AS Level / Year 1
Custom Mock 2

December 2017 Mocks

Question	Scheme		AO	Marks
1				
	$(3-k)^2 - 4(k)(-4)\ \{=0\}$	Uses the discriminant	AO1.1a	M1
	$\Rightarrow k^2 + 10k + 9 = 0 \Rightarrow k = ...$	Forms a 3TQ and attempts to solve their 3TQ	AO1.1a	dM1
	$k = -1,\ k = -9$	Correct values of *k*. Answers only scores 3/3.	AO1.1b	A1
				3
	Question 1 Notes			

1st M1 – this mark is for substituting the values of $a,\ b$ and c from the quadratic into $b^2 - 4ac\ \{=0\}$. Looking for the correct expression only, so ignore $<, >, \leq, \geq$. Condone sign errors in substituted values of $a,\ b$ and c.

2nd M1 – this mark is for forming a 3TQ and attempting to solve it using factorising, completing the square or the quadratic formula. This is dependent on the 1st M1

A1 – correct values of *k*, both values must be present to score the marks.

Question	Scheme		AO	Marks
2				
(a)	$\sqrt{a}+2\sqrt{a}=3$	Uses $a^{\frac{1}{2}}=\sqrt{a}$ oe Uses $\sqrt{4a}=2\sqrt{a}$ oe	AO1.1a AO1.1a	M1 M1
	$\sqrt{a}=1\Rightarrow a=1$	Correct solution only	AO1.1b	A1
				3
	Question 2 Notes			

1st M1 – uses $a^{\frac{1}{2}}=\sqrt{a}$ OR $\sqrt{4a}=(4a)^{\frac{1}{2}}$

2nd M1 – uses $\sqrt{4a}=2\sqrt{a}$ OR $(4a)^{\frac{1}{2}}=2a^{\frac{1}{2}}$

A1 – correct solution only. Additional solutions score A0

Question	Scheme		AO	Marks
3				
Method 1	$\frac{2-x}{x} < 3 \Rightarrow x(2-x) < 3x^2$	Multiplies by x^2. For multiplication by x, see special case in notes	AO1.1a	M1
	$2x^2 - x > 0$	Obtains the correct inequality oe	AO1.1b	A1 oe
	CVs $x = 0,\ x = \frac{1}{2}$	Correct critical values. Additional CVs is A0	AO1.1b	A1
	$\Rightarrow \text{Solution set} = \left\{x : x < 0 \text{ or } x > \frac{1}{2}\right\}$	Method to solve inequality. See notes	AO1.1a	M1
	OR $\{x : x < 0\} \cup \left\{x : x > \frac{1}{2}\right\}$	Correct solution set. Other equivalent formulations of the set should be accepted	AO1.2	A1FT **[5]**
Method 2	$\frac{2-x}{x} < 3 \Rightarrow \frac{2-x}{x} - 3 < 0 \Rightarrow \frac{2-4x}{x} < 0$	Attempts a common denominator Correct workings so far	AO1.1a AO1.1b	M1 A1
	Case 1: $2 - 4x < 0$ and $x > 0$ $\{\Rightarrow x > \frac{1}{2}\}$ Case 2: $x < 0$ and $2 - 4x > 0$ $\{\Rightarrow x < 0\}$	Identifies the two correct cases	AO1.1b	A1
	$\Rightarrow \text{Solution set} = \left\{x : x < 0 \text{ or } x > \frac{1}{2}\right\}$	Method to find solution set	AO1.1a	M1
	OR $\{x : x < 0\} \cup \left\{x : x > \frac{1}{2}\right\}$	Correct solution set. Other equivalent formulations of the set should be accepted	AO1.2	A1FT **[5]**
				5

	Question 3 Notes

SPECIAL CASE:

Multiplication by x can score M0 A0 A0 M1 A1FT max.

2nd M1 for attempting to solve their linear inequality (most probably, $2-x<3$).

3rd A1 for correct solution set following their inequality i.e. $\{x : x<-1\}$ (oe).

