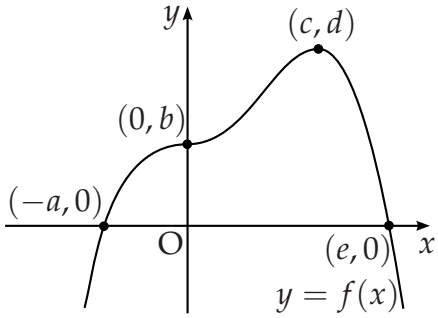
differentiation

[SQA] 1. Find the coordinates of the point on the curve $y = 2x^2 - 7x + 10$ where the tangent to the curve makes an angle of $45°$ with the positive direction of the x-axis. **4**

[SQA] 2. The graph of a function f intersects the x-axis at $(-a, 0)$ and $(e, 0)$ as shown.

There is a point of inflexion at $(0, b)$ and a maximum turning point at (c, d).

Sketch the graph of the derived function f'. **3**



[SQA] 3. If $y = x^2 - x$, show that $\dfrac{dy}{dx} = 1 + \dfrac{2y}{x}$. **3**

[SQA] 4. If $f(x) = kx^3 + 5x - 1$ and $f'(1) = 14$, find the value of k. **3**

[SQA] 5. A function f is defined by the formula $f(x) = (x-1)^2(x+2)$ where $x \in \mathbb{R}$.

(a) Find the coordinates of the points where the curve with equation $y = f(x)$ crosses the x- and y-axes. **3**

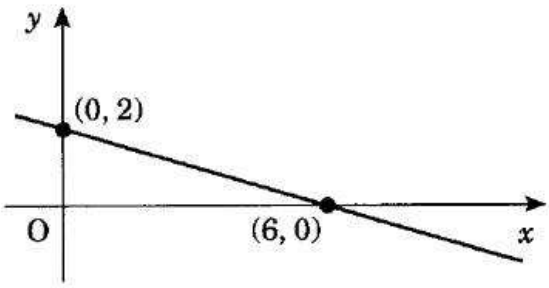
(b) Find the stationary points of this curve $y = f(x)$ and determine their nature. **7**

(c) Sketch the curve $y = f(x)$. **2**

[SQA] 6. Find the x-coordinate of each of the points on the curve $y = 2x^3 - 3x^2 - 12x + 20$ at which the tangent is parallel to the x-axis. **4**

[SQA] 7. The straight line shown in the diagram has equation $y = f(x)$.

Determine $f'(x)$. **2**



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[SQA] 8. Calculate, to the nearest degree, the angle between the x-axis and the tangent to the curve with equation $y = x^3 - 4x - 5$ at the point where $x = 2$. **4**

[SQA] 9. Find the equation of the tangent to the curve with equation $y = 5x^3 - 6x^2$ at the point where $x = 1$. **4**

[SQA] 10. For what values of x is the function $f(x) = \frac{1}{3}x^3 - 2x^2 - 5x - 4$ increasing? **5**

[SQA] 11. The point $\mathrm{P}(-2, b)$ lies on the graph of the function $f(x) = 3x^3 - x^2 - 7x + 4$.

(*a*) Find the value of b. **1**

(*b*) Prove that this function is increasing at P. **3**

[SQA] 12. A curve has equation $y = x^4 - 4x^3 + 3$.

(*a*) Find algebraically the coordinates of the stationary points. **6**

(*b*) Determine the nature of the stationary points. **2**

[SQA] 13. Find the values of x for which the function $f(x) = 2x^3 - 3x^2 - 36x$ is increasing. **4**

[SQA] 14. A ball is thrown vertically upwards.

After t seconds its height is h metres, where $h = 1{\cdot}2 + 19{\cdot}6t - 4{\cdot}9t^2$.

(*a*) Find the speed of the ball after 1 second. **3**

(*b*) For how many seconds is the ball travelling upwards? **2**

[END OF QUESTIONS]

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