THIRD SPACE
LEARNING
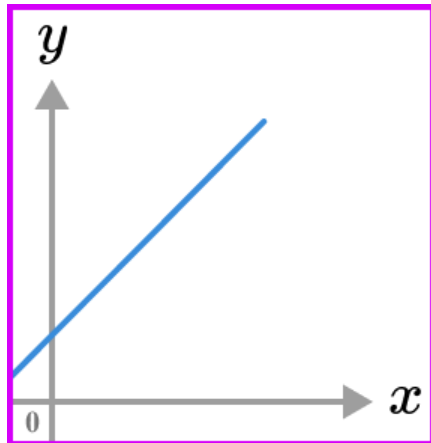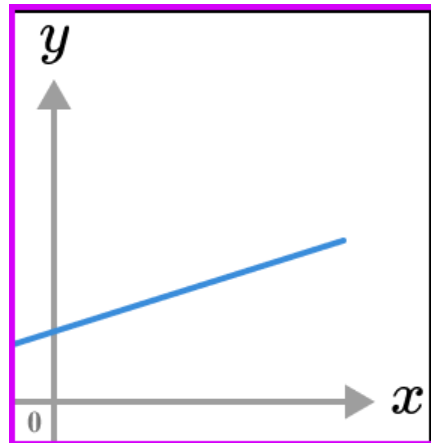
Rates of Change- Worksheet

Skill

Group A - Positive / negative / zero?

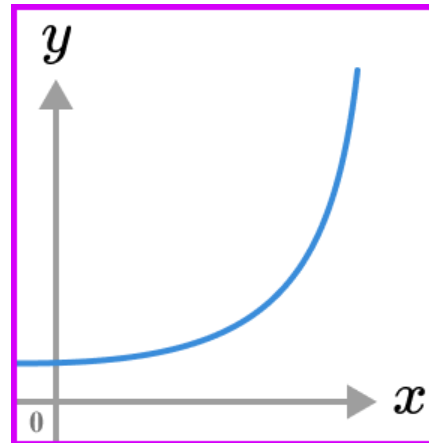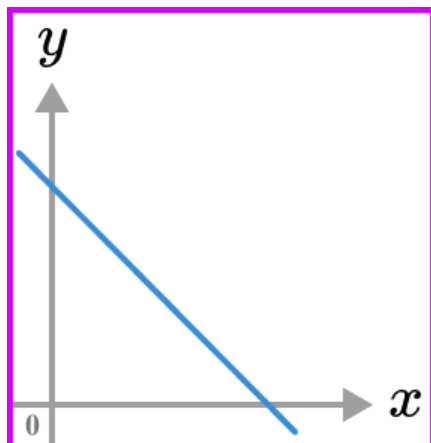Look at each of the graphs below. State whether the rate of change is positive, negative or zero

1)

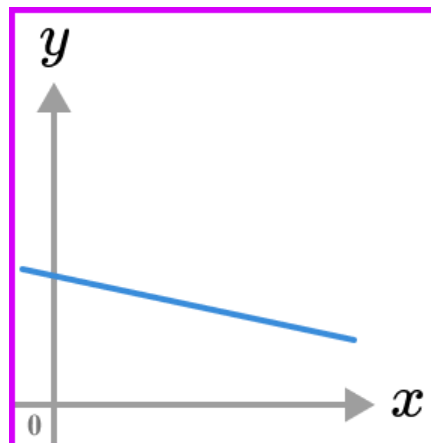**2)**

3)

4)

5)

6)
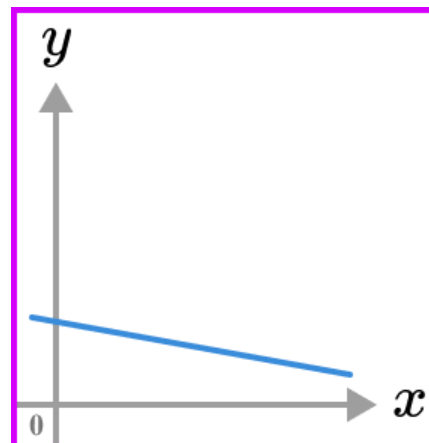
7)

8)

9)

