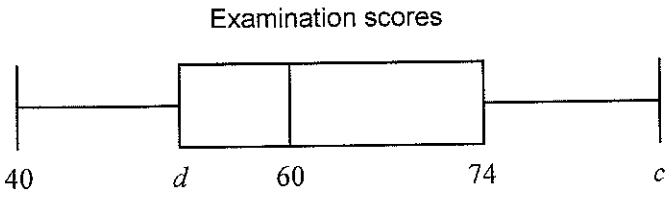
Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. You are therefore advised to show all working.

Section A

Answer **all** questions in the boxes provided. Working may be continued below the lines if necessary.

1. [Maximum mark: 5]

The following box-and-whisker plot represents the examination scores of a group of students.



(a) Write down the median score. [1]

The range of the scores is 47 marks, and the interquartile range is 22 marks.

(b) Find the value of

(i) c;

(ii) d. [4]

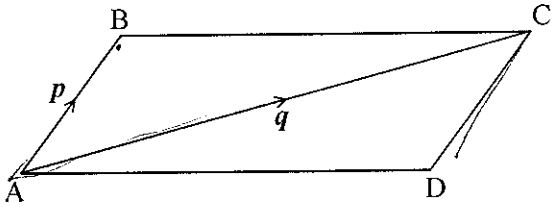
a) 60

bi) 87

bii) 52

2. [Maximum mark: 7]

The following diagram shows the parallelogram ABCD.



Let $\vec{AB} = p$ and $\vec{AC} = q$. Find each of the following vectors in terms of p and/or q.

(a) $\vec{CB}$ [2]

(b) $\vec{CD}$ [2]

(c) $\vec{DB}$ [3]

a) $-q+p$

b) $q-p$

c) $2p-q$

3. [Maximum mark: 6]

Let $f'(x) = 6x^2 - 5$. Given that $f(2) = -3$, find $f(x)$.

$\int 6x^2 - 5 \, dx = 2x^3 - 5x + C$

$-3 = 2(2)^3 - 5(2) + C$

$-3 = 16 - 10 + C$

$-3 = 6 + C$

$-9 = C$

$f(x) = 2x^3 - 5x - 9$

5. [Maximum mark: 6]

Let $f(x) = (x-5)^3$, for $x \in \mathbb{R}$.

(a) Find $f^{-1}(x)$. [3]

(b) Let g be a function so that $(f \circ g)(x) = 8x^6$. Find $g(x)$. [3]

$\sqrt[3]{x} = \sqrt[3]{(y-5)^3}$

$\sqrt[3]{x} = y - 5$

$5 + \sqrt[3]{x} = y$

$f^{-1}(x) = 5 + \sqrt[3]{x}$

$f(x) = (x-5)^3$

$g(x) = (2x^2 + 5)$

4. [Maximum mark: 7]

Let $f(x) = 3\sin(\pi x)$.

(a) Write down the amplitude of f. [1]

(b) Find the period of f. [2]

