HIGHER ONLY

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Name ..... Class .....

R15: Average and instantaneous rates

Solve problems using gradients of chords and tangents

20 marks · 25 minutes · Calculator allowed

1) An object's distance is $d = t^2 + 3t$ metres. Find its average speed between $t = 1$ and $t = 3$. Use a chord from $t = 1.9$ to $t = 2.1$ to estimate its speed at $t = 2$

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[Question 1: 5 marks]

2) A population is $P = 200 \times 1.5^t$ after t hours. Find the average rate of growth between $t = 2$ and $t = 4$

..... per hour

[Question 2: 3 marks]

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3) A drink's temperature is $T = 20 + 60 \times 0.5^t$ after t hours. Find the average rate of change of temperature in the first 2 hours.

..... °C per hour

[Question 3: 3 marks]

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4) Velocity is $v = 3t^2$. Use a chord from $t = 2$ to $t = 2.1$ to estimate the acceleration at $t = 2$

..... m/s^2

[Question 4: 3 marks]

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5) For $y = x^3$, is the average rate of change greater from $x = 1$ to $x = 2$ or from $x = 2$ to $x = 3$? Show your working.

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[Question 5: 3 marks]

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6) The depth of water is $h = 2\sqrt{t}$ cm after t minutes. Compare the average rates of increase in the first 4 minutes and in the next 5 minutes.

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[Question 6: 3 marks]

End of paper – 20 marks in total

Answers and brief mark scheme

Q	Answer	Method / notes
1	7; about 7	$d(1) = 4$, $d(3) = 18$ (P1); 7 (A1); $d(2.1) = 10.71$, $d(1.9) = 9.31$ (P1, P1); 7 (A1).
2	281.25	$P(2) = 450$, $P(4) = 1012.5$ (P1, P1); A1.
3	-22.5	$T(0) = 80$, $T(2) = 35$ (P1, P1); A1.
4	12.3	$v(2.1) = 13.23$ (P1, P1); A1.
5	2 to 3	Rates 7 and 19 (P1, P1); A1.
6	1 and 0.4 cm/min	$\frac{4}{4}$ (P1); $\frac{6-4}{5}$ (P1); first is faster (A1).