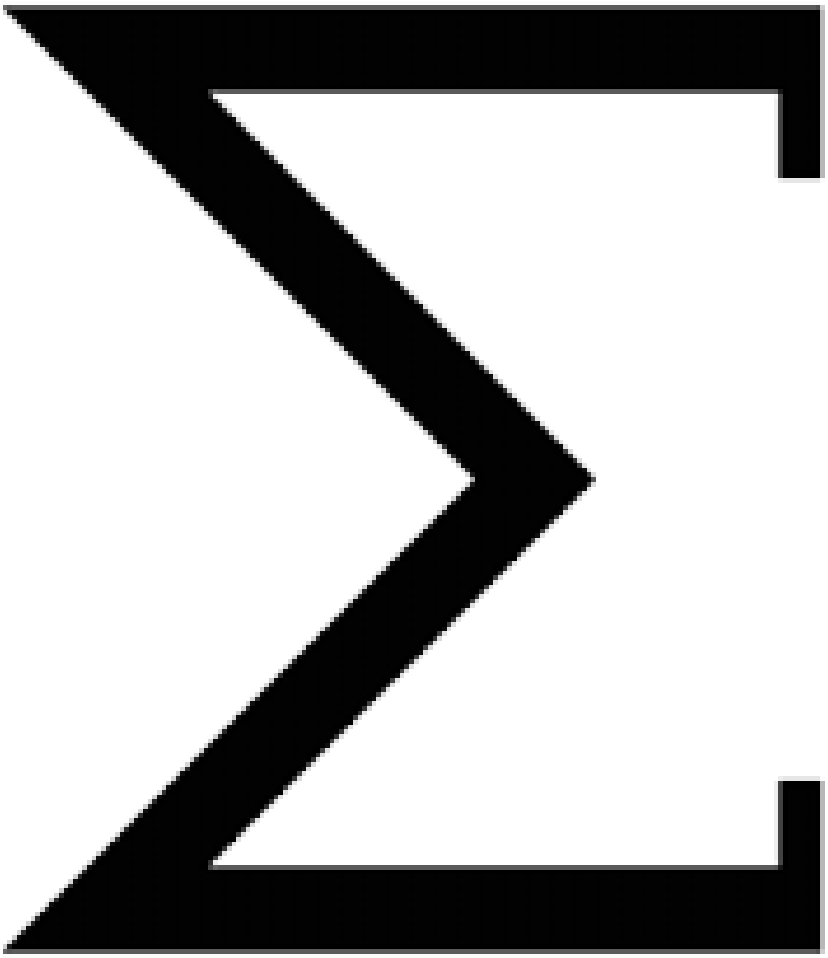
0606 IGCSE Additional Maths
Mini Drill
Assessment Test Prep



Prepared by:
The ReviseRoom Educator Team

Questions

1. The function h is defined by $h(x) = \sqrt{x^2 - 1}$ for $x \leqslant -1$.

(i) State the geometrical relationship between the graphs of $y = h(x)$ and $y = h^{-1}(x)$. [1]

(ii) Find an expression for $h^{-1}(x)$. [3]

2. **(a)** The function f is such that $f(x) = \ln(5x + 2)$, for $x > a$, where a is as small as possible.

