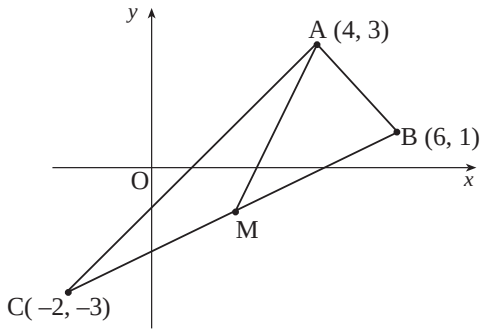
A triangle ABC has vertices A(4, 3), B(6, 1) and C(–2, –3) as shown in the diagram. Find the equation of AM, the median from A.



3

part	marks	Unit	non-calc		calc		calc neut		Content Reference :		**1.1**
			C	A/B	C	A/B	C	A/B	Main	Additional	
.	3	1.1					3		1.1.6	1.1.7	Source **1998 P1 qu.1**

- •1 $M = (2, -1)$
- •2 $m_{AM} = 2$
- •3 $y - (-1) = 2(x - 2)$

Express $x^3 - 4x^2 - 7x + 10$ in its fully factorised form.

4

part	marks	Unit	non-calc		calc		calc neut		Content Reference :		**2.1**
			C	A/B	C	A/B	C	A/B	Main	Additional	
.	4	2.1	4						2.1.3		Source **1998 P1 qu.2**

- •1 evaluating $f(k)$ for any integer by any method
- •2 find 1 value of k s.t. $f(k) = 0$
  e.g. $f(1)$ *or* $f(-2)$ *or* $f(5)$
- •3 quad factor *e.g.* $x^2 - 3x - 10$
- •4 $(x - 1)(x + 2)(x - 5)$

Vectors $\boldsymbol{p}$, $\boldsymbol{q}$ and $\boldsymbol{r}$ are defined by

$$\boldsymbol{p} = \boldsymbol{i} + \boldsymbol{j} - \boldsymbol{k}, \quad \boldsymbol{q} = \boldsymbol{i} + 4\boldsymbol{k} \quad \text{and} \quad \boldsymbol{r} = 4\boldsymbol{i} - 3\boldsymbol{j}.$$

(*a*) Express $\boldsymbol{p} - \boldsymbol{q} + 2\boldsymbol{r}$ in component form. 2

(*b*) Calculate $\boldsymbol{p}.\boldsymbol{r}$ 1

(*c*) Find $|\boldsymbol{r}|$. 1

part	marks	Unit	non-calc		calc		calc neut		Content Reference :		**3.1**
			C	A/B	C	A/B	C	A/B	Main	Additional	
(a)	2	3.1					2		3.1.1		Source
(b)	1	3.1					1		3.1.9		**1998 P1 qu.3**
(c)	1	3.1					1		3.1.1		

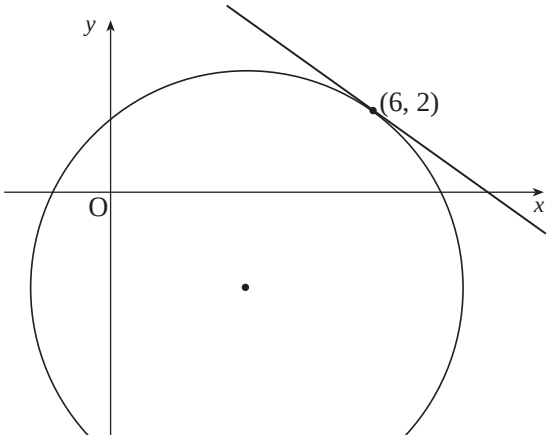
•1 $p = \begin{pmatrix} 1 \\ 1 \\ -1 \end{pmatrix}, \ q = \begin{pmatrix} 1 \\ 0 \\ 4 \end{pmatrix}, \ r = \begin{pmatrix} 4 \\ -3 \\ 0 \end{pmatrix}$ *s/i by* •2 •3 1

•2 $\begin{pmatrix} 8 \\ -5 \\ -5 \end{pmatrix}$ •4 5

The circle shown has equation

$(x-3)^2 + (y+2)^2 = 25$.