Method 1:

1st M1 – can also see multiplication by x^4, x^6, etc., which can score the M1.

1st A1 – for the correct **quadratic** inequality. Candidates that multiply by higher powers must reduce their inequality to a quadratic inequality for this mark. This can be implied by the correct CVs.

2nd A1 – correct CVs. Additional CVs is A0.

2nd M1 – this is not a dependent method mark. This is for an attempt to solve their inequality. This can be done through use of an appropriate graph, for example; sketching the appropriate graph and indication of the relevant region is M1.

3rd A1FT – this is for the correct solution set. The set can be expressed in any correct way. Use of x instead of $x \in \mathbb{R}$ should be **condoned**. This is ft their **quadratic** inequality.

Method 2:

1st M1 – attempts to form a correct common denominator with all terms on one side of the inequality.

1st A1 – for correct workings so far (i.e. correct inequality obtained)

2nd A1 – uses cases to solve the inequality.

2nd M1 – this is not a dependent method mark. This is for an attempt to find the correct solution set. It is for an attempt to find the set/range of values that satisfy **both** restrictions (if appropriate) and then taking the union of their corresponding sets.

3rd A1 FT – this is for the correct solution set. The set can be expressed in any correct way. Use of x instead of $x \in \mathbb{R}$ should be **condoned**. This is ft finding the intersection of their two restrictions on *x*

Question	Scheme		AO	Marks
4				
(a) Method 1	$2^{2(6-3x)} = 2^{3(2y)}$	Attempts to convert both sides into base 2. Can be implied	AO1.1a	M1
	$2(6-3x) = 3(2y) \Rightarrow y = 2 - x$	Correct expression	AO1.1b	A1 **[2]**
(a) Method 2	$\log\left(4^{6-3x}\right) = \log\left(8^{2y}\right) \Rightarrow (6-3x)\log 4 = 2y\log 8$	Takes logs (any base) **and** uses the power rule	AO1.1a	M1
	$6 - 3x = \frac{3}{2}(2y) \Rightarrow y = 2 - x$	Correct expression	AO1.1b	A1 **[2]**
(b) Method 1	$(x-2)^2 + 9(2-x)^2 = 10$	Substitutes **their** y in terms of x into the second equation	AO2.2	M1
	$x^2 - 4x + 4 + 9\left(4 - 4x + x^2\right) = 10$	Expands brackets and attempts to form a 3TQ	AO1.1a	dM1
	$\Rightarrow x^2 - 4x + 3 = 0$	Correct quadratic expression	AO1.1b	A1
	So $x = 1,\ 3$	Correct values of x	AO1.1b	A1
	When $x = 1 \Rightarrow y = 1$ When $x = 3 \Rightarrow y = -1$	Substitutes their x to find y Correct values of x and y	AO1.1a AO1.1b	dM1 A1 **[6]**

(b) Method 2	$(2-y-2)^2+9y^2=10$	Substitutes for x in the equation	AO2.2	M1
	$y^2+9y^2=10 \Rightarrow 10y^2-10=0$	Attempts to form a 3TQ Correct 3TQ	AO1.1a AO1.1b	dM1 A1
	So $y=-1,\ 1$	Correct values of y	AO1.1b	A1
	When $y=1 \Rightarrow x=1$ When $y=-1 \Rightarrow x=3$	Substitutes their y to find x Correct values of x and y	AO1.1a AO1.1b	dM1 A1 **[6]**
				8

Question 4 Notes

(a) Method 1

M1 – attempts to covert both sides of the equation to base 2. Condone errors like $\left(a^b\right)^c=a^{b+c}$. This can be implied – for example, by a correct equation.

(a) Method 2

M1 – takes logs and uses the power rule. Candidates can use any base.