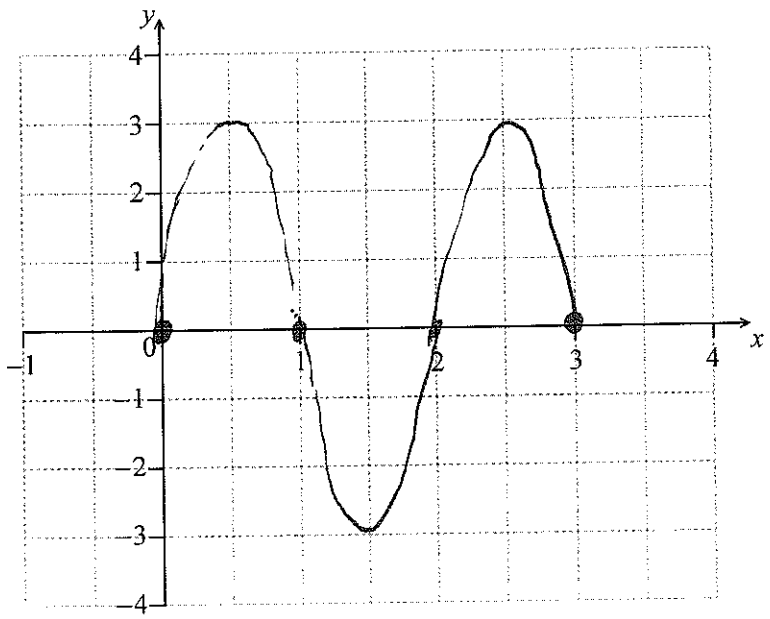
4a) 3

b) 2

$f(1) = 3\sin(\pi 1)$
$= 3\sin\pi$
$= 0$

$f(0) = 3\sin(\pi 0)$
$= 3\sin 0$
$= 0$

(c) On the following grid, sketch the graph of $y = f(x)$, for $0 \le x \le 3$. [4]



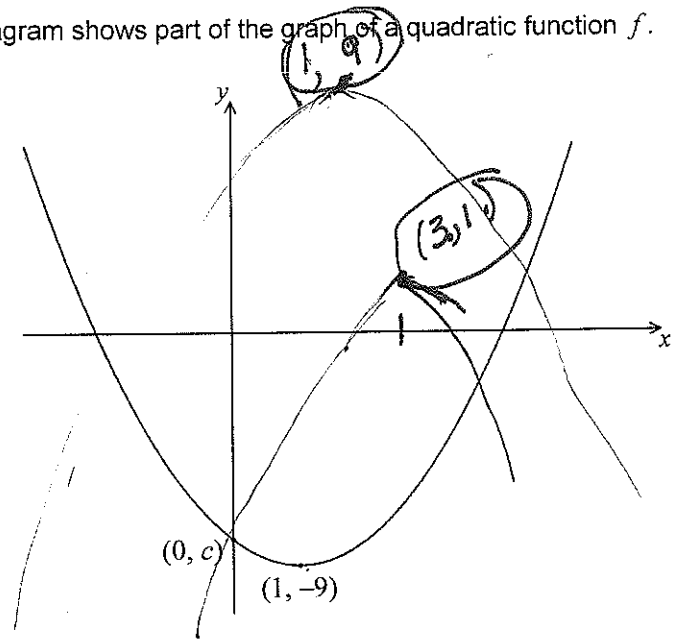
Do **not** write solutions on this page.

Section B

Answer **all** questions in the answer booklet provided. Please start each question on a new page.

8. [Maximum mark: 16]

The following diagram shows part of the graph of a quadratic function f.



The vertex is at $(1, -9)$, and the graph crosses the y-axis at the point $(0, c)$.

The function can be written in the form $f(x) = (x-h)^2 + k$.

(a) Write down the value of h and of k. [2]

(b) Find the value of c. [2]

Let $g(x) = -(x-3)^2 + 1$. The graph of g is obtained by a reflection of the graph of f in the x-axis, followed by a translation of $\begin{pmatrix} p \\ q \end{pmatrix}$.

(c) Find the value of p and of q. [5]

(d) Find the x-coordinates of the points of intersection of the graphs of f and g. [7]

Do **not** write solutions on this page.

9. [Maximum mark: 15]

A line L_1 passes through the points $A(0, -3, 1)$ and $B(-2, 5, 3)$.

(a) (i) Show that $\vec{AB} = \begin{pmatrix} -2 \\ 8 \\ 2 \end{pmatrix}$.

(ii) Write down a vector equation for L_1. [3]

A line L_2 has equation $\boldsymbol{r} = \begin{pmatrix} -1 \\ 7 \\ -4 \end{pmatrix} + s\begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix}$. The lines L_1 and L_2 intersect at a point C.

(b) Show that the coordinates of C are $(-1, 1, 2)$. [5]

(c) A point D lies on line L_2 so that $\left|\vec{CD}\right| = \sqrt{18}$ and $\vec{CA} \cdot \vec{CD} = -9$. Find $A\hat{C}D$. [7]

See next page

$(3x+1)^n$ 135n

$\begin{pmatrix} -1 \\ 1 \\ 2 \end{pmatrix} = C$ $\begin{pmatrix} -1+0s \\ 7+s \\ -4-s \end{pmatrix} = D$

$\overrightarrow{CD}$ $\begin{pmatrix} 0 \\ 6+s \\ -6-s \end{pmatrix}$ $\begin{pmatrix} 0 \\ -3 \\ 3 \end{pmatrix}$