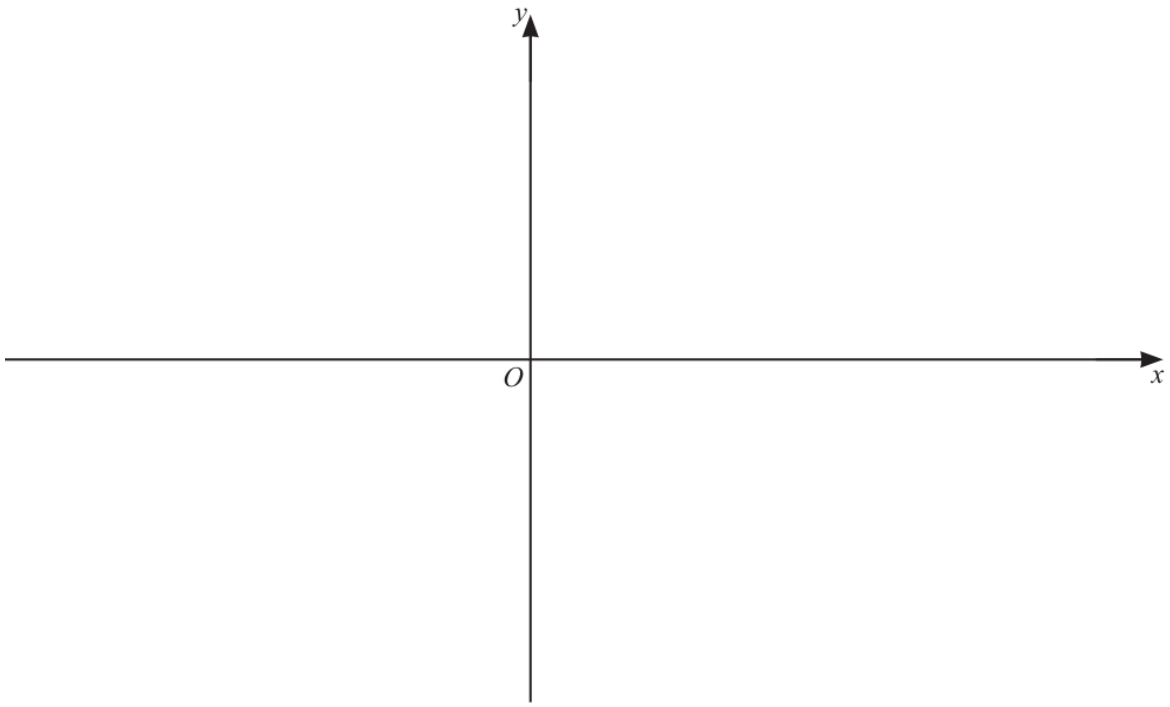
(i) Write down the value of a. [1]

(ii) Hence find the range of f. [1]

(iii) Find $f^{-1}(x)$, stating its domain. [3]

3. Find the possible values of k for which the equation $kx^2 + (k+5)x - 4 = 0$ has real roots. [5]

4. **(a)** On the axes, draw the graph of $y = |3x^2 + 13x - 10|$, stating the coordinates of the points where the graph meets the axes. [4]



(b) Find the set of values of the constant k such that the equation $k = |3x^2 + 13x - 10|$ has exactly 2 distinct roots. [4]

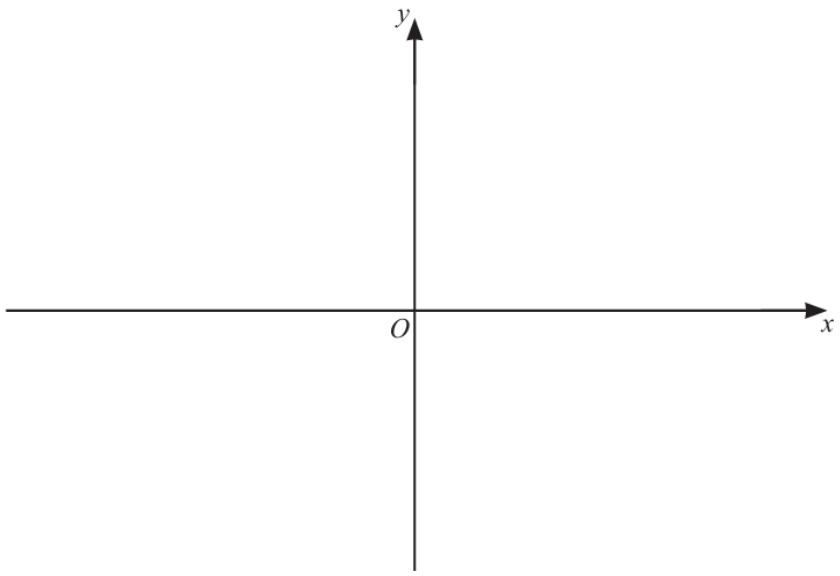
5. The polynomial p is such that $\mathrm{p}(x) = 6x^3 + x^2 - 12x + 5$.