Rates of Change- Worksheet

Group B - Calculating the rate of change

Use the below graph to calculate the rate of change at the points in each question.
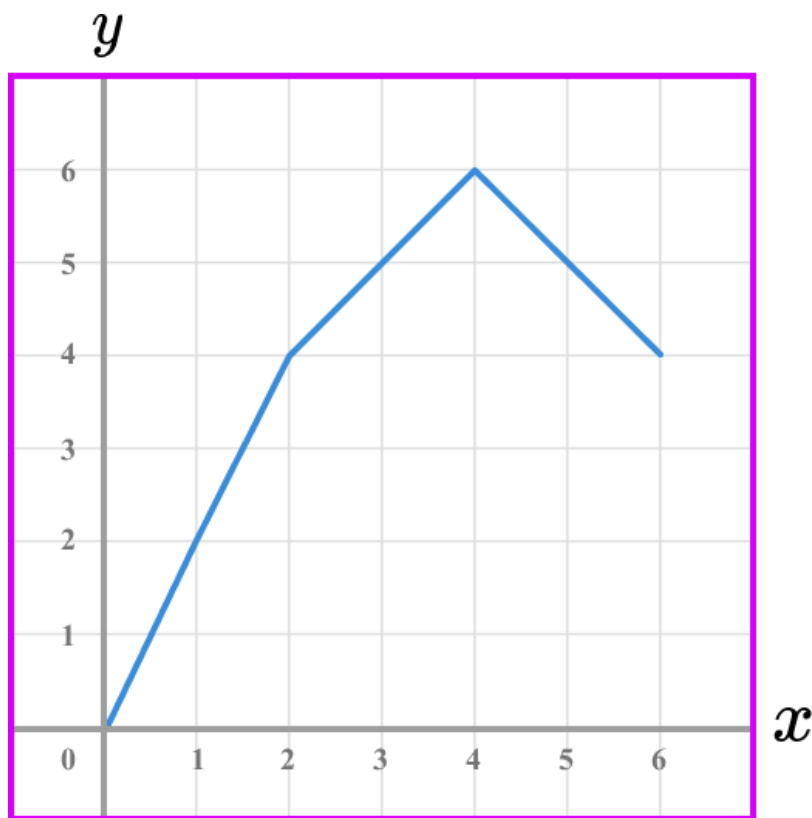
1) $x = 1$

2) $x = 1.5$

3) $x = 0.5$

4) $x = 3$

5) $x = 5$

6) $x = 2.2$

7) Between $x = 0$ and 2

8) Between $x = 4$ and 6

9) Between $x = 0$ and 6

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Rates of Change- Worksheet
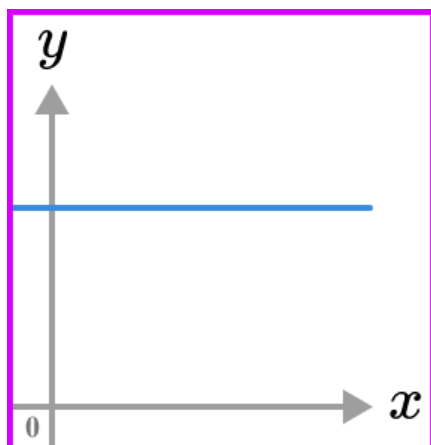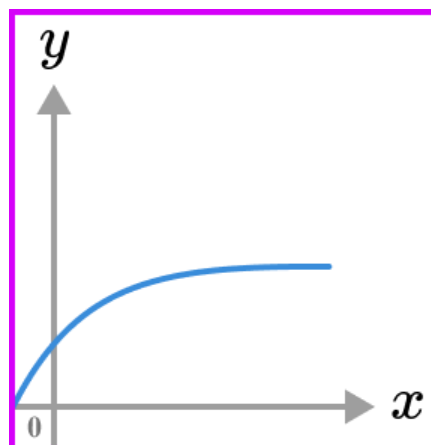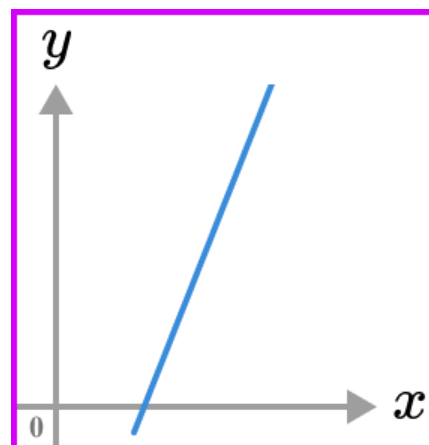
Group C- Calculating the rate of change

