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# VCE Mathematical Methods ¾

## Differentiation I [2.1]

## Test Solutions

24 Marks. 17 Minutes Writing.

**Results:**

| | |
|---|---|
| Test Questions | _____ / 16 |
| Extension | _____ / 8 |

## Section A: Test Questions (16 Marks)

**Question 1** (4 marks)

Tick whether the following statements are **true** or **false**.

| Statement | True | False |
|---|---|---|
| **a.** To find the average rate of change, we differentiate. | | ✓ |
| **b.** First principle is the key to all differentiation. | ✓ | |
| **c.** Derivative function gives us a gradient of a point. | ✓ | |
| **d.** Chain rule is used to differentiate composite functions. | ✓ | |
| **e.** Strictly increasing excludes its end values of the range. | | ✓ |
| **f.** If the gradient of the function is positive, zero and then negative in that order, we have a local minimum. | | ✓ |
| **g.** Derivative graphs' $y$-value indicates the gradient of the original function. | ✓ | |
| **h.** If the original function has a stationary point of inflection, the derivative graph has a $x$-intercept and turning point at the same time. | ✓ | |

Space for Personal Notes

**Question 2** (4 marks)

**a.** Let $y = x^2 \sin(x)$. Find $\frac{dy}{dx}$. (2 marks)

$2x\sin(x) + x^2\cos(x)$

**b.** Evaluate $f'(1)$, where $f: R \to R$, $f(x) = e^{x^2-x+3}$. (2 marks)

$f'(x) = (2x - 1) \times e^{x^2-x+3}$

$f'(1) = e^3$

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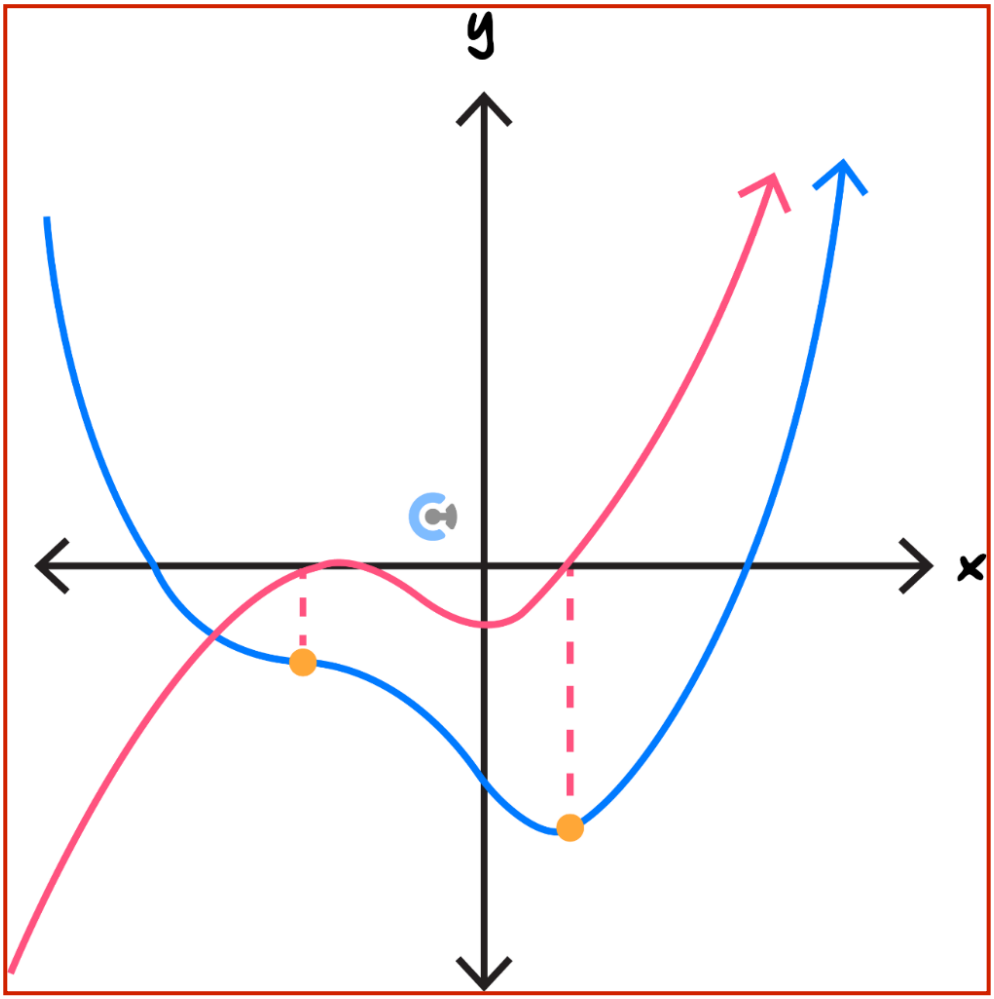
**Question 3** (3 marks)

Sketch the derivative graph of the function shown below, on the same set of axes.

