## AQA Level 2 Further Maths 2023 Paper 2

Do not turn over the page until instructed to do so.
This assessment is out of 80 marks and you will be given 90 minutes.

When you are asked to by your teacher write your full name below

## Name:

Total Marks: / 80

1 Factorise fully $5(2 x+1)^{5}-6(2 x+1)^{4}$
[3 marks]

2 Circle the equation of the circle with centre $(3,-1)$ and radius 13 .
[1 mark]

$$
\begin{array}{ll}
(x-3)^{2}+(y-1)^{2}=13 & (x-3)^{2}+(y+1)^{2}=169 \\
(x+3)^{2}+(y-1)^{2}=13 & (x+3)^{2}+(y-1)^{2}=169
\end{array}
$$

3 Express in the form $a \sqrt{7}$

$$
\sqrt{343}+2 \sqrt{175}-3 \sqrt{112}
$$

[2 marks]

4 Circle the graph that represents $y=2 \times 4^{-x}$
[1 mark]





5 A graph passes through (0,2). The rate of change of $y$ with respect to $x$ is always 2 . Draw the graph of $y$ for values of $x$ from 0 to 4 .
[4 marks]


6 The point $P(x, y)$ is transformed to the point $P^{\prime}$ by the matrix $\mathbf{A}=\left(\begin{array}{ll}4 & 5 \\ 2 & 1\end{array}\right)$. Given that the coordinates of $P^{\prime}$ are $(22,8)$ find $P$.
[3 marks]

7 In triangle $A B C, A B=x+3, B C=x$ and angle $A B C=150^{\circ}$. Given that the area of the triangle is 10 square units, find the value of $x$.

8 A circle, centre $C$, touches the $y$-axis at the point $(0,4)$.
The line $y=k$ intersects the circle at the points $(2, k)$ and $(8, k)$.


Find the equation of the circle.

9 a) Describe fully the transformation represented by the matrix
$\mathbf{M}=\left(\begin{array}{ll}3 & 0 \\ 0 & 3\end{array}\right)$.
[1 mark]
b) The unit square is transformed by the matrix $\mathbf{M}$ given in (a). What is the area of the resulting image?
[1 mark]
c) Let $S$ and $T$ be transformations in the $x-y$ plane.
$S: \quad$ Reflection in the $x$-axis.
$T$ : Rotation $270^{\circ}$ anticlockwise
i) Find the matrix representing $S$ followed by $T$.
[4 marks]
ii) $\quad S$ followed by $T$ is equivalent to a single transformation in the $x-y$ plane. What is this transformation.

10 Prove that the triangle with side lengths $n, n+1$ and $\sqrt{2 n+1}$ is a right angled triangle.
[4 marks]

11 Find the values of $x$ for which the function $f(x)=2 x^{2}-3 x-3$ is decreasing.

12 a) Given that $(x-2)$ and $(x+1)$ are factors of $p(x)=x^{3}+a x^{3}+b x^{2}-x+6$ find the values of $a$ and $b$.
[5 marks]
b) Hence, fully factorise $p(x)$.
[3 marks]

13 Simplify fully $\frac{5 x^{2}+7 x+2}{x+3} \div \frac{25 x^{2}-4}{3 x+9}$
$14 A B C D E F G H$ is a hollow cuboid made of rods.
$A B=3 \mathrm{~m}$
$B D=4 \mathrm{~m}$
$E A=8 \mathrm{~m}$
The point $I$ splits the length $E A$ in the ratio $3: 1$


A rope is connected from $H$ to $I$.
a) Find the length of the rope.
b) Find the angle the rope makes with the face $A B F E$.

15 An open box is made from a square sheet of cardboard, with sides 80 cm long, by cutting out a square from each corner, folding up the sides and joining the cut edges.
a) Show that the volume of the box, $V$, is given by $V=x(80-2 x)^{2}$
[2 marks]
b) Work out $\frac{\mathrm{d} V}{\mathrm{~d} x}$ and $\frac{\mathrm{d}^{2} V}{\mathrm{~d} x^{2}}$.
c) Use your answers to part (b) to find the value of $x$ for which the volume is maximised and state this volume.

16 a) Find the equation of the tangent to the circle $(x-3)^{2}+y^{2}=25$ at the point $A(0,4)$.
[3 marks]
b) This tangent meets the tangent to the circle which passes through the point $B(8,0)$ at the point $C$. Find the coordinates of point $C$.
c) Show that the length of $B C$ is the same as the length of $A C$.
[4 marks]

17 Let $f(x)=\frac{3}{2 x+5}, x>0$
a) For what value of $x$ is the function undefined.
[1 mark]
b) Hence, state the domain of $f(x)$.
[1 mark]
c) Find the inverse of $f(x)$.

18 Sketch the piecewise function defined below

$$
\begin{aligned}
f(x) & =x+1, & & 0 \leq x<3 \\
& =x^{2}-5, & & 3 \leq x<4 \\
& =-3 x+23, & & 4 \leq x<7
\end{aligned}
$$


[3 marks]

