Calculus 1 Tutorial Questions

1) Find the derivatives of:
   i. x^4 ii. $7x^3$ iii. x^{-1} iv. x^1
2) Find the derivative of:
   i. $f(x) = 5x^2 + 7x + 3$
   ii. $g(x) = 2x^3 + 4x^2 + x + 5$
   iii. $y = 8x + 4$
3) Find the slope of line y = 8x + 4 using differentiation
4) Product rule: $y = (4 + 3x^2)(6x + 4x^2)$ $Find\ \frac{dy}{dx}$
5) Quotient rule: $y = \frac{(5+6x)}{2x^2}$. $Find\ \frac{dy}{dx}$
6) Chain rule: $y = (2 + 3x)^4$. $Find\ \frac{dy}{dx}$
7) Chain rule: y = Cos (3x + 5). Find $\frac{dy}{dx}$
8) Find the following limits:
   i. $\lim_{x\to 1}\left(\frac{x^2+x-2}{x-1}\right)$
   ii. $\lim_{n\to\infty}\left(\frac{2n^2-3n+2}{6n^2+5n-6}\right)$
9) Find the derivative of $f(x) = 5 - 2x$ by first principles.

10) 2014 Paper 1 Q4

(a) Differentiate the function $2x^2 - 3x - 6$ with respect to x from first principles.

(b) Let f(x) = $\frac{2x}{x+2}, x \neq -2, x \in \mathbb{R}$. Find the co-ordinates of the points at which the slope of the tangent to the curve y = f(x) is $\frac{1}{4}$.

11) 2016 Paper 1 Q6

(a) Differentiate the function $(2x + 4)^2$ from first principles, with respect to x.

(b) (i) If y = xsin($\frac{1}{x}$), find $\frac{dy}{dx}$

(ii) find the slope of the tangent to the curve y = xsin($\frac{1}{x}$), when x = $\frac{4}{\pi}$. Give your answer correct to two decimal places.

12) 2017 Paper 1 Q3

(b) f(x) = ln($3x^2 + 2$) and g(x) = x+5, where $x \in \mathbb{R}$. Find the value of the derivative of f(g(x)) at x = $\frac{1}{4}$. Give your answer correct to 3 decimal places.

13) 2021 Paper 1 Q8

(a) h(x) = $0.001x^3 - 0.12x^2 + px + 5$ in the domain $0 \leq x \leq 75$

(i) Use h(10) = 30 to show that p = 3.6

(ii) Complete the table below and hence draw the graph of h(x) in the domain $0 \leq x \leq 75$ on the grid below.

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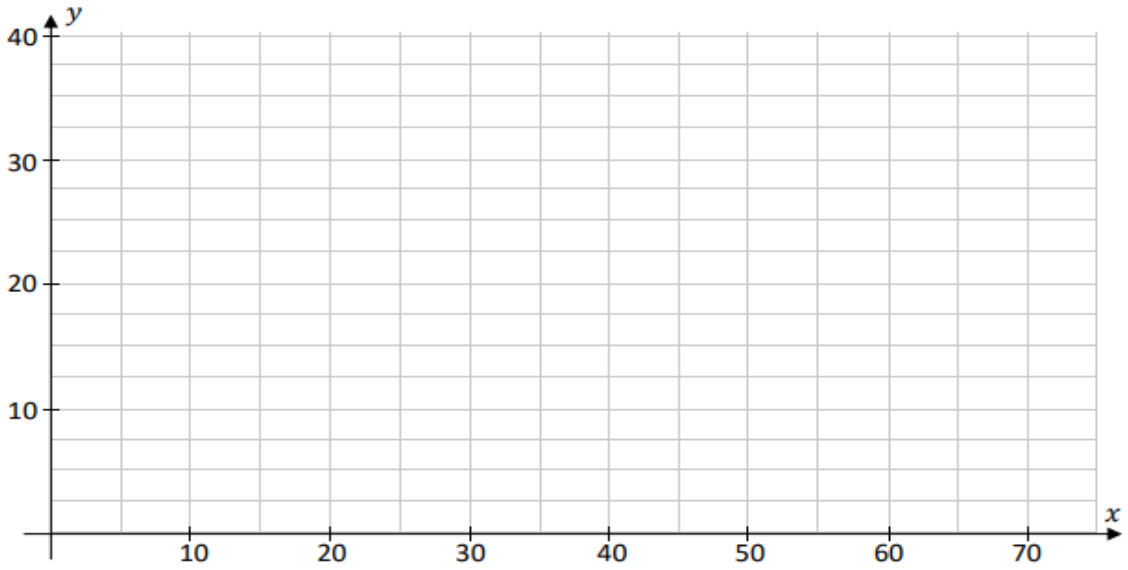
x	0	10	20	30	40	50	60	70	75
$h(x)$		30			21		5		21·875



(b) The function h(x) can be used to model the height above level ground (in metres) of a section of the path followed by a rollercoaster track, where x is the horizontal distance from a fixed point.

(i) Find h'(x), the derivative of h(x).

(ii) Show that this section of the track reaches its maximum height above level ground when x = 20.

(iii) Find using calculus, the height above ground in metres, at the instant the track passes through an inflection point.