$(6+s)^2 + (-6-s)^2 = 18$

$36+12s+s^2+36+12s+s^2 = 18$

$2s^2+24s+72 = 18$

$s^2+12s+36 = 9$

$s^2+12s+27 = 0$

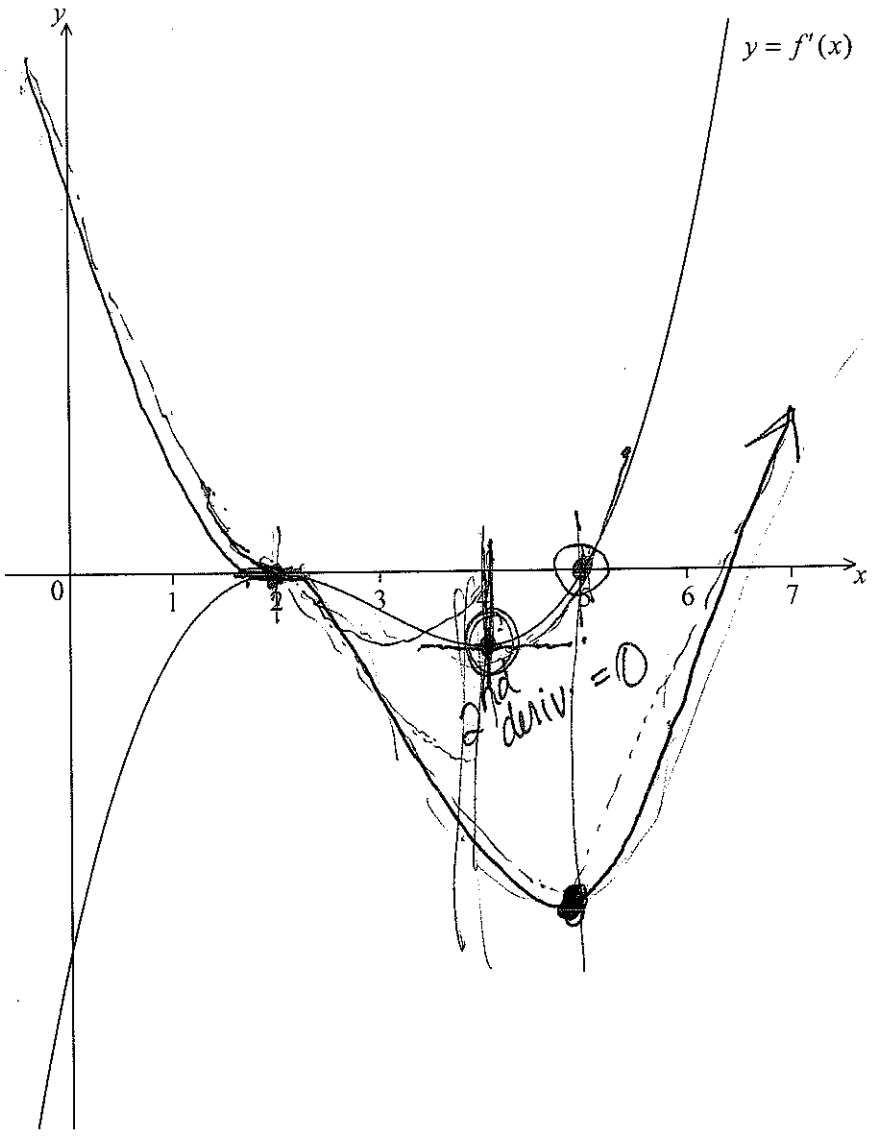
$(s+9)(s+3)$

$-9 \quad -3$

Do **not** write solutions on this page.

10. [Maximum mark: 15]

Let $y = f(x)$, for $-0.5 \le x \le 6.5$. The following diagram shows the graph of f', the derivative of f.



The graph of f' has a local maximum when $x = 2$, a local minimum when $x = 4$, and it crosses the x-axis at the point $(5, 0)$.

