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

2002
6 (a) Let $f(x)=\frac{1}{3}(x-8)$ for $x \in \mathbf{R}$.
Evaluate $f(5)$.
(b) (i) Find $\frac{d y}{d x}$ where $y=(x-1)^{7}$ and evaluate your answer at $x=2$.
(ii) Find $\frac{d y}{d x}$ where $y=\left(x^{3}-3\right)\left(x^{2}-4\right)$ and simplify your answer.
(c) Let $f(x)=x^{3}-a x+7$ for all $x \in \mathbf{R}$ and for $a \in \mathbf{R}$.
(i) The slope of the tangent to the curve $y=f(x)$ at $x=1$ is -9 .

Find the value of $a$.
(ii) Hence, find the co-ordinates of the local maximum point and the local minimum point on the curve $y=f(x)$.

7 (a) Differentiate $7 x^{3}-3 x^{2}+9 x$ with respect to $x$.
(b) (i) Differentiate $x^{5}-17+\frac{1}{x^{5}}$ with respect to $x$.
(ii) Differentiate $\frac{2 x}{x-1}$ with respect to $x$ and simplify your answer.
(c) A marble rolls along the top of a table. It starts to move at $t=0$ seconds.

The distance that it has travelled at $t$ seconds is given by

$$
s=14 t-t^{2}
$$

where $s$ is in centimetres.
(i) What distance has the marble travelled when $t=2$ seconds?
(ii) What is the speed of the marble when $t=5$ seconds?
(iii) When is the speed of the marble equal to zero?
(iv) What is the acceleration of the marble?

## Answers

6 (a) -1
(b) (i) $7(x-1)^{6} ; 7$
(ii) $5 x^{4}-12 x^{2}-6 x$
(c) (i) 12
(ii) $(2,-9),(-2,23)$

7 (a) $21 x^{2}-6 x+9$
(b) (i) $5 x^{4}-\frac{5}{x^{6}}$
(ii) $-\frac{2}{(x-1)^{2}}$
(c) (i) 24 cm
(ii) $4 \mathrm{~cm} \mathrm{~s}^{-1}$
(iii) $7 \mathrm{~s} \quad$ (iv) $-2 \mathrm{cms}^{-2}$

8 Let $f(x)=\frac{1}{x+2}$.
(i) Find $f(-6), f(-3), f(-1), f(0)$ and $f(2)$.
(ii) For what real value of $x$ is $f(x)$ not defined?
(iii) Draw the graph of $f(x)=\frac{1}{x+2}$ for $-6 \leq x \leq 2$.
(iv) Find $f^{\prime}(x)$, the derivative of $f(x)$.
(v) Find the two values of $x$ at which the slope of the tangent to the graph is $-\frac{1}{9}$.
(vi) Show that there is no tangent to the graph of $f$ that is parallel to the $x$-axis.
Answers
8 (i) $-0.25,-1,1,0.5,0.25$
(ii) $x=-2$
(iv) $-\frac{1}{(x+2)^{2}}$
(v) $x=-5,1$

