	Stationary Points	
1.	Find the coordinates of the stationary points for the curve y $= 2x^3 - 3x^2 - 12x + 20$ and determine their nature.	7
2.	f(x) is defined by the formula f(x) $= x^3 - 3x + 2$. Find the stationary points for this function and determine their nature	7
3.	A curve has the equation $y = x^4 - 4x^3 + 3$ Algebraically find the coordinates of the stationary points and determine their nature	7
4.	(a) Find the coordinates of the stationary points of the graph with equation $y = x^3 + 3x^2 - 24x$ and determine their nature (b) Hence determine the range of values of x for which the function is strictly decreasing	7 2
5.	(a) Find the x coordinates of the stationary points on the graphs with equation $y = \frac{1}{3}x^3 - 2x^2 - 5x - 4$ (b) Hence determine the range of values of x for which this graph is strictly increasing	4 2

	Stationary Points - Answers	
1	Differentiate the function $\frac{dy}{dx} = 6x^2 - 6x - 12$ Set the derivative = 0 $6x^2 - 6x - 12 = 0$ Factorise $6(x + 1)(x - 2) = 0$ Solve for x $x = -1, \quad x = 2$ Find values for y by substituting into the original function $y = 27, \quad y = 0$ Use a nature table $\begin{array}{c\|ccccc} x & -1^- & -1 & -1^+ & 2 & 2^+ \\ \hline \frac{dy}{dx} & + & 0 & - & 0 & + \end{array}$ State a conclusion Maximum at (-1,27) Minimum at (2,0)	
2	Differentiate the function $\frac{dy}{dx} = 3x^2 - 3$ Set the derivative = 0 $3x^2 - 3 = 0$ Factorise $3(x + 1)(x - 1) = 0$ Solve for x $x = -1, \quad x = 1$ Find values for y by substituting into the original function $y = 4, \quad y = 0$	

Use a nature table

x	-1^-	-1	-1^+	1	1^+
$\frac{dy}{dx}$	+	0	-	0	+

State a conclusion — Maximum at (-1,4) Minimum at (1,0)

3

Differentiate the function — $\frac{dy}{dx} = 4x^3 - 12x^2$

Set the derivative = 0 — $4x^3 - 12x^2 = 0$

Factorise — $4x^2(x - 3) = 0$

Solve for x — $x = 0$, $x = 3$

Find values for y by substituting into the original function — $y = 3$, $y = -24$

Use a nature table

x	0^-	0	0^+	3	3^+
$\frac{dy}{dx}$	-	0	-	0	+

State a conclusion — Point of inflexion at (0,3) Minimum at (3,-24)

4

Differentiate the function — $\frac{dy}{dx} = 3x^2 + 6x - 24$

Set the derivative = 0 — $3x^2 + 6x - 24 = 0$

Factorise — $3(x + 4)(x - 2) = 0$

Solve for x — $x = -4$, $x = 2$

Find values for y by substituting into the original function — $y = 80$, $y = -28$

Use a nature table

x	-4^-	-4	-4^+	2	2^+
$\frac{dy}{dx}$	+	0	-	0	+

State a conclusion — Maximum at (-4, 80) Minimum at (4,-24)

State where the curve is decreasing (dy/dx) is negative — $-4 < x < 2$

5

Differentiate the function — $\frac{dy}{dx} = x^2 - 4x - 5$

Look for stationary points — $x^2 - 4x - 5 = 0$

$(x + 1)(x - 5) = 0$

Stationary points at — $x = -1$, $x = 5$

Use a nature table to identify the shape of the curve

x	-1^-	-1	-1^+	5	5^+
$\frac{dy}{dx}$	+	0	-	0	+

State where the curve is increasing (dy/dx) is positive — $x < -1$ and $x > 5$