |  |  |
| AO2 | 12 | Solve a quadratic equation by completing the square |  |  |  |
| AO2 | 13 | Use algebra to construct a proof |  |  |  |
| AO2 | 14 | Use a formula for the $n$th term of a quadratic sequence |  |  |  |
| AO2 | 15 | Find an approximate solution to a cubic equation |  |  |  |
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