Find the equation of the tangent at the point (6, 2). 4



part	marks	Unit	non-calc		calc		calc neut		Content Reference :		**2.4**
			C	A/B	C	A/B	C	A/B	Main	Additional	
.	4	2.4					4		2.4.4		Source
											1998 P1 qu.4

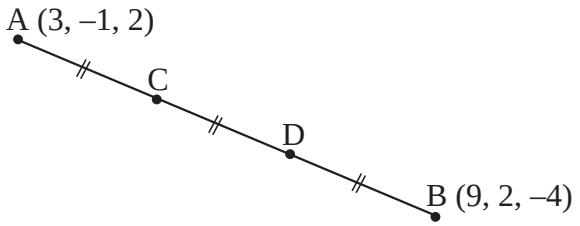
•1 Centre $= (3, -2)$

•2 $m_{rad} = \frac{4}{3}$

•3 $m_{tgt} = -\frac{3}{4}$

•4 $y - 2 = -\frac{3}{4}(x-6)$

The line AB is divided into 3 equal parts by the points C and D, as shown. A and B have coordinates (3, –1, 2) and (9, 2, –4).



(*a*) Find the components of $\overrightarrow{AB}$ and $\overrightarrow{AC}$. 2

(*b*) Find the coordinates of C and D. 2

part	marks	Unit	non-calc		calc		calc neut		Content Reference :		**3.1**
			C	A/B	C	A/B	C	A/B	Main	Additional	
(a)	2	3.1					2		3.1.1		Source
(b)	2	3.1					2		3.1.1		**1998 P1 qu.5**

•1 $\overrightarrow{AB} = \begin{pmatrix} 6 \\ 3 \\ -6 \end{pmatrix}$

•2 $\overrightarrow{AC} = \begin{pmatrix} 2 \\ 1 \\ -2 \end{pmatrix}$

•3 $C = (5, 0, 0)$

•4 $D = (7, 1, -2)$

The functions *f* and *g* are defined on a suitable domain by $f(x) = x^2 - 1$ and $g(x) = x^2 + 2$.

(*a*) Find an expression for $f(g(x))$. 2

(*b*) Factorise $f(g(x))$. 2

part	marks	Unit	non-calc		calc		calc neut		Content Reference :		**1.2**
			C	A/B	C	A/B	C	A/B	Main	Additional	
(a)	2	1.2					2		1.2.6		Source
(b)	2	1.2					1	1	0.1		**1998 P1 qu.6**

•1 $f(x^2 + 2)$

•2 $(x^2 + 2)^2 - 1$

•3 $((x^2 + 2) + 1)((x^2 + 2) - 1)$

•4 $(x^2 + 3)(x^2 + 1)$

OR

•3 $x^4 + 4x^2 + 3$

•4 $(x^2 + 3)(x^2 + 1)$

A and B are acute angles such that $\tan A = \frac{3}{4}$ and $\tan B = \frac{5}{12}$.

Find the exact value of

(*a*) $\sin 2A$ 2

(*b*) $\cos 2A$ 1

(*c*) $\sin (2A + B)$. 2

part	marks	Unit	non-calc		calc		calc neut		Content Reference :		**2.3**
			C	A/B	C	A/B	C	A/B	Main	Additional	
(a)	2	2.3	2						2.3.3		Source
(b)	1	2.3	1						2.3.3		**1998 P1 qu.7**
(c)	2	2.3	2						2.3.2		

•1 $\sin A = \frac{3}{5}$ and $\cos A = \frac{4}{5}$

•2 $\sin 2A = 2 \times \frac{3}{5} \times \frac{4}{5} = \frac{24}{25}$ (*accept* 0.96)

•3 $\cos 2A =$ *e.g.* $\left(\frac{4}{5}\right)^2 - \left(\frac{3}{5}\right)^2 = \frac{7}{25}$ (*accept* 0.28)

•4 $\sin 2A \cos B + \cos 2A \sin B$

•5 $\sin B = \frac{5}{13}$ *and* $\cos B = \frac{12}{13}$ *and* $\frac{323}{325}$

Two sequences are defined by these recurrence relations:

$u_{n+1} = 3u_n - 0.4$ with $u_0 = 1$, $\quad v_{n+1} = 0.3v_n + 4$ with $v_0 = 1$.