(a) Find the remainder when $\mathrm{p}(x)$ is divided by $x - 2$. [1]

(b) **(i)** Show that $2x - 1$ is a factor of $\mathrm{p}(x)$. [1]

(ii) Hence write $\mathrm{p}(x)$ as a product of linear factors. [3]

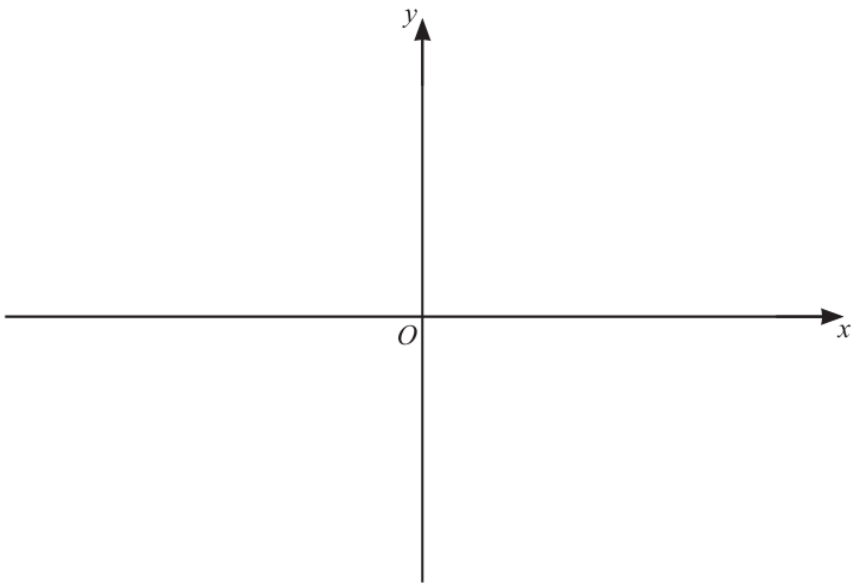
6. **(a)** On the axes, sketch the graph of $y = (2x-5)(x+3)(1-x)$, stating the intercepts with the coordinate axes. [3]



(b) Hence

(i) solve the inequality $(2x-5)(x+3)(1-x) \leqslant 0$ [2]

(ii) on the axes below, sketch the graph of $y = |(2x-5)(x+3)(1-x)|$. [1]



7. Solve the inequality $|5x+4| \leqslant |2x-3|$. [4]

8. Find the exact solution of $3^{2x} - 3^{x+1} - 4 = 0$. [4

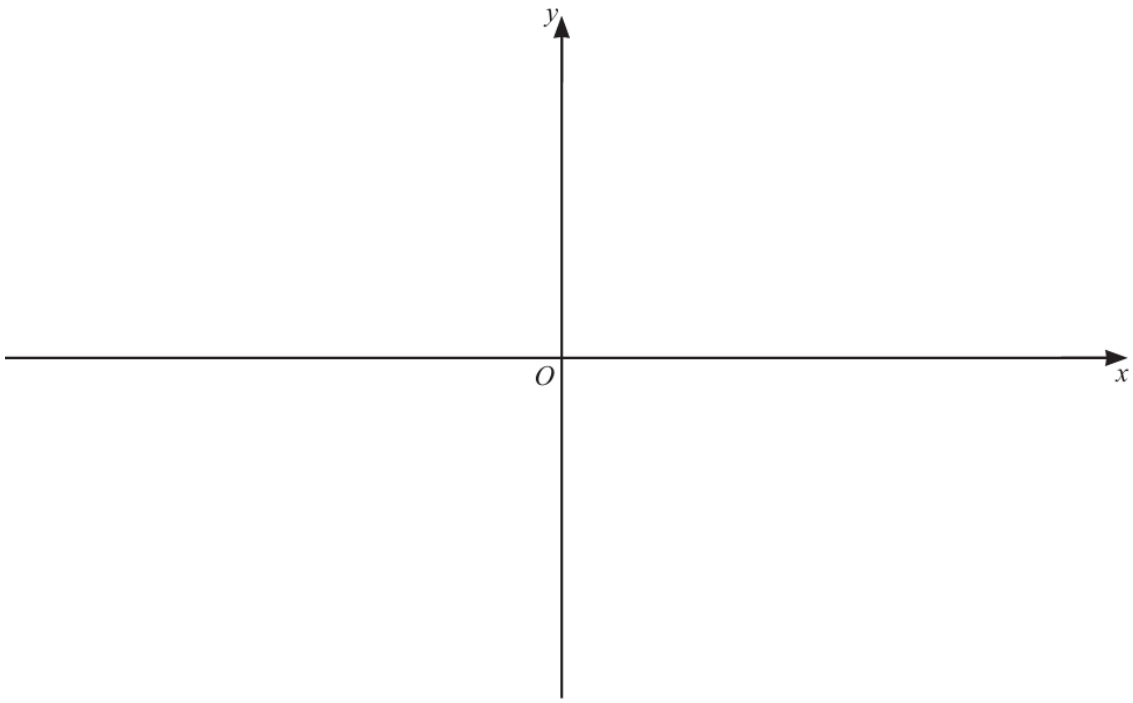
9. A function $f(x)$ is such that $f(x) = \ln(2x+3) + \ln 4$, for $x > a$, where a is a constant.

