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PURE MATH

ALGEBRA AND FUNCTION

Level & Board	EDEXCEL (A-LEVEL)
TOPIC:	DIFFERENTIATION
PAPER TYPE:	SOLUTION - 7
TOTAL QUESTIONS	8
TOTAL MARKS	43

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1)

Differentiate y with respect to x:

- Apply the quotient rule:

$$\frac{dy}{dx} = \frac{(3x^2 - 4x + 4)(x^2 - 2x + 1)(x^3 - 2x^2 + 4x - 8)(2x - 2)}{(x^2 - 2x + 1)^2}$$

$$= \frac{3x^4 - 6x^3 + 4x^2 - 4x^3 + 8x^2 - 4x + 4x^3 - 8x^2 + 16x - 16 - 2x^4 + 4x^3\ 8x^2 + 8x}{(x^2 - 2x + 1)^2}$$

$$\frac{dy}{dx} = \frac{x^4\ 6x^3 + 9x^2 + 12x - 16}{(x^2 - 2x + 1)^2}$$

Determine where the curve is increasing:

- Set $\frac{dy}{dx} > 0$ to find the range where the curve is increasing:
  $x^4 - 6x^3 + 9x^2 + 12x - 16 > 0$
- This polynomial inequality may require further analysis or numerical methods to find the exact range of values for which the curve is increasing.

2)

Differentiate y with respect to x:

$$\frac{dy}{dx} = \frac{(4x^3\ 9x^2 + 4x + 5)(x^3 - 2x^2 + x)(x^4 - 3x^3 + 2x^2 + 5x - 6)(3x^2 - 4x + 1)}{(x^3 - 2x^2 + x)^2}$$

$$= \frac{4x^6 - 11x^5 + 5x^4 - 8x^3 + 4x^4 - 11x^3 + 5x^2 - 10x - x^4 + 3x^3 + 2x^2 - 5x - 6 - 3x}{(x^3 - 2x^2 + x)^2}$$

$$\frac{dy}{dx} = \frac{x^6 - 4x^5 + 8x^4 - 14x^3 - 13x^2 - 16x\ 6}{(x^3 + 2x^2 + x)^2}$$

Determine where the curve is increasing:

- Set $\frac{dy}{dx} > 0$ to find the range where the curve is increasing:
  $x^6 - 4x^5 + 8x^4 - 14x^3 + 13x2 - 16x - 6 > 0$
- This polynomial inequality may require further analysis or numerical methods to find the exact range of values for which the curve is increasing.

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3)

Differentiate y with respect to x:

$$= \frac{(5x^4 - 8x^3 + 9x^2 + 8x - 5)\,(x^4 - 3x^3 + 2x^2 + 1)(x^5 - 2x^4 + 3x^3 + 4x^2 - 5x + 6)\,(4x^3 - 9x^2 + 4x)}{(x^4 - 3x^3 + 2x^1 + 1)^2}$$

$$= \frac{5x^8 - 23x^7 + 47x^6\ 45x^5 + 12x^4 + 40x^3 - 72x^2 + 36x\ 5x^8 + 17x^7\ 30x^6\ 8x^5 + 17x^4 + 18x^3\ 36x^2\ 24x\ 4x^5 + 8x^4}{(x^4 - 3x^3 + 2x^1 + 1)^2}$$

$$\frac{dy}{dx} = \frac{12x^8 - 40x^7 + 77x^6 - 73x^5 + 29x^4 + 58x^3 - 162x^2 + 32x}{(x^4 - 3x^3 + 2x^1 + 1)^2}$$

Determine where the curve is increasing:

- Set $\frac{dy}{dx} > 0$ to find the range where curve is increasing:
  $12x^8 - 40x^7 + 77x^6 - 73x^5 + 29x^4 + 58x^3 - 162x^2 + 32x > 0$
- This polynomial inequality may require further analysis or numerical methods to find the exact range of values for which the curve is increasing.

4)

Differentiate y with respect to x:

- Apply the quotient rule:
  $$\frac{dy}{dx} = \frac{(3x^2 - 6x + 2)(x^2 - 2x + 1)(x^3 - 3x^2 + 2x + 1)(2x - 2)}{(x^2 - 2x + 1)^2}$$

$$= \frac{3x^4 - 6x^3 + 2x^2 - 6x^3 + 12x^2 - 4x + 2x^3\ \ 4x^2 + 2x - x^4 + 3x^3 - 2x^2 - 2x + 2}{(x^2 - 2x + 1)^2}$$

$$\frac{dy}{dx} = \frac{2x^4 + 2x^3 + 6x^2 - 2x + 2}{(x^2 - 2x + 1)^2}$$

Determine where the curve is increasing:

- Set $\frac{dy}{dx} > 0$ to find the range where the curve is increasing:
  $2x^4 - 2x^3 + 6x^2 - 2x + 2 > 0$
- The polynomial inequality may require further analysis or numerical methods to find the exact range of values for which the curve is increasing.