Question	Scheme		AO	Marks
5				
(a)	$f(4) = -2(4)^3 + 9(4)^2 - (4) - 12$ $= -128 + 144 - 4 - 12$ $= 0$ $\therefore$ the curve y = f(x) crosses the *x* axis when *x* = 4	Substitutes 4 into f **and shows** that it is equal to 0 (all of the terms or groups of terms must be evaluated) **and** concludes: 'therefore, it crosses {the *x* axis} when *x* = 4' oe	AO2.1	B1 **[1]**
(b) **Method 1**	$$\begin{array}{r} -2x^2+x+3 \\ x-4\overline{)-2x^3+9x^2-x-12} \\ \underline{-2x^3+8x^2} \\ +1x^2-1x \quad (*) \\ \underline{+1x^2-4x} \\ 3x-12 \\ \underline{3x-12} \\ 0 \end{array}$$	Attempts to find the other quadratic factor by long division All working leading up to and including the line (*) correct, including the $-2x^2$ in the quotient	AO1.1a AO1.1b	M1 A1
	$\therefore f(x) = (x-4)(-2x^2+x+3)$ $= -(x-4)(2x-3)(x+1)$	Attempts to factorise **their** quadratic factor Correct factorisation oe (e.g. accept –ve sign distributed into one of the factors)	AO1.1a AO1.1b	dM1 A1 **[4]**

(b) **Method 2**	$\text{f}(x)=(x-4)(-2x^2+bx+3)$ Attempts to find out quadratic factor using inspection Quadratic factor of the form $-2x^2+bx+3$	AO1.1a AO1.1b	M1 A1
	$\therefore \text{f}(x)=(x-4)(-2x^2+x+3)$ $=-(x-4)(2x-3)(x+1)$ Attempts to factorise **their** quadratic factor Correct factorisation oe (e.g. accept –ve sign distributed into one of the factors)	AO1.1a AO1.1b	dM1 A1 **[4]**
(c)	$x-4=-1,\ \frac{3}{2},\ 4$ $\Rightarrow x=3,\ \frac{11}{2},\ 8$ Sets $x-4$ equal to at least one of the roots of their graph in (c) Correct values of *x*	AO2.2 AO1.1b	M1 A1 **[2]**
			7

Question 5 Notes

(a) B1 – substitutes 4 into f, **shows** that it is 0 and then gives a conclusion. At least some of the terms have to be evaluated here, either individually or in groups. For example,

$\text{f}(4)=-2(4)^3+9(4)^2-(4)-12=0$ is NOT enough and scores B0, but $\text{f}(4)=-2(4)^3+9(4)^2-(4)-12=16-16=0$ is OK

The conclusion requires something simple: 'therefore, it crosses the *x* axis at 4' oe

(b) Method 1:

2nd M1 – writes their factor $ax^2+bx+c=(px+r)(qx+s)$, where $pq=\pm a,\ rs=\pm c$ (M0 if their quadratic factor is irreducible)

(b) Method 2:

1st M1 – attempts to find the quadratic factor by inspection. This mark is awarded for one the coefficients of the quadratic factor correct.

1st A1 – their quadratic factor of the form $-2x^2+bx+3$ for some number **or letter** *b*.

2nd M1 – writes their factor $ax^2+bx+c=(px+r)(qx+s)$, where $pq=\pm a,\ rs=\pm c$ (M0 if their quadratic factor is irreducible)