(a) Write down the least possible value of a. [1]

(b) Using your value of a, write down the range of f. [1]

(c) Using your value of a, find $f^{-1}(x)$, stating its range. [4]

(d) On the axes below, sketch the graphs of $y = f(x)$ and $y = f^{-1}(x)$, stating the exact intercepts of each graph with the coordinate axes. Label each of your graphs. [4]



10. $p(x) = ax^3 + 3x^2 + bx - 12$ has a factor of $2x+1$. When $p(x)$ is divided by $x-3$ the remainder is 105.

(a) Find the value of a and of b. [5]

(b) Using your values of a and b, write $p(x)$ as a product of $2x+1$ and a quadratic factor. [2]

(c) Hence solve $p(x) = 0$. [2]

Answers

1.

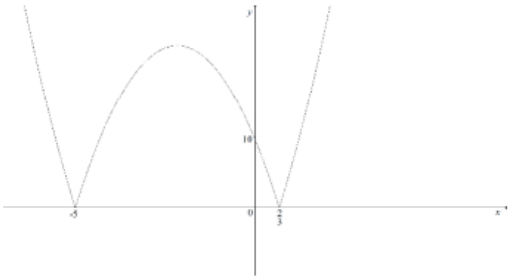
(i)	(They are) **reflections** (of each other) in (the line) $y = x$ oe	**B1**	
(ii)	$x^2 = y^2 + 1$ or $y^2 = x^2 + 1$	**M1**	
	$x = [\pm]\sqrt{y^2 + 1}$ or $y = [\pm]\sqrt{x^2 + 1}$	**A1**	
	$-\sqrt{x^2 + 1}$ nfww	**A1**	

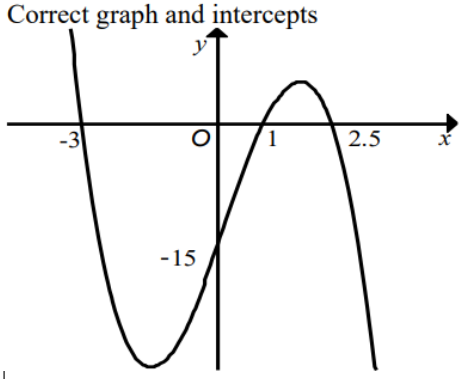
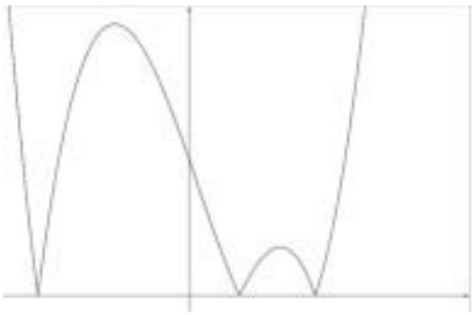
2.

)(i)	-0.4	**B1**	
)(ii)	$f(x) \in \mathbb{R}$ oe	**B1**	
(iii)	$x = \ln(5y + 2)$ oe $e^x = 5y + 2$ oe	**M1**	For a correct attempt to find the inverse
	$f^{-1}(x) = \frac{e^x - 2}{5}$	**A1**	Must be in the correct form
	$x \in \mathbb{R}$	**B1**	

3.