Use the below graph to calculate the rate of change at the points in each question. *Some coordinates are noted for you on the graph*. Also state whether each is a calculator of an instantaneous rate of change or an average rate of change.
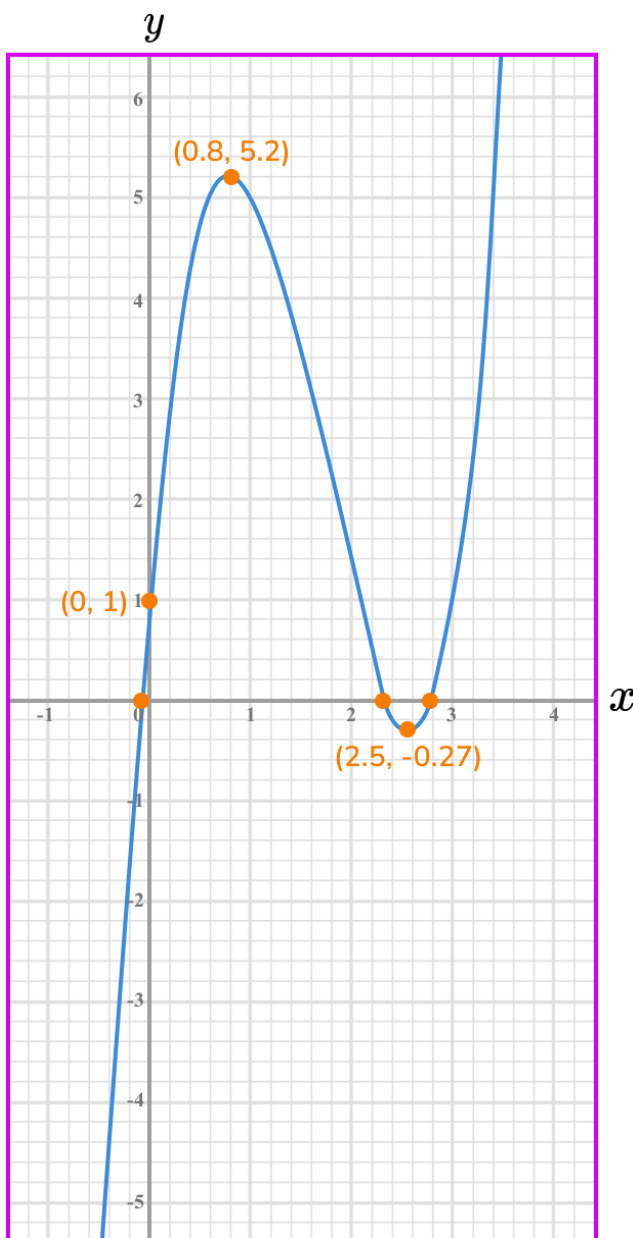
1) $x = 3$ **2)** $x = 2$ **3)** $x = 1$

4) $x = 2.5$ **5)** $x = 0.8$ **6)** $x = 0$

7) Between $x = 0$ and 0.8 **8)** Between $x = 1$ and 2.8

Rates of Change - Worksheet

Applied

1) A company makes teddy bears. The retail price (£P) of the teddy bear relates directly to the amount of time (t hours) it takes to make one. The linear function of this is defined as $P = 10t$

    (a) Which is the dependent variable? Select the correct one:
- The Retail Price of the Teddy Bear
- The Amount of Time it takes to make one

    (b) If a teddy bear takes 3 hours to make, how much does it cost?

    (c) If a teddy bear cost £20, how many hours did it take to make?

    (d) What is the constant rate of change of the price of the teddy bear in relation to the time taken?

2) A car moves a distance of $30m$ in 5 seconds. What was the average rate of change of the distance of the car in relation to the time taken?

3)   **(a)** A horizontal tangent line indicates what kind of rate of change? Select the correct one:

    A Positive rate of change
    A Negative rate of change
    A rate of change of zero
    Undefined

    (b) A vertical tangent line indicates what kind of rate of change? Select the correct one:

    A Positive rate of change
    A Negative rate of change
    A rate of change of zero
    Undefined

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Rates of Change - Exam Questions

1)   Use the graph $y = f(x)$ to answer the following questions:

$f(x)$

x

(a)   What is the instantaneous rate of change at $x = 1$?

....

