DELEGATE BOOKLET 2

(Mark Scheme)

Pearson Edexcel International GCSE Further Pure Mathematics:

Effective Delivery and Assessment

January 2016 Paper 2 Question 3

Question Number	Scheme	Marks
3	$3y = 12 - 4x \Rightarrow y = 4 - \frac{4}{3}x$ OR $4x = 12 - 3y \Rightarrow x = 3 - \frac{3}{4}y$	B1
	$(x+1)^2 + (4 - \frac{4}{3}x - 2)^2 = 4$ | $\left(3 - \frac{3}{4}y + 1\right)^2 + (y-2)^2 = 4$	M1
	$\Rightarrow 25x^2 - 30x + 9 = 0$ 3TQ | $\Rightarrow 25y^2 - 160y + 256 = 0$ 3TQ	M1A1
	$(5x-3)(5x-3) = 0 \Rightarrow x = \frac{3}{5}$ | $(5y-16)(5y-16) = 0 \Rightarrow y = \frac{16}{5}$	M1A1
	$y = 4 - \frac{4}{3} \times \frac{3}{5} = \frac{16}{5}$ | $x = 3 - \frac{3}{4} \times \frac{16}{5} = \frac{3}{5}$	A1
		(7)
B1	Write the linear equation to read $x = \ldots$ or $y = \ldots$.May be seen explicitly or implied by subsequent working. (Equivalent forms accepted)	
M1	Substitute to obtain a quad equation in one variable	
M1	Simplify to a 3 term quadratic - terms in any order - coeffs need not be integers	
A1	Correct 3 term quadratic - terms in any order - coeffs need not be integers	
M1	Their 3 term quadratic solved by any valid method. (Can still be earned if the discriminant is negative.)	
A1	Correct values for one variable	
A1	(B1 on e-pen) Correct values for the second variable Equivalents accepted for both variables **NB**: Calculator solutions for the quadratic accepted **provided** both roots correct.	

June 2016 Paper 1 Question 9

Question Number	Scheme	Marks
9 (a) (i)	$\alpha+\beta=\frac{5}{3},\quad \alpha\beta=-\frac{4}{3}$	B1 Award in (i) or (ii)
	$\frac{\alpha}{\beta}+\frac{\beta}{\alpha}=\frac{\alpha^2+\beta^2}{\alpha\beta}=\frac{(\alpha+\beta)^2-2\alpha\beta}{\alpha\beta}$	M1
	$\frac{\frac{25}{9}+\frac{8}{3}}{-\frac{4}{3}}=-\frac{49}{12}$	A1
	$\frac{\alpha}{\beta}\times\frac{\beta}{\alpha}=1$	B1
	$x^2-(\text{sum })x+\text{product}\quad (=0)$	M1
	$x^2-\left(-\frac{49}{12}\right)x+1\ (=0)$	
	$12x^2+49x+12=0$	A1 (6)
(ii)	$2\alpha+\beta+\alpha+2\beta=3\times\frac{5}{3}=5$	B1
	$(2\alpha+\beta)(\alpha+2\beta)=2\alpha^2+5\alpha\beta+2\beta^2$	
	$=2(\alpha+\beta)^2+\alpha\beta,=2\times\frac{25}{9}-\frac{4}{3}=\frac{38}{9}$	M1,A1
	$x^2-5x+\frac{38}{9}\quad (=0)$	M1
	$9x^2-45x+38=0$	A1 (5)
(b)	$\text{f}(x)=3\left(x^2-\frac{5}{3}x\right)-4=3\left[\left(x-\frac{5}{6}\right)^2-\frac{25}{36}\right]-4$	M1
	$=3\left(x-\frac{5}{6}\right)^2-\frac{73}{12}$	A1A1 (3)
	(or by expanding $A(x+B)^2+C$ and equating coeffs)	
(c)	$\text{f}(x)=-8\ \Rightarrow 3\left(x-\frac{5}{6}\right)^2-\frac{73}{12}=-8$	
	$3\left(x-\frac{5}{6}\right)^2=\frac{73}{12}-8<0\quad \therefore$ no values of x possible ie no real roots	M1A1cso (2)
	(or any other complete method M1; correct solution and conclusion A1)	[16]

Notes

(a) (i)

B1: for writing down the product and sum of the roots. This could be embedded in their calculations for sum and product.

M1: for forming the **correct** algebraic equation for the sum ie., $\frac{\alpha}{\beta}+\frac{\beta}{\alpha}=\frac{(\alpha+\beta)^2-2\alpha\beta}{\alpha\beta}$.