Uses $b^2 - 4ac$ oe: $(k + 5)^2 - 4k(-4)$ [* 0, where * could be = or any inequality sign]	**M1**	
Forms a correct 3-term expression: $k^2 + 26k + 25$	**A1**	
Factorises $k^2 + 26k + 25$ or solves $k^2 + 26k + 25 = 0$ oe	**M1**	**dep** on first **M1**, **FT** *their* 3-term quadratic in k
Correct critical values -1, -25 soi	**A1**	
$k \leqslant -25$, $k \geqslant -1$	**A1**	mark final answer

4.	(a)		**4**	**B1** for a correct basic shape, allow 'construction curve' **Dep B1** for (0, 10) must have correct basic shape, must be convinced that this is the vertical intercept **B1** for $(-5, 0)$ and $\left(\frac{2}{3},0\right)$ or (0.667, 0) or better **Dep B1** on all previous **B** marks for all correct with cusps and the correct shape for $x<-5$ and $x>\frac{2}{3}$
	(b)	Stationary point when $x=-\frac{13}{6}$ soi	**M1**	For differentiation or completing the square or use of symmetry
		$(-)\frac{289}{12}$ or $(-)24.1$ or better	**A1**	For y-value of stationary point, allow +ve or –ve value.
		$k>\frac{289}{12}$ or $k>24.1$ or better	**A1**	
		$k=0$	**B1**	
5.	(a)	33	**B1**	
	)(i)	$6\left(\frac{1}{2}\right)^3+\left(\frac{1}{2}\right)^2-12\left(\frac{1}{2}\right)+5=0$ oe or $6\left(\frac{1}{8}\right)+\frac{1}{4}-\frac{12}{2}+5=0$ oe or $\frac{3}{4}+\frac{1}{4}-6+5=0$ oe	**B1**	
	)(ii)	Finds the quadratic factor $3x^2+2x-5$	**M2**	**M1** for any two terms correct in $3x^2+2x-5$
		$(2x-1)(3x+5)(x-1)$ oe	**A1**	If 0 scored then **SC2** for justifying $x-1$ as a factor and writing down $(2x-1)(3x+5)(x-1)$ without any incorrect work seen
	)(iii)	$[\sin\theta=0.5]$ $\theta=30$ nfww $[\sin\theta=1]$ $\theta=90$ nfww and no value of θ from $3\sin\theta+5=0$	**B2**	**B1** for $\sin\theta=0.5$ or $\theta=30$ or **B1** for $\sin\theta=1$ nfww or $\theta=90$ nfww

6.	(a)	Correct graph and intercepts  	**B3**	**B1** for correct shape; the ends must extend above and below the x-axis **B1** for correct roots indicated; must have attempted a cubic shape **B1** for correct y-intercept indicated; must have attempted a cubic shape
	(b)(i)	$-3 \leqslant x \leqslant 1$, $x \geqslant 2.5$ mark final answer	**B2**	**FT** *their* **(a)** providing it is an equivalent cubic shape and has 3 stated or indicated roots for **B2, B1** or **SC1** **B1** for one correct inequality out of two If 0 scored then **SC1** for $-3 < x < 1$, $x > 2.5$ or $-3 < x \leqslant 1$, $x > 2.5$ or $-3 \leqslant x < 1$, $x > 2.5$
	(b)(ii)	Graph of correct shape, with cusps, positive y-intercept and x-intercepts which match **(a)** 	**B1**	**FT** *their* **(a)** providing it is an equivalent cubic shape

7.

