2009 Paper 2 Solutions

Qu. 1

The primary method m.s is based on the following generic m.s.

This generic marking scheme may be used as an equivalence guide but only where a candidate does not use the primary method or any alternative method shown in detail in the marking scheme.

$\bullet^1$	ss	know to differentiate
$\bullet^2$	pd	differentiate
$\bullet^3$	ss	set derivative to zero
$\bullet^4$	pd	factorise
$\bullet^5$	pd	solve for x
$\bullet^6$	pd	evaluate y-coordinates
$\bullet^7$	ss	know to, and justify turning points
$\bullet^8$	ic	interpret result

Primary Method : Give 1 mark for each $\bullet$

$\bullet^1$ $\frac{dy}{dx} = \ldots (1 \text{ term correct})$

$\bullet^2$ $3x^2 - 6x - 9$

$\bullet^3$ $\frac{dy}{dx} = 0$

$\bullet^4$ $3(x+1)(x-3)$

	$\bullet^5$	$\bullet^6$
$\bullet^5$	$x = -1$	$x = 3$
$\bullet^6$	$y = 17$	$y = -15$

		$\bullet^7$			$\bullet^8$		
	x	…	-1	…	…	3	…
$\bullet^7$							
	$\frac{dy}{dx}$	$+$	0	$-$	$-$	0	$+$
$\bullet^8$		max			min		

Qu. 2

The primary method m.s is based on the following generic m.s.

This generic marking scheme may be used as an equivalence guide but only where a candidate does not use the primary method or any alternative method shown in detail in the marking scheme.

$\bullet^1$	ss	substitute for $g(x)$ in $f(x)$
$\bullet^2$	ic	complete
$\bullet^3$	ic	sub. and complete for $q(x)$
$\bullet^4$	ss	simplify
$\bullet^5$	pd	differentiate
$\bullet^6$	pd	solve

Primary Method : Give 1 mark for each $\bullet$

$\bullet^1$ $f(x^2 - 2)$ **s / I by $\bullet^2$**

$\bullet^2$ $3(x^2 - 2) + 1$

$\bullet^3$ $(3x+1)^2 - 2$

	$\bullet^4$	$\bullet^5$	
$\bullet^4$	$3x^2 - 5$	$9x^2 + 6x - 1$	**s / I by $\bullet^5$**
$\bullet^5$	$6x$	$18x + 6$ *or equiv.*	

$\bullet^6$ $x = -\frac{1}{2}$

Qu. 3

The primary method m.s is based on the following generic m.s.

This generic marking scheme may be used as an equivalence guide but only where a candidate does not use the primary method or any alternative method shown in detail in the marking scheme.

$\bullet^1$	ss	know and use $f(a)=0 \Leftrightarrow a$ is a root
$\bullet^2$	ic	start to find quadratic factor
$\bullet^3$	ic	complete quadratic factor
$\bullet^4$	pd	factorise fully
$\bullet^5$	ss	use log laws
$\bullet^6$	ss	know to & convert to exponential form
$\bullet^7$	ic	write cubic in standard form
$\bullet^8$	pd	solve cubic
$\bullet^9$	ic	interpret valid solution

Primary Method : Give 1 mark for each $\bullet$

$\bullet^1$	$f(1)=1+8+11-20=0$ *so* $x=1$ *is a root*	**See Note 1**
$\bullet^2$	$(x-1)(x^2\ldots\ldots)$	
$\bullet^3$	$(x^2+9x+20)$	
$\bullet^4$	$(x-1)(x+4)(x+5)$	**Stated explicitly**
$\bullet^5$	$\log_2\left((x+3)(x^2+5x-4)\right)$	**s / i by $\bullet^6$**
$\bullet^6$	$(x+3)(x^2+5x-4)=2^3$	
$\bullet^7$	$x^3+8x^2+11x-20=0$	
$\bullet^8$	$x=1$ *or* $x=-4$ *or* $x=-5$	**Stated explicitly here**
$\bullet^9$	$x=1$ *only*	

Qu. 4

The primary method m.s is based on the following generic m.s.

This generic marking scheme may be used as an equivalence g

but only where a candidate does not use the primary method or

alternative method shown in detail in the marking scheme.