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**Question 4** (5 marks)

Consider $f(x) = \frac{x}{x^2+1}$.

**a.** Find the stationary points and state their nature. (4 marks)

```
Solve[f'[x] == 0 && y == f[x], {x, y}]
```
풀이 함수

$$\left\{\left\{x \to -1,\ y \to -\frac{1}{2}\right\},\ \left\{x \to 1,\ y \to \frac{1}{2}\right\}\right\}$$

```
{f'[-2], f'[-1], f'[0], f'[1], f'[2]}
```

$$\left\{-\frac{3}{25},\ 0,\ 1,\ 0,\ -\frac{3}{25}\right\}$$

```
(* Local Min: (-1, -1/2) and Local Max: (1, 1/2) *)
```

**b.** Hence, state the value(s) of $x$ where the function is strictly increasing. (1 mark)

$[-1, 1]$

Space for Personal Notes

## Section B: Extension (8 Marks)

**Question 5** (2 marks)

The table below shows selected values of a differentiable and decreasing function $f$.

| $x$ | **0** | **1** | **2** |
|---|---|---|---|
| $f(x)$ | 4 | 2 | $-3$ |
| $f'(x)$ | $-2$ | $-4$ | $-6$ |

If $g$ is the inverse of the function $f$, then evaluate the value of $g'(2)$.

$-\frac{1}{4}$

Space for Personal Notes

**Question 6** (6 marks)

Consider $f(x) = \log_e(16 - x^2)$.

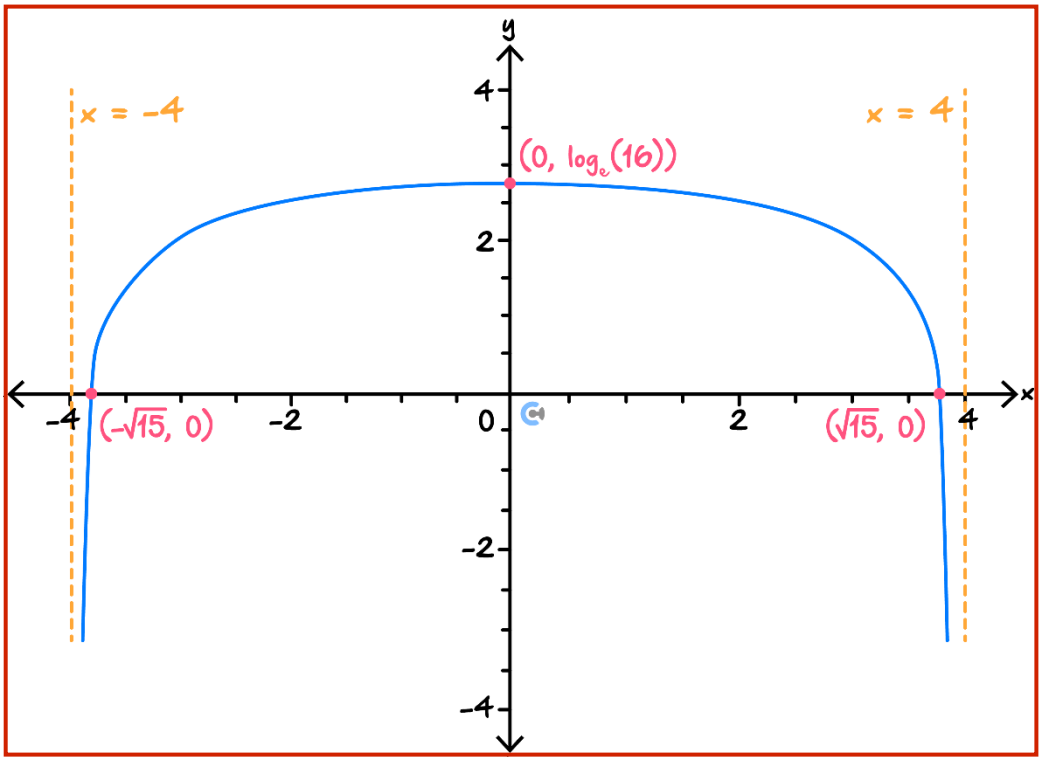
**a.** Find its asymptotes. (2 marks)

$x = \pm 4$

**b.** Find its stationary point and state its nature. (2 marks)

$(0, \log_e(16))$ and Local Max.

**c.** Hence, on the axes below, sketch the function of $f(x)$. Label all the asymptotes, axes intercepts and stationary points. (2 marks)



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