(2)
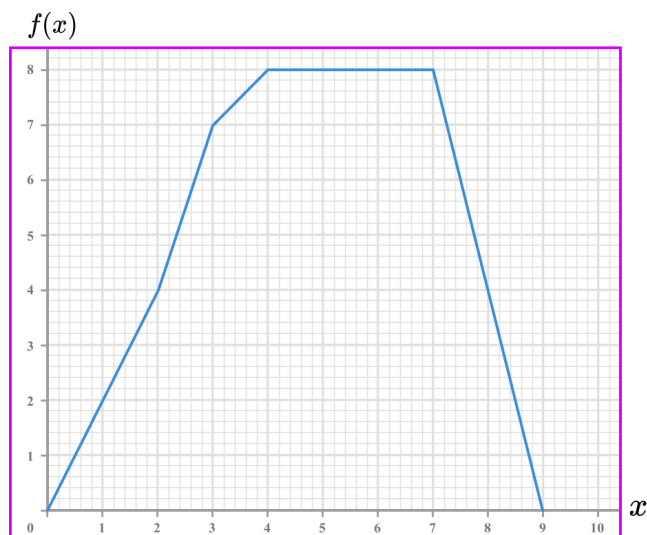
(b)   What is the instantaneous rate of change at $x = 3.5$?

....

(2)

(c)   What is the instantaneous rate of change at $x = 5$?

....

(2)

(d)   What is the instantaneous rate of change at $x = 8$?

....

(2)

(e)   What is the average rate of change between $x = 2$ and $x = 7$?

....

(2)

(f)   Between what values of x does the function have a rate of change of 0?

....

(1)

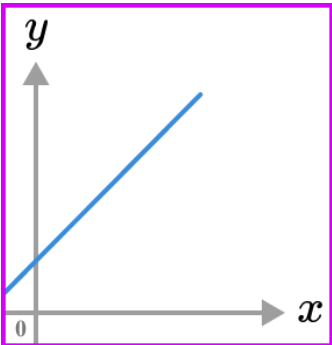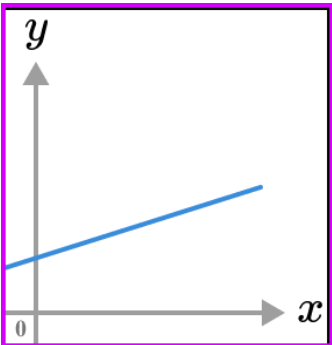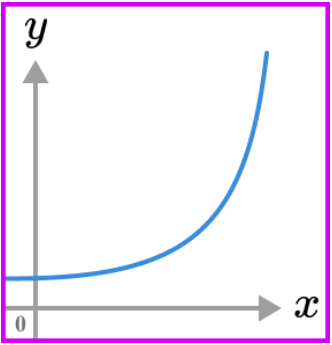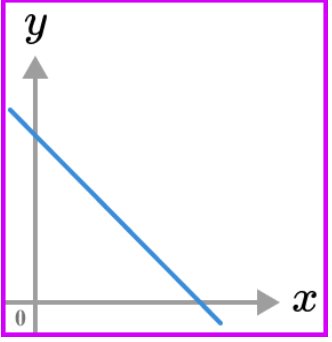**(11 marks)**

