## Differentiation \& Functions (Q 6, 7 \& 8, Paper 1)

## 2005

6 (a) Let $g(x)=\frac{x+5}{2}, x \in \mathbf{R}$.
Find $g(0)+g(2)$.
(b) Differentiate $3 x-x^{2}$ with respect to $x$ from first principles.
(c) Let $f(x)=x^{2}+p x+10, x \in \mathbf{R}$, where $p \in \mathbf{Z}$.
(i) Find $f^{\prime}(x)$, the derivative of $f(x)$.
(ii) The minimum value of $f(x)$ is at $x=3$. Find the value of $p$.
(iii) Find the equation of the tangent to $f(x)$ at the point $(0,10)$.

7 (a) Differentiate $9+3 x-5 x^{2}$ with respect to $x$.
(b) (i) Differentiate $\left(3 x^{2}-2\right)\left(x^{2}+4\right)$ with respect to $x$.
(ii) Given that $y=\frac{x^{2}}{x-1}$, find $\frac{d y}{d x}$ when $x=3$.
(c) A car begins to slow down at $p$ in order to stop at a red traffic light at $q$.


The distance of the car from $p$, after $t$ seconds, is given by

$$
s=12 t-\frac{3}{2} t^{2}
$$

where $s$ is in metres.
(i) Find the speed of the car as it passes $p$.
(ii) Find the time taken to stop.
(iii) The car stops exactly at $q$. Find the distance from $p$ to $q$.

## Answers

6 (a) 6
(b) $3-2 x$
(c) $2 x+p$
(ii) $p=-6$
(iii) $6 x+y-10=0$

7 (a) $3-10 x$
(b) (i) $12 x^{3}+20 x \quad$ (ii) $\frac{3}{4}$
(c) (i) $12 \mathrm{~ms}^{-1}$
(ii) 4 s
(iii) 24 m

8 Let $f(x)=\frac{1}{x-1}, x \in \mathbf{R}, x \neq 1$.
(i) Find $f(-3), f(-1.5), f(0.5), f(1.5), f(5)$.
(ii) Draw the graph of the function $f$ from $x=-3$ to $x=5$.
(iii) On the same diagram, draw the graph of the function

$$
g(x)=x+1
$$

in the domain $-2 \leq x \leq 2, x \in \mathbf{R}$.
(iv) Use your graphs to estimate the values of $x$ for which $f(x)=g(x)$.
(v) Find, using algebra, the values of $x$ for which $f(x)=g(x)$.

## Answers

8 (i) $-0.25,-0.4,-2,2,0.25$
(iv) $\pm 1.4$
(v) $\pm \sqrt{2}$