(*a*) Explain why only one of these sequences approaches a limit as $n \to \infty$. 1

(*b*) Find algebraically the exact value of the limit. 2

(*c*) For the other sequence, find

(i) the smallest value of n for which the n^{th} term exceeds 1000, and

(ii) the value of that term. 2

part	marks	Unit	non-calc		calc		calc neut		Content Reference :		**1.4**
			C	A/B	C	A/B	C	A/B	Main	Additional	
(a)	1	1.4			1				1.4.4		Source
(b)	2	1.4			2				1.4.5		**1998 P1 qu.8**
(c)	2	1.4				2			1.4.3		

•1 Only V_n has a limit because $-1 < 0.3 < 1$

•2 e.g. use $L = aL + b$

•3 $L = \frac{40}{7}$

•4 evaluate enough terms to exceed 1000

•5 $u_7 = 1749.8$

Solve the equation $2\sin\left(2x-\frac{\pi}{6}\right)=1, \quad 0\le x<2\pi$. 4

part	marks	Unit	non-calc C	non-calc A/B	calc C	calc A/B	calc neut C	calc neut A/B	Content Reference : Main	Additional	**2.3**
.	4	2.3	4						2.3.1	1.2.1	Source **1998 P1 qu.9**

•1 $\sin\left(2x-\frac{\pi}{6}\right)=\frac{1}{2}$

•2 $2x-\frac{\pi}{6}=\frac{\pi}{6},\frac{5\pi}{6}$ (*accept* 30, 150)

•3 $x=\frac{\pi}{6},\ \frac{\pi}{2}$

•4 $x=\frac{7\pi}{6},\ \frac{3\pi}{2}$

Alternative for 2nd and 3rd marks

•2 $2x-\frac{\pi}{6}=\frac{\pi}{6},\quad x=\frac{\pi}{6}$

•3 $2x-\frac{\pi}{6}=\frac{5\pi}{6},\ x=\frac{\pi}{2}$

A curve, for which $\frac{dy}{dx}=6x^2-2x$, passes through the point (–1, 2).

Express y in terms of x. 3

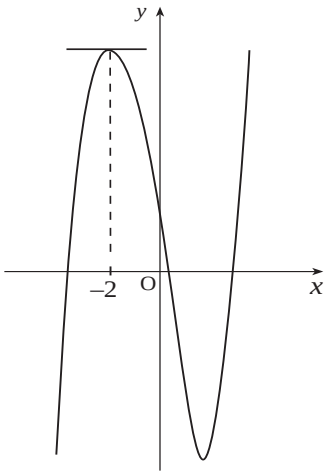
part	marks	Unit	non-calc C	non-calc A/B	calc C	calc A/B	calc neut C	calc neut A/B	Content Reference : Main	Additional	**2.2**
.	3	2.2	3						2.2.8		Source **1998 P1 qu.10**

•1 $y=2x^3-x^2$

•2 $y=2x^3-x^2+k$ and substituting

•3 $k=5$

The diagram shows a sketch of the curve $y = x^3 + kx^2 - 8x + 3$. The tangent to the curve at $x = -2$ is parallel to the x-axis.
Find the value of k.