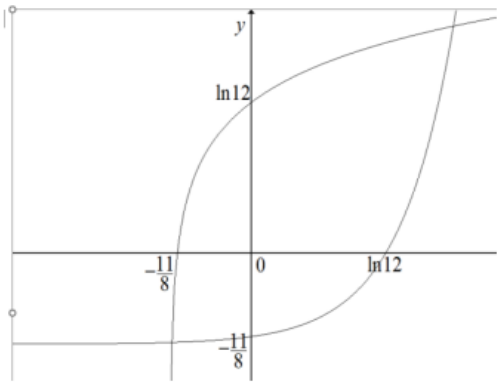
$(5x+4)^2 * (2x-3)^2$ soi where * is any inequality sign or =	**M1**	
$21x^2+52x+7*0$	**A1**	
Critical values: $-\frac{1}{7}, -\frac{7}{3}$ soi	**A1**	
$-\frac{7}{3} \leqslant x \leqslant -\frac{1}{7}$ mark final answer	**A1**	**FT** *their* derived critical values
Alternative method		
$5x+4*2x-3$ oe soi and $5x+4*3-2x$ oe soi where * is any inequality sign or =	**(M1)**	
Critical values: $-\frac{1}{7}, -\frac{7}{3}$ soi	**(A2)**	**A1** for $-\frac{1}{7}$ or $-\frac{7}{3}$
$-\frac{7}{3} \leqslant x \leqslant -\frac{1}{7}$ mark final answer	**(A1)**	**FT** *their* derived critical values

8.

Rewrites in quadratic form soi e.g. $y=3^x$ then $y^2-3y-4=0$ or $(3^x)^2-3(3^x)-4=0$	**M1**	
Factorises or solves *their* 3-term quadratic e.g. $(y+1)(y-4)$ [= 0] or $(3^x+1)(3^x-4)$ [= 0]	**M1**	
$3^x=4$	**A1**	ignore $3^x=-1$
$x=\log_3 4$ or $\frac{\ln 4}{\ln 3}$ oe, only	**A1**	

9.

(a)	−1.5	**B1**	
(b)	$f \in \mathbb{R}$	**B1**	Allow $y \in \mathbb{R}$, $\mathbb{R}$, $-\infty < f(x) < \infty$ oe, $f(x) \in \mathbb{R}$

(c)	$\ln(8x+12)$ or $\ln(4(2x+3))$	**B1**	May be implied
	$f^{-1}(x)=\frac{e^x-12}{8}$ oe Range: $f^{-1} > their(-1.5)$	**2** **B1**	**M1** for attempt to find the inverse, allow one sign error **A1** allow $y = \ldots$ Must be correct notation, follow through on *their* **(a)** $f^{-1}(x) > their(-1.5)$, $y > their(-1.5)$
	Alternative		
	$f^{-1}(x)=\frac{e^{x-\ln 4}-3}{2}$ oe Range: $f^{-1} > their(-1.5)$	**(3)** **(B1)**	**B1** for $e^{x-\ln 4}$ or $e^{y-\ln 4}$ **M1** for attempt to find the inverse, allow one sign error **A1** allow $y = \ldots$ Must be correct notation, follow through on *their* **(a)** $f^{-1}(x) > their(-1.5)$, $y > their(-1.5)$
(d)		**4**	**B1** for correct shape of $f(x)$ in quadrants 1, 2 and 3, with asymptotic behaviour **B1** for $\ln 12$ and $-\frac{11}{8}$ or -1.375 in correct position, must have a correct shape. **B1** for correct shape of $f^{-1}(x)$ in quadrants 1, 3 and 4, with asymptotic behaviour **B1** for $\ln 12$ and $-\frac{11}{8}$ or -1.375 in correct position, must have a correct shape and intersect at least once with $y = f(x)$

10.	(a)	$p\left(-\frac{1}{2}\right): -\frac{a}{8}+\frac{3}{4}-\frac{b}{2}-12=0$ $p(3): 27a+27+3b-12=105$	**M1**	For attempt at an equation using either $p\left(-\frac{1}{2}\right)$ or $p(3)$
		$a+4b=-90$	**A1**	Allow equivalent with constants collected
		$9a+b=30$	**A1**	Allow equivalent with constants collected
		$a=6, b=-24$	**2**	**M1** for attempt to solve *their* equations, dep on first M mark **A1** for both
	(b)	$(2x+1)(3x^2-12)$	**2**	**B1** for $3x^2$ **B1** for -12 and no extra term in x
	(c)	$x=-\frac{1}{2}$	**B1**	
		$x=\pm 2$	**B1**	Dep on both B marks in part (b)

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