5)

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Differentiate y with respect to x:

- Apply the quotient rule:

$$= \frac{(4x^3 - 6x^2 + 6x + 4)(x^3 - 3x^2 + 2x)\,(x^4 - 2x^3 + 3x^2 + 4x - 5)(3x^2 - 6x + 2)}{(x^3 - 3x^2 + 2x)^2}$$

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$$\frac{4x^6-12x^5+18x^4+24x^4-72x^3+48x^3+24x^3-72x^2+36x^2+12x^2-36x-24x^4+72x^3-108x^2-6x^4+12x^3-18x^2-24x+20}{(x^3-3x^2+2x)^2}$$

$$\frac{dy}{dx} = \frac{4x^6-12x^5+42x^4-96x^3+144x^2-60x+20}{(x^3-3x^2+2x)^2}$$

Determine where the curve is increasing:

- Set $\frac{dy}{dx} > 0$ to find the range where the curve is increasing:

$4x^6 - 12x^5 + 42x^4 - 96x^3 + 144x^2 - 60x + 20 > 0$

- This polynomial inequality may require further analysis or numerical methods to find the exact range of values for which the curve is increasing.

6)

Differentiate y with respect to x:

- Apply the quotient rule:

$$\frac{dy}{dx} = \frac{(3x^2 - 4x + 3)(x^2 - 3x + 2)(x^3 - 2x^2 + 3x - 4)(2x - 3)}{(x^2 - 3x + 2)^2}$$

$$\frac{dy}{dx} = \frac{3x^4-11x^3+17x^2-12x+6x^3-10x^2+15x-8+2x^4+4x^3-6x^2+9x}{(x^2-3x+2)^2}$$

$$\frac{dy}{dx} = \frac{x^4-4x^3+11x^2-6x-8}{(x^2-3x+2)^2}$$

Determine where the curve is increasing:

- Set $\frac{dy}{dx} >= 0$ to find the range where the curve is increasing:
  $x^4 - 4x^3 + 11x^2 - 6x - 8 > 0$
- The polynomial inequality may require further analysis or numerical methods to find the exact range of values for which the curve is increasing.

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7)

Differentiate y with respect to x:

- *Apply the quotient rule:*

$$= \frac{(4x^3 - 12x^2 + 12x - 8)(x^3 - 3x^2 + 2x)\ (x^4 - 4x^3 + 6x^2 - 8 + 10)(3x^2 - 6x + 2)}{(x^3 - 3x^2 + 2x)^2}$$

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$$= \frac{4x^6 - 12x^5 + 12x^4 - 8x^4 + 24x^3 - 24x^2 + 12x^2 - 36x + 6x^3 - 18x^2 + 12x - 3x^4 + 12x^3 - 18x^2 + 24x^2 - 48x + 20}{(x^3 - 3x^2 + 2x)^2}$$

$$\frac{dy}{dx} = \frac{x^6 - 6x^5 + 7x^4 - 2x^3 + 0x^260x + 20}{(x^3 - 3x^2 + 2x)^2}$$

Determine where the curve is increasing:

- Set $\frac{dy}{dx} > 0$ to find the range where the curve is increasing:
  $x^6 - 6x^5 + 7x^4 - 2x^3 - 60x + 20 > 0$
- This polynomial inequality may require further analysis or numerical methods to find the exact range of values for which the curve is increasing:

8)

Differentiate y with respect to x:

- Apply the quotient rule:

$$\frac{dy}{dx} = \frac{(3x^2 - 4x + 4)(x^2 - 2x + 1)\ (x^3 - 2x^2 + 4x - 6)(2x - 2)}{(x^2 - 2x + 1)^2}$$

$$\frac{dy}{dx} = \frac{3x^4 - 6x^3 + 4x^2 - 4x^3 + 8x^2 - 8x + 4x^2 - 8x + 4 - 2x^4 + 4x^3 - 8x^2 + 12x - 6}{(x^2 - 2x + 1)^2}$$

$$\frac{dy}{dx} = \frac{x^4 - 2x^3 + 7x^2 - 12x - 2}{(x^2 - 2x + 1)^2}$$

Determine where the curve is increasing:

- Set $\frac{dy}{dx} > 0$ to find the range where the curve is increasing:
  $x^4 - 2x^3 + 7x^2 - 12x - 2 > 0$
  - This polynomial inequality may require further analysis or numerical methods to find the exact range of values for which the curve is increasing.

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