$\bullet^1$	pd	substitute
$\bullet^2$	ic	find centre
$\bullet^3$	ss	use mid-point result for Q
$\bullet^4$	ss	know to, and find gradient of radi
$\bullet^5$	ic	find gradient of tangent
$\bullet^6$	ic	state equation of tangent
$\bullet^7$	ic	state radius
$\bullet^8$	ss	know how to find centre
$\bullet^9$	ic	state equation of one circle
$\bullet^{10}$	ic	state equation of the other circle

Primary Method : Give 1 mark for each $\bullet$

$\bullet^1$	$(5+1)^2+(10-2)^2=100$	
$\bullet^2$	*centre* $=(-1,2)$	
$\bullet^3$	$Q=(-7,-6)$	**(no evidence requ.)**
$\bullet^4$	$m_{rad}=\frac{8}{6}$	
$\bullet^5$	$m_{tgt}=-\frac{3}{4}$	**s / i by $\bullet^6$**
$\bullet^6$	$y-(-6)=-\frac{3}{4}(x-(-7))$	
$\bullet^7$	*radius* $=20$	**s / i by $\bullet^9$ or $\bullet^{10}$**
$\bullet^8$	*centre* $=(5,10)$	**s / i by $\bullet^9$**
$\bullet^9$	$(x-5)^2+(y-10)^2=400$	
$\bullet^{10}$	$(x+19)^2+(y+22)^2=400$	

Qu. 5

The primary method m.s is based on the following generic m.s.

This generic marking scheme may be used as an equivalence guide but only where a candidate does not use the primary method or any alternative method shown in detail in the marking scheme.

•1	ic	interprets graph
•2	ss	knows how to find intersection
•3	pd	starts to solve
•4	pd	finds x-coordinate in the 1st quadrant
•5	pd	finds x-coordinate in the 2nd quadrant
•6	pd	finds y-coordinates
•7	ss	knows how to find area
•8	ic	states limits
•9	pd	integrate
•10	pd	integrate
•11	ic	substitute limits
•12	pd	evaluate area

Primary Method : Give 1 mark for each •

- •1 $m = 3$ *and* $n = 2$
- •2 $3\cos 2x = -4\cos 2x + 3$
- •3 $\cos 2x = \frac{3}{7}$
- •4 $x = 0.6$
- •5 $x = 2.6$
- •6 $y = 1.3,\ 1.3$
- •7 $\int (-4\cos 2x + 3 - 3\cos 2x)\ dx$
- •8 $\int_{0.6}^{2.6}$
- •9 "$-7\sin 2x$"
- •10 $3x - \frac{7}{2}\sin 2x$
- •11 $(3\times 2.6 - \frac{7}{2}\sin 5.2) - (3\times 0.6 - \frac{7}{2}\sin 1.2)$
- •12 12.4

Qu. 6

The primary method m.s is based on the following generic m.s.

This generic marking scheme may be used as an equivalence guide but only where a candidate does not use the primary method or any alternative method shown in detail in the marking scheme.

•1	ic	substitute into equation
•2	pd	evaluate exponential expression
•3	ic	interpret info and substitute
•4	ss	convert expo. equ. to log. equ.
•5	pd	process

Primary Method : Give 1 mark for each •

- •1 $61e^{0.016\times 14}$
- •2 76 million *or equiv.*
- •3 $10.2 = 5.1e^{0.0043t}$
- •4 $0.0043t = \ln 2$
- •5 $t = 161.2$ years

Qu. 7

The primary method m.s is based on the following generic m.s.

This generic marking scheme may be used as an equivalence guide but only where a candidate does not use the primary method or any alternative method shown in detail in the marking scheme.

$\bullet^1$	ss	use distributive law
$\bullet^2$	ic	interpret scalar product
$\bullet^3$	pd	processing scalar product
$\bullet^4$	ic	interpret perpendicularity
$\bullet^5$	ic	interpret scalar product
$\bullet^6$	pd	complete processing
$\bullet^7$	ic	interpret vectors on a 2-D diagram
$\bullet^8$	pd	evaluate magnitude of vector sum
$\bullet^9$	ic	interpret vectors on a 2-D diagram
$\bullet^{10}$	pd	evaluate magnitude of vector difference

Primary Method : Give 1 mark for each $\bullet$

$\bullet^1$	$\boldsymbol{p}.\boldsymbol{q}+\boldsymbol{p}.\boldsymbol{r}$	**s / i by $(\bullet^2$ and $\bullet^4)$**
$\bullet^2$	$4\times 3\cos 30°$	**s / i by $\bullet^3$**
$\bullet^3$	$6\sqrt{3}$ (10.4)	
$\bullet^4$	$\boldsymbol{p}.\boldsymbol{r}=0$	**explicitly stated**
$\bullet^5$	$-\lvert\boldsymbol{r}\rvert\times 3\cos 120°$	
$\bullet^6$	$r=\frac{3}{2}$ *and* ... $\frac{9}{4}$	
$\bullet^7$	$\boldsymbol{q}+\boldsymbol{r}\equiv$ from D to the projection of A onto DC	
$\bullet^8$	$\lvert\boldsymbol{q}+\boldsymbol{r}\rvert=\frac{3\sqrt{3}}{2}$	
$\bullet^9$	$\boldsymbol{p}-\boldsymbol{q}\equiv\overrightarrow{AC}$	
$\bullet^{10}$	$\lvert\boldsymbol{p}-\boldsymbol{q}\rvert=\sqrt{\left(4-\frac{3\sqrt{3}}{2}\right)^2+\left(\frac{3}{2}\right)^2}$ (2.05)	