EXCEL IN MATHSCI
HIGHER MATHEMATICS • TOPIC RESOURCE

2026–27
Portfolio 7

Differentiation

PUPIL WORKSHEET

Skills covered: Indices and surds; differentiating algebraic and trigonometric functions; chain rule; tangents; stationary points and their nature; rates of change.

Instructions: Attempt all questions. Show sufficient working to justify your answers. Give exact values unless a degree of accuracy is stated. Each section is separate for targeted revision.

Prerequisite core skills revise earlier learning; *topic practice* develops individual techniques; *exam-style and challenge* combines skills.

Pupil: _____ **Date:** _____

SECTION A | Prerequisite core skills

Question 1

[3 marks]

Differentiate $y = x^4 - 3x^2 + \dfrac{2}{x}$ with respect to x.

Question 2

[4 marks]

Express $y = 4\sqrt{x^3} - \dfrac{3}{x^2}$ using indices. Hence find $\dfrac{dy}{dx}$.

Question 3

[2 marks]

Find the derivative of $y = (x + 3)(x - 4)$.

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Question 4

[2 marks]

Find $f'(x)$ for $f(x) = \dfrac{x^2 + 2x}{x}$, $x \neq 0$.

Question 5

[2 marks]

Differentiate $y = 5\sin x - 3\cos x$ with respect to x, where x is in radians.

Question 6

[3 marks]

Differentiate $f(x) = (2x + 1)^5$.

SECTION B | Topic practice

Question 7

[4 marks]

Given $f(x) = \sqrt{3x + 1}$, find $f'(x)$ and evaluate $f'(1)$.

Question 8

[3 marks]

Differentiate $y = (x^2 - 4x + 1)^3$ with respect to x.

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Question 9

[4 marks]

Find the equation of the tangent to $y = x^2 - 3x + 5$ at the point where $x = 2$.

Question 10

[6 marks]

Find the coordinates of the stationary points of $f(x) = x^3 - 6x^2 + 9x$ and determine their nature using the second derivative test.

Question 11

[6 marks]

For $f(x) = x^3 - 3x^2 - 9x + 2$, find the coordinates and natures of both stationary points.

Question 12

[5 marks]

Find the intervals on which $f(x) = x^3 - 6x^2 + 9x + 2$ is strictly increasing and strictly decreasing.

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Question 13

[3 marks]

Differentiate $y = 3\cos 2x$, where x is in radians.

Question 14

[5 marks]

The displacement s metres of a particle after t seconds is $s(t) = t^3 - 6t^2 + 8t$. Find its velocity and acceleration at $t = 2$.

SECTION C | Exam-style and challenge

Question 15

[5 marks]

Find the equation of the tangent to $y = x^3 - 3x^2 - 9x + 5$ at $x = 1$. Give the equation in the form $ax + by = c$, with integer coefficients.

Question 16

[6 marks]

$f(x) = x + \dfrac{1}{x}$, $x \neq 0$. Find its stationary points and state their nature.

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Question 17

[5 marks]

The curve has equation $f(x) = x^3 - 3x$. Sketch the graph of $y = f'(x)$, labelling its x-intercepts and minimum turning point.

Question 18

[6 marks]

For $f(x) = x^4 - 8x^2 + 9$, determine the coordinates and natures of all stationary points.

— End of pupil worksheet —

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