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VCE Mathematical Methods ¾

Differentiation I [2.1]

Test

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.		

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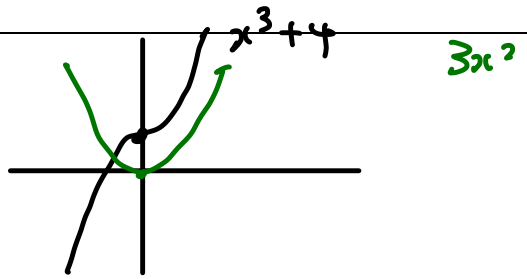

Question 2 (4 marks)

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

$\frac{dy}{dx} = 2x\sin(x) + x^2\cos(x)$

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

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

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

$= e^3$

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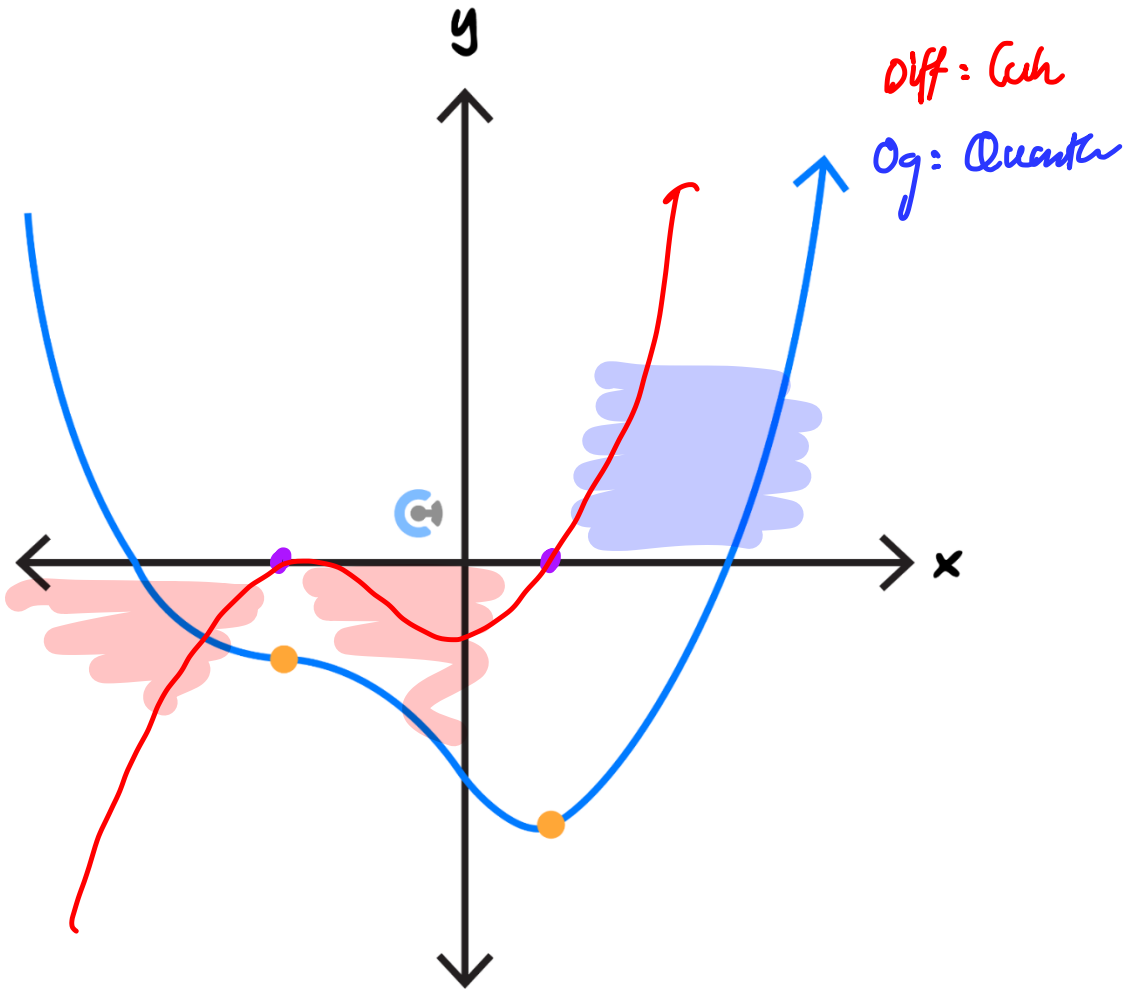
Question 3 (3 marks)