Question	Scheme		AO	Marks
6				
(a/i)	e.g. $5x+2(2-x)=3\Rightarrow x=...$	Eliminates one variable from the two equations of the circles	AO3.1a	M1
	$x=-\frac{1}{3},\ y=\frac{7}{3}$	Correct centre of the circle. Accept coordinates etc.	AO1.1b	A1 **[2]**
(a/ii)	$(x-2)^2-4+(y+1)^2-1=0$	Completes the square on both *x* and *y* terms	AO1.1a	M1
	Radius is $\sqrt{5}$	Correct radius oe	AO1.1b	A1 **[2]**
(b)	Distance between centre and *A* is $\sqrt{\left(-\frac{1}{3}-1\right)^2+\left(\frac{7}{3}--1\right)^2}=\frac{2\sqrt{29}}{3}$	Method to find distance between (1, –1) and **their** centre of the circle	AO1.1a	M1
	$\frac{2\sqrt{29}}{3}>\sqrt{5}$, so (1, –1) lies outside the circle	Convincing proof with comparison and no errors seen	AO1.1a	A1 **[2]**
(c)	$\frac{2\sqrt{29}}{3}-\sqrt{5}=$ {awrt} 1.35	Subtracts **their** $\sqrt{5}$ from **their** $\frac{2\sqrt{29}}{3}$ or the other way around	AO1.1a	M1
		Awrt 1.35	AO1.1b	A1 **[2]**
(d)	$\left(x+\frac{1}{3}\right)^2+\left(y-\frac{7}{3}\right)^2=\frac{485}{36}$	LHS correct	AO1.1b	B1
		RHS correct	AO1.1b	B1 **[2]**

(e)	$\sqrt{\frac{485}{36}}-\sqrt{5}>0$, so C_2 is not completely contained within C_1	Correct answer with some justification that the radius of C_2 is greater than C_1	AO2.1	B1 **[1]**
				11

Question	Scheme		AO	Marks
7				
(a)	$\left(2-\frac{1}{\sqrt{x}}\right)^8 = 2^8 + \binom{8}{1}(2)^7\left(-\frac{1}{\sqrt{x}}\right)^1 + \binom{8}{2}(2)^6\left(-\frac{1}{\sqrt{x}}\right)^2 +$ $+\binom{8}{3}(2)^5\left(-\frac{1}{\sqrt{x}}\right)^3 + \ldots$	See notes for mark breakdown	AO1.1b AO1.1a AO1.1b AO1.1b	B1 M1 A1 A1
	$\left(2-\frac{1}{\sqrt{x}}\right)^8 = 256 - \frac{1024}{\sqrt{x}} + \frac{1792}{x} - \frac{1792}{\sqrt{x^3}} + \ldots$	Correct binomial expansion oe (accept $\frac{1}{\sqrt{x}} = \frac{1}{x^{\frac{1}{2}}} = x^{-\frac{1}{2}}$ etc.)	AO1.1b	A1 oe **[5]**
(b/i)	$(1+x)^r = 1^r x^0 + \binom{r}{1}x^1 + \binom{r}{2}x^2 + \ldots + 1^0 x^r$ $= 1 + rx + \binom{r}{2}x^2 + \ldots + x^r$	Uses the binomial expansion. Need to see 1 and rx appearing clearly. Some candidates may also use $(1+x)^r = 1 + rx + \frac{r(r-1)}{2!}x^2 + \ldots$	AO2.1	M1
	$\binom{r}{2}x^2 + \ldots + x^r \geq 0$, since $x > 0$, so $(1+x)^r \geq 1 + rx$	Convincing proof with an explanation. Accept $>$.	AO2.4	A1 **[2]**
(b/ii)	LHS = $(1+0)^r = 1^r = 1$ RHS = $1 + r(0) = 1$ LHS = RHS, so true for $x = 0$	Correct verification	AO2.1	B1 **[1]**

(b/iii)	e.g. let $x=-3$, then if $r=5$, we have $\text{LHS} = (1-3)^5 = -32$ $\text{RHS} = 1+5(-3) = -14$	Attempts to use a suitable counter-example: picks a value of $x < -1$, substitutes it into the LHS and RHS with a fixed r and attempts to LHS < RHS	AO2.1	M1
	LHS < RHS, therefore it is not true for $x < -1$.	Convincing proof with conclusion	AO2.1	A1 **[2]**
				10
	Question 7 Notes			

(a) B1 – sight of 2^8 as the constant term oe

1st M1 – term of the form $\binom{8}{r}(2)^{8-r}\left(-\frac{1}{\sqrt{x}}\right)^r$ or equivalent for any r, $r \neq 0,8$ (in particular, accept $8-r$ and r switched).

