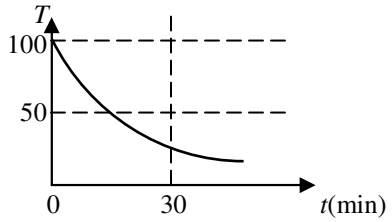
= Year 12 **= Calculus** **= Worksheet 5**

1. The position x (in metres) of a particle moving in a straight line is given by $x = t^2 - 8t + 18$ at time t (in seconds). Find the (i) average velocity, i.e. average rate of change of x with respect to t over the interval $[4,5]$ and (ii) instantaneous velocity, i.e. instantaneous rate of change of x with respect to t, at $t = 5$.	2. The graph shows the temperature T (in °C) of boiling water decreases when the burner is turned off at $t = 0$. Estimate (i) the average rate of change in temperature in the first 30 minutes and (ii) the rate of change in temperature at $t = 30$ min. 
3. The volume V (in litres) of water remaining in a tank after draining for t minutes is given by $V(t) = 50000\left(1 - \frac{t}{60}\right)^2$. Find the rate at which the water is draining after 30 min.	4. A 4-metre ladder leans against a vertical wall. If the bottom of the ladder slides away from the wall at 0.3 ms^{-1}, find the speed of the top of the ladder sliding down the wall when the bottom of the ladder is 2 m from the wall.
5. Refer to the ladder in Q4. The sliding ladder makes an angle θ with the vertical wall at time t. Find the rate of increase of θ (in $°s^{-1}$) when the bottom of the ladder is 2 m from the wall.	6. A spherical balloon is inflated at 80 cm^3s^{-1}. How fast is the radius r (in cm) increasing when $r = 20$?
7. Refer to the balloon in Q6. How fast is the surface area A (in cm^2) increasing when $r = 20$?	8. Two cars move away from the intersection of two perpendicular straight roads. Car A travels at 60 kmh^{-1} and car B at 80 kmh^{-1}. If both cars are at the intersection initially, at what rate are they moving apart after 6 min?
9. Refer to the two cars in Q8. At what rate are the two cars moving apart after 6 min if initially car B is at the intersection and car A is 3 km from the intersection?	10. Refer to the two cars in Q8. If both cars are at the intersection initially, at what rate are they moving apart when they are 2 km from each other?
11. The volume of a cube increases at 0.5 cm^3s^{-1}. How fast does the surface area increase when the length of its edge is 20 cm?	Numerical, algebraic and worded answers. 1. (i) 9 ms^{-1} (ii) 2 ms^{-1} 2. (i) –2.5 °Cmin^{-1} (ii) –0.9 °Cmin^{-1} 3. 833.3 Lmin^{-1} 4. 0.1732 ms^{-1} 5. 4.96 $°s^{-1}$ 6. 0.016 cms^{-1} 7. 8 cm^2s^{-1} 8. 100 kmh^{-1} 9. 98 kmh^{-1} 10. 100 kmh^{-1} 11. 0.1 cm^2s^{-1}