4

part	marks	Unit	non-calc		calc		calc neut		Content Reference : Main	Additional	1.3
			C	A/B	C	A/B	C	A/B			
.	4	1.3	4						1.3.4	1.3.7	Source **1998 P1 qu.11**

- •1 $\frac{dy}{dx} = \ldots\ldots$
- •2 $3x^2 + 2kx - 8$
- •3 $3x^2 + 2kx - 8 = 0$ when $x = -2$
- •4 $k = 1$

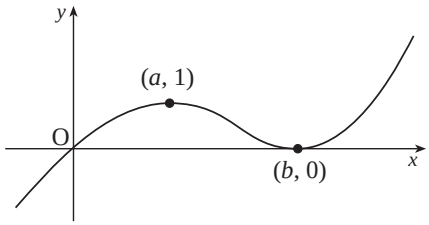
Evaluate $\int_1^2 \left(x^2 + \frac{1}{x}\right)^2 \, dx$.

5

part	marks	Unit	non-calc		calc		calc neut		Content Reference : Main	Additional	2.2
			C	A/B	C	A/B	C	A/B			
.	5	2.2	5						2.2.4		Source **1998 P1 qu.12**

- •1 know to expand brackets
- •2 $x^4 + 2x + x^{-2}$
- •3 $\frac{1}{5}x^5 + x^2$
- •4 $-\frac{1}{x}$
- •5 $9\frac{7}{10}$

A sketch of the graph of the cubic function f is shown. It passes through the origin, has a maximum turning point at $(a, 1)$ and a minimum turning point at $(b, 0)$.



(*a*) Make a copy of this diagram and on it sketch the graph of $y = 2 - f(x)$, indicating the coordinates of the turning points. 3

(*b*) On a separate diagram sketch the graph of $y = f'(x)$. 2

(*c*) The tangent to $y = f(x)$ at the origin has equation $y = \frac{1}{2}x$. Use this information to write down the coordinates of a point on the graph of $y = f'(x)$. 1

part	marks	Unit	non-calc C	non-calc A/B	calc C	calc A/B	calc neut C	calc neut A/B	Content Reference : Main	Additional	**1.2**
(a)	3	1.2					3		1.2.4		Source
(b)	2	1.2						2	1.2.4		**1998 P1 qu.13**
(c)	1	1.2						1	1.3.8		

- •1 clear evidence of reflection in $y = 0$
- •2 clear evidence of translation $\begin{pmatrix} 0 \\ 2 \end{pmatrix}$ subsequent to a reflection
- •3 indication of passing through $(a, 1)$ **and** $(b, 2)$
- •4 roots at $x = a$ and $x = b$
- •5 parabolic shape with min. turning point between the roots and no other turning points
- •6 $\left(0, \frac{1}{2}\right)$

Differentiate $2\sqrt{x}(x+2)$ with respect to x. 4

part	marks	Unit	non-calc C	non-calc A/B	calc C	calc A/B	calc neut C	calc neut A/B	Content Reference : Main	Additional	**1.3**
.	4	1.3	4						1.3.4		Source
											1998 P1 qu.14

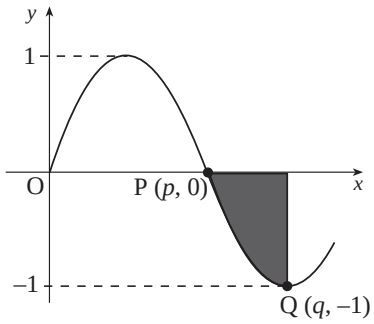
- •1 know to expand
- •2 $2x^{\frac{3}{2}} + 4x^{\frac{1}{2}}$
- •3 $3x^{\frac{1}{2}}$
- •4 $2x^{-\frac{1}{2}}$

A sketch of part of the graph of $y = \sin 2x$ is shown in the diagram.

The points P and Q have coordinates $(p, 0)$ and $(q, -1)$.