(a) Explain why the graph of f has a local minimum when $x = 5$. b/c $f' = 0$ at $x = 5$ [2]

(b) Find the set of values of x for which the graph of f is concave down. [2]

2 to 4

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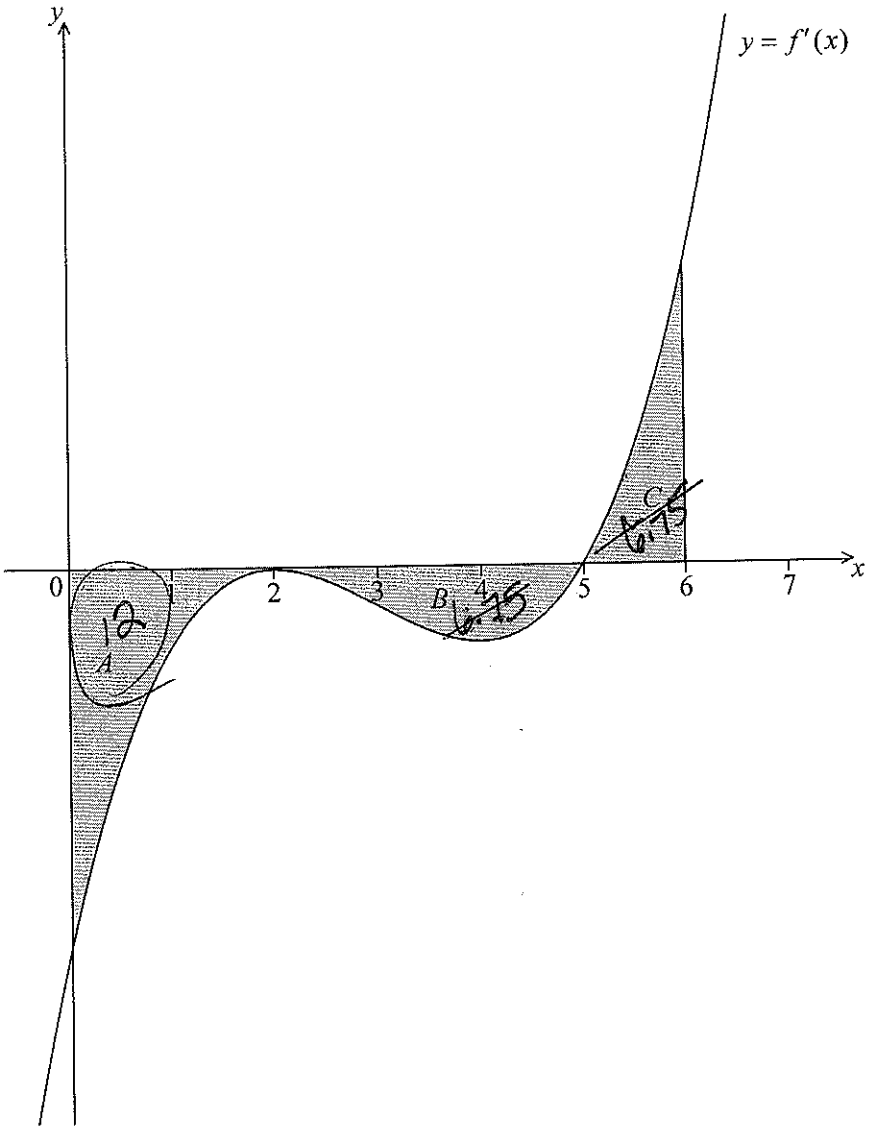
(Question 10 continued)

The following diagram shows the shaded regions A, B and C.



The regions are enclosed by the graph of f', the x-axis, the y-axis, and the line $x = 6$. The area of region A is 12, the area of region B is 6.75 and the area of region C is 6.75.

(c) Given that $f(0) = 14$, find $f(6)$. [5]

(d) Let $g(x) = (f(x))^2$. Given that $f'(6) = 16$, find the equation of the tangent to the graph of g at the point where $x = 6$. [6]

$g(x) = (f(x))^2$ $\quad f'(6) = 16$ $\quad x = 6$

$m = 16$ @ 6 $\quad (f(6))^2 = 4$

$g'(x) = 2f(x)f'(x)$

$2(2)(16) = \boxed{64}$

$m = 64$

$y - 4 = 64(x - 6)$

$\boxed{y = 64x - 380 \ (?)}$

Need to check IB mark scheme