Rates of Change - Exam Questions

2)   Use the graph $y = f(x)$ to answer the following questions:
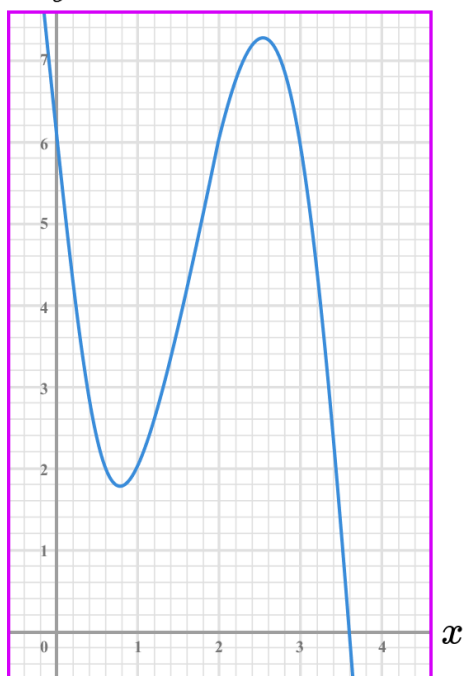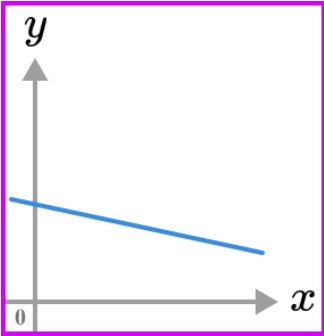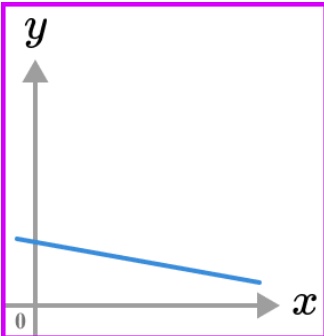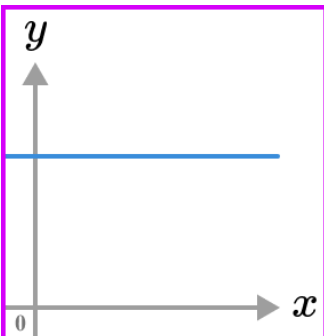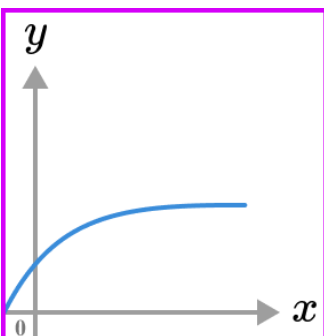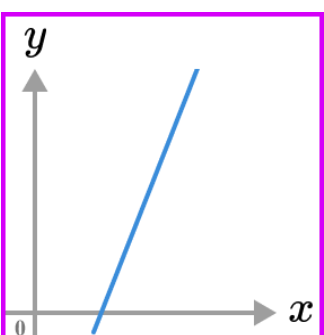
(a)   What is the instantaneous rate of change at $x = 1$?

....
   (2)

(b)   What is the instantaneous rate of change at $x = 3$?

....
   (2)

(c)   At how many points does the function have a rate of change of zero?

....
   (1)

(d)   At what points does the function have a rate of change of zero?

....
   (3)

(e)   What is the average rate of change between $x = 0$ and 1?

....
   (2)

(f)   State the range of values for x where the graph has a negative rate of change.

....
   (2)
   (12 marks)

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Rates of Change - Answers

	Question	Answer
	Skill Questions	
Group A	Look at each of the graphs below. State whether the rate of change is positive, negative or zero **1)**	**1)** Positive
	2)	**2)** Positive
	3)	**3)** Positive
	4)	**4)** Negative

Rates of Change - Answers

5)

5) Negative

6)

6) Negative

7)

7) Zero

8)

8) Positive

9)

9) Positive

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Rates of Change - Answers

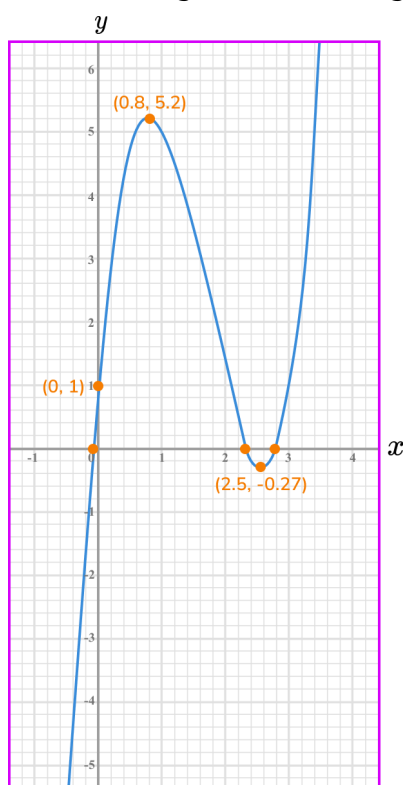| Group B	Use the below graph to calculate the rate of change at the points in each question.	
	1) $x = 1$	**1)** 2 - instantaneous
	2) $x = 1.5$	**2)** 2 - instantaneous
	3) $x = 0.5$	**3)** 2- instantaneous
	4) $x = 2.5$	**4)** 1 - instantaneous
	5) $x = 5$	**5)** -1 - instantaneous
	6) $x = 2.2$	**6)** 1 - instantaneous
	7) Between $x = 0$ and 2	**7)** 2 - average
	8) Between $x = 4$ and 6	**8)** -1 - average
	9) Between $x = 0$ and 6	**9)** $\frac{2}{3}$ - average