(*a*) Write down the values of p and q. 1

(***b***) Find the area of the shaded region. 4



part	marks	Unit	non-calc		calc		calc neut		Content Reference :		**3.2**
			C	A/B	C	A/B	C	A/B	Main	Additional	
(a)	1	1.2	1						1.2.3		Source
(b)	4	3.2	1	3					2.2.6	**3.2.1**	**1998 P1 qu.15**

•1 $p = \frac{\pi}{2}$ and $q = \frac{3\pi}{4}$

•2 $\int_{\frac{\pi}{2}}^{\frac{3\pi}{4}} (\sin 2x)\ dx$

•3 $-\frac{1}{2}\cos 2x$

•4 $-\frac{1}{2}$

•5 deal with $-$ ve correctly giving $\frac{1}{2}$

Given $f(x) = (\sin x + 1)^2$, find the exact value of $f'\left(\frac{\pi}{6}\right)$. 3

part	marks	Unit	non-calc		calc		calc neut		Content Reference :		**3.2**
			C	A/B	C	A/B	C	A/B	Main	Additional	
.	3	3.2		3					3.2.1	3.2.2	Source
											1998 P1 qu.16

•1 $2(\sin x + 1)$

•2 $\times \cos x$

•3 $\frac{3\sqrt{3}}{2}$

Alternative

•1 expand and differentiate $2\sin x + 1$

•2 differentiate $\sin^2 x$

•3 $\frac{3\sqrt{3}}{2}$

A ball is thrown vertically upwards.

After t seconds its height is h metres, where $h = 1.2 + 19.6t - 4.9t^2$.

(*a*) Find the speed of the ball after 1 second. 3

(*b*) For how many seconds is the ball travelling upwards? 2

part	marks	Unit	non-calc		calc		calc neut		Content Reference :		**1.3**
			C	A/B	C	A/B	C	A/B	Main	Additional	
(a)	3	1.3					1	2	1.3.5	1.3.6	Source
(b)	2	1.3						2	1.3.5	1.3.6	**1998 P1 qu.17**

•^{1} $\frac{dh}{dt} = \ldots\ldots$

•^{2} $19.6 - 9.8t$

•^{3} 9.8

•^{4} $\frac{dh}{dt} = 0$

•^{5} $t = 2$

Alternative

•^{4} $h(t)$ is a parabola which is **symmetric** about its **maximum**

•^{5} (*e.g.*) $h(1) = 15{\cdot}9,\ h(2) = 20.8,\ h(3) = 15{\cdot}9$ ***so*** $t = 2$

(*a*) Write the equation $\cos 2\theta + 8\cos\theta + 9 = 0$ in terms of $\cos\theta$ and show that, for $\cos\theta$, it has equal roots. 3

(*b*) Show that there are no real real roots for θ. 1

part	marks	Unit	non-calc		calc		calc neut		Content Reference :		**2.3**
			C	A/B	C	A/B	C	A/B	Main	Additional	
(a)	3	2.3					1	2	2.3.3	2.1.6	Source
(b)	1	1.2						1	1.2.1		**1998 P1 qu.18**

•^{1} $2\cos^2\theta - 1 + 8\cos\theta + 9$

•^{2} $2(\cos\theta + 2)^2 = 0$

or $\text{“}b^2 - 4ac\text{”} = 16 - 4 \times 1 \times 4$

•^{3} $\cos\theta = -2$ twice or $\text{“}b^2 - 4ac\text{”} = 0$

•^{4} $\cos\theta = -2$ has no solution

Given $x = \log_5 3 + \log_5 4$, find algebraically the value of x. 4

part	marks	Unit	non-calc		calc		calc neut		Content Reference :		**3.3**
			C	A/B	C	A/B	C	A/B	Main	Additional	
.	4	3.3	1	3					3.3.3	3.3.1, 3.3.4	Source **1998 P1 qu.19**

- •1 $x = \log_5 12$
- •2 $5^x = 12$
- •3 $\log 5^x = \log 12$
- •4 $\frac{\log_{10} 12}{\log_{10} 5}$ ***or*** $\frac{\log_e 12}{\log_e 5}$ ***or*** $\frac{\log 12}{\log 5} = 1.54$