# Gradients, Tangents & Normals

## Question Paper 3

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| **Level** | International A Level |
| **Subject** | Maths |
| **Exam Board** | CIE |
| **Topic** | Differentiation |
| **Sub Topic** | Gradients, Tangents & Normals |
| **Booklet** | Question Paper 3 |

**Time Allowed:** **60 minutes**

**Score:** **/50**

**Percentage:** **/100**

**Grade Boundaries:**

| A* | A | B | C | D | E | U |
|---|---|---|---|---|---|---|
| >85% | '77.5% | 70% | 62.5% | 57.5% | 45% | <45% |

**1** A curve has equation $y = kx^2 + 1$ and a line has equation $y = kx$, where $k$ is a non-zero constant.

**(i)** Find the set of values of $k$ for which the curve and the line have no common points. [3]

**(ii)** State the value of $k$ for which the line is a tangent to the curve and, for this case, find the coordinates of the point where the line touches the curve. [4]

**2** A curve has equation $y = \mathrm{f}(x)$. It is given that $\mathrm{f}'(x) = 3x^2 + 2x - 5$.

**(i)** Find the set of values of $x$ for which f is an increasing function. [3]

**(ii)** Given that the curve passes through $(1, 3)$, find $\mathrm{f}(x)$. [4]

**3** The equation of a curve is $y = \frac{1}{6}(2x - 3)^3 - 4x$.

**(i)** Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$. [3]

**(ii)** Find the equation of the tangent to the curve at the point where the curve intersects the $y$-axis. [3]

**(iii)** Find the set of values of $x$ for which $\frac{1}{6}(2x - 3)^3 - 4x$ is an increasing function of $x$. [3]

**4** The equation of a curve is such that $\dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{6}{\sqrt{(3x - 2)}}$. Given that the curve passes through the point $P\,(2, 11)$, find

**(i)** the equation of the normal to the curve at $P$, [3]

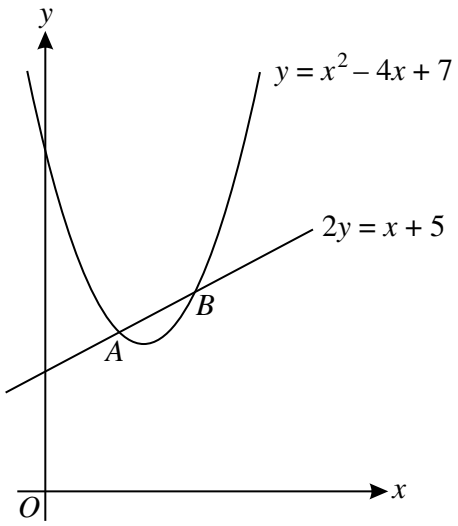
**(ii)** the equation of the curve. [4]

**5** A curve is such that $\dfrac{\mathrm{d}y}{\mathrm{d}x} = k - 2x$, where $k$ is a constant.

**(i)** Given that the tangents to the curve at the points where $x = 2$ and $x = 3$ are perpendicular, find the value of $k$. [4]

**(ii)** Given also that the curve passes through the point $(4, 9)$, find the equation of the curve. [3]

**6**




**(i)** The diagram shows the line $2y = x + 5$ and the curve $y = x^2 - 4x + 7$, which intersect at the points $A$ and $B$. Find

**(a)** the $x$-coordinates of $A$ and $B$, [3]

**(b)** the equation of the tangent to the curve at $B$, [3]

**(c)** the acute angle, in degrees correct to 1 decimal place, between this tangent and the line $2y = x + 5$. [3]

**(ii)** Determine the set of values of $k$ for which the line $2y = x + k$ does not intersect the curve $y = x^2 - 4x + 7$. [4]