Rates of Change - Answers

Group C	Use the below graph to calculate the rate of change at the points in each question. *Some coordinates are noted for you on the graph.* Also state whether each is a calculator of an instantaneous rate of change or an average rate of change.	
	1) $x = 3$	**1)** 5 - instantaneous $\pm\ 0.5$
	2) $x = 2$	**2)** $-\ 4.5$ - instantaneous $\pm\ 0.5$
	3) $x = 1$	**3)** $-\ 1.5$ - instantaneous $\pm\ 0.5$
	4) $x = 2.5$	**4)** 0 - instantaneous
	5) $x = 0.8$	**5)** 0 - instantaneous
	6) $x = 0$	**6)** 14 - instantaneous $\pm\ 0.5$
	7) Between $x\ = 0$ and 0.8	**7)** 6.5 - average $\pm\ 0.5$
	8) Between $x\ = 1$ and 2.8	**8)** 2.8 - average $\pm\ 0.5$

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Rates of Change - Answers

	Question	Answer
	Applied Questions	
1)	A company makes teddy bears. The retail price (£P) of the teddy bear relates directly to the amount of time (t hours) it takes to make one. The linear function of this is defined as $P = 10t$.	
a)	Which is the dependent variable? Select the correct one: The Retail Price of the Teddy Bear The Amount of Time it takes to make one	**a)** The Retail Price of the Teddy Bear
b)	If a teddy bear takes 3 hours to make, how much does it cost?	**b)** £30
c)	If a teddy bear cost £20, how many hours did it take to make?	**c)** 2 hours
d)	What is the constant rate of change of the price of the teddy bear in relation to the time taken?	**d)** 10
2)	A car moves a distance of $30m$ in 5 seconds. What was the average rate of change of the distance of the car in relation to the time taken?	$6m/s$
3) **a)**	A horizontal tangent line indicates what kind of rate of change? Select the correct one: A Positive rate of change A Negative rate of change A rate of change of zero Undefined	**a)** A Rate of Change of Zero
b)	A vertical tangent line indicates what kind of rate of change? Select the correct one: A Positive rate of change A Negative rate of change A rate of change of zero Undefined	**b)** Undefined

Rates of Change - Mark Scheme

	Question	Answer	
	Exam Questions		
1)	Use the graph $y = f(x)$ to answer the following questions:		
(a)	What is the instantaneous rate of change at $x = 1$?	**(a)** Attempt to calculate the gradient at the point $x = 1$ 2	**(1)** **(1)**
(b)	What is the instantaneous rate of change at $x = 3.5$?	**(b)** Attempt to calculate the gradient at the point $x = 3.5$ 1	**(1)** **(1)**
(c)	What is the instantaneous rate of change at $x = 5$?	**(c)** Attempt to calculate the gradient at the point $x = 5$ 0	**(1)** **(1)**
(d)	What is the instantaneous rate of change at $x = 8$	**(d)** Attempt to calculate the gradient at the point $x = 8$ -4	**(1)** **(1)**
(e)	What is the average rate of change between $x = 2$ and $x = 7$?	**(e)** Attempt to calculate the gradient between he points $(2, 4)$ and $(7, 8)$ 0.8	**(1)** **(1)**
(f)	Between what values of x does the function have a rate of change of 0?	**(f)** $4 < x < 7$ *Accept "between 4 and 7"*	**(1)**

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Rates of Change - Mark Scheme

2)	Use the graph $y = f(x)$ to answer the following questions:			
(a)	What is the instantaneous rate of change at $x = 1$?	**(a)**	Attempt to calculate the gradient at the point $x = 1$ by drawing a tangent 1.7 ± 0.5	**(1)** **(1)**
(b)	What is the instantaneous rate of change at $x = 3$?	**(b)**	Attempt to calculate the gradient at the point by drawing a tangent at $x = 3$ -5 ± 1	**(1)** **(1)**
(c)	At how many points does the function have a rate of change of zero?	**(c)**	2	**(1)**
(d)	At what points does the function have a rate of change of zero?	**(d)**	$(x, 1.8)$ **or** $(0.8, y)$ **or** $(x, 7.3)$ **or** $(2.5, y)$ $(0.8, 1.8)$ **or** $(2.5, 7.3)$ $(0.8, 1.8)$ **and** $(2.5, 7.3)$ *Accept any value of x or y within the range ± 0.2*	**(1)** **(1)** **(1)**
(e)	What is the average rate of change between x=0 and 1	**(e)**	Attempt to calculate the gradient between the points $(0, 6)$ and $(1, 2)$ -4	**(1)** **(1)**
(f)	State the range of values for x where the graph has a negative rate of change.	**(f)**	$x < 0.8$ $x > 2.5$	**(1)** **(1)**