1st A1 – at least **any** two terms of the expansion correct, unsimplified or better

2nd A1 – the four terms required terms given, unsimplified or better. Ignore extra terms

3rd A1 – correct expansion, with each term simplified. Accept equivalent simplified forms. Ignore extra terms

SC: first 4 terms in ascending powers of *x* (or any other 4 terms given instead of the first 4 descending in *x*) can score at most B1M1A1A0A0.

(b/i) M1 – uses the binomial expansion with the terms 1 and *rx* clearly appearing. Needs to show one extra term **and** the final term. '+ …' without a final term is not sufficient as this can suggest the series is infinite.

A1 – justifies the inequality by stating that the other terms are positive.

Note: Accept $>$ instead of $\geq$.

(b/iii) M1 – a suitable counter-example: for this mark, candidates need to pick a value of $x < -1$ and attempt to show that this value does not satisfy the inequality for any **integer** *r* (i.e. substituting into both sides of the inequality). NOTE: *r* does not have to be non-negative or arbitrary.

A1 – complete and convincing proof with a conclusion.

Question	Scheme		AO	Marks
8				
(a)	$2x-4y=10 \Rightarrow y=...$	Attempts to make y the subject	AO1.1a	M1
	$y=\frac{1}{2}x-\frac{5}{2}$, so $m_{l_2}=\frac{1}{2}$			
	$\Rightarrow m_{l_1}=-2$	Correct gradient of l_1	AO1.1b	A1 **[2]**
	Credit in (c) can be given for work in (b), but credit in (b) cannot be given for work in (c)			
(b)	$l_1 : y=-2x+c$, so $A\left(\frac{c}{2},0\right)$, $B(0,c)$	Attempts to find expressions for the points *A* and *B*	AO3.1a	M1
	$\frac{1}{2}\left(\frac{c}{2}\right)(c)=4 \Rightarrow c^2=16$	Attempts to use area of right-triangle formula with their *A* and *B* co/ords Correct expression: $c^2=16$	AO2.2 AO1.1b	M1 A1
	$\Rightarrow c=-4\ \{c \neq 4\}$			
	$A(-2,0), B(0,-4)$	Correct coordinates of *A* and *B*	AO2.2	A1 **[4]**

(c)	$y=-2x-4 \Rightarrow 2x+y+4=0\ \{k=4\}$	Substitutes their *y* coordinate of *B* as 'c' in the equation of l_1	AO1.1a	M1
		Correct equation of l_1 in required form or value of *k* stated. Value of *k* stated alone is **2/2**	AO1.1b	A1 **[2]**
(d)	$D\left(0,-\frac{5}{2}\right)$	Correct coordinates of *D*	AO3.1a	B1
	e.g. $-2x-4=\frac{1}{2}x-\frac{5}{2} \Rightarrow x=...$	Attempts to find the coordinates of *C* by solving **their** equation for l_1 and the equation of l_2 simultaneously. Can be implied by correct coordinates	AO3.1a	M1
	$C\left(-\frac{3}{5},-\frac{14}{5}\right)$	Correct coordinates of *C*	AO1.1b	A1
	Area of $OACD$ = area of *OAB* – area of *BCD* Area of *BCD* $=\frac{1}{2}\left(\frac{3}{5}\right)\left(4-\frac{5}{2}\right)=\frac{9}{20}$	Area of *BCD* with subtraction seen (using their *C* and *D*)	AO3.1a	dM1
	$\Rightarrow$ area of *OACD* $=4-\frac{9}{20}=\frac{71}{20}$	Correct area	AO2.1	A1 **[5]**
				13

	Question 8 Notes
(d) 2nd M1 – there are likely to be many ways to find the area of the quadrilateral. For this mark, candidates need to calculate the relevant, unknown areas involved using their *C* and/or *D*, and then show use of subtraction/addition. **Alternative for (d):** 2nd M1 – can split the quadrilateral *OACD* into a right-triangle and a trapezium. M mark is for attempting to calculate both the area of the trapezium and triangle (ft their *C* and/or *D*) and adding these together.	