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)

$$f'(x) = \frac{1\cdot(x^2+1) - x\cdot(2x)}{(x^2+1)^2}$$

$$= \frac{x^2+1-2x^2}{(x^2+1)^2}$$

$$= \frac{-x^2+1}{(x^2+1)^2} = 0$$

$$x^2 = 1$$

$$x = \pm 1$$

$\therefore (1, \frac{1}{2})$ & $(-1, -\frac{1}{2})$

Local Max Local Min

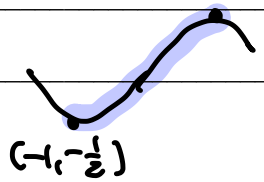
x	-2	-1	0	1	2
$f'(x)$	$\ominus$	0	$\oplus$	0	$\ominus$
Shape	\	—	/	—	\

$f'(-2) = \frac{-4+1}{(\text{big})^2} = \ominus$

$f'(0) = \frac{1}{(\text{big})^2} = \oplus$

$f'(2) = \frac{-4+1}{(\text{big})^2} = \ominus$

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



$x \in [-1, 1]$

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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 $g'(2)$.

f: (0,4) (1,2) (2,−3)

m = −2 m = −4 m = −6.

g: (4,0) (2,1) (−3,2)

m = g'(2) = −1/4

Q. What happens when you inv?

dy/dx ⇒ dx/dy

Flip

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$$g'(2) = -\frac{1}{4}$$

Question 6 (6 marks)

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

a. Find its asymptotes. (2 marks)

$16 - x^2 = 0$

$x = \pm 4$

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

$f'(x) = \frac{1}{16 - x^2} \times -2x = 0$

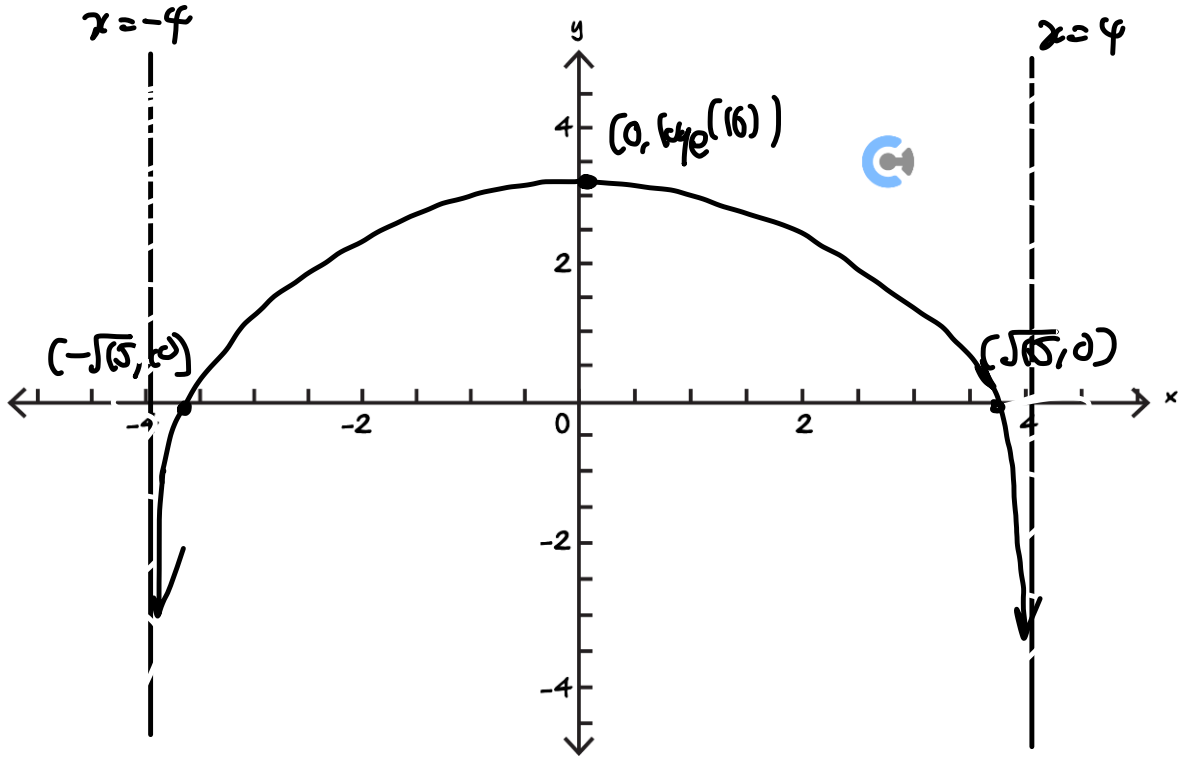
$x = 0$

$(0, \log_e(16))$

x	-1	0	1
f'	$+$	0	$-$
Shape	/	—	\

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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