A1: for the correct sum = $-\frac{49}{12}$ oe

Note: $a^2+b^2=\frac{49}{9}$

B1: for product of roots = 1 (You may not see this explicitly, but can be implied if their constant in their formed equation

M1: for forming an equation using their sum and product

For this mark you **must see** $x^2+(-\text{sum})x+(+\text{product})$ (=0)

A1: for the correct equation as shown including **= 0** Accept equivalent integer values, eg $24x^2+98x+24=0$

(ii)

B1: for the sum of roots = 5

M1: for the algebraic product of roots. Multiplying out, simplifying to a minimally acceptable $m(\alpha+\beta)^2+n\alpha\beta$ where $m\neq 0$ and $n\neq 0$

A1: for the product = $\frac{38}{9}$

M1: for forming an equation using their sum and product

A1: for the correct equation as shown **= 0**. **If =0 missing in part (i) do not penalise here again.** Accept equivalent integer values.

(b)

M1: for an attempt to complete the square. For this mark, they must take out 3 as the common factor in the term in x^2 and x (ignore the constant), and then complete the square (see General Guidance for minimally acceptable attempt)

A1: for two of A, B or C correct

A1: for A, B and C correct

ALT

M1: for $A(x+B)^2+C=Ax^2+2ABx+B^2+C\Rightarrow Ax^2+2ABx+B^2+C\equiv 3x^2-5x-4$

Must lead to values for A, B and C for this mark $\left(\Rightarrow A=3, B=-\frac{5}{6}, C=-\frac{73}{12}\right)$

A1: for two of A, B or C correct

A1: for A, B and C correct

(c)

M1: for $3\left(x-\frac{5}{6}\right)^2-\frac{73}{12}=-8\Rightarrow 3\left(x-\frac{5}{6}\right)^2=-\frac{23}{12}$ or using b^2-4ac on the **given** f(x) + 8 = 0

A1: for a correct conclusion of eg., cannot find square root of negative number hence no real roots, or $b^2-4ac<0$ hence no real roots. They **must** substitute correct values into b^2-4ac .

This A mark is **cso**

January 2016 Paper 2 Question4

4	$\mathrm{f}'(x) = 2\mathrm{e}^{2x}(x+1)^{0.5} + \mathrm{e}^{2x}\dfrac{(x+1)^{-0.5}}{2}$	M1A1A1
	$\mathrm{f}'(x) = \mathrm{e}^{2x}\left(2(x+1)^{0.5} + \dfrac{1}{2(x+1)^{0.5}}\right)$	dM1
	$\Rightarrow \mathrm{e}^{2x}\left(\dfrac{4(x+1)+1}{2(x+1)^{0.5}}\right) \Rightarrow \dfrac{\mathrm{e}^{2x}(4x+5)}{2\sqrt{x+1}}$ ***	dM1A1cso **(6)**

M1	Attempt to differentiate using the product rule. Must be the sum of two terms both with $(x+1)^{+/-0.5}$ and e^{2x}. Constants may be incorrect If quotient rule is used the numerator must be the difference of two terms both with $(x+1)^{+/-0.5}$ and e^{2x} and the denominator must be $(x+1)^{-1}$.
A1A1	A1A1 Both terms fully correct; A1A0 one term fully correct
dM1	Extract a common factor of form $k\mathrm{e}^{2x}$ where k is an integer
dM1	Simplify the bracket by combining to a single term The above steps may be carried out in either order but marks **must** be entered in this order. These 2 M marks are dependent on the first M mark but not on each other.
A1cso	Obtain the GIVEN answer with no errors seen $(x+1)^{\frac{1}{2}}$ scores A0

Activity 3 Mark schemes

Question 6 from Paper 1 of the Sample Assessment Material 4PM1

Question	Working	Mark	AO
6	$\frac{dy}{dx}=e^x\left(x^2-3x\right)+e^x\left(2x-3\right)\left[\Rightarrow e^x\left(2x-3\right)=\frac{dy}{dx}-y\right]$	M1M1A1	4
	$\frac{d^2y}{dx^2}=e^x\left(x^2-3x\right)+e^x\left(2x-3\right)+e^x\left(2x-3\right)+2e^x=y+2\left(\frac{dy}{dx}-y\right)+2e^x$	M1A1	4
	$2e^x=\frac{d^2y}{dx^2}-2\left(\frac{dy}{dx}-y\right)-y\Rightarrow 2e^x=y-2\frac{dy}{dx}+\frac{d^2y}{dx^2}$ *	M1M1A1	
		(8)	

Part of Question 8 Paper 1 June 2015

Question Number	Scheme	Marks
8(a)(i)	$\cos 2A = \cos^2 A - \sin^2 A$	M1
	$= (1-\sin^2 A) - \sin^2 A, = 1 - 2\sin^2 A$ *	M1,A1
		(3)
(ii)	$\sin 2A = 2\sin A\cos A$	B1
		(1)
(b)	$\sin 3A = \sin 2A\cos A + \cos 2A\sin A$	M1
	$= \sin A(1-2\sin^2 A) + 2\sin A\cos^2 A$	M1
	$\sin A - 2\sin^3 A + 2(1-\sin^2 A)\sin A$	M1
	$= 3\sin A - 4\sin^3 A$	A1
		(4)